Volume II: Environmental Impact Assessment Report

Graiguenamanagh-Tinnahinch Flood Relief Scheme

Report No. W3451-ENV-R008

September 2025

Revision 00

Kilkenny County Council

Preface

This Environmental Impact Assessment Report for Graiguenamanagh-Tinnahinch Flood Relief Scheme comprises three volumes as follows:

Volume 1 – Non-Technical Summary

Volume II – Main Environmental Impact Assessment Report

Volume III – Technical Appendices

This document is Volume II – Main Environmental Impact Assessment Report. This document is a detailed assessment of the environmental impacts of Graiguenamanagh-Tinnahinch Flood Relief Scheme. A simplified version of this document is outlined in Volume I – Non-Technical Summary which summarises the key findings.

Document Control

Project

Graiguenamanagh-Tinnahinch Flood Relief Scheme

Client

Kilkenny County Council

Document

Volume II: Environmental Impact Assessment Report

Report Number:

W3451-ENV-R008

Document Checking:

Date	Rev	Details of Issue	Prepared by	Checked by	Approved by
September 2025	00	For Planning	Andrea Brogan	Jackelyn Wren	Barry Sheridan

Disclaimer: Please note that this report is based on specific information, instructions, and information from our Client and should not be relied upon by third parties.

www.ayesa.com/en

Contents

[1] Introduction 1-1

[1.1] Context and Project Background 1-1
[1.2] Need for the Scheme 1-1
[1.3] Scheme Objectives 1-2
[1.4] The Scheme Area 1-2
[1.5] The Proposed Scheme 1-3
[1.6] Legislative Basis and Scope of EIA 1-6
[1.7] Structure of the EIAR 1-14
[1.8] Project Team 1-14
[1.9] References 1-16

[2] Planning and Policy 2-1

[2.1] Introduction 2-1
[2.2] Legislation Context 2-1
[2.3] Policy Guidance 2-4
[2.4] Summary 2-14
[2.5] References 2-14

[3] Previous Studies, Alternatives Considered and Options 3-1

[3.1] CFRAM and Associated Reporting 3-1
[3.2] Environmental Constraints Study 3-5
[3.3] Options Reporting 3-5
[3.4] Options Assessment Process and Methodology 3-6
[3.5] Choosing the Preferred Option 3-12
[3.6] References 3-24

[4] Description of the Proposed Scheme and Construction Methodology 4-1

[4.1] Introduction 4-1
[4.2] Location of Proposed Scheme 4-1
[4.3] The Proposed Scheme 4-3
[4.4] Construction Details 4-23
[4.5] Detailed Construction Methodology 4-33
[4.6] Construction Stage Risks 4-43
[4.7] Programme, Phasing and Sequencing 4-44
[4.8] Long-term Operations and Maintenance 4-47

Contents

[5] Consultation and Stakeholder Engagement 5-1

[5.1] Introduction 5-1
[5.2] Project Stakeholder Consultation Overview 5-1
[5.3] Public Engagement 5-3
[5.4] Statutory and Non-Statutory Consultation 5-6
[5.5] References 5-19

[6] Population and Human Health 6-1

[6.1] Scope of the Assessment 6-1
[6.2] Statutory and Policy Context 6-2
[6.3] Assessment Methodology 6-4
[6.4] Baseline Environment 6-9
[6.5] Sensitive Receptors 6-19
[6.6] Potential Impacts and Effects 6-29
[6.7] Mitigation Measures 6-47
[6.8] Monitoring 6-50
[6.9] Residual Impacts and Effects 6-50
[6.10] Interactions with other Environmental Effects 6-51
[6.11] Cumulative Impacts 6-52
[6.12] Limitations in Preparing the Chapter 6-53
[6.13] Summary Table 6-54
[6.14] References 6-59

[7] Material Assets (Build Services; Roads, Traffic and Transportation; Waste Management) 7-1

[7.1] Scope of the Assessment 7-1
[7.2] Statutory and Policy Context 7-2
[7.3] Assessment Methodology 7-4
[7.4] Baseline Environment 7-6
[7.5] Sensitive Receptors 7-21
[7.6] Potential Impacts and Effects 7-22
[7.7] Mitigation Measures 7-36
[7.8] Monitoring 7-42
[7.9] Residual Impacts and Effects 7-42
[7.10] Interactions with other Environmental Effects 7-44
[7.11] Cumulative Impacts 7-44

Contents

[7.12] Limitations in Preparing the Chapter 7-45
[7.13] Summary 7-46
[7.14] References 7-50

[8] Hydrology – Surface Water 8-1

[8.1] Scope of the Assessment 8-1
[8.2] Statutory and Policy Context 8-1
[8.3] Assessment Methodology 8-6
[8.4] Baseline Environment 8-11
[8.5] Sensitive Receptors 8-26
[8.6] Potential Impacts and Effects 8-26
[8.7] Mitigation Measures 8-37
[8.8] Monitoring 8-40
[8.9] Residual Impacts and Effects 8-41
[8.10] Interactions with other Environmental Effects 8-42
[8.11] Cumulative Impacts 8-43
[8.12] Limitations in Preparing the Chapter 8-43
[8.13] Summary 8-44
[6.14] References 8-48

[9] Cultural Heritage 9-1

[9.1] Scope of the Assessment 9-1
[9.2] Statutory and Policy Context 9-1
[9.3] Assessment Methodology 9-3
[9.4] Baseline Environment 9-9
[9.5] Sensitive Receptors 9-41
[9.6] Potential Impacts and Effects 9-49
[9.7] Mitigation Measures 9-61
[9.8] Monitoring 9-66
[9.9] Residual Impacts and Effects 9-66
[9.10] Interactions with other Environmental Effects 9-67
[9.11] Cumulative Impacts 9-68
[9.12] Limitations in Preparing the Chapter 9-68
[9.13] Summary 9-69
[6.14] References 9-83

[10] Biodiversity 10-1

[10.1] Scope of the Assessment 10-1
[10.2] Statutory and Policy Context 10-2
[10.3] Assessment Methodology 10-4
[10.4] Baseline Environment 10-37
[10.5] Sensitive Receptors 10-70
[10.6] Identification of Potential Sources of Impact 10-74
[10.7] Description of Potential Impacts 10-76
[10.8] Mitigation Measures 10-87
[10.9] Monitoring 10-96
[10.10] Biodiversity Enhancement Measures 10-96
[10.11] Residual Impacts and Effects 10-104
[10.12] Interactions with other Environmental Effects 10-105
[10.13] Cumulative Impacts 10-105
[10.14] Limitations in Preparing the Chapter 10-106
[10.15] Summary 10-107
[10.16] References 10-114

[11] Landscape and Visual 11-1

[11.1] Scope of the Assessment 11-1
[11.2] Statutory and Policy Context 11-1
[11.3] Assessment Methodology 11-3
[11.4] Baseline Environment 11-4
[11.5] Sensitive Receptors 11-32
[11.6] Potential Impacts and Effects 11-32
[11.7] Mitigation Measures 11-69
[11.8] Monitoring 11-70
[11.9] Residual Impacts and Effects 11-71
[11.10] Interactions with other Environmental Effects 10-71
[11.11] Cumulative Impacts 11-72
[11.12] Limitations in Preparing this Chapter 11-72
[11.13] Summary 10-73
[11.14] References 11-84

[12] Land, Soils, Geology & Hydrogeology 12-1

[12.1] Scope of the Assessment 12-1

Contents

[12.2] Statutory and Policy Context 12-1
[12.3] Assessment Methodology 12-3
[12.4] Baseline Environment 12-11
[12.5] Sensitive Receptors 12-19
[12.6] Potential Impacts and Effects 12-19
[12.7] Mitigation Measures 12-26
[12.8] Monitoring 12-31
[12.9] Residual Impacts and Effects 12-31
[12.10] Interactions with other Environmental Effects 12-32
[12.11] Cumulative Impacts 12-32
[12.12] Limitations in Preparing the Chapter 12-33
[12.13] Summary 12-34
[12.14] References 12-39

[13] Air Quality 13-1

[13.1] Scope of the Assessment 13-1
[13.2] Statutory and Policy Context 13-1
[13.3] Assessment Methodology 13-4
[13.4] Baseline Environment 13-12
[13.5] Sensitive Receptors 13-14
[13.6] Potential Impacts and Effects 13-15
[13.7] Mitigation Measures 13-21
[13.8] Monitoring 13-25
[13.9] Residual Impacts and Effects 13-25
[13.10] Interactions with other Environmental Effects 13-26
[13.11] Cumulative Impacts 13-26
[13.12] Limitations in Preparing the Chapter 13-27
[13.13] Summary 13-28
[13.14] References 13-29

[14] Climate 14-1

[14.1] Scope of the Assessment 14-1
[14.2] Statutory and Policy Context 14-1
[14.3] Assessment Methodology 14-4
[14.4] Baseline Environment 14-6
[14.5] Sensitive Receptors 14-8

Contents

[14.6] Potential Impacts and Effects 14-8
[14.7] Mitigation and Monitoring 14-11
[14.8] Residual Impacts and Effects 14-12
[14.9] Interactions with other Environmental Effects 14-12
[14.10] Cumulative Impacts 14-13
[14.11] Limitations in Preparing the Chapter 14-13
[14.12] Summary 14-14
[14.13] References 14-16

[15] Noise and Vibration 15-1

[15.1] Scope of the Assessment 15-1
[15.2] Statutory and Policy Context 15-1
[15.3] Assessment Methodology 15-1
[15.4] Baseline Environment and Sensitive Receptors 15-15
[15.5] Potential Impacts and Effects 15-20
[15.6] Mitigation Measures 15-30
[15.7] Monitoring 15-31
[15.8] Residual Impacts and Effects 15-31
[15.9] Interactions with other Envrionmental Effects 15-32
[15.10] Cumulative Impacts 15-33
[15.11] Limitations in Preparing the Chapter 15-33
[15.12] Summary 15-34
[15.12] References 15-35

[16] Interactions and Cumulative Effects 16-1

[16.1] Interactions between Environmental Aspects 16-1
[16.2] Cumulative Effects 16-7
[16.3] References 16-14

[17] Major Accidents and Disasters 17-1

[17.1] Scope of the Assessment 17-1
[17.2] Statutory and Policy Context 17-1
[17.3] Assessment Methodology 17-3
[17.4] Baseline Environment 17-7
[17.5] Sensitive Receptors 17-9
[17.6] Risk Assessment and Mitigation 17-9

Contents

[17.7] Discussion 17-14
[17.8] Mitigation Measures and Monitoring 17-15
[17.9] Residual Impacts and Effects 17-15
[17.10] Cumulative Impacts 17-15
[17.11] References 17-15

[18] Summary of Effects and Schedule of Environmental Commitments 18-1

[18.1] Summary of Effects 18-1
[18.2] Schedule of Environmental Commitments 18-51

[19] Reference List 19-1

Glossary of Terms and Abbreviations

°C	degrees Celsius
%	Percentage
I	One
II	Two
III	Three
IV	Four
V	Five
AADT	Annual Average Daily Traffic
AAS	Areas of Archaeological Sensitivity
ACA	Architectural Conservation Area
ADT	Annual Daily Traffic
AEP	Annual Exceedance Probability
AFA	Area for Further Assessment
AlluviMIN	EPA geoportal code for mineral alluvium
AminDW	EPA geoportal code for deep well drained mineral (derived from mainly acidic parent materials)
AminPD	EPA geoportal code for deep poorly drained mineral (derived from mainly acidic parent materials)
AminPDPT	EPA geoportal code for poorly drained mineral soils with peaty topsoil (derived from mainly acidic parent materials)
AminSP	EPA geoportal code for shallow poorly drained mineral soil (derived from mainly acidic parent materials)
AminSW	EPA geoportal code for shallow well drained mineral (derived from mainly acidic parent materials)
AQIH	Air Quality Index for Health
BL	ByrneLooby
BminSP	EPA geoportal code for shallow poorly drained mineral soil (derived from mainly basic parent materials)

BminSW	EPA geoportal code for shallow well drained mineral (derived from mainly basic parent materials)
BOD	Biological Oxygen Demand
c.	Approximately
CEMP	Construction Environmental Management Plan
CFRAMS	Catchment Flood Risk Assessment and Management Study
Co.	County
COVID-19	Coronavirus disease 2019
DCCAE	Department of the Environment, Climate and Communications
DCHG	Department of Culture, Heritage and the Gaeltacht
EC	Executive Council
EIA	Environmental impact assessment
EIAR	Environmental impact assessment report
Eir	Eircom Limited
EirGrid	EirGrid Group
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EQSD	Directive on Environmental Quality Standards
ESB	Electricity Supply Board
EU	European Union
FRMP	Flood Risk and Management Plan
FRS	Flood Relief Scheme
FSU	Flood Studies Update
GIS	Geographic Information Systems
GLAP	Graiguenamanagh Local Area Plan
GSI	Geological Survey Ireland
GTFRS	Graiguenamanagh-Tinnahinch Flood Relief Scheme
GWB	Groundwater Bodies
HCV	Heavy Commercial Vehicles
HEP	Hydroelectric plant

HLC	Historic Landscape Characterisation
IFI	Inland Fisheries Ireland
IPC	Integrated Pollution Control
IPCC	Irish Peatland Conservation Council
KCC	Kilkenny County Council
km	Kilometres
km^2	Kilometres squared
kV	Kilovolt
LAP	Local Area Plan
LCA	Landscape Character Assessment
Made	EPA geoportal code for made ground
m	meter(s)
mg/l	Milligrams per litre
mm/yr	Millimeters per year
NBDC	National Biodiversity Data Centre
NHA/ pNHA	Natural Heritage Areas / Proposed Natural Heritage Areas
NIAH	National Inventory of Architectural Heritage
NMI	National Museum of Ireland
NMS	National Monuments Service
NPWS	National Parks and Wildlife Service
NRA	National Road Schemes
NSS	National Spatial Strategy
NTA	National Transport Authority
OPW	Office of Public Works
pe	Population Equivalent.
PA	Project Archaeologist
PAHs	Poly Aromatic Hydrocarbons
Pers. Comm.	Personal Communication
Pre-WFD	Pre-Water Framework Directive

Q1	Quarter one
QI	Qualifying Interests
Q-value	Biological River Quality Classification System
RMP	Record of Monuments and Places
RPS	Record of Protected Structures
SAC	Special Areas of Conservation
SCI	Sites of Community Importance OR Species of Conservation Interest
SEA	Strategic Environmental Assessment OR Social and Environmental Assessment
SI	Site Investigation OR Statutory Instrument
SL	Speed Limit
SMR	Sites and Monuments Record
SPA	Special Protection Area
sp.	Species (singular)
spp.	Species (plural)
TII	Transport Infrastructure Ireland
UNESCO	United Nations Educational, Scientific and Cultural Organization
V85	85% of the vehicles are driving at or below the speed limit
Va	Average Speed
WFD	Water Framework Directive
WHS	World Heritage Site
WwTP	Wastewater Treatment Plant
ZAP	Zone of Archaeological Potential

1 Introduction

1.1 Context and Project Background

1.1.1 Kilkenny County Council (KCC), through partnership with the Office of Public Works (OPW) and Carlow County Council (CCC), is progressing the Graiguenamanagh-Tinnahinch Flood Relief Scheme (GTFRS) (hereafter referred to as the 'Proposed Scheme'). KCC progressed the scheme to address the high levels of flood risk in Graiguenamanagh and Tinnahinch (G-T), under the EC Directive on the Assessment and Management of Flood Risks 2007 and the EU Floods Directive, as implemented in Ireland by SI 122 of 2010 EC Regulations 2010 and SI 495/2015. This Environmental Impact Assessment Report (EIAR) is produced as part of the Planning Process.

1.2 Need for the Scheme

1.2.1 The towns of Graiguenamanagh in County Kilkenny, and Tinnahinch in County Carlow, have a history of flooding. The two towns are separated by the River Barrow which causes flooding when the channel exceeds its capacity. The Barrow River Basin is predominantly rural and agricultural in nature and covers an area of 3,025 km^2 and includes much of County Carlow, portions of south Kildare, east Laois, southeast Offaly, east Kilkenny and small areas within west Wexford and Wicklow. The main river in this area is the River Barrow and its tributaries. G-T are located on the River Barrow with the Duiske River, a tributary of the River Barrow, running through the town of Graiguenamanagh.

1.2.2 The River Barrow drains a large catchment and has typically risen slowly during historical flood events. During these events, the two affected areas are the quay front of Graiguenamanagh and the quay front of Tinnahinch. The River Duiske is a small flashy river that flows through the town of Graiguenamanagh before joining the River Barrow. During past flood events, out of bank flow from the River Duiske has travelled through Graiguenamanagh affecting residential and commercial properties along Main Street and Turf Market area, as reported during 2015/2016 flood events. A total of 17 reports of flood events have been cited between 1930 and 2020. There have been no flood events since 2020.

1.2.3 The South-Eastern Catchment-based Flood Risk Assessment and Management (CFRAM) Programme included G-T as an Area for Further Assessment (AFA) and concluded that a flood relief scheme would be viable and effective for the community. The CFRAM Study came about at a time of shifting emphasis in addressing flood risk towards a catchment-based, proactive approach for identifying and managing existing and potential future flood risk. This study was driven by a requirement for compliance with relevant legislation and achieved the following:

- Identification and mapping of existing and potential future flood hazards and the associated risks.
- Identified viable structural and non-structural measures for managing flood risk.

- Built a strategic information database to make informed decisions to manage flood risk.
- Developed an environmentally, socially and economically appropriate long-term strategy to manage the flood risk and help ensure safety and sustainability of communities.
- Carried out a Strategic Environmental Assessment (SEA) and Appropriate Assessment (AA) to ensure environmental issues and opportunities for enhancement are included in all decisions.

1.3 Scheme Objectives

1.3.1 The objective of the Proposed Scheme is to deliver a Flood Relief Scheme, that is technically, socially, environmentally and economically acceptable, to alleviate the risk of flooding to the communities of G-T in accordance with the standards of the EU Directive on the Assessment and Management of Flood Risk (Floods Directive 2007/60/EC) transposed into Irish Law as SI 122 of 2010.

1.3.2 The Proposed Scheme will be designed to provide protection to properties in the study area from the 1 in 100-year flood event (1% AEP). There is also an objective to not contribute to an increase in water levels, whether upstream or downstream of the Scheme Area, as a result of the implementation of the GTFRS preferred measure.

1.4 The Scheme Area

1.4.1 The Scheme Area (see Figure 1-1) covers the following:

- Lengths of river channel/ watercourse that have hydraulic influence on the area intended to benefit from, and be protected by, any feasible scheme.
- Full hydrological catchment areas draining to the downstream end of those river channels.
- Places that have the potential to be environmentally impacted from any such scheme.

1.4.2 The environmental study area has been developed in consideration of the Proposed Scheme. It considers the lengths of river channel / watercourse that have hydraulic influence on the area intended to benefit from, and be protected by, any feasible scheme as well as the catchment areas draining to the downstream ends of those river channels. The study area boundary for each environmental discipline varies according to the location of receptors and individual topic best practice, appropriate statutory and/or specialist guidance, and applicable legislation and regulations. This is outlined further in each environmental discipline chapter (Chapters 6 to 15).

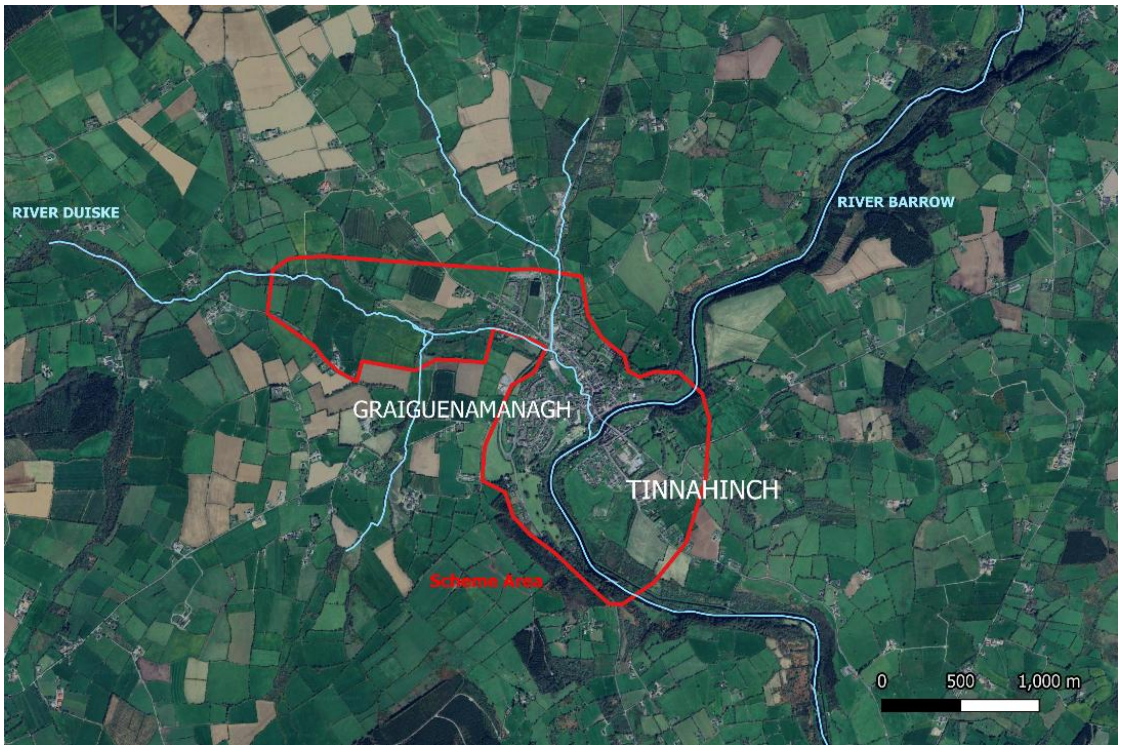


Figure 1-1: Scheme Area

1.5 The Proposed Scheme

1.5.1 As outlined previously, a preliminary scheme option was identified at the CFRAM level of assessment. Following this, a project-level options assessment was conducted to assess and consider all possible measures to reduce flood risk, not just those in the CFRAM assessment. Development was based on more detailed information than was available for the CFRAM, including detailed hydrological assessment, hydraulic modelling and environmental studies.

1.5.2 Initially, a lost list of individual measures that provide flood mitigation were reviewed for applicability to the scheme and from this review a list of viable measures was established. From these measures, five (nos. 5) options were identified and assessed through Multi-Criteria Analysis (MCA) and were presented for public and stakeholder engagement in August 2022. Combining objective analysis and professional judgement, with reference to the information gathered through the technical and environmental assessment and public consultation, the preferred option was determined. Further details of the optioneering and MCA process is outlined in Chapter 3 ‘Previous Studies, Alternatives and Options’ of this EIAR.

1.5.3 The Proposed Scheme consists of a series of raised defences (Glass/Concrete flood walls and embankments) along the River Duiske and River Barrow, as well as a number of flood gates on G-T Quays. It further includes upstream storage of flood waters (upstream on the River Duiske) to facilitate a reduced extent of flood walls downstream in the built-up area of Graiguenamanagh, particularly in the complex areas of Turf Market where there are significant buildability, ecological, archaeological and cultural constraints. This is

considered to provide a significant technical and environmental advantage over the other options, as well as from a public engagement perspective. Where possible, new flood defence walls will replace existing walls throughout the scheme, with the exception of along the Graiguenamanagh quay where there are currently no walls.

1.5.4 A detailed description is provided in Chapter 4 'Description of the Proposed Scheme and Construction Methodology' of this EIAR, with scheme drawings under Appendix 4-1. However, in summary, the Proposed Scheme includes the following:

- Upstream Storage:
    - Installation of flood storage area approximately 1.5km upstream from the River Barrow and River Duiske confluence. The storage area will consist of a grass seeded fill material embankment that ranges from 0-8m above existing ground level, with side slopes at a ratio of 3:1. The embankment length will tie into the existing high ground to hold a flood storage extent of approximately 0.074 km2.
    - A flow control device (hydrobrake) will be constructed in the centre of the embankment within the Duisk channel which will include debris screen on the upstream side to prevent blockage.
    - Road and associated services into the surrounding landscape, tree, hedge, riparian planting and wildflowers meadows have been proposed to assist integration of the embankment.
- River Barrow Defences:
    - Defences at the Graiguenamanagh Rowing Club consist of hard and soft defences set back from the Quayside. The flood defence wall in front of the Club will be circa 1.5 m high above ground level and will include 1 m high glazing within its height in front of the clubhouse. The riverward side of the wall will be clad in natural stone. A soft earthen embankment will be constructed 1.8m high nearest to the river and will tie into high ground to the North of the building. The embankment will have side slopes of 1V:2.5H and will be grass seeded. For the southern vehicular access to the Boathouse, a double gate arrangement is proposed to allow for pedestrian access to facilities while providing a secure boundary to the boathouse. Mooring and boat access will be available along the length of The Quay. Further, the slipway and concrete steps opposite the Boat Club will remain. The vehicular route within the club carpark will be altered to a one-way system for safer pedestrian movements.
    - A new raised defence (stone clad wall) will be constructed from the Rowing Club along Graiguenamanagh Quay and will tie into the existing wall near the junction of Barrow Lane. A flood gate will be installed across the junction to the Rowing Club, flushed with the flood defence walls. This flood gate will restrict access to the Rowing Club during flood conditions. An access ramp

will be installed over the defence wall to maintain access to the site before the Rowing Club.

- New raised defences (cut stone clad and glass wall) upstream of the Graiguenamanagh Bridge to tie into the flood gate at the Graiguenamanagh Rowing Club/Barrow Lane junction. The vehicular route will be altered to a one-way system, with wider footpaths proposed for easier and safer pedestrian movement and permeability. Site clearance work will consist of removal of existing bollards, demolition of boundary wall/hoarding at corner of the Quay and Barrow Lane and demolition of existing streetscape along the entire quay.
- Flood gates will be placed along Graiguenamanagh Quay and Tinnahinch Quay to retain access for water activities. These will be closed in flood conditions.
- A new raised defence (stone clad flood wall) downstream of the Graiguenamanagh Bridge that will follow the existing natural line of the edge of the carriageway.
- A new raised defence (earthen embankment) on the left bank upstream of the Graiguenamanagh Bridge. The embankment will be circa 240 m long with a maximum height of 1.25 m above ground level. The embankment will have side slopes of 1V:2.5H and will be grass seeded. The embankment will tie into a short section of concrete flood wall at its north eastern end. Trees and ornamental planting will be introduced at the entrance to the amenity pathway, both for visual and biodiversity benefit.
- Modifications to, or a new raised defences (flood concrete walls) on the left bank downstream of Graiguenamanagh Bridge along Tinnahinch Quay.
- Installation of non-return valves on outfalls to the River Barrow.
- Behind wall drainage improvements/pumping stations

- River Duiske Defences:
  - New raised defences (concrete wall) along both the left and right banks of the River Duiske, at the confluence with the River Barrow up to the Turf Market Bridge.
  - A new raised defence (earthen embankment) along the eastern boundary of the Hub. The embankment will be 62m in length with side slopes of 1V:2.5H and will be grassed seeded. Formal and informal pathways and planting are to be provided throughout the area, linking the area to the town, and residential area to the west. These will also provide linkage to the South Leinster Way/Brandon Hill.

- A new raised defence (concrete wall) on the left bank of the River Duiske, downstream from the High Street Bridge.
- A new raised defence (concrete wall) and wall improvements on the left bank of the River Duiske, upstream of the High Street Bridge to Clapper Bridge. Ornamental planting is proposed between the proposed flood wall and the existing stone wall. Further steps are to be introduced towards Clapper Bridge with guardrails/handrails.
- Installation of debris trap upstream of Clapper Bridge.
- Removal and raised replacement of two existing foot bridges, near the Mass Path and at Turf Market.

1.6 Legislative Basis and Scope of EIA

Statutory Requirement for an EIA

1.6.1 This EIAR has been prepared to support Kilkenny County Councils' preparation of a Part 10 Planning Application to An Bord Pleanála, under Section 175, of the Planning and Development Regulations 2001-2020.Planning Application to An Bord Pleanála, under Section 175, of the Planning and Development Regulations 2001-2020.

1.6.2 EIA is a procedure required under the terms of EU Directive 2014/52/EU, transposed into Irish Law through the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (SI 296 of 2018). This Directive requires an assessment of the effects of certain public and private projects on the environment. Ireland implements this Directive through the Planning and Development Regulations 2001-2020.

1.6.3 The mandatory requirement is generally based on the nature or scale of a proposed development, as set out in EU Directive 85/337/EEC (as amended by Directive 97/11/EC). The Planning and Development Regulations 2001-2024 – Schedule 5 also identify certain types and scales of development, generally based on thresholds of scale, for which an EIA is mandatory.

1.6.4 The Proposed Scheme falls within the criteria set out for which a mandatory EIA is required. With respect to GTFRS, it is subject to the requirements of Part X of the Act and Part 10 of the Planning and Development Regulations on the basis of criteria set out in Schedule 5, Part 2, Section 10 (f) (ii)[1]:

Canalisation and flood relief works, ***where the immediate contributing sub-catchment of the proposed works (i.e., the difference between the contributing catchments at the upper and lower extent of the works) would exceed 100 hectares*** *or where more than 2*

[1] These thresholds are also outlined in Annex II of the EIA Directive (Annex II Projects). These have been transposed into Irish Planning Law in Schedule 5 of the Planning and Development Regulations 2001.

hectares of wetland would be affected or ***where the length of river channel on which works are proposed would be greater than 2 kilometres.***

1.6.5 Those conditions highlighted in **bold** are relevant to the GTFRS and, given that both conditions are exceeded, the determination of the requirement for an EIA for the Project.

1.6.6 The extent of the contributing Duiske sub-catchment is >440 hectares with a river channel reach of 4.35km within the catchment.

EIA Guidance

1.6.7 In preparing the EIAR, regard has been had to the following overarching EIA related guidance:

- Interpretation of definitions of project categories of annex I and II of the EIA Directive (European Commission, 2024).
- Department of Housing, Planning and Local Government (2018) Circular PL 05/2018 -Transposition into Planning Law of Directive 2014/52/EU amending Directive 2011/92/EU on the effects of certain public and private projects on the environment (the EIA Directive) and Revised Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment.
- Department of Housing, Planning, Community and Local Government (2017) Key Issues Consultation Paper on the Transposition of 2014 EIA Directive (2014/52/EU) in the Land Use Planning and EPA Licencing Systems.
- Department of Housing, Planning, Community and Local Government (2017) Circular PL 1/2017 - Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive): Advice on the Administrative Provisions in Advance of Transposition.
- Environmental Protection Agency (2022) Guidelines on the Information to be contained in Environmental Impact Assessment Reports (May 2022).
- European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018, S.I. No. 269/2018.
- European Commission (2017) Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report.
- European Commission (2012) Interpretation suggested by the Commission as regards the application of the EIA Directive to ancillary/associated works.
- European Commission (1999) Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions.
- European Union (2013) Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment.

- Government of Ireland (2018) Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (August 2018).

1.6.8 Additional topic-specific guidance used to undertake assessments is identified in Chapters 6 - 17 as appropriate.

EIAR Stages

Initial Screening

1.6.9 EIA Screening is the first step in the EIA process. It is an examination of classifications defined in legislation, to determine if a development requires an EIA. Where no mandatory requirement is concluded (from review of Schedule 5, Part 1 of the Planning and Development Regulations 2001-2020), screening advances to Sub-Threshold Development Assessment where the Competent Authorities evaluates whether the project is likely to have a significant effect on the environment, with reference to its scale, nature, location and context.

1.6.10 A Screening Assessment was carried out for the Proposed Scheme under report reference W3451-ENV-R002 dated February 2021. It was determined that the Proposed Scheme falls within the criteria set out for which a mandatory EIA is required, as outlined in Section 1.6.4.

Informal Environmental Scoping

1.6.11 Following the determination of the Initial Screening of the need for an EIAR, an informal EIA Scoping Report was carried out for the Proposed Scheme (W3541-ENV-R007, dated May 2023). It was decided by the Steering Group that the EIA Scoping Report would not be issued to ABP as part of a formal scoping but would be carried out to aid in identifying the key elements that would have the potential to result in impacts on the environs of the site. This exercise also assisted in determining the nature and level of detail of information to be contained in the EIAR, essentially determining what is to be 'scoped in' and 'scoped out' of the EIAR.

1.6.12 Statutory bodies that have an interest or whom may be affected by the Proposed Scheme, as well as non-governmental organisations and other relevant organisations were contacted, and the informal Scoping Report was circulated to them. Their responses are summarised in Chapter 5 'Consultation and Stakeholder Engagement'.

1.6.13 Table 1-1 below summarises the findings of the EIA Scoping Report. It was determined that there could be potential impact (negative or positive) with respect to all aspects of the environment. The environmental factors that were deemed to be 'scoped in' have been assessed within this EIAR and the results of that can be seen in Chapters 6 to 15, with interactions and cumulative effects of these assessed in Chapter 16 'Interactions and Cumulative Effects'. The parameters that are 'scoped out' are predicted to have no significant effect as a result of the operation of the Proposed Scheme.

Table 1-1: Scoping Assessment Results

Chapter within this EIAR	Environmental Parameter	Construction Phase	Operation and Maintenance Phase
Chapter 6	Population and Human Health	✓	✓
Chapter 7	Material Assets	✓	-
Chapter 8	Hydrology - Surface Water	✓	✓
Chapter 9	Cultural Heritage	✓	-
Chapter 10	Biodiversity	✓	✓
Chapter 11	Landscape and Visual	✓	✓
Chapter 12	Land, Soils, Geology and Hydrogeology	✓	✓
Chapter 13	Air Quality	✓	-
Chapter 14	Climate	✓	✓
Chapter 15	Noise and Vibration	✓	-
Chapter 16	Interactions and Cumulative Effects	✓	✓

Impact Assessment & Description of Effects

1.6.14 This EIAR has been prepared to provide information on the likely significant effects of the Proposed Scheme on the environment as per the Planning and Development Regulations 2001 (as amended by Schedule 6 of the European Union (Planning and development) (Environmental Impact Assessment) Regulations 2018, (S.I. No. 296 of 2018)

1.6.15 EIA Regulations require reporting on those environmental effects arising from a project that are considered likely to be significant. With no statutory definition of what constitutes a 'significant effect', the professional opinion of competent experts is utilised based on:

- The baseline conditions, and the sensitivity and importance of receptors.
- The expected magnitude of change on each receptor (considering the nature and duration of change, including site specific and wider effects; positive and negative effects; temporary and permanent effects; direct, indirect and secondary effects; and cumulative effects such as the interaction of scheme effects acting in combination upon a receptor, or the interaction of the scheme with other projects); and
- The potential to avoid or reduce any potential effects such that they are unlikely to be significant.

1.6.16 The criteria for the presentation of the characteristics of potential significant effects will be described with reference to the magnitude, spatial extent, nature, complexity, probability, duration, frequency, reversibility, cumulative effect and transboundary nature (if applicable) of the effect. The environmental effects for each relevant topic have been predicted by determining the baseline environmental conditions which is the situation without the Proposed Scheme. This is then compared to the conditions that would prevail if the Proposed Scheme were to go ahead.

1.6.17 The classification and description of effects in the Proposed Scheme's EIAR follows the terms provided in Table 3.4 of the EPA Guidelines (2022), modified in Table 1-2. According to the Guidelines, the relevant terms listed in the table below can be used to consistently describe specific effects, but all categories of terms do not need to be used for every effect. The guideline has six key processes of describing environmental effect (or impact), including (see Table 1-2):

- Determining the quality of effect,
- Determining the significance of effect,
- Determining the extent and context of effect,
- Determining the probability of effect,
- Determining the duration of effect, and
- Determining the type of effect.

1.6.18 The assessment of each environmental aspect has been undertaken for the 'do nothing' effect (i.e., effects should the project not be carried out), the 'construction phase' and the 'operation and maintenance phase' of the Proposed Scheme.

Mitigation Measures and Monitoring

1.6.19 For each significant adverse effect that has been identified by this EIAR, potential mitigation and monitoring measures have been recommended by the competent experts, consistent with statutory requirements and good industry practice in their respective field. Those relevant to the construction stage have been included in the Construction Environmental Management Plan (CEMP) (see Appendix 4-4).

Residual Impacts

1.6.20 The likely residual environmental impact(s) for each environmental topic are then outlined, determined through a review of what likely remaining impact is following implementation of the suggested mitigation and monitoring measures. These are outlined in the assessment tables, have been summarised further in Chapter 18 'Summary of Residual Effects and Schedule of Environmental Commitments'.

Interactions and Cumulative Effects

1.6.21 As is required of an EIA the interactions between effects on different environmental factors is considered. This allows for careful consideration of pathways, both direct and indirect, that can magnify effects through the interaction or accumulation of effects. A consideration of other projects and their potential to contribute to the overall environmental impact upon shared receptors has been undertaken, whereby the addition of several perceived minor or insignificant effects may contribute to a larger more significant cumulative impact.

1.6.22 A review of interactions and cumulative impacts has been included at the end of each impact assessment chapter, and then separately in Chapter 16 ‘Interactions and Cumulative Effects’.

Table 1-2: Description of Effects Terminology used within EIAR (Modified from EPA, 2022)

Significance Level	Criteria
Quality of Effects	
Positive Effects	A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).
Neutral Effects	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
Negative/adverse Effects	A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance).
Describing the Significance of Effect	
Imperceptible	An effect capable of measurement but without significant consequences.
Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Significant Effects	An effect which, by its character, magnitude, duration, or intensity alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration, or intensity significantly alters most of a sensitive aspect of the environment.
Profound Effects	An effect which obliterates sensitive characteristics
Describing the Extent and Context of Effects	
Extent	Describe the size of the area, the number of sites and the proportion of a population affected by an effect.
Context	Describe whether the extent, duration or frequency will confirm or contrast with established (baseline) conditions (if it the biggest, longest effect ever?).
Describing the Probability of Effect	
Likely Effects	The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.

Significance Level	Criteria
Unlikely Effects	The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.
Describing the Duration of Effects	
Momentary Effects	Effects lasting from seconds to minutes
Brief Effects	Effects lasting less than a day
Temporary Effects	Effects lasting less than a year
Short-term Effects	Effects lasting one to seven years.
Medium-term Effects	Effects lasting seven to fifteen years
Long-term Effects	Effects lasting fifteen to sixty years.
Permanent Effects	Effects lasting over sixty years
Reversible Effects	Effects that can be undone, for example through remediation or restoration
Frequency of Effects	Describe how often the effect will occur (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually).
Describing the Types of Effects	
Indirect Effects (a.k.a. secondary or off-site effects)	Effects on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway.
Cumulative Effects	The addition of many minor or insignificant effects, including effects of other projects, to create larger, more significant effects.
Do-nothing Effects	The environment as it would be in the future should the subject project not be carried out.
Worst-Case Effects	The effects arising from a project in the case where mitigation measures substantially fail.
Indeterminable Effects	When the full consequences of a change in the environment cannot be described.
Irreversible Effects	When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost.
Residual Effects	The degree of environmental change that will occur after the proposed mitigation measures have taken effect.
Synergistic Effects	Where the resultant effect is of greater significance than the sum of its constituents (e.g. combination of SOx and NOx to produce smog).

1.7 Structure of the EIAR

1.7.1 The EIAR comprises three volumes as follows:

Volume I This provides the 'Non-Technical Summary' to summarise the findings of the EIAR in a clear, accessible format that uses non-technical language.

Volume II This encompasses the main EIAR (this volume) including the chapters outlined below. Chapters 1-5 provide the project context and stakeholder consultation, the assessment chapters (Chapters 6-15) provide a description of the relevant environmental aspects, the cumulative effects and interactions of these are outlined in Chapter 16, the impact assessment related to major accidents and disasters in Chapter 17 and the findings of the assessment in Chapter 18.

Volume III This provides the technical appendices and figures that support the EIAR and are cross-referenced within Volume II.

1.7.2 The EIAR (Volume II) is structured as follows:

Chapter 1 Introduction
Chapter 2 Planning and Policy
Chapter 3 Previous Studies, Alternatives Considered and Options
Chapter 4 Description of the Proposed Scheme and Construction Methodology
Chapter 5 Consultation and Stakeholder Engagement
Chapter 6 Population and Human Health
Chapter 7 Material Assets (including Built Services, Traffic & Transportation and Waste)
Chapter 8 Hydrology - Surface Water
Chapter 9 Cultural Heritage
Chapter 10 Biodiversity
Chapter 11 Landscape and Visual
Chapter 12 Land, Soils, Geology and Hydrogeology
Chapter 13 Air Quality
Chapter 14 Climate
Chapter 15 Noise and Vibration
Chapter 16 Interactions and Cumulative Effects
Chapter 17 Major Accidents and Disasters
Chapter 18 Summary of Residual Impacts and Schedule of Environmental Commitments

1.8 Project Team

1.8.1 The EIAR has been prepared by a multidisciplinary team of environmental specialists as set out in Table 1-3. Supporting documentation has been prepared by specialists and are referenced where appropriate throughout this EIAR.

Table 1-3 EIAR Team and Qualifications

Consultants	Experienced/Competent Expert and qualifications	Contribution
Ayesa Building 2100, Cork Airport Business Park, Kinsale Road, Cork, T12 KV8R	**Barry Sheridan** **Director, Environment** BA Hons. (Environmental Sciences), Higher Diploma (Environmental Engineering), Higher Diploma (Acoustics & Noise Control) **Lynn Morrissey** **Principal Environmental Specialist** BSc (Hons), MSc (Agr), CIWM (2023) **Andrea Brogan** **Environmental Consultant** MA (Environmental Humanities), BSc (Tourism Management) **Jackelyn Wren** **Principal Environmental Specialist** BA Hons. (Geography), ISEP Affiliate	Chapters 1 – 5 (introductory chapters) Chapters 6, 7, 8 & 12 (environmental assessment chapters) Chapters 16, 17 and 18 (cumulative effects, major accidents and disasters, and interactions and summary chapters)
	Sean Harrington **Director & Project Manager** PhD (River/Water Engineering), BEng Hons. (Structural Engineering)	Chapters 1 & 4 (Introduction and project description & construction methodology)
	Brendan O'Connor **Senior Ecologist, Aquafact / APEM** PhD (Ecology), BSc (Ecology), MCIEEM **Joe Butler** **Ecologist** MSc (Wildlife Conservation & Management) BSc (Zoology), QCIEEM	Chapter 10 (Biodiversity) Associated Appropriate Assessment (AA) Screening & Natura Impact Statement (NIS)
Amplitude Acoustics G2 The Steelworks, Foley Street, Dublin, D01 KP03, Ireland	**Dominic Parkinson** **Acoustic Specialist** Diploma (Institute of Acoustics and Noise Control) BSc (Mechanical Design and Manufacturing Engineering), IOA **Miguel Cartuyvels** **Acoustic Specialist** BSc (Industrial Engineering) IOA Certificate (Competence in Environmental Acoustics)	Chapter 15 (Noise and Vibration)
Courtney Deery Lynwood House	**Siobhan Deery** **Senior Partner**	Chapter 9 (Cultural Heritage)

Consultants	Experienced/Competent Expert and qualifications	Contribution
Ballinteer Road, Dublin 16, D16 H9V6	BA (Archaeology and Geography), MA (Archaeology and Heritage), Advanced Diploma (Planning & Environmental Law) **Lisa Courtney** **Senior Partner** BA, MSC (Archaeology, Economics, Environmental Resource Management)	
The Archaeological and Commercial Diving Company Beverley Studios, Church Terrace, Bray, Co. Wicklow	**Dr. Niall Brady** **Director** PhD (Medieval Studies), MA (Archaeology) BA (Archaeology and Geography), HSE Part III Diver	Chapter 9 (Cultural Heritage – underwater archaeology elements)
Southgate Associates Farren House, Cork Road, Midleton, Cork, P25 XY42	**Christopher Southgate** **Director** BA and MA (Civil and Structural Engineering), Engineers Ireland Fellow	Chapter 9 (Cultural Heritage – conservation engineer elements)
The Big Space Ltd. Creative Dock Malahide Marine Village, Malahide, Co. Dublin	**Linda Maher** **Landscape Architect** PhD (Landscape Architecture), MSc (World Heritage Management, BAgriSc Hons (Landscape Horticulture)	Chapter 11 (Landscape and Visual)
Chris Shackleton Consulting Ltd. 19 Waterside Crescent Swords Road Malahide, Co Dublin	**Chris Shackleton** **Principle** BA BAI (Engineering)	Appendix 4-3 - Photomontages

1.9 References

Ayesa, 2025. *Graiguenamanagh-Tinnahinch Flood Relief Scheme, Natura Impact Statement, W3394-BL-ENV-R-010,* s.l.: s.n.

Ayesa, 2025. *Graiguenamanagh-Tinnahinch FRS, Options Report, W3451-BLP-R-W-R009, Rev 07,* s.l.: s.n.

ByrneLooby, 2020. *Graiguenamanagh-Tinnahinch Flood Relief Scheme, Hydrological Method Statement, W3451-W-R001.,* s.l.: s.n.

ByrneLooby, 2021. *Environmental Constraints Study Report , W3451-BL-ENV-R001,* s.l.: s.n.

ByrneLooby, 2021. *Graiguenamanagh-Tinnahinch Flood Relief Scheme, EIAR Screening Report, W3451-ENV-R002,* s.l.: s.n.

ByrneLooby, 2022. *Graiguenamanagh-Tinnahinch Flood Relief Scheme, Hydrology Report, W3451-W-R002.,* s.l.: s.n.

ByrneLooby, 2023. *Graiguenamanagh-Tinnahinch Flood Relief Scheme, EIAR Scoping Report, W3451-ENV-R007,* s.l.: s.n.

Department of Housing, Local Government and Heritage, 2000. *Planning and Development Act 2000,* s.l.: s.n.

Department of Housing, Local Government and Heritage, 2001. *Planning and Development Regulations 2001, S.I. No. 600 of 2001,* s.l.: s.n.

Department of Housing, Local Government and Heritage, 2018. *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment,* s.l.: s.n.

Department of Housing, Local Government and Heritage, 2022. *Planning and Development Regulations 2001-2022 (Unofficial Consolidation) ,* s.l.: s.n.

Environmental Protection Agency, 2015. *Advice Notes on the Current Practice in the Preparation of Environmental Impact Statements,* s.l.: EPA.

EPA, 2022. *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports,* s.l.: s.n.

European Commission, 2024. *Interpretation of definitions of project categories of annex I and II of the EIA Directive,* s.l.: s.n.

European Communities (Assessment and Management of Flood Risks) Regulations 2010, 2010. *S.I. No. 122 of 2010,* s.l.: s.n.

The European Parliament and the Council of the European Union , 2007. *Directive 2007/60/EU of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks,* s.l.: s.n.

The European Parliament and the Council of the European Union, 2014. *Directive 2014/52/EU of the European Parliament and of the Council of 16 Apeil 2014 ammending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment. ,* s.l.: s.n.

2 Planning and Policy

2.1 Introduction

2.1.1 Kilkenny County Council (KCC), on behalf of the Office of Public Works (OPW) and in partnership with Carlow County Council (CCC), wishes to submit a Part 10 Planning Application to An Bord Pleanála under Sections 175 and 177AE of the Planning & Development Act, 2000 (as amended) for the construction of the GTFRS.

2.1.2 This Chapter provides a summary of the national, regional and local legislation and policy of relevance to the site and the Proposed Scheme.

2.2 Legislation Context

2.2.1 Further to the EU Directive 2014/52/EU (EIA Directive) discussed in Chapter 1 'Introduction' of this EIAR, there are a number of other EU Directives and Irish Acts and Statutory Instruments that inform and guide the preparation of this EIAR.

Planning and Development Acts 2000 (as amended) & Planning and Development Regulations 2001 (as amended)

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

2.2.3 The requirements of the EIA Directive are transposed into Irish Law and included in the Planning and Development Act 2000, as amended, and Planning and Development Regulations 2001 as amended. The Planning and Development Regulations 2001 (Schedules 5 and 7) also identify certain types and scales of development, generally based on thresholds of scale, for which an EIA is mandatory. The requirements in respect of EIA are contained within the Planning Act, and these are described in detail in Chapter 1 'Introduction'.

European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296/2018)

2.2.4 These Regulations extensively amend the Planning and Development Act 2000 and the Planning and Development Regulations 2001 in order to transpose into Irish law the provisions of Directive 2014/52/EU amending Directive 2011/92/EU of the European Parliament and of the Council on the assessment of the effects of certain public and private projects on the environment.

2.2.5 The publication of the Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment (2018) coincided with the making of the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 in order to transpose the Directive into Irish planning law.

EU Floods Directive

2.2.6 The EU Directive on the Assessment and Management of Flood Risks (2007/60/EC) (the Floods Directive) was transposed into Irish law by the EU (Assessment and Management of Flood Risks) Regulations SI No. 122 of 2010. The aim of the EU 'Floods' Directive, which came into force in 2007, is to reduce the adverse consequences of flooding on human health, the environment, cultural heritage and economic activity. The Directive requires Member States to undertake three key steps of analysis and planning:

- Carry out a screening of flood risk to identify Areas of Potentially Significant Flood Risk (APSFRs), which were referred to as Areas for further Assessment (AFAs) for the National CFRAM Programme. This Preliminary Flood Risk Assessment is based on available or readily derivable information.
- Prepare flood hazard and risk maps for the AFAs.
- Prepare plans setting out objectives and a set of measures aimed at the management and reduction of flood risk within the AFAs.

2.2.7 Implementation of the EU Floods Directive is being coordinated with the requirements of the EU Water Framework Directive and the current River Basin Management Plans. The Office of Public Works (OPW) is the national authority for the implementation of the Directive.

2.2.8 The design of the Proposed Scheme is a direct and coordinated measure proposed in line with the requirements of the Floods Directive as transposed into Irish law by SI No. 122 of 2010.

EU Water Framework Directive

2.2.9 The EU has developed the Water Framework Directive (WFD) which establishes a legislative framework for the protection of all waters including rivers, lakes, estuaries, coastal waters and groundwater, and their dependent wildlife and habitats. Specifically, the WFD aims to:

1. *"protect/enhance all waters (surface, ground and coastal waters);*
2. *achieve 'good status' for all waters by December 2015;*
3. *manage water bodies based on river basins (or catchments);*
4. *involve the public; and*
5. *streamline legislation".*

2.2.10 The objectives and targets required by the WFD are set out in the statutory River Basin Management Plan (RBMP) for Ireland 2022-2027 (Department of Housing, Local

Government and Heritage, 2022). The RBMP requires that all member states adopt a comprehensive integrated basin-based approach to water management.

2.2.11 Rivers, lakes, estuaries and coastal waters (surface waters) can be awarded one of five statuses i.e., 'High', 'Good', 'Moderate', 'Poor' and 'Bad whereas groundwater can be awarded only 'Good' or 'Poor' status. Ecological status for surface water bodies is primarily driven by the Biological Quality Elements (BQEs) which includes fish, aquatic flora, macroinvertebrates and phytoplankton. Standards for general physio-chemical parameters, specific pollutants and hydro morphology are set at levels in order that they are sufficient to support the status of the BQEs (Catchments.ie, 2025).

2.2.12 The WFD has been transposed into Irish law by means of the following main Regulations.

- European Communities (Water Policy) Regulations, 2014 (S.I. No. 350 of 2014)
- European Communities (Drinking Water) Regulations 2014 (S.I. No. 122 of 2014).
- European Communities Environmental Objectives (Surface Waters) (amendments) Regulations, 2019 (S.I. No. 77 of 2019).
- European Communities Environmental Objectives (Groundwater) (Amendments) Regulations, 2016 (S.I. No. 366 of 2016).
- European Communities (Good Agricultural Practice for Protection of Waters) (Amendments) Regulations, 2020 (S.I. No. 40 of 2020).
- European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations, 2011 (S.I. No. 489 of 2011).

2.2.13 The Proposed Scheme is obligated to ensure that it does not result in the reduction of WFD quality statuses or prevent the restoration of those assets awarded a status below 'good'.

2.2.14 The Department of Housing, Local Government and Heritage held a public consultation with regards to the 'Designation of Ireland's Heavily Modified Water Bodies arising out of the 2024 Water Action Plan', published on 27th March 2025 and closed on 23rd May 2025. The watercourse present within the Study Area (Barrow_230) is listed as a candidate Heavily Modified Water Body (HMWB). These are waterbodies that have been physically modified in the past to serve a specified use, such as navigation as is the case with the River Barrow (Barrow_230). HMWB's have an alternative environmental objective of Good Ecological Potential (GEP), as opposed to an environmental objective of Good Ecological Status (GES). This takes account of the changes in aquatic ecology caused by the physical modification. The potential for the Proposed Scheme to impact upon this objective has been discussed further in Chapter 8 'Hydrology-Surface Water' and Chapter 10 'Biodiversity'.

The European Union Environmental Objectives (Surface Water) (Amendment) Regulations, 2019

2.2.15 The European Union Environmental Objectives (Surface Water) (Amendments) Regulations 2019, provide a more complete and stringent set of surface water quality regulations which address the requirements of the WFD and Council Directive 2006/11/EC on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community. These regulations specify the conditions and physio-chemical concentrations that should be considered in the assessment of surface water quality. These regulations also give effect to Council Directive 2008/105/EC on environmental quality standards in the field of water policy.

European Communities (Quality of Salmonid Waters) Regulations, 1988

2.2.16 Legislation for salmonid waters was first established under Council Directive 78/659/EEC on the quality of freshwaters needing protection or improvement in order to support fish life (the Freshwater Fish Directive). The Directive was given effect in Ireland through the S.I. No. 293/1988 - European Communities (Quality of Salmonid Waters) Regulations, 1988. The Freshwater Fish Directive was subsequently superseded by Water Framework Directive, but the Irish Regulations remain in force. The Regulations defined freshwaters as being waters capable of supporting Salmon (S*almo Salar*), Trout (*Salmo trutta*), Char (*Salvelinus*) and whitefish (*Coregonus*) and are designated as Salmonid waters.

EU Habitats Directive and Birds Directive

2.2.17 EU Directive 92/43/EEC on the Conservation of Habitats and Wild Flora and Fauna (known as the 'Habitats Directive') protects habitats and species of European nature conservation importance. Together with Directive 2009/147/EC on the Conservation of Wild Birds (the 'Birds Directive'), the Habitats Directive establishes a network of nationally important sites designated for their ecological status. These include Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). Internationally important wetlands designated under the 1971 Ramsar Convention are also afforded the same protection as SPAs and SACs.

2.2.18 The Project is subject to Appropriate Assessment (AA) in accordance with the EU Directive 92/43/EEC on the Conservation of Habitats and Wild Flora and Fauna (known as the 'Habitats Directive'), given the proximity to European Sites and the nature of the work resulting in potentially significant effects.

2.2.19 As such, a Natura Impact Statement (NIS) has been prepared for the Proposed Scheme and will accompany the Planning Application (W3451-BLP-R-ENV-010).

2.3 Policy Guidance

2.3.1 As well as the legislative context, there are a number of national, regional and local policies supporting the Proposed Scheme. They are listed in the following sections.

National Policy Guidance

National Flood Policy, 2004

2.3.2 The National Flood Policy was adopted by the Government in 2004 after an inter-departmental review on how to manage flood risk most effectively and efficiently. The National Flood Policy builds on the Arterial Drainage (Amendment) Act 1995, which permits the OPW to implement localised flood relief schemes, by identifying that the OPW is the lead agency coordinating the management of flood risk in Ireland.

2.3.3 The National Flood Policy identifies that "the flooding problem cannot be eliminated but can be managed so as to minimise its impact" and that there are "a considerable number of heavily populated urban centres that are currently at risk of flooding and where flood defence may be the only feasible solution". The National Floods Policy generally advocates for sustainable flood prevention, mitigation and protection in areas of flood risk.

2.3.4 The Proposed Scheme is consistent with the National Flood Policy as the Proposed Scheme would reduce exposure to flood risk and provide appropriate flood protection and mitigation for the most vulnerable areas of the communities of Graiguenamanagh-Tinnahinch (G-T).

Water Action Plan, 2024

2.3.5 The Water Action Plan 2024: A River Basin Management Plan for Ireland was published September 2024 (Department of Housing, Local Government and Heritage, 2024). This RBMP covers the period 2022-2027. This plan outlines the new approach that Ireland will take as it works to protect and restore its rivers, lakes, estuaries and coastal waters over the third cycle of the WFD. The key objectives outlined in the Water Action Plan are:

- to prevent the deterioration of water bodies and to protect, enhance and restore them with the aim of achieving at least good status; and
- to achieve compliance with the water standards and objectives for designated protected areas.

Ireland 2040 Plan

2.3.6 In 2019, the Department of Housing, Planning, and Local Government published the Ireland 2040 Plan: National Planning Framework (NPF), replacing the National Spatial Strategy. The National Planning Framework and the National Development Plan 2021-2030 combine to form Project Ireland 2040. It is intended that the NPF will focus on integrating Ireland's economic development, spatial planning, infrastructure planning and social considerations. It promotes environmentally focused planning at local level to tackle climate change and the implementation of appropriate measures to mitigate existing issues, guiding regional and local development plans (Department of Housing, Planning and Local Government, 2018).

2.3.7 The NPF aims to align with the UN Sustainable Development Goals, by ensuring that the decision process will safeguard the needs of future generations. The NPF supports the provision of infrastructure, services and amenities and advocates for the delivery of 'must have' physical infrastructure that defines quality of life and personal wellbeing.

2.3.8 These objectives are integrated as part of the National Strategic Outcomes [NSOs] in areas such as climate action, sustainable cities and innovation and infrastructure. National Strategic Outcome 9 outlines the urgency of upgrading and investing in water management and environmental resources:

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

2.3.9 Flood relief measures are further highlighted under Section 9 of the NPF, titled 'Protecting Conserving and Enhancing our Natural Capital'. It is envisioned that planning will play a vital role in mitigating development in inappropriate or vulnerable areas and will aid the delivery and design of necessary infrastructure in our towns and cities. Further, National Policy Objective 41b emphasises the importance of flood relief works as part of the national agenda for climate adaption.

2.3.10 The National Development Plan Review 2025 was released July 2025 outlining capital ceilings for infrastructure investment. This document advises the Government has prioritised increased investment levels in water, energy, transport and housing.

2.3.11 The Proposed Scheme is consistent with the NPF as it supports the recommendations of the CFRAM and contributes to the mitigation and adaption to impacts from climate change.

National Development Plan, 2021-2030

2.3.12 The National Development Plan 2021-2030 (NDP) was published in October 2021. It is the national plan setting out investment priorities to guide national, regional and local planning and investment decisions.

2.3.13 The NDP is a high-level financial and budgetary framework, which sets out the framework and broad direction for investment priorities over the period 2021 to 2030. This includes expenditure commitments to secure a wide range of Strategic Investment Priorities which have been determined by the relevant Departments as central to the delivery of the NPF vision. Under National Strategic Outcome 8: *Transition to a Climate-Neutral and Climate-Resilient Society*, there has been investment of €186m since the start of 2018 underpinning the commitment of the NDP to 2027 of €1bn. This has allowed the number of flood relief schemes receiving Government investment to almost treble from 33 to 92 in that time.

Strategic Outcome 8 outlines a number of investment actions relating to flood risk management.

2.3.14 As outlined in the NDP, the Government is committed to the policy objective of delivering further capital works/flood relief schemes to minimise the impacts of river and coastal flooding on society. Investment of €440 million since 1995 has already delivered 48 major flood relief schemes around the country that are providing protection to over 10,000 properties and an economic benefit to the State in damage and losses avoided estimated at €1.8 billion. Some 150 schemes are to be progressed over the lifetime of the NDP, identified by the Flood Risk Management Plans to protect approximately 23,000 properties (Department of Public Expenditure, Infrastructure, Public Service Reform and Digitisation, 2021).

2.3.15 It is noted that "all flood relief schemes are designed to be adaptable to the impacts of climate change scenarios, in line with the Government's Climate Change Sectoral Adaptation Plan for Flood Risk Management 2019 – 2024 (see section 2.3.21 below). Scheme design now also includes identifying locations in the scheme's contributing catchment where there may be opportunity to implement measures for Nature-based Catchment Management, which can comprise a broad range of multi-functioning measures that use natural processes and features to reduce flood risk, improve water quality and create habitats". A Natural Flood Risk Management Report carried out by Ayesa (W3451-W-R006 date February 2022) concluded that whilst Woodland Creation and Offline Wetlands had potential, the cost and performance of these Natural Water Retention Measures meant that they were not viable to protect against the 1% AEP.

2.3.16 The Proposed Scheme is consistent with the objectives of the NDP through the fulfilment of a flood relief scheme in G-T.

Climate Action Plan, 2024

2.3.17 The objective of the Climate Action Plan is to enable Ireland to meet its EU targets to halve its carbon emissions by 2030 and lay the foundations for achieving net zero carbon emissions by 2050, at the latest. The 2024 Climate Action Plan details the strategies and sets the course towards a sustainable, low-carbon, and climate-resilient future. It outlines the importance of climate adaptation in the form of flood defences (Department of the Climate, Energy and the Environment, 2024).

2.3.18 The Climate Action Plan, which will be monitored quarterly and updated annually, sets out a number of ambitious environmental targets for Ireland to meet over the next 40 years.

2.3.19 The Climate Action Plan outlines the importance of climate adaptation integration:

"Successful adaptation generally requires that an analysis of the future impacts of climate change is mainstreamed into decision-making and policies across a large number of sectors that are vulnerable to climate change impacts. In Ireland, work undertaken in the area of flood-risk management provides a good illustration of this principle. Flood risk management strategies make use of assessments of potential long-term changes in flood intensity and

frequency based on climate projections and an understanding of how natural systems will be impacted. This informs the building of long-term resilience into flood defences by designing them with a view to cope with, or be readily adaptable to, conditions that may arise in the future."

National Adaptation Framework, 2024)

2.3.20 Ireland's National Adaptation Framework (NAF), Planning for a Climate Resilient Ireland, was prepared in accordance with the Climate Action and Low Carbon Development Act (S.I. No. 46 of 2015), as amended in 2021. The NAF sets the context to ensure mitigation and adaptation are mainstreamed into local, regional and national planning and policy making, and will be reviewed every five years. Under the NAF, sectors and lead Government departments, as well as local authorities, are required to prepare statutory sectoral adaptation plans (Department of Climate, Energy and the Environment, 2024). Guidelines for preparation of these adaptation plans have been published by the DCCAE under the NAF.

Flood Risk Management Climate Change Sectoral Adaptation Plan, 2025

2.3.21 The first Climate Change Sectoral Adaptation Plan for Flood Risk Management was produced by the OPW in 2015 under the mandate of the National Climate Change Adaptation Framework (Department of the Environment, Community and Local Government, 2012). Now, the Flood Risk Management Climate Change Sectoral Adaptation Plan (2025) has been revised under the National Adaptation Framework 2018 (Department of Climate, Energy and the Environment, 2024).This updates the 2019 Plan taking into account new information available on climate change and its potential impacts, developments in flood risk management since 2095 and the Guidelines for the preparation of the Sectoral Adaptation Plans (Department of Climate, Energy and the Environment, 2024).

2.3.22 This plan sets out actions needed to adapt flood risk management practises for effective and efficient future outcomes and are shaped by a broad, long-term goal and defined set of objectives. The goal adopted by the OPW on climate adaptation for flooding and flood risk management is ''Enhance resilience against flood risk and reduce impacts of flooding now and into the future, by integrating climate adaptation strategies and measures that reduce vulnerability, protect communities, and promote sustainable flood risk management.'' To deliver this goal for adaptation in flood risk management, the OPW has identified the following adaptation objectives:

1. *''Enhancing our knowledge and understanding of the potential impacts and future risks of climate change for flooding and flood risk management through research and assessments.*

2. *Strengthen capacity and awareness of the impacts of climate change, relating to flooding and flood risk management, within the OPW and across wider stakeholder groups including public bodies, professional sectors and the general public.*

3. *Embed climate change adaptation into flood risk management practices undertaken by the OPW and other sectors.*

4. *Increase the awareness and suitable application of Nature-based Solutions for Catchment Management to improve climate resilience."*

2.3.23 A series of targeted actions have been identified under each adaptation objective, spanning the key areas of flood risk prevention, protection, preparedness and resilience, as well as research and capacity building.

2.3.24 Individual flood schemes are key to the Plan, with the following noted:

"The evidence in the Flood Risk Management Plans highlights that 95% of properties at risk within the communities assessed to be at significant risk from flooding can be protected by flood relief schemes, completed, at design and construction, or planned."

2.3.25 The Proposed Scheme is in accordance with the Flood Risk Management Climate Change Sectoral Adaptation Plan as it has been designed having due regard to climate change projections. Noted in the plan:

"For new flood relief schemes, including those arising from the measures set out in the FRMPs, the consideration of climate change forms part of the design process as a requirement under the project brief, including the preparation of a scheme adaptation plan. This is with the aim of ensuring that all new schemes provide for potential future increases in flood levels and/or flows as part of the design process.

Regional Policy Guidance

Regional Spatial and Economic Strategy for the Southern Region 2020-2032

2.3.26 The Regional Spatial and Economic Strategy (RSES) for the Southern Region is a strategic plan which identifies regional assets, opportunities and pressures and provides appropriate policy responses in the form of Regional Policy Objectives (RPOs). At this strategic level it provides a framework for investment to better manage spatial planning and economic development to sustainably grow the Southern Region, with a long-term vision to 2040 (Southern Regional Assembly, 2020-2032).

2.3.27 The RSES is a significant evolution of regional policy making and replaces the existing Regional Planning Guidelines (RPGs), which provided strategic policy and recommendations at a regional level with which both county and city development plans have to be consistent in policy making.

2.3.28 The principal statutory purpose of the RSES is to support the implementation of the NPF and NDP 2021-2030 and the economic policies of the Government by providing a long-term strategic planning and economic framework for the development of the Southern Region.

2.3.29 The RSES sets out the following Regional Policy Objectives regarding flooding:

- RPO 89 (b): Building Resilience to Climate Change -

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

- RPO 113-119 relate to the management of water and flooding including:

  - RPO 113: Floods Directive -

    "It is an objective to support, at a regional level, the implementation of the Floods Directive to manage flood risks. It is an objective to encourage collaboration between local authorities, the OPW and other relevant Departments and agencies to implement the recommendations of the Catchment Flood Risk Assessment and Management (CFRAM) programme to ensure that flood risk management policies and infrastructure are progressively implemented."

  - RPO 119: Flood Relief Schemes –

    "It is an objective to:

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

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

    c. Ensure that all infrastructure and energy providers/operators provide for adaptation measures to protect strategic infrastructure (including roads, railways, ports and energy infrastructure) from increased flood risk associated with climate change."

- RPO 121: Effective Collaboration to Implement River Basin Management Plans and Water Framework Directive -

  "It is an objective to:

  a. Ensure a cross-agency collaborative approach to implementing the River Basin Management Plan. Planning authorities will be consistent with the Plan through their land use plans and strategies,

b. Ensure effective co-ordination between the requirements of the Floods Directive and the Water Framework Directive,

c. Promote a catchment-based approach to water management to facilitate cross boundary collaboration and shared responsibility at a regional level. The RSES supports bottom-up community initiatives through the integrated catchment management approach. The RSES recognises that there are opportunities for a collaborative regional approach to address issues such as invasive species,

d. The RSES supports the work of the Local Authority Waters Programme (LAWPro) in promoting an integrated approach to catchment management as part of the implementation of the RSES."

2.3.30 The Proposed Scheme is compliant with the policy objectives of the RSES in that KCC, in conjunction with the OPW, propose to implement flood relief measures to reduce the risk of flooding in G-T. KCC, in conjunction with the OPW will also seek opportunities to enhance biodiversity and amenities in the local area and will ensure the protection of environmentally sensitive sites and habitats.

Local Policy Guidance

Graiguenamanagh-Tinnahinch Joint Local Area Plan, 2020-2026

2.3.31 Kilkenny County Council and Carlow County Council jointly prepared the Graiguenamanagh-Tinnahinch Joint Local Area Plan (LAP) (2020 – 2026) of which sustainable management of surface water and flooding was identified as a key challenge for the towns. It is noted in this plan that flood risk has prohibited development. With the implementation of a flood relief scheme, regeneration of existing vacant and derelict buildings in the town centre can take place.

Flood Risk Management

2.3.32 With specific focus on 'Flood Risk Management', the Graiguenamanagh-Tinnahinch Joint LAP set an objective of the Plan:

"INFO3.1: To support and co-operate with the OPW and other stakeholders in delivering Graiguenamanagh-Tinnahinch Flood Relief Scheme under the South Eastern CFRAM Programme, whilst ensuring heritage considerations inform the design of proposed works and to ensure development maximises the protection of the integrity of the historical settlement."

Green Infrastructure and Recreation

2.3.33 The importance of access to the River Barrow for the communities of G-T is highlighted in the LAP objectives for Green Infrastructure. The overall strategic objective is:

"SO4: To support the creation and enhancement of a network of pedestrian walkways, footbridges and open spaces connecting the River Barrow and other recreational and tourist attractions within the settlement."

2.3.34 The Proposed Scheme contributes to the achievement of the above policies laid out in the Graiguenamanagh-Tinnahinch LAP by providing a FRS contributing to Flood Risk Management, and by considering the importance of the River Barrow as an amenity to the communities.

Kilkenny County Development Plan 2021-2027

2.3.35 The Kilkenny County Development Plan 2021 – 2027 highlights the importance of flood management with the inclusion of the Strategic Flood Risk Assessment (SFRA) 2021 – 2027 included as an accompanying and standalone report. Moreover, they set the avoidance of flood risk as a Strategic Aim.

Climate Change

2.3.36 In the chapter on Climate Change, 'Flood Resilience' is recognised as key for climate change mitigation and adaption. The plan includes a requirement that a Flood Risk Assessment is carried out for any development proposal, where flood risk may be an issue.

2.3.37 The GTFRS flood parameters have been designed with appropriate allowances for two possible future scenarios, namely the Mid-Range Future Scenario (MRFS) and the High-End Future Scenario (HEFS) that take account of possible future changes such as climate change. Further, there is a Climate Change Adaptation Plan for the Scheme, which sets out how it may be necessary to adapt and amend the Scheme to maintain the defined Standard of Protection as the potential impacts of climate change may be realised over time.

Flooding

2.3.38 The Development Plan outlines policies to flood management including ensuring that *"new developments do not reduce the effectiveness or integrity of any existing or new flood defence infrastructure, and will facilitate the provision of new, or the reinforcement of existing, flood defences and protection measures where necessary"* (p.185).

Greenways and Blueways

2.3.39 The Development Plan recognises the potential of the Rivers Nore, Suir and Barrow to offer "amenity, recreational, biodiversity and tourism benefits for the city and county generally". The Council will work with adjoining local authorities, agencies and communities to improve access and facilities along the rivers in appropriate locations subject to the availability of resources. The River Barrow towpath is recognised as a significant amenity resource which runs along the riverbank on the County Carlow side of the river.

2.3.40 A requirement of developments along rivers is that land must be set aside for recreation routes that could be linked to the wider network of green infrastructure and any established settlements in their vicinity.

Green Infrastructure

2.3.41 Green Infrastructure is recognised for its potential to assist the protection of Natura 2000 sites, biodiversity in the wider countryside and climate resilience. It can be managed as multifunctional resource capable of delivering a wide range of benefits including adaption to the impacts of climate change and flooding and places for people to access nature, outdoor recreation and for social interaction.

2.3.42 The Proposed Scheme will help to achieve objectives of the Development Plan by providing defences for the communities of G-T against impacts of Climate Change and Flooding.

Carlow County Development Plan 2022-2028

Flood Risk Management

2.3.43 The Council intends to align with the CFRAM Programme in the development and implementation of catchment-based strategies for the management of flood risk. An objective is set to:

"FR.02: Facilitate the provision of new, or the augmentation of existing flood defences and protective measures where necessary, and to support the implementation of proposed flood schemes subject to compliance with the requirements of the EU Habitats Directive, the protection of natural and built heritage and visual amenities".

2.3.44 Another objective relevant to the Proposed Scheme is to:

"FR.03: Seek to ensure that where flood risk management works take place that the cultural and natural heritage of rivers, streams and watercourses are protected, and improved where possible".

Nature-Based Approaches and Green Infrastructure

2.3.45 A Policy by the Council aims to "actively promote and encourage nature-based approaches and green infrastructure solutions as viable mitigation and adaptation measures to reduce greenhouse gas emissions, increase the adaptive capacity of ecosystems and optimise the multifaceted benefits". Amongst other benefits, this policy can assist with water and flood risk management.

2.3.46 The Proposed Scheme supports the Carlow County Development Plan by contributing to Flood Risk Management for the communities of G-T.

Others

2.3.47 Other local policy documents have been referenced in relevant sections of this EIAR, including:

- Graiguenamanagh-Tinnahinch Mobility Management Study 2021-2026 (Carlow and Kilkenny County Council , 2021).
- Graiguenamanagh / Tinnahinch Tourism and recreational project concept study (Kilkenny County Council).
- County Carlow Tourism Strategy and Action Plan 2020-2025 (Carlow County Council, 2020a).
- County Carlow Outdoor Recreation Strategy 2020-2023 (Carlow County Council, 2020b).
- Kilkenny Biodiversity Action Plan 2025-2030 (Kilkenny County Council, 2025)
- Draft Carlow Biodiversity Action Plan 2023-2028 (Carlow County Council , 2022)

2.4 Summary

2.4.1 Having regard to the provisions of the planning and policy documentation outlined in this Chapter, it is concluded that the Proposed Scheme would be in compliance with national, regional and local planning policy provisions and, under the current land use objectives for Co. Kilkenny and Co. Carlow, would also contribute to the sustainable development of the area.

2.5 References

Kilkenny County Council. (2025). *Kilkenny Biodiversity Action Plan 2025-2030.*

Ayesa. (2025). *Graiguenamanagh-Tinnahinch FRS, Options Report, W3451-BLP-R-W-R009, Rev 07.*

Carlow and Kilkenny County Council . (2021). *Graiguenamanagh-Tinnahinch Mobility Management Study 2021-2026.*

Carlow County Council . (2022). *Draft Carlow Biodiversity Action Plan 2023-2028.*

Carlow County Council. (2020a). *County Carlow Tourism Strategy and Action Plan 2020-2025.*

Carlow County Council. (2020b). *County Carlow's Outdoor Recreation Strategy 2020-2023.*

Department of Climate, Energy and the Environment. (2024). *National Adaption Framework.*

Department of Communications, Climate Action and Environment. (2018). *National Adaptation Framework (NAF), Planning for a Climate Resilient Ireland.*

Department of Housing, Local Government and Heritage. (2000). *Planning and Development Act 2000.*

Department of Housing, Local Government and Heritage. (2001). *Planning and Development Regulations 2001, S.I. No. 600 of 2001.*

Department of Housing, Local Government and Heritage. (2022). *Planning and Development Regulations 2001-2022 (Unofficial Consolidation) .*

Department of Housing, Local Government and Heritage. (2022). *River Basin Management Plan (RBMP) for Ireland 2022-2027 .*

Department of Housing, Local Government and Heritage. (2024). *The Water Action Plan 2024: A River Basin Management Plan for Ireland.* Government of Ireland.

Department of Housing, Planning and Local Government. (2018). *Project Ireland 2040: National Planning Framework.* Government of Ireland.

Department of Public Expenditure, Infrastructure, Public Service Reform and Digitisation. (2021). *National Development Plan 2021-2030.* Government of Ireland.

Department of the Climate, Energy and the Environment. (2024). *Climate Action Plan 2024.* Government of Ireland.

Department of the Environment, Climate & Communications. (2013). *National Policy Position on Climate Action and Low Carbon Development.*

Department of the Environment, Community and Local Government. (2012). *National Climate Change Adaptation Framework (NCCAF).*

European Commission. (2024). *Interpretation of definitions of project categories of annex I and II of the EIA Directive.*

European Communities . (2014). *(Drinking Water) Regulations 2014 (S.I. No. 122 of 2014).*

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

European Communities. (1988). *(Quality of Salmonid Waters) Regulations.*

European Communities. (2011). *(Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations, 2011 (S.I. No. 489 of 2011).*

European Communities. (2014). *(Water Policy) Regulations, 2014 (S.I. No. 350 of 2014).*

European Communities. (2016). *Environmental Objectives (Groundwater) (Amendments) Regulations, 2016 (S.I. No. 366 of 2016).*

European Communities. (2019). *Environmental Objectives (Surface Waters) (amendments) Regulations, 2019 (S.I. No. 77 of 2019).*

European Communities. (2020). *Good Agricultural Practice for Protection of Waters) (Amendments) Regulations, 2020 (S.I. No. 40 of 2020).*

European Union. (1992). *EU Directive 92/43/EEC on the Conservation of Habitats and Wild Flora and Fauna .*

Kilkenny County Council . (n.d.). *In Focus: Graiguenamanagh Regeneration .*

Kilkenny County Council. (n.d.). *Graiguenamanagh / Tinnahinch Tourism and Recreational Project Concept Study .*

Office of Public Works. (2019). *Flood Risk Management Climate Change Sectoral Adaption Plan.*

Southern Regional Assembly. (2020-2032). *Regional Spatial & Economic Strategy for the Southern Region 2020-2032.*

The European Parliament and the Council of the European Union . (2007). *Directive 2007/60/EU of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks.*

The European Parliament and the Council of the European Union. (2014). *Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 ammending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment.*

3 Previous Studies, Alternatives Considered and Options

3.1 CFRAM and Associated Reporting

3.1.1 The Flood Relief Scheme (FRS) and Environmental Impact Assessment Report (EIAR) have been informed and prepared in consideration of the series of documentation procured by the OPW for the South-Eastern CFRAM, including:

- South Eastern CFRAM Study – Flood Risk Review (OPW, 2011).
- Flood Risk Management Plan for the Barrow River Basin (UOM14) (OPW, 2018).
- Appropriate Assessment Determination in accordance with Regulation 42(11) of the European Communities (Birds and Natural Habitats) Regulations 2011 – 2015 for Flood Risk Management Plan for the Barrow River Basin (UoM14) (OPW, 2018).
- South Eastern CFRAM Study UoM14 Strategic Environmental Assessment Statement (OPW, 2017).
- South Eastern CFRAM Study UoM14 Flood Risk Management Plan, Natura Impact Statement (OPW, 2016).
- South Eastern CFRAM Study - Preliminary Options Report UoM14 (OPW, 2016).
- South Eastern CFRAM Study - Hydrology Report for UoM14 (OPW, 2016).

3.1.2 Most notable to this EIAR is the Strategic Environmental Assessment (SEA) Statement prepared in 2017. It identified that components of the UoM014 Barrow River Basin under the South Eastern CFRAM could give rise to potentially significant effects (i.e. likely to have a major or moderate positive or negative effect) relative to baseline conditions. The 'key issues' across each parameter is included in Table 3-1, for reference.

Table 3-1: Key Environmental Issues Identified in the Strategic Environmental Assessment Statement for the Barrow River Basin (OPW, 2017)

SEA Chapter	Key Issued Identified
Biodiversity, Flora and Fauna	• Consideration of effects of flood risk management measures on SACs, SPAs, NHAs, (including proposed NHAs), Ramsar Sites and other designated nature conservation sites and National Parks within the UoM14 study area, in addition to those outside the study area that may be impacted by proposals within the FRMP. • Where there is a potential risk to European sites (SPAs and SACs) from the implementation of measures, it will be necessary to undertake appropriate assessment in accordance with the Birds and Natural Habitats Regulations to ensure that adverse impacts on these sites will not arise. • Consideration must also be given to effects on flora and fauna, such as migratory bird species and invertebrates or sensitive habitats in areas which do not hold designations, to avoid habitat fragmentation or loss. • Freshwater pearl mussel (FPM), Atlantic salmon and lamprey species are particularly sensitive to pollution and in-channel flood risk management measures. As well as there being FPM designated areas in UoM14, there may also be connectivity with designated areas in adjacent catchments. Other protected fish and shellfish species may also be affected by flood risk management measures. • Changes to the flooding regime may have effects on sensitive habitats, e.g., bogs, fens, peatlands, limestone habitats or wetland areas; • Changes to the flooding regime can adversely impact upon biodiversity through nutrient enrichment, detrimental impacts on water quality, siltation and community changes. • Implementation of flood risk management measures can also contribute towards the spread of invasive/non-native species if not properly managed.
Population and Human Health	• Ongoing population growth for all counties within the UoM14 study area creating increasing pressures on water resources, e.g. quality of water supply for drinking water abstraction (including private supplies as well as municipal treatment) and waste water treatment; • Interactions with public use of waterbodies (e.g. bathing, fishing, leisure craft, sailing, water sports). • Population centres in this UoM tend to be located in urbanised areas located near Portlaoise, Portarlington, the Curragh and Dunlavin; • Certain invasive species (e.g., giant hogweed) can be harmful to human health (relationship with biodiversity). • Flood events can impact on water quality through the mobilisation of contaminants, pollutants, waste and sediment into contact with the population, e.g., into drinking water supplies and into homes. • Effects on connectivity of communities. Flooding in the past has caused areas to be “cut off” from surrounding infrastructure. Aging and young populations are particularly vulnerable to these impacts. • A number of vulnerable receptors (e.g., schools, hospitals, nursing homes) located in lowland areas which are potentially at flood risk; • In addition to residential properties, schools, hospitals, health service centres and nursing homes (as well as their ancillary services and roads) are recognised as vulnerable receptors to flooding. Impacts on these are key indicators of the UoM14 Study.

SEA Chapter	Key Issued Identified
Geology, Soils & Land use	• Effects of changes in the flooding regime on rates of coastal erosion; waterlogged sands lose their cohesive properties and are at much greater risk of erosion. • Influence of changes in flooding regime on land use practices (e.g. fertiliser application) or soil quality/productivity; • Effects on geomorphology such as river channels and landforms. • Flood management options under consideration in the FRMPs include non-structural options such as planning control and land use management. Publication of the FRMPs may result in the zoning of lands for particular land use practices for the purpose of preventing or protecting against flooding. Changes in land use zoning may reduce land values by limiting development potential. • Appropriately managed pasture, rough semi-natural vegetation, wetlands (including peat bogs) and forestry/woodland can all assist in the attenuation and storage of rapid surface runoff and floodplain flows upstream of flood risk receptors. • The targeted use of appropriate agri-environment scheme agreements could be used for multiple benefits, including flood management and biodiversity gains. • Natural flood storage and attenuation areas on floodplains including wetlands, should be protected from development pressures. • Effects of changes in the flooding regime on access to land; many areas have been “cut off” by floods in the past.
Water	• All strategic flood risk management options being proposed should fully consider any WFD implications and, wherever possible, link to and support the programme of measures in the UoM to improve the ecological status of water bodies. • Flooding of key water supply and water treatment facilities would present a pollution risk with associated impacts on human health, water quality and ecology; however, flood risk management may provide opportunities to improve water quality. • Morphological impacts on water bodies from engineering and other works. • Licensed abstractions and discharges should not be affected by strategic flood risk management options. • Group Water Schemes and private wastewater treatment systems, where poorly installed, operated or maintained, can be a threat to water quality. Flood risk management options should ensure that water quality is not compromised further. • The effects of upstream storage on water quality in downstream catchments should be considered.
Air	• Scoped out.
Climate	• There is a strong likelihood of increased fluvial and coastal flooding resulting from the effects of climate change. • The carbon footprint of flood risk management options should be a consideration during their development. • Ability of FRM Measures to adapt to future flood risk.
Material Assets	• Protection and enhancement of water related assets. • Application of sustainable uses of water. • Development of roads and other transport assets can alter land drainage run-off characteristics and can result in related changes in river hydrology and therefore flooding. • Effects on potential future demand for natural resources, such as biofuels, and other renewable energy sources.

SEA Chapter	Key Issued Identified
	• Effects on energy supplies, telecommunications infrastructure, commercial properties, farm assets and personal property.
Cultural, Archaeological & Architectural Heritage	• Effects on key national sites, many of which are located in river valleys. • Many Records of Monuments and Places (RMP) are associated with watercourses, such as mills, mill races and bridges; these may potentially be impacted by the implementation of flood risk management measures. • Other features, including churches, religious buildings and country houses, are located in close proximity to watercourses and as such may constrain the application of certain flood risk management measures at these locations. • Tidal and coastal flood risk management measures may potentially impact upon maritime archaeology. • Effects of flood risk management measures on historic landscapes or cultural landscapes.
Landscape & Visual Amenity	• Effects on areas of designated high landscape quality and scenic views in CDPs and other plans. • Effect on local parks, gardens, amenity walks and designed landscapes. Flood protection measures can intrude upon views and prospects. • Effects on the general landscape as well as riverscapes, lakescapes and seascapes. Flood risk management options need to be sympathetic towards landscape character and opportunities to enhance landscape character should be explored.
Fisheries, Aquaculture & Angling	• Flood risk management measures should give consideration to the protection and enhancement of fishery habitat and should have regard to any fishery management programmes. Also, fish migration needs to be considered in the identification of flood risk management options. • Consideration should be given to the enhancement and preservation of commercial and tourism fishery facilities. • Implementation of flood risk management measures may contribute towards the spread of invasive species if not properly managed.
Amenity, Community and Socio-economics	• Protecting and promoting heritage and amenity assets. • Maintenance and enhancement of beaches and coastal assets. • Development and promotion of existing and new quality visitor accommodation and business facilities. • Effects on connectivity of communities. Flooding in the past has caused areas to be “cut off” from surrounding infrastructure. Aging and young populations are particularly vulnerable to these impacts. • Social infrastructure facilities tend to be at the heart of communities, however not always built on the best land to save cost. These facilities may be more vulnerable to flooding as located in low lying areas. • Loss of local revenue from flooding of non-residential / commercial properties. • Non-residential / commercial properties, social amenity and social infrastructure properties are key indicators of the UoM14 Study.

3.2 Environmental Constraints Study

3.2.1 The FRS options and this EIAR have been informed and framed by initial environmental studies, prepared by Ayesa at the outset of the Project, including namely the Environmental Constraints Study (W3451-BL-ENV-R001, January 2021).

3.2.2 The Environmental Constraints Study was undertaken to determine the key known constraints (physical, procedural, legal, environmental etc.) and drivers which would inform the development of potential flood relief measures. It also contributed to the establishment of the environmental baseline conditions and a review of potential impacts that needed to inform this EIAR. Constraints were identified to inform options development and included in the study depending on whether they had the potential to affect the Proposed Scheme in terms of design, cost and schedule and gave opportunity to highlight key environmental concerns at an early stage in the Project.

3.2.3 This study also provided a basis for the preparation of this EIAR, and followed the same headings herein:

- Population and Human Health
- Resources and Materials
- Water
- Cultural Heritage
- Ecology and Biodiversity
- Landscape and Visual
- Soils, Geology and Hydrogeology
- Air Quality
- Noise and Vibration

3.2.4 Consideration was given to the key constraints identified for each heading, enabling the design to be developed in line with the constraints highlighted and recommendations made. The Environmental Constraints Study was also the initial means of characterising the environment of the River Barrow and River Duiske and their surrounding environs which would later inform the Options Report, Scoping Report and this EIAR. A broad range of environmental constraints were reviewed in the context of the study area, prior to the development of specific flood relief measures.

3.3 Options Reporting

Introduction

3.3.1 Directive 2014/52/EU requires the main alternatives to the Proposed Scheme to be considered and presented in the EIAR:

3.3.2 "A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects".

3.3.3 An assessment was completed of the various options and measures considered to provide flood protection of the River Barrow and River Duiske. This was completed as part of Stage 1, with results presented in Ayesa's Options Report (W3451-BLP-R-W-R009 dated March 2023). The aim of this was to fully consider the list of potential flood defence options and measures taking account of the technical, economic, environmental and social aspects and to determine the preferred option to alleviate flooding in scheme area. The key findings are summarised below.

3.4 Options Assessment Process and Methodology

Preliminary Screening

Methodology

3.4.1 The purpose of the Preliminary Options Report (W3451-BLP-R-W-004, 2022) was to narrow down the broad range of potential measures and options to determine which are likely to be effective. The process is described in the Preliminary Options Report but generally consisted of ensuring that options that are likely to be technically, economically socially and environmentally viable are brought forward to the detailed options assessment phase.

3.4.2 The assessment was undertaken for the below criteria, mimicking those assessed during the OPW's Multi-Criteria Analysis (see section on Multi-Criteria Analysis (MCA) below for more information) and are considered to cover the key issues that the planning process would require of an assessment in terms of viability of the options and potential alternatives:

1. A check that the measure was technically feasible (viable). This means that the measure can mitigate the flood risk to the scheme design standard 1% AEP event. Options that were not viable were not considered further as the sole method for providing flood relief.
2. A check that the measure was economically viable. For this purpose, economically viable is defined as any measure where the cost would be expected to be no more than twice the benefit as a precautionary approach. For the purposes of screening, estimated damages of €15m was assumed, meaning measures deemed to cost less than €30m could be potentially viable and brought forward for further assessment.
3. Environmental consideration of the measure to avoid significant adverse effects where possible.
4. Social consideration of the measure.

Results

3.4.3 The full preliminary screening assessment is outlined in Ayesa's (formerly ByrneLooby) Preliminary Options Report however a summary is included below.

3.4.4 Initially, a long list of flood risk management measures was reviewed with non-viable measures screened out. The measures suggested to be progressed to further options appraisal were:

- For the Barrow:
  - Flood Warning/Alert system (for demountable defences if forming part of a viable option)
  - Raised defences (incl. consideration of demountable defences if required for access)
- For the Duiske:
  - Upstream storage area
  - Diversion channel (Tunnelling or open cut)
  - Raised defences

3.4.5 Following the Preliminary Options Report, it became apparent that the only option to address flood risk arising from the River Barrow was to provide raised defences. Therefore, the options presented below vary by measures on the Duiske only.

Options Review

3.4.6 From the Preliminary Screening phase, five options were brought forward and underwent detailed technical, economic, environmental, and social review through MCA. These options were presented to the public on the Public Consultation Day held on 19th August 2022 (see Chapter 5 'Stakeholder Consultation'). The options included:

- Option 1: Raised Defences
- Option 2: Raised Defences & River Duiske Diversion
- Option 3: Raised Defences & River Duiske Storage
- Option 4: Raised Defences & River Duiske Storage and Diversion
- Option 5: Raised Defences & River Duiske Culvert

3.4.7 This Section provides a review of the options that underwent MCA and environmental assessment and were presented to the public in Summer 2022.

Option 1 – Raised Defences

3.4.8 This option consisted of providing raised defences walls and flood gates along mainly the left bank of the River Duiske from Well Lane downstream to Turf Market Bridge. It would

impact on private property and the many established accesses from Turf Market over the River Duiske to the properties on the left bank.

3.4.9 During the modelling, if was found that several properties were only marginally affected by flooding on the right bank and did not represent flood routes to other properties. Hence, the option modelled included Individual Property Protection (IPP) for these properties, and the Hydraulics Report provides the results of same. IPP imposes an active management burden on the future maintenance and operation of the scheme and given the short nature of the hydrograph on the Duiske it was deemed undesirable. Further modelling work was then completed to determine flood levels when IPP are not used. This showed that the water levels increased slightly due to the containment within the Duiske and the Barrow locally, but properties not affected significantly elsewhere (outside the protected areas). Tinnahinch would be protected by the measures on the River Barrow. Flood defence walls, floodgates to maintain access would be required to mitigate the food risk.

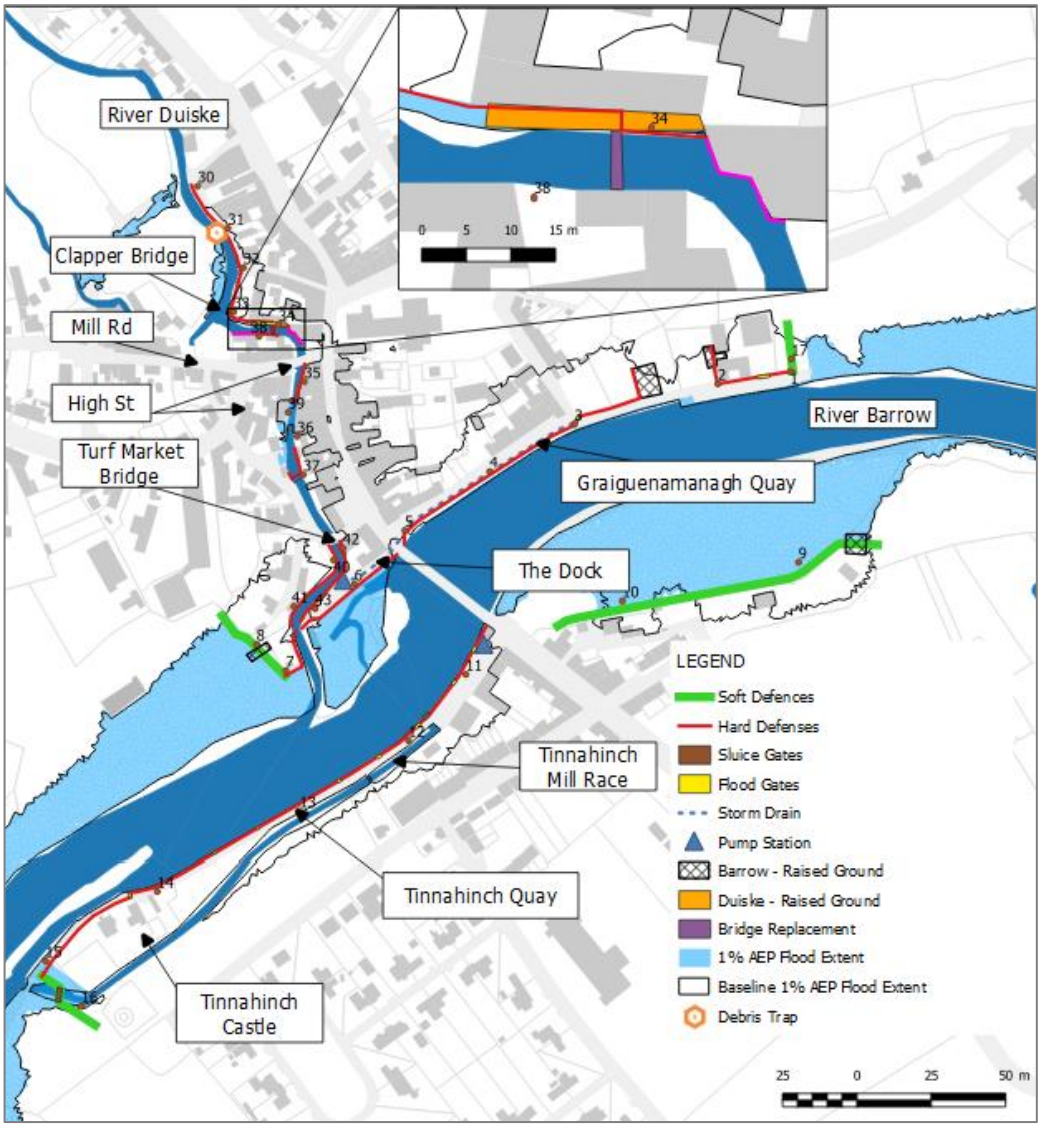


Figure 3-1: Option 1 measures and 1% AEP flood extent

Option 2 – Raised Defences & River Duiske Diversion

3.4.10 This option explores the use of a flow diversion combined with raised defences on the River Duiske to allow assessment of the level of reduction in raised defences on the Duiske – in particular the need for raised defences between Well Lane and Turf Market Bridge where significant technical and environmental challenges exist. The option would entail the construction of a flow diversion pipeline and also includes a raised defence on the left bank of the River Duiske at Well Lane downstream to Clapper Bridge area to tie in with the proposed in channel flow control structure/weir. A new access bridge would be required to maintain access to the Hub, and a new open channel would be provided in the grounds of the Hub.

3.4.11 The modelling results indicated that this option was technically viable. Flood levels increased locally upstream of the diversion location where an instream structure would be required near to Clapper Bridge, but given the steepness of the River Duiske, the effects are relatively local and are not observed upstream of the R705 bypass road. However, the local increases are in the order or 1-1.2m at the most impacted area and would result in significantly higher walls on Well Lane compared to any of the other options.

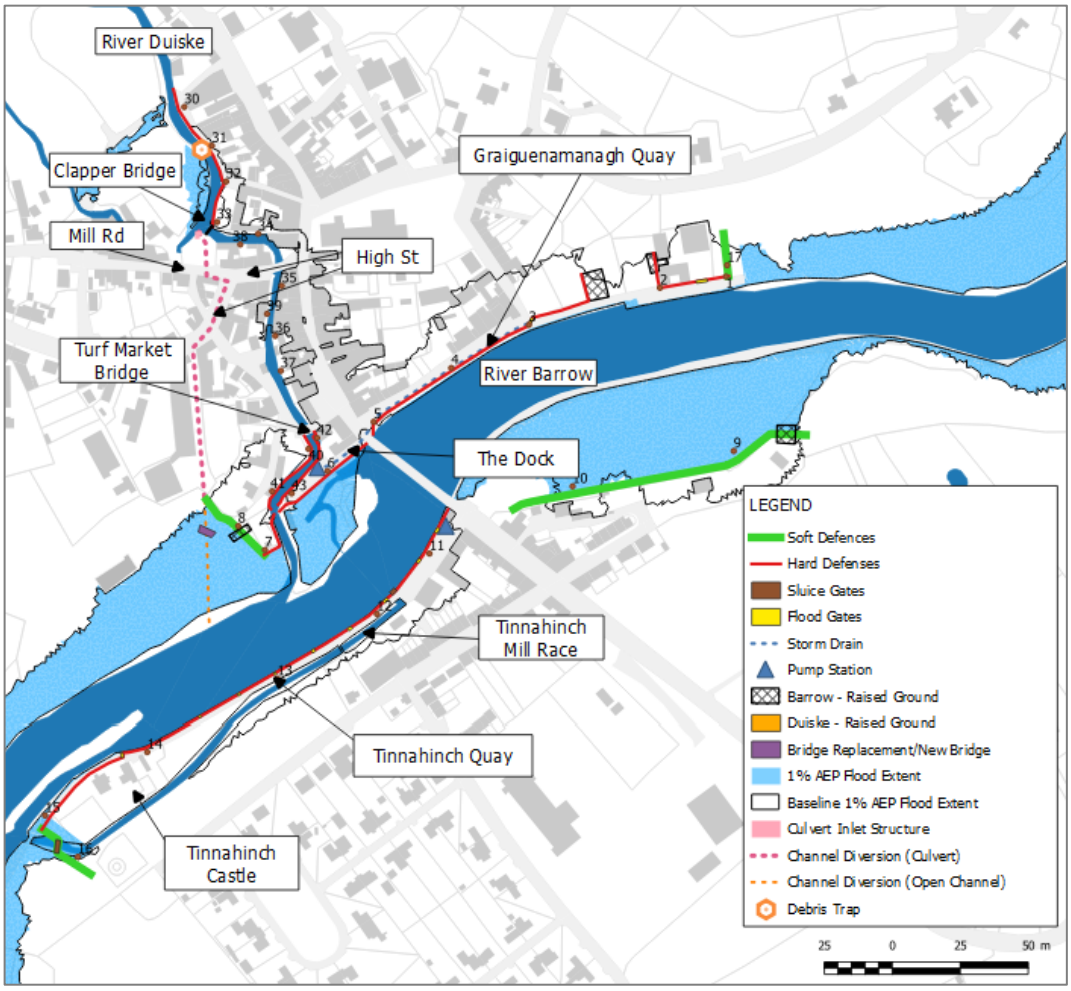


Figure 3-2: Option 2 measures and 1% AEP flood extent

Option 3 – Raised Defences & River Duiske Storage

3.4.12 This is the Proposed Scheme and is described in detail in Chapter 4 'Description of the Proposed Scheme and Construction Methodology'.

Option 4 – Raised Defences & River Duiske Storage and Diversion

3.4.13 Modelling showed that storage alone cannot reduced flows such that flooding can be avoided in Graiguenamanagh. This option therefore consists of upstream storage of flood waters, which facilities a reduced volume capacity requirements for the diversion arrangement, making it technically possible to address flood risk. Raised defences on the Duiske are entirely avoided. As with all options with diversion as a measure, an instream flow control structure would be required in the Clapper Bridge area. A new access bridge would be required to maintain pedestrian access to the Hub, and a new open channel would be provided in the grounds of the Hub.

3.4.14 The modelling results indicated that this option was technical viable and achieves the desired outcome of avoiding raised defences on the riverbanks. Flood levels increase upstream of the storage area, which is composed of agricultural pastureland. Unlike Option 2, flood levels are not significantly increased upstream of the flood control structure near Clapper Bridge due to the smaller peak flood flows facilitated by the storage area.

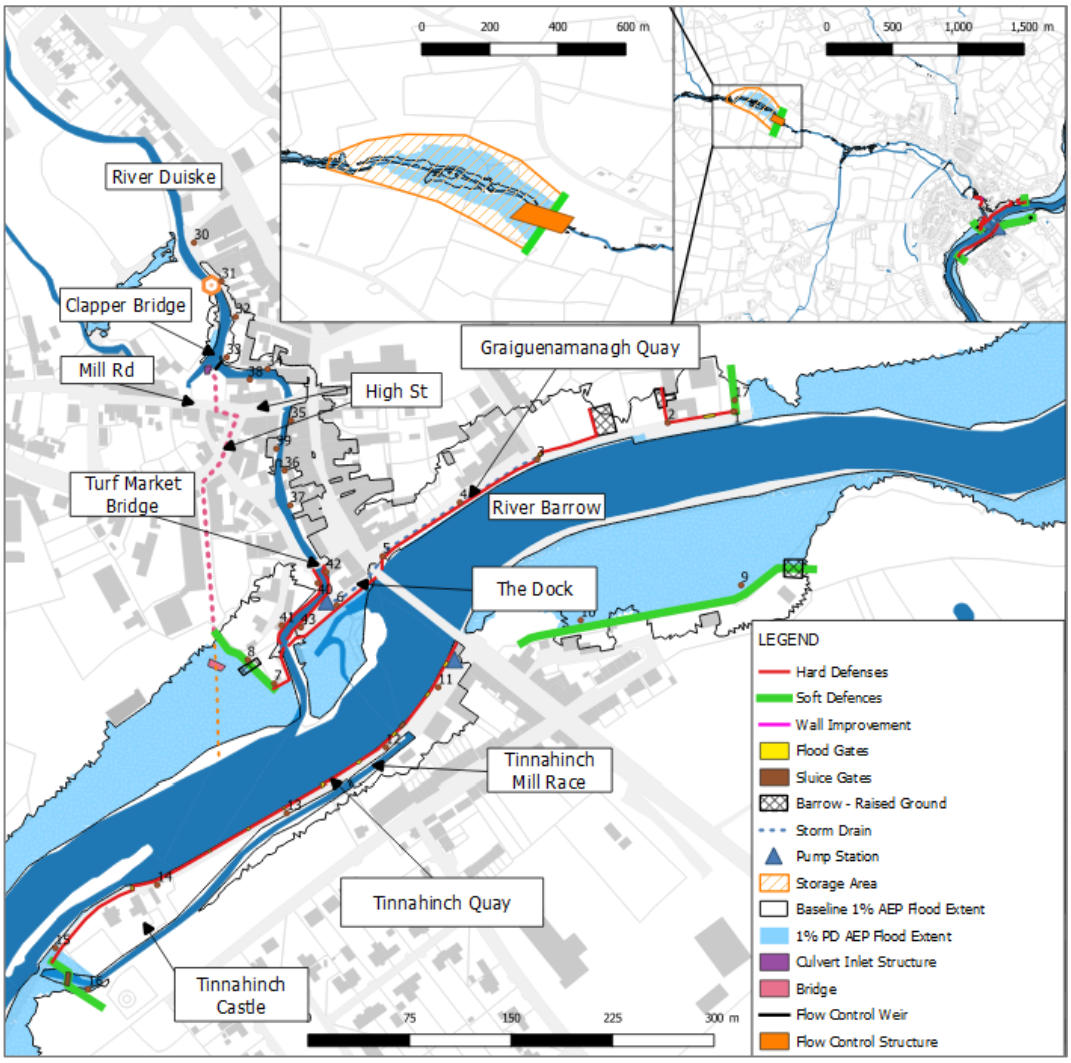


Figure 3-3: Option 4 measures and 1% AEP flood extent

Option 5 – Raised Defences & River Duiske Culvert

3.4.15 This option is a slightly modified version of Option 1, wherein the extent of raised defences downstream of High St. Bridge are reduced by the inclusion of a culvert downstream of High St. Bridge. This option was considered because this reach of the Duiske is already heavily modified and partially covered.

3.4.16 The option consists of raised defences on the left bank of the River Duiske between Well Lane and High St. Bridge. A new section of culvert would be installed from High Street Bridge to upstream of the Mill building on the right bank of the River Duiske at Turf Market, which avoids the need for raised defences in this section and maintains the existing access arrangements to the properties for the long term. It is noted that there remain significant buildability challenges with this option as well as temporary access arrangements during construction, but long term it would be a better option both technically and socially. It will not be favourable from an environmental or archaeological viewpoint as compared to the

other options. This option did not eliminate the need for a wall on the left bank opposite the Mill building at Turf Market which would have been advantageous as against Option 1.

3.4.17 The modelling results indicated that this option was technical viable and achieves the desired outcome of avoiding the vast majority of raised defences in the Turf Market area.

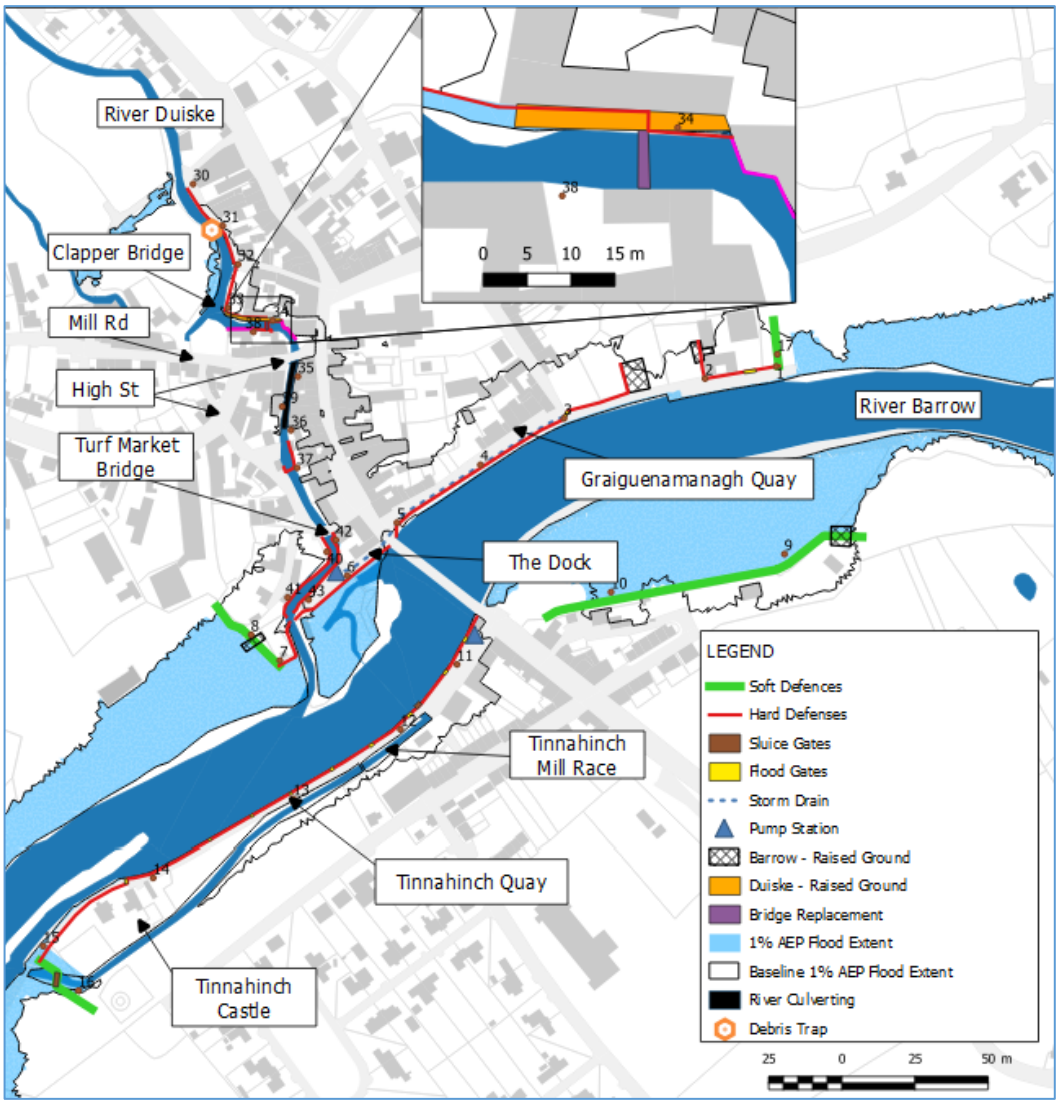


Figure 3-4: Option 5 measures and 1% AEP flood extent

3.5 Choosing the Preferred Option

Multi-Criteria Analysis (MCA)

3.5.1 The approach to selecting the preferred option is multifaceted. Initially a Multi-Criteria Analysis (MCA) to help inform the project team and public in the determination on the preferred option in undertaken. In line with OPW requirements, the MCA undertaken follows the guidance "*Technical Methodology Note - Option Appraisal and the Multi-Criteria Analysis (MCA) Framework"* (OPW, September 2018). The MCA is then considered along with

particular local considerations that exist at scheme level to select the preferred scheme. Such local considerations vary by scheme but may include cultural and built heritage, construction buildability, environmental assessment, and statutory approval issues where there are complex issues not captured in the MCA process.

3.5.2 In order to apply the MCA, various technical, environmental, and social and economic assessments must be undertaken such as:

- Defining the baseline environmental constraints in the study area.
- Calculating the damages arising from flooding up to the design standard for the scheme.
- Estimating the costs of the various Options under consideration

3.5.3 There are 4 main criteria in the MCA:

- Technical - scores the different viable options based on how the options are operationally robust and how adaptable they are to future flood risks. The criterion also considers the health and safety risk associated with the construction, operation, and maintenance of the flood risk management option.
- Economic - assesses how the options will minimise the risk to transport infrastructure, agriculture, utilities infrastructure and economic risk.
- Social – considers the options ability to minimise risk to human health and life and also minimise risk to the Graiguenamanagh-Tinnahinch community.
- Environmental - assesses the ability of the options to support the objective of the WFD and the Habitats Directive, the ability of the option to avoid damages to flora, fauna, and fisheries and where possible to enhance it. The options are also scored on their ability to protect and possibly enhance landscape character and visual amenities within the river corridor. Cultural heritage sites are also considered in this section, and scores are based on the options ability to prevent damages to cultural heritage.

MCA Scoring

3.5.4 To derive the Option Selection MCA Score, the scores for all four of the criteria are summed. This score compliments the MCA Benefit Score with the Technical Criteria Score and hence includes all of the aspects that should be considered in considering the preferred option for a given location.

3.5.5 To derive the MCA Benefit Score, Criteria Scores should be summed. This score represents the net benefits of the option, excluding financial considerations. The MCA Benefit Score can be divided by the cost of the option to provide a numerical, but non-monetarised, MCA Benefit- Cost Ratio (BCR) that provides an indication of the overall benefits that can be delivered per Euro invested for a given option. OPW guidance recommends assigning the greatest weight to the option selection to the MCA BCR, which provides a measure of the overall benefits per euro investment. However, it is acknowledged that professional judgement must be applied, considering local consultation outcomes.

Other Considerations

3.5.6 The MCA process helps characterise and compare the relative strengths and weakness of the options considered and allows a scoring of options in a consistent manner at national level. It is considered that further assessment and professional judgement is needed to determine the preferred option at scheme level, appropriate to the local setting.

3.5.7 The following are other matters to be addressed in selecting the preferred option, based on professional judgement:

- Statutory Approval Process
- Construction Complexity
- Environmental
- Public Engagement & Collaborative Partners
- Economic

3.5.8 The Statutory Approval Process, Construction Complexity and Economic considerations have been outlined in Ayesa's Options Report (Ayesa, 2025). The Environmental and Public Engagement and Collaborative Partners considerations are outlined in the following sections.

Environmental Considerations

3.5.9 When assessing how, and to what extent, each option may cause impact to the environment, the following key guidance was referred to:

- Guidelines on the Information to be contained in Environmental Impact Assessment Reports (EPA, 2022).
- OPW guidance on undertaking a multi-criteria analysis for flood risk management, including assessment and scoring of potential impacts to environmental aspects (OPW, 2018).
- PFRA Methodology for Classifying the Vulnerability of National Monuments from Flooding in the Republic of Ireland (OPW, 2011).

3.5.10 In line with the EPA Guidance (2022), the following environmental factors/disciplines were considered for each option:

- Population and Human Health
- Biodiversity
- Land, soil, and water
- Climate

- Material Assets
- Cultural Heritage
- Landscape

3.5.11 In addition, the OPW MCA methodology was considered. The environmental objectives included within the MCA are to:

- Support the objectives of the WFD,
- Support the objectives of the Habitats Directive,
- Avoid damage to, and where possible enhance, the flora and fauna of the catchment,
- Protect and where possible enhance fisheries resource within the catchment,
- Protect, and where possible enhance, landscape character and visual amenity within the river corridor,
- Avoid damage to or loss of features, institutions and collections of cultural heritage importance and their setting,

3.5.12 These MCA objectives are consistent with the topics of Biodiversity, Water, Cultural Heritage and Landscape as set out in the EPA guidance (2022).

Table 3-2: Comparison of EPA and OPW MCA Environmental Topics

EPA (2022)	OPA MCA Environmental Objectives
Population and Human Health	-
Biodiversity	• Support the objectives of the Habitats Directive. • Avoid damage to, and where possible enhance, the flora and fauna of the catchment. • Protect and where possible enhance fisheries resource within the catchment.
Land, soil, and water	• Support the objectives of the WFD. • Support the objectives of the Habitats Directive. • Protect and where possible enhance fisheries resource within the catchment.
Air Quality	-
Climate	• Ensure flood risk management options are adaptable to future flood risk, and the potential impacts of climate change.
Material Assets	-
Cultural Heritage	• Avoid damage to or loss of features, institutions and collections of cultural heritage importance and their setting.
Landscape	• Protect, and where possible enhance, landscape character and visual amenity within the river corridor.

3.5.13 The environmental review of options sought to identify the option which (i) achieves the least significant impact to those typical environmental parameters/topics, and (ii) to mitigate/reduce the significance and/or duration of environmental impacts and where possible provide environmental benefits. The assessment is made with consideration of both short-term (construction phase) impacts and long-term/permanent (operation phase) impacts.

Biodiversity and Water

3.5.14 The review of the preferred option in relation to these parameters is made in reference to the following environmental objectives:

- Support the objectives of the WFD.
- Support the objectives of the Habitats Directive.
- Avoid damage to, and where possible enhance, the flora and fauna of the catchment.
- Protect and where possible enhance fisheries resource within the catchment.

3.5.15 To achieve the above, whilst also resulting in the least environmental impact (in line with EPA's 2022 impact assessment guidelines), the preferred scheme is one which:

1. Results in the least amount of in-river disturbance during construction. Duration is an important factor in determining significance of impact, and this is considered a short-term effect.
2. Results in the least amount of habitat disturbance / removal (both aquatic and terrestrial).
3. Results in the least amount of river alteration during operation (long-term/permanent impact), including physical barriers which may affect normal flow, river hydro-morphology, water quality, and fish migration. Duration is an important factor in determining significance of impact, and this is considered a long-term / permanent effect and would have a greater bearing on the overall impact.

3.5.16 During construction, all options are considered to have negative impact to the WFD objectives, the River Barrow and River Nore SAC, the local flora and fauna and fisheries interest, as all require in-river construction works (i.e., within the SAC) in varying degrees. These works give rise to potential direct localised loss/disturbance of flora and fauna in the footprint of construction and potentially to areas downstream from impacts sedimentation and/or contamination. Whilst all options provide opportunity to reduce impact through good planning, appropriate timing of works, environmental mitigation measures and good construction practise, there are some which provide greater cause for mitigation than others and result in more irreversible impact. The option considered most favourable in this regard are Options 1 and 2, as neither require significant removal/alteration of habitat for the construction of an upstream storage area (unlike

Option 3). Option 2 will entail a significant short term impact during construction that directly affects the qualifying interests of the SAC. The long-term impact however is low and suitable mitigations is possible. Option 2 will require the construction of an instream weir at the entrance of the flow diversion, and therefore Option 1 is considered to be slightly less impactful compared to Option 2.

3.5.17 In terms of avoidance of impacts on the SAC QIs during construction, Option 3 is preferred. However, the reduced impact on the SAC is offset by the increased impact on WFD in the long term, whereby lands that previously experienced period wetting between the storage areas and the town would no longer flood in the 1-in-2-year flood event but will still experience regular wetting during smaller events. The habitats present on the floodplain in these locations will not be altered as a result of this option. This places a long-term impact on the catchment which can be considered more impactful than the short-term impact on the SAQ QIs. However, and fundamentally, the storage area included in Option 3 will not prevent or impact the achieving of water quality objectives under the WFD for the River Duiske. This is not captured within the MCA methodology.

3.5.18 Permanent operational impacts of Option 2 include introducing a physical obstacle such as a flow control structure on the River Duiske. The WFD states that barriers can negatively impact river water quality and fish migration. The flow control structure proposed in Option 2 would replicate Figure 3-5 below, which is a flow control structure installed in the south of Ireland in the 1970s. The structure redirects flows from a stream into a diversion culvert to avoid downstream flooding within the catchment.

3.5.19 Unlike Figure 3-5, the flow structure for Option 2 would not divert all low water flows into the diversion culvert. The structure would also provide an opening to the original bed level which would facilitate fish movement. However, the impact of this structure will be permanent, and it will impact on fisheries movement within the SAC. This is considered highly undesirable.



Figure 3-5: Example of a small flow control structure

3.5.20 Option 3 will result in the greatest permanent loss of riparian habitat, agricultural land (under footprint of embankment) and potential disturbance to roosting or nesting fauna, during a flood. However, whilst there is a flow control structure, it would not restrict the channel. Figure 3-6 shows an example of a flow control structure on an operation storage area in the south of Ireland. As can be seen, flows in the river channel are typically unhindered and the impact of fish movement would be reduced. Option 2 is considered most impactful as it represents a permanent change in the hydro morphology and fisheries regimes. Option 1 impacts less area and for a shorter duration but directly impacts habitat in the SAC. The impacts can be mitigated.

3.5.21 Based on the above Option 2 is the least preferred. Whilst the MCA results indicate otherwise, professional judgement informs that Option 1 is not preferable over Option 3, and in fact has a similar scale environmental impact. On balance Option 1 is probably marginally preferable over Option 3, but not to the degree that it should swing the option selection in favour of Option 1 over Option 3 should such a scenario arise.



Figure 3-6: Example flow control structure on a storage area

Land & Soils

3.5.22 Land and Soils is considered an important consideration in the EPA 2022 Guidelines. The preferred scheme is one which:

1. Results in the least amount of ground/soil disturbance (i.e., excavation, top-soil removal).
2. Results in the least amount of 'land take'.
3. Results in the least amount of river course alteration during operation, including physical barriers which may affect normal flow (hydro morphology and sediment movements).

3.5.23 Option 1 is considered to be the most favourable with regards to land and soils, as many of the defences are planned above ground and will not require significant ground/soil disturbance and/or land take.

3.5.24 Option 3 results in the most significant ground disturbance (excavation & ground shifting) and land take, due to the construction of the storage area. Additionally, the volume of imported material to construct the impoundment at the storage areas is significant.

3.5.25 Option 2 requires excavation for the diversion system, which will generate more arisings than Option 1 or Option 3. Option 2 will be more favourable than Option 3.

Landscape and Visual

3.5.26 The review of the preferred option in relation to these parameters is made in reference to the following environmental objective:

- Protect, and where possible enhance, landscape character and visual amenity within the river corridor.

3.5.27 To achieve the above, whilst also resulting in the least environmental impact (in line with EPA's 2022 impact assessment guidelines), the preferred scheme is one which:

1. Results in the least amount of impact to the visual amenity and landscape of the study area, including the blocking of sensitive views, impact to protected views and alteration of general visual amenity.
2. Provides the greatest ability to mitigate through public realm improvements and landscaping.

3.5.28 With the above in mind, Option 2 is considered to be the most favourable, as it minimises the development of raised defences on the River Duiske by proposing a culverted channel diversion. This option focuses the defences within the town's infrastructure, rather than along the river channel, which results in a relatively lesser visible impact upon sensitive and protected views when compared to the other options.

3.5.29 The order thereafter, from most to least favourable, is Option 3 then Option 1. Option 1 (least favourable) results in greater visual impact to the River Duiske through presence of concentrated defences, which are higher and more extensive than Option 3. Option 3 poses impact to protected views through the construction of the storage area but given the steepness of the valley is considered it can be situated in the valley without significant altering the landscape.

Cultural Heritage

3.5.30 The review of the preferred option in relation to these parameters is made in reference to the following environmental objective:

- Avoid damage to or loss of features, institutions and collections of cultural heritage importance and their setting.

3.5.31 To achieve the above, whilst also resulting in the least environmental impact (in line with EPA's 2022 impact assessment guidelines), the preferred scheme is one which:

1. Results in the least amount of damage to or loss of cultural heritage, including archaeological (terrestrial, underwater and industrial) and architectural heritage.
2. Results in the least amount of change to the intangible cultural heritage (i.e., historic character) of the study area.
3. Supports and enhances the tangible and intangible cultural heritage and its importance of and to the study area including the reducing the risk of damage to cultural heritage caused by flooding.

3.5.32 The baseline environmental for cultural heritage is broadly the same across all options and the full details of the below mentioned protected structures are provided in Chapter 9 'Cultural Heritage'.

3.5.33 Option 1 would entail disturbance to significant cultural heritage within the town. Numerous protected structures and NIAH buildings would be affected and structural works may also be needed. Alterations to the mass path would also be needed, but other channel changes near Clapper Bridge, a protected structure (RMP no. KK029-018008-) would be minimal compared to Option 3.

3.5.34 Option 2 eliminates the impact on protected structures and NIAH structures associated with works on the Duiske River almost entirely but introduces significant change at Clapper Bridge, a protected structure. Significant mitigation would be needed to protect the cultural heritage at this location if this option was chosen.

3.5.35 Option 3 entails similar works to walls near Clapper Bridge to Option 1. However, the extent and height of the required works is about half that of Option 1, making it strongly preferrable to Option 1.

3.5.36 On balance it is considered that an isolated more significant impact is more preferable to a more dispersed albeit lower impacts but would cause a cumulative effect. This would maintain as much original character as possible, as opposed to altering more if it in a small way. Option 2 is therefore considered preferable as it minimises the number and extent of area affected. Option 3 is then preferred over Option 1, given the difference in scale in the proposed work.

Climate

3.5.37 The climate assessment consideration would be the same as those presented in the MCA which includes an objective (4C) to ensure flood risk can be managed effectively and sustainably into the future, and the potential impacts of climate change considered. This is discussed in the technical assessment of the MCA, but in summary, Option 3 was considered most favourable for adaptability to a changing climate as the flood storage potential can be increased, and the walls can be heightened should this be required.

Social & Human

3.5.38 For impact on humans, Options 1 and 3 would impose very restrictive conditions on residential properties near to the works whereby both options impeded access over long periods to properties and result in heavy civils works alongside the properties for extended durations (at least in the order of months).

3.5.39 Option 2 relocates elements of the works to less densely populated residential areas but has potential to impact on other otherwise unaffected members of the public, but in a less intensive manner. In particular, the direct impact on private residential property is far less for Option 2 compared to Options 1 or 3, but the impact on local traffic is far higher for Option 2.

3.5.40 It is considered that the best option is where the least amount of disruption is imposed and where the level of disruption on any one individual can be justified for the community need. On this basis, Option 2 and 3 are preferred, with Option 1 being the least preferred option.

Public Engagement & Collaborative Partners

3.5.41 A Public Information Day (PID) was held on Tuesday 9th August 2022 in Graiguenamanagh to ascertain the views of the public on all options. No. 27 responses were received with no. 36 persons attending on the day. The result of the questionnaire, and the sentiment gather by the team on the day, was that Option 4 was preferred. In the survey results, 59% favoured Option 4, with Option 1 being the next most preferred option. Option 2 was the 4th preference whilst Option 3 was the least preferred.

3.5.42 However, what was evident during discussion with the attendees was that the preference for Option 4 was due the use of upstream storage and the flow diversion channel which minimised wall heights and lengths along the Duiske. This sentiment that was also strongly conveyed by the statutory stakeholders attending the Collaborative Workshops on the 23rd of August 2022.

3.5.43 This is important to consider in the context of a thought train that eliminating Option 4 would make Option 1 the next preferred option in the public eyes. However, if Option 4 was removed as a choice to the public, Options 3 (the only option that includes upstream storage) may have been more preferred. This cannot be substantiated, but it does indicate that caution needed to be applied when assessing the preference of the public given the choices presented to them. The Teams' understanding from the PID was that upstream storage was strongly supported and this message carried into the subsequent development of the scheme.

Preferred Option

3.5.44 From objective analysis using the multi-criteria assessment methodology the preferred option was considered to be 'Option 1 – Raised Defences Only', however in applying professional judgement with reference to the information gathered through the environmental assessment and public consultation there appeared to be an alternative

preferred option; 'Option 3 – Raised Defences and River Duiske Storage', as it represented the optimum combination of measures with the most appropriate balance of impact across all disciplines. It also met Kilkenny County Council's desire for passive, sustainable flood defences, whilst balancing the various and competing interests of other legislation and objectives.

3.5.45 The main reasons why this is the Preferred Option over all the others and in particular Option 1 is that:

- A significant element of the work is concentrated outside of the town.
- A large portion of the works on the River Duiske are located outside the River Barrow and River Nore Special Area of Conservation (SAC)
- The works within the town are reduced in nature and scale, limiting impacts on protected structures within the historic town.
- The option will not negatively impact on the water quality objectives under the WFD of the Barrow or the Duiske.
- The risk to the project budget due to construction price inflation is lower than for the other options.
- It is the least sensitive options to ground conditions, a major source of cost overruns on projects.
- The risk of flooding during construction is reduced as the volume of instream works in the River Duiske is reduced compared to Option 1 and can be mitigated due to the nature of the scheme.
- The extent of works instream in the SAC is reduced compared to Option 1.
- In consideration of the Climate Sectoral Adaptation Plan for Flood Risk Management (2019 -2024) this approach allows for an integrated assessment of flood management at the catchment scale.
- The WFD has also called for a shift in flood management approach away from site specific raised engineering solutions, towards an integrated assessment of water resources and flood management at the catchment scale.

Results and Summary

3.5.46 As outlined in this Chapter, the development of the preferred option was informed by a combination of assessment, studies and discussions, including a Constraints Study, engagement with the public, MCA, collaborative meetings with stakeholders, and an environmental appraisal (incl. climate change implications). The options were also appraised economically with the cost benefit ratio of defending to the design standard of 1% AEP established to inform a detailed benefit analysis.

3.5.47 All options were presented to the public in August 2022. The public identified Option 4 as their preferred option however, both Options 2 and 4 are economically unviable given recent increases in cost due to inflation. A main concern highlighted by the public related

to the proposed permanent wall along Graiguenamanagh Quay. This sentiment was also echoed in meetings with the collaborative stakeholders.

3.5.48 The preferred option was determined to be Option 3, which includes the construction of raised defences on the River Barrow along with raised defences and an upstream storage area on the River Duiske. A full description is provided in Chapter 4 of this EIAR, and a summary of the options review included below:

Table 3-3: Option Review Summary

Statutory Approval	Level of importance compared to other sub- topics	Preferred Option based on Professional Judgement
Statutory Approval	Low	Option 2, Options 1 and 3 similar
Construction & Buildability	High	Option 3
Environmental	High	Option 3*
- Biodiversity & Water	High	Option 1 preferred, but Option 3 very similar and both clearly preferred over Option 2
- Land and Soils	Low	Option 1 – others both undesirable.
- Landscape & Visual	High	Option 2, Option 3 clearly more preferred than Option 1
- Cultural Heritage	High	Option 2, Option 3 clearly more preferable than Option 1
- Social/Humans	High	Option 2 or 3, Option 1 clearly not preferred.
Public Engagement & Collaborative Partners	High	Option 1
Economic Costs	High	Option 1 or 3, not Option 2

*Considering the variation in preferred options for the reviewed environmental topics, Option 1 and 2 appear most favourable. However, all but one case, Option 3 is the 2nd preferred option, making it a more balanced options than Option 1 or 2 from a solely environmental perspective. On balance, Option 3 is the preferred environmental option.

3.5.49 With Option 3, it was found that there would be 84 benefitting properties, as outlined in Table 3-4. The benefit cost-ratio of this option was found to be 1.70 with total of damages avoided with the implementation of the scheme calculated to be €32,771,139.

Table 3-4: Number of properties benefitting from Scheme

Property Type	Number of properties benefiting for the 1% AEP Design Standard
Residential	31
Commercial	53
TOTAL	**84**

3.6 References

Ayesa, 2025. *Graiguenamanagh-Tinnahinch Flood Relief Scheme, Options Report, W3451-BLP-R-W-009, Rev07,* s.l.: s.n.

ByrneLooby, 2021. *Environmental Constraints Study, W3451-BL-ENV-R001,* s.l.: s.n.

OPW, 2011. *South Eastern CFRAM Study – Flood Risk Review - Final Report, IBE060-Rp0001-F01/Nov 2011,* s.l.: s.n.

OPW, 2016. *South Eastern CFRAM Study - Hydrology Report for UoM14, IBE0601Rp0011,* s.l.: s.n.

OPW, 2016. *South Eastern CFRAM Study - Preliminary Options Report UoM14, IBE060Rp0024,* s.l.: s.n.

OPW, 2016. *South-Eastern CFRAM Study UoM14 Flood Risk Management Plan, Natura Impact Statement ,* s.l.: s.n.

OPW, 2017. *South Eastern CFRAM Study UoM14 Strategic Environmental Assessment Statement,* s.l.: s.n.

OPW, 2018. *Appropriate Assessment Determination in accordance with Regulation 42(11) of the European Communities (Birds and Natural Habitats) Regulations 2011 – 2015 for Flood Risk Management Plan for the Barrow River Basin (UoM14),* s.l.: s.n.

OPW, 2018. *Flood Risk Management Plan for the Barrow River Basin (UOM14),* s.l.: s.n.

4 Description of the Proposed Scheme and Construction Methodology

4.1 Introduction

4.1.1 This chapter describes the Proposed Scheme, including all construction and temporary works. It also describes the benefits of the Scheme, how the Scheme design accounts for climate change, and plans for maintenance of the Scheme. This chapter has been structured to describe the following:

- A detailed description of the Proposed Scheme including the division into Works Areas, all components of the flood defences, as well as the landscape design and public realm proposals.
- A review of the construction details including the preparatory and early works requirements (additional surveys, utilities diversions and site clearance), site layout requirements (site compounds, access routes, lighting, hoarding etc.) as well as details of traffic requirements and likely road and parking closures,
- A detailed description of the construction methodology, including all in-stream, structural, and drainage works, as well as works required for the construction of the scheme defences (i.e., concrete walls, raised ground, embankments, flow control structure and outfalls etc.).
- A review of the construction stage risks and proposed mitigation.
- A description of the construction works programme, the planning phasing and sequencing of the Works Packages (WPs).
- A description of the long-term operation and maintenance regime of the Proposed Scheme.

4.1.2 Certain aspects of the Scheme may be subject to minor refinements at tender design and construction stages. To ensure that these are included in the impact assessment, the EIAR has presented a 'maximum project' scenario and considered the likely significant effects and mitigation measures accordingly. Those areas where the detailed design may result in minor alterations to the planned works are addressed in the mitigation section.

4.2 Location of Proposed Scheme

4.2.1 The settlements of Graiguenamanagh – Tinnahinch (G-T) are located in counties Kilkenny and Carlow respectively. The settlements are a contiguous formation and have benefitted from a joint development planning approach in recent years. The settlements area circa 28 km south east of Kilkenny City. Both Carlow and Kilkenny County Councils have responsibility for their respective jurisdictions. are located in counties Kilkenny and Carlow respectively. The settlements are a contiguous formation and have benefitted from a joint development planning approach in recent years. The settlements area circa 28 km

south east of Kilkenny City. Both Carlow and Kilkenny County Councils have responsibility for their respective jurisdictions.

4.2.2 The settlements were developed surrounding the Barrow River and the Duiske River, on the Graiguenamanagh side. The majority of the Barrow Catchment lies upstream and outside the control of either Local Authority. The catchment area for the Duiske is significantly smaller at 24 km^2 and the river flows from west to east before joining the Barrow. The location of G-T showing the catchment boundaries of the River Barrow and River Duiske is shown in Figure 4-1, and an aerial image of the towns in Figure 4-2.



Figure 4-1: Study Area highlighting Barrow and Duiske Catchments



Figure 4-2: Aerial Image of Graiguenamanagh and Tinnahinch (Source: Google Maps)

4.3 The Proposed Scheme

4.3.1 Chapter 1 of the EIAR 'Introduction' provides detail to the need for the Scheme, and the scheme objectives. In short, the Proposed Scheme is intended to provide flood protection measures to residential and commercial properties along the River Barrow and River Duiske to alleviate flooding for the 1 in 100-year flood event (1% AEP). There is also an objective to minimise upstream or downstream increases in water levels arising from the preferred measure to be adopted.

Works Areas

4.3.2 To facilitate assessment throughout this EIAR, the Proposed Scheme has been divided into Works Areas (WAs), as set out in the table below. Also below is a summary of the permanent works proposed in each area.

Table 4-1: Proposed Scheme Overview

Area No.	Description	Aspects of Work
Area 1	Storage Area	Raised earth-filled impoundment structure and debris screen. Reinforced concrete flow control structure with hydraulic control and downstream flume for flow control. Spillway. New access roads, lighting and mechanical and electrical equipment to storage area. Diversion of ESB poles.
Area 2	Well Lane to High Street Bridge	Raised defence on the left bank from The Globe upstream to the first pedestrian access bridge. Local land raising/steps to tie into new raised flood defences. Removal, re-use and raising of pedestrian access bridge deck and railings. Local waterproofing of existing walls and raising of windowsills Debris Trap at Well Lane Installation of Non-Return Valves (NRVs) at outfalls.
Area 3	Turf Market	Raised defences on left bank from High Street Bridge downstream to first pedestrian access bridge. Replacement pedestrian access bridge and parapets. Installation of NRVs at outfalls on left bank.
Area 4	Turfmarket to The Hub (Lower Turfmarket)	Raised defences on both banks from Turfmarket Bridge to the bridge at The Hub. Drainage system at Peg Washingtons Lane.
Area 5	Boat Club	Raised embankment on the right bank in the field north of the boat club.

Area No.	Description	Aspects of Work
		Raised defence on the right bank, to include glass panels at various points along the wall, from upstream of the boat club to Graiguenamanagh Quay. Installation of non-return valves on outfalls to the River Barrow. Drainage system to include pumped rising main. Local land raising to facilitate orderly completion of flood defences whilst maintaining access. Public Realm/landscaping works.
Area 6	Graiguenamanagh Quay	Raised defence on the right bank along Graiguenamanagh Quay to include glass wall section and sliding flood gates. Installation of non-return valves on outfalls to the River Barrow. Drainage system. Public Realm/Landscaping Works to include new 1-way system on Graiguenamanagh Quay. Install NRVs at outfalls. Undergrounding and diversion of ESB and Eir cables.
Area 7	The Dock	Raised defence on the right bank from Graiguenamanagh Quay to the bridge at The Hub to include hinged flood gate for access to historic dock. Drainage system and a pumping station. Landscape and Public Realm Works.
Area 8	The Hub	Raised defence on the right bank from the bridge at The Dock to the rear of the UÉ pumping station. Raised embankment on the right bank within the ground of The Hub. Local land raising to facilitate orderly completion of flood defences whilst maintaining access. Drainage System. Install NRVs at outfalls.
Area 9	Hotel Street	Raised embankment and flood defence wall on the left bank in the field upstream of Graiguenamanagh Bridge. Groundwater drainage systems to tie into drainage on Tinnahinch Quay. Local ramps to maintain access to Barrow River. Install NRVs at outfalls.
Area 10	Tinnahinch Quay	Raised defences on the left bank at Tinnahinch Quay tying into high ground at a private residence on Tinnahinch Quay, adjacent to the Millrace. Drainage systems including small pump station (underground).

Area No.	Description	Aspects of Work
		Flood gate fitted to the Quay Road at existing Millrace sluice gate. Kiosk relocation. Install NRVs at outfalls. Undergrounding and diversion of ESB and Eir cables.

Proposed Scheme Drawings

4.3.3 Reference should be had to the full set of planning drawings accompanying the application for approval. A summary set of drawings are included in Appendix 4-1 'Scheme Drawings' as described in Table 4-2 below.

Table 4-2: Summary of Proposed Flood Relief Works and Drawing List.

Dwg no.	Description
ENGINEERING DRAWINGS	
W3451-AYE-DWG-W-14XX	Cover Sheet (Name, Revision and Scheme Details)
W3451-AYE-DWG-W-1400	Drawing List
W3451-AYE-DWG-W-1401	Flood Relief Works - Site Location Map
W3451-AYE-DWG-W-1402	Flood Relief Works - Site Extents & Notices
W3451-AYE-DWG-W-1403	Flood Relief Works - Site Location Plan
W3451-AYE-DWG-W-1404	Flood Relief Works - Tinnahinch Hotel Street - Site Plan & Longitudinal Sections
W3451-AYE-DWG-W-1405	Flood Relief Works - Tinnahinch Hotel Street - Sections - Sheet 1
W3451-AYE-DWG-W-1406	Flood Relief Works - Tinnahinch Hotel Street - Sections - Sheet 2
W3451-AYE-DWG-W-1407	Flood Relief Works - Tinnahinch Quay - Site Plan & Longitudinal Sections
W3451-AYE-DWG-W-1408	Flood Relief Works - Tinnahinch Quay - Sections
W3451-AYE-DWG-W-1409	Drawing no longer in use
W3451-AYE-DWG-W-1410	Flood Relief Works - Graiguenamanagh Quay - Site Plan & Longitudinal Sections
W3451-AYE-DWG-W-1411	Flood Relief Works - Graiguenamanagh Quay - Sections - Sheet 1
W3451-AYE-DWG-W-1412	Flood Relief Works - Graiguenamanagh Quay - Sections - Sheet 2
W3451-AYE-DWG-W-1413	Flood Relief Works - Graiguenamanagh Quay - Sections - Sheet 3
W3451-AYE-DWG-W-1414	Flood Relief Works - Docks & Hub - Site Plan & Longitudinal Sections
W3451-AYE-DWG-W-1415	Flood Relief Works - Docks & Hub - Sections - Sheet 1
W3451-AYE-DWG-W-1416	Flood Relief Works - Docks & Hub - Sections - Sheet 2

Dwg no.	Description
W3451-AYE-DWG-W-1417	Flood Relief Works - Lower Turf Market - Site Plan & Longitudinal Sections
W3451-AYE-DWG-W-1418	Flood Relief Works - Lower Turf Market - Sections
W3451-AYE-DWG-W-1419	Flood Relief Works - High St. Lower - Site Plan & Longitudinal Sections
W3451-AYE-DWG-W-1420	Flood Relief Works - High St. Lower - Sections
W3451-AYE-DWG-W-1421	Flood Relief Works - Upstream Storage Area - Duiske River - GA Site Plan & Sections
W3451-AYE-DWG-W-1422	Flood Relief Works - Upstream Storage Area - Duiske River - Access Road Plan & Details
W3451-AYE-DWG-W-1423	Flood Relief Works - Upstream Storage Area - Duiske River - Flood Extents
W3451-AYE-DWG-W-1424	Flood Relief Works - Treatment of Existing Walls
W3451-AYE-DWG-W-1425	Flood Relief Works - Flood Defences Overall Asset Numbers
W3451-AYE-DWG-W-1426	Site Works - Arboreal Impact GA Layout
W3451-AYE-DWG-W-1427	Site Works - ESB Diversions Layout
W3451-AYE-DWG-W-1428	Site Works - Public Lighting Diversions Layout
W3451-AYE-DWG-W-1429	Site Works - Eir Diversions Layout
W3451-AYE-DWG-W-1430	Stormwater Drainage - Overall Layout Plan
W3451-AYE-DWG-W-1431	Stormwater Drainage - Tinnahinch Hotel Street & Quay - GA Layout
W3451-AYE-DWG-W-1432	Stormwater Drainage - Graiguenamanagh Quay - GA Layout
W3451-AYE-DWG-W-1433	Stormwater Drainage - Docks & Hub - GA Layout
W3451-AYE-DWG-W-1434	Stormwater Drainage - Pumping Station No.1 - GA Layout, Plan & Sections
W3451-AYE-DWG-W-1435	Stormwater Drainage - Pumping Station No.2 - GA Layout, Plan & Sections
W3451-AYE-DWG-W-1436	Stormwater Drainage - Pumping Stations No.3-5 - GA Layout, Plan & Sections
W3451-AYE-DWG-W-1437	Outfall Works - Overall Layout Plan
W3451-AYE-DWG-W-1438	Outfall Works - River Barrow Outfalls - Sheet 1
W3451-AYE-DWG-W-1439	Outfall Works - River Barrow Outfalls - Sheet 2
W3451-AYE-DWG-W-1440	Outfall Works - River Duiske Outfalls
W3451-AYE-DWG-W-1441	Conservation Strategy - Overall Layout Plan
W3451-AYE-DWG-W-1442	Conservation Strategy - Wall Details
W3451-AYE-DWG-W-1443	Site Works - UE Water Diversions Layout
W3451-AYE-DWG-W-1444	Site Works - Auto tracking Layout
PUBLIC REALM/ STREETSCAPING DRAWINGS	
1579_300	Overall Landscape Plan
1579_301	Landscape Plan - Area 1
1579_302	Landscape Plan - Area 2 & Area 3
1579_303	Landscape Plan, Section & Visual - Area 2

Dwg no.	Description
1579_304	Landscape Plan - Area 4, Area 7 & Area 8
1579_305	Landscape Plan - Area 5 & Area 6
1579_306	Landscape Plan & Section - Area 5
1579_307	Landscape Plan & Section - Area 6
1579_308	Landscape Sections - Area 6
1579_309	Landscape Plan & Section - Area 8
1579_310	Landscape Plan - Area 9
1579_311	Landscape Plan & Sections - Area 10

4.3.4 As part of the scheme, extensive public realm improvements and landscaping is proposed, particularly along the G-T Quays. These works will be carried out at the end of the construction period, once the flood defences have been completed. The Public Realm Proposal has been prepared by The Big Space (TBS) and is included in Appendix 4-2.

4.3.5 A series of photomontages have been established to present the Proposed Scheme, and all public realm improvements, in an illustrative format. These are included in Appendix 4-3.

Detail of Works Areas and Proposed Defences

Area 1 – Storage Area

4.3.6 The works at Area 1 - Storage Area entail the establishment of a flood storage area by constructing a raised earthen dam which will impound flood waters during extreme events. Water will be conveyed through the dam in a hydrobrake, which will have a debris screen upstream to prevent blockage. Water levels will be monitored using sensors which can be accessed remotely. Task lighting and access to the site will also be provide from the R703.



Figure 4-3: Example of hydrobrake upstream with debris screen (courtesy of Hydro International)



Figure 4-4: Example of hydrobrake flow control structure upstream

4.3.7 The proposed works are shown on Drawings W3451-AYE-DWG-W-1421 and W3451-AYE-DWG-W-1422. Photomontages reference Drone01 included under Appendix 4-3 illustrate the flood defence and public realm proposals planned in Area 1.

4.3.8 The existing use for the area where the direct works will occur is agricultural grassland separated by sod and stone ditches. Site clearance will consist of removal of topsoil. Removal of ditches has been minimised as part of the design.

4.3.9 The embankment will be up to 8 m height in the centre, where the flow control structure will be sited. The embankment will have side slopes of 1V:3H and will be grass seeded.

4.3.10 A spillway will form the south half of the dam, which is set lower than the northern side and will have erosion control matting placed on the downstream face.

4.3.11 During times of flood, the area upstream of the dam will be inundated with water up to the maximum design level. This will temporarily impact the lands shown in Drawing No. W3451-AYE-DWG-W-1423 for the extent shown.

4.3.12 Access to the storage area will be from the R703, where a new vehicular access will be made. From here, a new access road will be constructed, respecting and maintaining the exiting field boundaries. Minor grading of the land will be required to provide safe access.

4.3.13 A stage/working platform will be created to the north end of the dam where communication control and power will be established.

Landscape Design and Public Realm

4.3.14 The landscaping proposals are included drawing number 1579_301 in Appendix 4-2.

Area 2 – Well Lane to High Street Bridge

4.3.15 The works at Area 2 - Well Lane to High Street Bridge include the construction of a debris trap at Well Lane, improvements to existing walls at the Mass Path on the left bank along the Mass Path to The Globe (RPS C133)[1]. An existing private footbridge will also need to be modified (raised) and ground raising to provide adequate protection against flooding. A low-level flood defence wall (ca. 0.5 m) will replace an existing stub wall (shown in the bottom left foreground of the photo below)



Figure 4-5: Area along Mass Path to receive proposed works (photo courtesy of Doyle's)

[1] RPS and RMP references applied to Cultural Heritage Assets in this chapter. See Chapter 9 'Archaeology and Cultural Heritage' for detailed information.

4.3.16 The proposed works are outlined on Drawing No. W3451-AYE-DWG-W-1419 and W3451-AYE-DWG-W-1420. Photomontage reference PM10 included under Appendix 4-3 illustrate the flood defence and public realm proposals planned in Area 2.

4.3.17 Site clearance will consist of the demolition of circa 10 m of existing stone masonry stub wall, removal of shrubs and vegetation, removal of existing pedestrian footbridge and removal of plaster from walls to be improved.

4.3.18 The debris trap will entail placing auger or driven piles into the bed of the river to trap and catch any heavy debris flowing down the Duiske River. This will serve to protect the clapper bridge (RMP KK029-018008) from future damage and ensure blockages do not impact the scheme further downstream where multiple structures exist. This trap will be maintained from Well Lane in future. An example is shown in Figure 4-17.

4.3.19 The wall improvement will entail casing or applying a waterproof casing to the existing walls to the rear of Doyle's. This will be circa 0.5 m high and may extend up to 100 mm out from the existing wall. It will run from upstream of clapper bridge to the existing pedestrian footbridge. A similar approach will be taken to improving the wall at The Globe, where the wall will be improved to a height of circa 1.2 m, including raising the windowsills by 250 mm. Between these sections there will be a low-level flood wall, some 0.5 m high that will replace the existing stub wall. This will be faced in stone to replicate the existing.

4.3.20 Outfalls that could potentially provide a pathway for floodwater behind flood defence will have non-return valves fitted. This can be seen on Drawings W3451-AYE-DWG-W-1437 to W3451-AYE-DWG-W-1440.

Landscape Design and Public Realm

4.3.21 The public realm proposals are included in drawing number 1579_302 and 1579_303 in Appendix 4-2. The proposals for Well Lane to High Street Bridge are combined with those proposed for Turf Market (High Street Lower) in the Public Realm Proposals.

4.3.22 The informal seating/terrace area at the Mass Path will be retained, along with the existing stone wall at the river's edge. Ornamental planting is proposed between the proposed flood wall and the existing stone wall. Steps are to be introduced at the bridge crossing (which is to be removed and re-used at a raised position), as well as new guardrails/handrails (threat mounted). Further steps are to be introduced towards Clapper Bridge, again with guardrails/handrails.

Area 3 – Turf Market (High Street Lower)

4.3.23 The works at Area 3 – Turf Market include the construction of a flood defence wall and bridge replacement which will act, in combination with the upstream storage, to limit flows downstream such that no further works are required in Turf Market.

4.3.24 The proposed works are outlined on Drawing No. W3451-AYE-DWG-W-1419 and W3451-AYE-DWG-W-1420. Photomontage reference PM09 included under Appendix 4-3 illustrate the flood defence and public realm proposals planned in Area 3.

4.3.25 Site clearance will consist of the demolition down to below bed level of the existing walkway to the rear of Hughes (RPS C134) and removal of existing pedestrian access bridge.

4.3.26 The proposed flood defence wall is to be located in a restricted working environment, which will require instream works. The wall will be circa 1.8 m above bed level and 0.7 m above existing ground level along the path. A waterproof render will be applied to the existing wall on the left bank of the Duiske from the pedestrian bridge to Turf Market Bridge.



Figure 4-6: Turf Market Works Area – Flood Defence walls to right of channel shown, bridge replacement in foreground.

4.3.27 Flood doors and pump sumps are to be provided at key locations and low-lying properties as shown on drawing W3451-AYE-DWG-W-1419 to mitigate against the risk of seepage under the existing wall. In the event of infiltration behind the defences, pumping will commence. The proposed flood doors are mitigation in the unlikely event of a failure of the pumping.

4.3.28 Outfalls that could potentially provide a pathway for floodwater behind flood defence will have non-return valves fitted. This can be seen on Drawings W3451-AYE-DWG-W-1437 to W3451-AYE-DWG-W-1440.

Area 4 – Turf Market to The Hub

4.3.29 The works at Area 4 – Turf Market to the Hub consist of the construction of flood defence walls on both banks of the River Duiske. On the right bank the walls vary from circa 1.2-1.5 m above ground level, whilst on the left bank, facing The Dock, the walls are a typically 1.1 m above ground level.

4.3.30 The proposed works are outlined on Drawing No. W3451-AYE-DWG-W-1417 and W3451-AYE-DWG-W-1418. Photomontage reference PM08 included under Appendix 4-3 illustrate the flood defence and public realm proposals planned in Area 4.

4.3.31 On the left bank immediately downstream of Turf Market Bridge, the wall will sit on a bored pile foundations to avoid excavations adjoining the dwelling and provide cut-off for seepage. On the right bank immediately upstream of The Hub Bridge, leading to Peg Washingtons Lane, a bored pile solution will also be implemented to reduce excavation next to the historic building and to provide cut-off for seepage. Some rock outcropping is potentially located at this location. Both walls will be faced with natural stone on the both the landward and riverward sides of the walls

4.3.32 Outfalls that could potentially provide a pathway for floodwater behind flood defence will have non-return valves fitted. This can be seen on Drawings W3451-AYE-DWG-W-1437 to W3451-AYE-DWG-W-1440.

Area 5 – Boat Club

4.3.33 The works at Area 5 – Boat Club entail the construction of flood defence walls, an embankment and associated works surrounding the boat club on the right bank of the River Barrow. Significant landscaping is included in the works to maintain connectivity between the building and the water, acknowledging the building usages. An access ramp into the greenfield lands between the Boat Club and Graiguenamanagh Quay will also be provided.

4.3.34 The proposed works are outlined on Drawing No. W3451-AYE-DWG-W-1410 to W3451-AYE-DWG-W-1413. Photomontages references PM01, PM02 and PM06 included under Appendix 4-3 illustrate the flood defence and public realm proposals planned in Area 5.

4.3.35 Site clearance will consist of removal of the existing wall fronting the Boat Club and partial demolition of the existing access gate to the land upstream of the Boat Club. Existing footpaths and surfaces will be broken out. Existing railing and lighting posts will be decommissioned. The existing boundary of stone masonry and sod and stone ditches between Graiguenamanagh Quay and the Boat Club will be demolished. The existing gates and pillars along this section of the wall will be retained.

4.3.36 In the land upstream of the Boat Club, an earthen embankment will be constructed. It will be 1.8 m high nearest the river and will be built to tie into high ground to the north. The embankment will have side slopes of 1V:2.5H and will be grass seeded.

4.3.37 The flood defence wall in front of the Boat Club will be circa 1.5m high above ground level and will include 1 m high glazing within its height in front of the clubhouse. The riverward side of the wall will be solid and cladded in natural stone. The wall at this location is well set back from the quayside. Waterways Ireland are progressing plans to complete repairs to the quays and slipway near the Boat Club currently.

4.3.38 Lift and turn hinged flood gates will be provided to maintain access for vehicles. An area of the carparks will be raised by up to 800 mm to provide adequate flood protection whilst

maintaining access to the boat storage building. The surrounding carpark areas will be re-profiles and resurfaced to suit.

4.3.39 A reinforced concrete wall, with natural stone cladding will be constructed between the Boat Club and Graiguenamanagh Quay. It will typically be up to 1.5 m high and access through it via a ramp access will be facilitate access the lands to the north of the wall.



Figure 4-7: 1.5 m high flood defence wall clad with natural stone will be placed on the dry side of the existing boundary wall.

4.3.40 Outfalls that could potentially provide a pathway for floodwater behind flood defence will have non-return valves fitted. This can be seen on Drawings W3451-AYE-DWG-W-1437 to W3451-AYE-DWG-W-1440.

Landscape Design and Public Realm

4.3.41 The public realm proposals are included drawing number 1579_305 and 1579_306 in Appendix 4-2. The proposals for The Boat Club are combined with those proposed for Graiguenamanagh Quay in the Public Realm Proposals.

4.3.42 A series of public realm improvements are proposed along The Quay, cognisant of its function as providing access for both vehicles and pedestrians. The vehicular route will be altered to a one-way system, with improved footpaths proposed along The Quay and within the carpark of the Boat Club for easier and safer pedestrian movement. An informal stop-go system is proposed after Barrow Lane, east of the proposed flood gate in this area. The existing lay-by will still remain, but only 1 vehicle can turn the corner at Barrow Lane at a time.

4.3.43 For the southern vehicular access to the Boathouse, a double gate arrangement is proposed to allow for pedestrian access to facilities while providing a secure boundary to the boathouse.

4.3.44 Mooring and boat access will be available along the length of The Quay. Further, the slipway and concrete steps opposite the Boat Club will remain.

Area 6 – Graiguenamanagh Quay

Flood Defences

4.3.45 The works at Area 6 – Graiguenamanagh Quay includes the construction of flood defence walls from the entrance to the Boat Club downstream to Graiguenamanagh Bridge (RPS C125). The wall is to be built set back from the quay edge by 4-5 m, to allow adequate space for pedestrian and quay use simultaneously.

4.3.46 Vehicular access to Graiguenamanagh Quay will be restricted to one lane travelling.

4.3.47 The proposed flood defence works are outlined on Drawing No. W3451-AYE-DWG-W-1410 to W3451-AYE-DWG-W-1413. Photomontage reference PM02, PM03, PM04 and PM06 included under Appendix 4-3 illustrate the flood defence and public realm proposals planned in Area 6.

4.3.48 Site clearance work will consist of removal of existing bollards, demolition of boundary wall/hoarding at corner of the Quay and Barrow Lane and demolition of existing streetscape along the entire quay. An existing telecommunications pole at the corner of Barrow Lane/The Quay will be removed. Note the existing quay flagstones or steps will not be interfered with.



Figure 4-8: Graiguenamanagh Quay

4.3.49 The existing quay have been significantly repaired and improved by Waterways Ireland circa 2011. A dive survey undertaken in 2023 informed the quays are generally in reasonable condition.



Figure 4-9: Repair Works to Graiguenamanagh Quay circa 2011

4.3.50 The proposed walls will be founded on sheet piles or auger piles. The maximum wall height is circa 1.4m above ground level. The wall consists of at least 1m high glass panels sitting on 400mm of reinforced concrete with natural stone cladding both sides. Three (3no.) sliding flood gates with glass top section are included to encourage connectivity between both sides of the wall.

4.3.51 A single telecommunications pole at the corner of Barrow Lane and The Quay will be demolished and the cables undergrounded. This will be completed as part of the streetscaping works.

4.3.52 Surface water drainage works are proposed along the Quays. These are shown on Drawing No. W3451-AYE-DWG-W-1432.

4.3.53 Outfalls that could potentially provide a pathway for floodwater behind flood defence will have non-return valves fitted. This can be seen on Drawings W3451-AYE-DWG-W-1437 to W3451-AYE-DWG-W-1440.

Landscape Design and Public Realm

4.3.54 The public realm proposals are included drawing number 1579_305 and 1579_307 in Appendix 4-2 The proposals for Graiguenamanagh Quay are combined with those proposed for The Boat Club in the Public Realm Proposals.

4.3.55 A series of public realm improvements are proposed along The Quay, cognisant of its function as providing access for both vehicles and pedestrians. The vehicular route will be altered to a one-way system, with wider footpaths proposed for easier and safer pedestrian movement and permeability. Footpaths, of granite paving, are proposed both

sides of the road, with three pedestrian crossings proposed at the location of the sliding gates. Along the footpath proposed on the water side of The Quay, several resin-bound granite areas are proposed for public seating and landscaping.

4.3.56 Various types of surfaces, materials, furniture and lighting are proposed to add visual interest and functionality. These have been selected appropriate to the historical quayside setting. A granite paving area is proposed to provide a café terrace to the Waterside Guesthouse, whilst still maintaining pedestrian movement.

4.3.57 Vehicular access to both the Supervalu carpark and the Waterside Guesthouse (RPS C149) carpark are to remain. Mooring and boat access will be available along the length of The Quay.

Area 7 – The Dock

4.3.58 The works at Area 7 – The Dock include the construction of flood defence walls from Graiguenamanagh Bridge to The Hub Bridge. Stormwater drainage is proposed along with a stormwater pumping station and a new outfall to the River Duiske.

4.3.59 The proposed flood defence works are outlined on Drawing No. W3451-AYE-DWG-W-1414 to W3451-AYE-DWG-W-1416. Photomontage reference PM05 included under Appendix 4-3 illustrate the flood defence and public realm proposals planned in Area 7.

4.3.60 Site clearance work will consist of removal of vegetation and demolition of existing walls. The existing wall attached to the bridge will remain, but the ruined building immediately closest the bridge will be demolished to allow a new outfall to be constructed whilst avoiding the existing foul sewer.



Figure 4-10: Existing streetscape in The Dock (resurfaced since photo taken)

4.3.61 The proposed flood defence wall will be built along the left bank of the River Barrow and will follow the already existing natural line of the edge of the carriageway.

4.3.62 A pumping station will be built near the turning circle to facilitate pumping of stormwater in times of flood. A new stormwater outfall will be constructed downstream of the

dilapidated building near the entrance to The Hub, into the River Duiske. The northern section of the building will be demolished to accommodate the new outfall. The southern section will remain.

4.3.63 Outfalls that could potentially provide a pathway for floodwater behind flood defence will have non-return valves fitted. This can be seen on Drawings W3451-AYE-DWG-W-1437 to W3451-AYE-DWG-W-1440.

Landscape Design and Public Realm

4.3.64 The public realm proposals are included drawing number 1579_304 in Appendix 4-2. The proposals for The Dock are combined with those proposed for Turf Market and The Hub in the Public Realm Proposals.

4.3.65 For The Dock, pedestrian and cyclist access is to be provided to The Hub from the east (i.e., Graiguenamanagh Town). Vehicular access is provided, however for emergency cases only. The main vehicular access to The Hub will be from the western side of the development.

4.3.66 Landscaping (tree planting) is proposed along The Dock.

Area 8 – The Hub

4.3.67 The works at Area 8 – The Hub entail the construction of a flood defence wall along the bank of the River Duiske, wrapping around an Uisce Éireann (UÉ) Wastewater Pumping Station. The wall will form into an earthen embankment within The Hub ground and tie back into high ground to the north-east of the Hub building. Stormwater drainage is proposed along with a small pumping station and a new outfall to the River Duiske.

4.3.68 The proposed flood defence works are outlined on Drawings W3451-AYE-DWG-W-1414 to W3451-AYE-DWG-W-1416. Photomontage reference PM07 included under Appendix 4-3 illustrate the flood defence and public realm proposals planned in Area 8.

4.3.69 The proposed flood defence have been designed in co-ordination with Uisce Eireann who are also proposing to upgrade the station for stormwater holding. This development may proceed before or after the GTFRS.

4.3.70 Site clearance will include the removal of an existing container, removal of mature trees, removal of topsoil and exiting pathways and roads.



Figure 4-11: Uisce Éireann Wastewater Pumping Station and The Hub Campervan site

4.3.71 A 42 m long flood defence wall will be constructed on sheet piles to a maximum height of 1.6 m above ground level. The wall will be clad with natural stone on both sides, with a rounded capping.

4.3.72 The wall will form into an earthen embankment, 62 m in length to where there is space in The Hub grounds so it will blend with the surroundings better. The embankment will have side slopes of 1V:2.5H and will be grass seeded. The ground to the south-west of the embankment will be graded to soften the transition to the embankment and to provide ease of passage over the embankment for pedestrians.

4.3.73 Pathways will be provided to connect the existing connections routes coming from the town centre to the Hub and to the path to the north of the Hub. Pitches/sites for Campervans will be amended to suit the new grade, including electrical equipment.

4.3.74 Stormwater drainage to take local runoff and run-off from Peg Washingtons Lane will be installed and a new outfall immediately west of the Uisce Éireann Pump station. Ground levels locally will be adjusted to suit the new stormwater arrangement.

4.3.75 Outfalls that could potentially provide a pathway for floodwater behind flood defence will have non-return valves fitted. This can be seen on Drawings W3451-AYE-DWG-W-1437 to W3451-AYE-DWG-W-1440.

Landscape Design and Public Realm

4.3.76 The public realm proposals are included drawing number 1579_304 and 1579_309 in Appendix 4-2. The proposals for The Hub are combined with those proposed for Turf Market and The Dock in the Public Realm Proposals.

4.3.77 For The Hub, formal and informal pathways are to be provided throughout the area, linking the area to the town, and residential area to the west. These will also provide linkage to the South Leinster Way/Brandon Hill.

4.3.78 The main vehicular access to The Hub will be from the west, through the Brandondale area. Only emergency vehicular access will be permitted from the east (The Dock).

Area 9 – Hotel Street

4.3.79 The works at Area 9 – Hotel St. include the construction of a flood defence embankment and wall along the south-eastern boundary of the agricultural field, set-back from the left bank of the River Barrow. The works include an access ramp to maintain access and stormwater drainage and pumping station to serve Tinnahinch.

4.3.80 The proposed flood defence works are outlined on Drawings W3451-AYE-DWG-W-1404 to W3451-AYE-DWG-W-1406. Photomontage reference PM13 included under Appendix 4-3 illustrate the flood defence and public realm proposals planned in Area 9.

4.3.81 Site clearance will include the removal of low levels of vegetation and mature trees. An existing fence will be removed, and any drains encountered will be redirected to a new stormwater drainage network. An existing pile of historic masonry and stone will need to be removed/relocated to facilitate the embankment.



Figure 4-12: Agricultural setting of works area parallel to Hotel Street.



Figure 4-13: Wetland areas in left to centre middle ground to be retained. Historic masonry in piles in right middle ground.

4.3.82 The embankment will be circa 240 m long with a maximum height of 1.25 m above ground level. The embankment will have side slopes of 1V:2.5H and will be grass seeded.

4.3.83 At the north-eastern extent, there is insufficient space for an embankment and there is a small wetland/marshy area that is desirable to be conserved. A new wall and access ramp is proposed at this location. The wall is 38 m long and will be circa 1.5 m high. The wall will be finished in concrete.

4.3.84 A lift-and-swing flood gate will be incorporated into the flood wall to maintain access.

4.3.85 A new pumping station and outfall will be constructed to discharge to the River Barrow immediately upstream of Graiguenamanagh Bridge.

4.3.86 Outfalls that could potentially provide a pathway for floodwater behind flood defence will have non-return valves fitted. This can be seen on Drawings W3451-AYE-DWG-W-1437 to W3451-AYE-DWG-W-1440.

Landscape Design and Public Realm

4.3.87 The public realm proposals are included drawing number 1579_310 in Appendix 4-2.

4.3.88 Improved and safer pedestrian and cycle movement is proposed on the bridge, with surface markings established to alter drivers that the surface will be shared an that pedestrian movement should be prioritised.

4.3.89 Trees and ornamental planting will be introduced at the entrance to the amenity pathway, both for visual and biodiversity benefit.

4.3.90 An enhanced pedestrian crossing shall be established at the Tinnahinch side of the bridge, with connection to the footpath proposed along Tinnahinch Quay.

Area 10 – Tinnahinch Quay

Flood Defences

4.3.91 The works at Area 10 – Tinnahinch Quay include the construction of a flood defence wall from Graiguenamanagh Bridge to Tinnahinch Car Park at the mill channel. The defence consists of a flood wall, hinged flood gates along the quays to maintain access. Local changes to the stormwater network are also proposed.

4.3.92 The proposed flood defence works are outlined on Drawings W3451-AYE-DWG-W-1407 to W3451-AYE-DWG-W-1408. Photomontage reference PM11 and PM12 included under Appendix 4-3 illustrate the flood defence and public realm proposals planned in Area 10.

4.3.93 Site clearance will include the removal of made surfaces along the tow path and carpark, and the existing flood defence gates. The existing wall will be retained.

4.3.94 The proposed flood defence wall will consist of a new reinforced concrete wall 130 m long. The majority of the wall will range from 0.36m high near the mill channel to 1.1m high along the Quay.

4.3.95 There are 2no. hinged flood gates to be constructed in the existing openings in the existing wall to maintain access to the quay. The walls will be modified locally to facilitate installation of the gates. One new larger hinged flood gate will be placed across the tow path, but its default position will be open.

4.3.96 Outfalls that could potentially provide a pathway for floodwater behind flood defence will have non-return valves fitted. This can be seen on Drawings W3451-AYE-DWG-W-1437 to W3451-AYE-DWG-W-1440.

Landscape Design and Public Realm

4.3.97 The public realm proposals are included drawing number 1579_311 in Appendix 4-2.

4.3.98 Improved and safer pedestrian movement is proposed from the bridge and new pedestrian crossing (see previous section).

4.3.99 The existing car park downstream of the bridge is to be retained with surface markings established to alter drivers that the surface will be shared an that pedestrian movement should be prioritised. Vehicular access to the Lockhouse and Tinnahinch Castle will be retained by a flood gate in a fixed open position.

4.3.100 The amenity pathway along The Quay will form part of the regional hiking trail, The Barrow Way.

Design Considerations

Design Standard

4.3.101 The flood relief design caters for the 1% Annual Exceedance Probability (AEP) fluvial flood event (also known as the 1 in 100-year fluvial flood event).

Freeboard

4.3.102 Freeboard is an allowance in the design height of flood defence walls and embankments to account for uncertainties in the scheme design in the areas of hydrology (flow estimation and probability) and hydraulic modelling (roughness of the river channel, afflux through bridges, etc.). A scheme specific freeboard assessment was completed, and it was found that a nominal freeboard of 350 mm would be provided, increasing to 550 mm for embankments to allow for settlement. This is marginally above the typical OPW standards for constructing flood defence schemes in Ireland.

Resilience of the Proposed Scheme to Climate Change

4.3.103 In the design of any flood relief scheme (FRS), it is important that flood mitigation measures are considered in the context of a long-term strategy which is flexible and adaptive to changes in climate and their potential impact on flood risk.

4.3.104 The recommended allowance for potential mid-range future climate change for fluvial flooding is a 20% increase in flood flow magnitude regardless of the return period. This is the general guidance adopted for both Ireland (OPW) and the UK (DEFRA 2006, EA 2011).

4.3.105 To allow for future climate change adaptability, the flood defences (flood defence walls, upstream storage and embankment) have been designed to facilitate future amendments (increases) in their heights without imposing a significant impact on environmental and landscape features. The upstream storage has been specifically chosen for factors such as climate change and adaptation having a lower impact socially and environmentally than the other alternatives considered.

Land Requirements

4.3.106 A schedule of lands to be acquired will need to be developed for each property to include land ownership arrangements both during and after the works are completed. In some cases, it is anticipated that lands will be acquired for the construction and returned to the original owner on completion. A GIS based schedule of landowners has been developed for the Project.

4.3.107 The lands required to construct the proposed development are in the ownership of KCC, CCC and other landowners. The lands not in the ownership of KCC and CCC will be acquired pursuant to the following legislation:

- Form of Compulsory Purchase Order under Section 76 of, and the Third Schedule to, the housing Act, 1966, as extended by Section 10 of the Local Government (No.2) Act, 1960 and amended by the Planning and Development Act, 2000, as amended.
- Local Government (No.2) Act, 1960.
- Section 10 of the Local Government Ireland Act, 1898, as amended by Section 213 of the Planning and Development Act, 2000, as amended, as applied by Section 93 of the Water Services Act, 2007.

4.3.108 The Compulsory Purchase Order (CPO) includes, under the CPO Schedule, the extent of the following:

- Lands to be acquired (purchased),
- Permanent wayleaves,
- Permanent rights of ways,
- Temporary wayleaves.

4.3.109 Wayleaves will be needed at some locations in order to facilitate the construction of the works.

Consent Requirements

4.3.110 This section provides an overview of the relevant consents, licences, authorisations and permits that will be required in addition to the consent for the proposed development from An Bord Pleanála (Refer to Section 1.3 of Chapter 1 'Introduction' for further information on the planning process).

4.3.111 Section 50 consent from the Office of Public Works (in accordance with the Arterial Drainage Act 1945 and 1995 and The European Communities (Assessment and Management of Flood Risks) Regulations 2010 and 2015) will be required to modify the proposed pedestrian bridges on the River Duiske. Section 50 may also be required to install the debris trap at Well Lane.

4.3.112 Archaeological licences will also be required to undertake works proximate to cultural heritage sites. These include Section 14, Section 26, Section 2 and Section 3. Further details of the requirements for these are outlined in Chapter 9 'Cultural Heritage'.

4.4 Construction Details

Preparatory and Enabling Works

4.4.1 Preparatory and enabling works might include the following works, depending on the result of the Site Investigation:

- Additional Site Investigations
- Archaeological Services Contract
- Utilities Diversion / Power Supply (ESB works)
- Site Clearance

Additional Site Investigations and Surveys

4.4.2 A detailed site investigation has been completed under planning ref. ABP-3100996-21. Further site investigations are expected to be required to confirm results and infill gaps in information.

4.4.3 At the time of preliminary design, it was not possible to undertake site investigations at all desired locations. It will therefore be necessary to complete some minor investigations at some locations to confirm assumptions made in the planning design.

4.4.4 It is assumed that site investigations could take place in any location within the red boundary line.

4.4.5 The following types of investigation will be required:

Table 4-3: Typical Site Investigations to be completed post planning

Site Investigation Measure	Typical Locations
Exploratory Trial Pits	Embankment at Hotel Street
Exploratory Inspection Pits	Instream at Peg Washingtons Lane Turf Market Bridge
Slit Trenches	The Dock, Quays and Tinnahinch
Boreholes	TBC

4.4.6 Whilst the precise location is not known, the nature of the site investigations envisaged and outlined above is less impactful that the works previously undertaken under grant of approval from An Bord Pleanála (310/S310996).

Archaeological Services Contract

4.4.7 There is significant archaeological and cultural heritage density within the footprint of the works as described in Chapter 9 'Cultural Heritage'. In order to reduce risk , some of the archaeological mitigations/resolution proposed in the mitigation proposed in Chapter 9 may be advanced before a main works contract is commenced. This may include additional geophysical surveys and archaeological excavations/testing.

Utilities Diversions

4.4.8 The works are in built up areas which are serviced by known utilities such as water, storm foul, storm drains, electricity, and telecom etc. It is possible that unknown utilities will be impacted by the works. The Contractor will liaise with the relevant bodies to ensure disruption is minimal. However, utility diversions are known to be required in just a few of the working areas. It is possible that a short-term disruption to some services may occur when the diversions are taking place. However, it is not considered that these disruptions will result in significant negative impacts on customers. All utility diversions will be carried out in consultation with relevant utility organisation. The Contractor will be required to submit diversion proposals to relevant utility organisation for their approval prior to works being carried out.

4.4.9 Table 4-4 below lists the expected utility diversion and Drawing No. W3451-AYE-DWG-W-1427 to W3451-AYE-DWG-W-1429 shows these locations.

Table 4-4: Table of Utility Diversions at each Works Area

Area No.	Description	Utility Diversion Requirements
Area 1	Storage Area	Diversion of ESB poles around proposed flood storage area New Electrical Supply to power monitoring devices/provide task lighting.
Area 2	Well Lane to High Street Bridge	-
Area 3	Turf Market	-
Area 4	Turf Market to The Hub	-
Area 5	Boat Club	Non-return valve of foul sewer crossing flood defence line.
Area 6	Graiguenamanagh Quay	Removal undergrounding of telecommunications cables at corner of Barrow Lane and The Quay. Diversion of foul rising main from pumping station to dry side of wall.
Area 7	The Dock	Build over existing foul sewer clashing with wall alignment in localised point. Diversion of underground ESB clashing with wall alignment.
Area 8	The Hub	Diversion of private electrical supplies at Campervan pitches
Area 9	Hotel Street	Potentially an existing underground fuel tank at site of pumping station. SI to confirm.
Area 10	Tinnahinch Quay	-

Site Clearance

4.4.10 Once the works begin, the main initial task will be site clearance. This will entail the following:

- Establishment of site access
- Establishment of compounds
- Demolition of existing structures
- Clearance of brush, scrub and trees identified for felling.

4.4.11 There will be a number of trees and vegetation which will require removal to facilitate the works throughout the flood relief scheme area. The trees to be removed are shown in Drawing No. W3451-AYE-DWG-W-1426, and further details of these trees (species, quality

category, ecological characteristics) are included in the Arboriculture Report (Appendix 10-11).

4.4.12 All vegetation clearance and site preparatory works will be conducted outside of the bird nesting season (1 March to 31 August inclusive) where possible. However, in the event that vegetation clearance works and/ or site preparatory works are required during the bird nesting season, these will only occur once an advance breeding bird survey has been carried out and the area proposed for clearance has been approved by a suitably qualified and experienced ecologist.

4.4.13 Where possible, tree roots will not be pulled from the riverbank. Silt controls will be put in place in the River Duiske to minimise silt generation into the river channel and banks will be stabilised. Similar measures are not required for the Barrow given the proposed works are offset from the banks on the River Barrow.

Construction Site Layout

Site Compounds

4.4.14 Site Compounds (SCs) will be needed to facilitate execution of the works. It is envisaged that a main compound would serve as a base, where the key staff involved in administrative duties would work together on both the client and contractor side. Additionally, local compounds nearer to the works areas are also envisaged, which would accommodate welfare facilities and allow for storage of the materials and plant needed to construct the works.

4.4.15 The following table outlines the anticipated compounds for each area. The locations of the compounds (A-F) are shown graphically in drawing W3451-AYE-DWG-W-1402 in Appendix 4-1.

Table 4-5: Site Compounds

Area No.	Area Description (Compound No.)	Work Area/Compound Details	Offices	Welfare	Plant & Materials
-	Main Compound (A)	Main location for offices onsite. All ER and Contractor staff co-located.	Yes	Yes	-
1	Storage Area (B)	A large compound within the lands to be purchased to facilitate storage of materials such as bulk material for embankment construction and reinforcement for structural concrete works. Access from R703.	No	Yes	Yes

Area No.	Area Description (Compound No.)	Work Area/Compound Details	Offices	Welfare	Plant & Materials
2	Well Lane to High Street Bridge (C)	Use current vacant site at High Street as mini-compound to provide access and storage of materials for works at Clapper Bridge. Avoid need to cross Clapper Bridge. Working space at Well Lane to facilitate access upstream of Clapper Bridge.	No	Yes	Yes
3	Turf market	No - working space only.	No	Area 2	Area 2
4	Turf Market to The Hub	No - working space only.	No	Area 7/ Area 2	Area 7/ Area 2
5	Boat Club (D) (E)	Greenfield site (currently used for summertime camping) at the boat club. A small parcel of the land east of the boat club.	No No	Yes No	Yes Yes
6	Graiguenamanagh Quay	No -working space only.	No	No	No
7	The Dock	No -working space only.	No	Area 2	Area 7
8	The Hub	No -working space only.	No	No	Yes
9	Hotel Street (F)	Compound within the greenfield within to allow storage of bulk material for embankment construction and reinforcement for structural concrete works at Tinnahinch. Access from R703.	No	No	Yes
10	Tinnahinch Quay	No -working space only.	No	Main Compound	Area 7

4.4.16 The following additional enabling works, associated with site clearance, will typically be required at each of the SCs and the WAs:

- Undertake vegetation removal and stripping of topsoil as required in relevant working areas, site compounds and material laydown areas.
- Install vehicle set down and material storage areas (typically by laying down hardcore to a depth of approximately 200 mm) in relevant working areas.
- Install the main construction compounds to accommodate site offices and welfare facilities for construction activities.

Construction Compound Site Drainage

4.4.17 Drainage within the construction compounds will be designed in such a manner so as to minimise the risk of contamination of the surrounding soil, surface water and groundwater. Rainwater run-off from the contractor's compounds will be controlled via a temporary surface water control system comprising measures such as swales (ditches) and settlement ponds (or similar system) which will minimise the risk of pollution to soil, surface water or groundwater. The temporary surface water control system will be subject to a visual inspection as well as routine maintenance.

4.4.18 The inspection frequency will be increased during periods of exceptional high rainfall. Written procedures will be maintained, and a log recorded for the inspections.

4.4.19 The contractor facilities will contain toilets, canteen, construction containers and a site office. A grease trap will also be installed at the canteen. The disposal of sanitary effluent during construction will be via tankers if connection to the public foul sewer is not available.

4.4.20 Chapter 8 'Hydrology-Surface Water' and the Construction Environmental Management Plan (CEMP) (Appendix 4-4 of this EIAR) provides further detail to how surface water is to be managed on site, to mitigate against any detrimental water quality effects within the River Barrow and Duiske.

Construction Access

4.4.21 Access to the works areas will be gained from the dry (land) side of the Barrow and Duiske channels to minimise impact on the watercourses. In some locations however, due to the constricted works area or access issues, temporary access via residential/ commercial properties (where space allows) will be required to facilitate the construction of the works adjacent to the river channel. Thus, these works will be carried out in the dry.

4.4.22 Access routes are public roads and entryways within the site boundary shown in Drawing No. W3451-AYE-DWG-W-1402.

4.4.23 Accommodation works for landowners may take place outside these areas with their agreement. Traffic management setups will be required outside these areas on the approaches to the works areas. In general, the public will be excluded from entering these areas during the construction period for the reasons of health and safety, however, it is acknowledged that some works will be located within Graiguenamanagh Boat Club, the Dock and the Hub , where vehicular and pedestrian access will be maintained to the

commercial and residential properties and therefore construction access to these properties will be need to be discussed and agreed with residents prior to construction works commencing.

4.4.24 It is noted that many linear defences will be require the temporary removal of boundary walls and fences to facilitate construction access (generally parallel with both watercourses). These boundary walls/ fences will be reinstated on completion in agreement with the landowners.

Management of Materials and Plant

4.4.25 All plant and machinery will use the site and compounds as previously identified. In construction areas where no compounds are available, material will not be stored on-site but rather brought as needed to accommodate the work anticipated during a given shift.

4.4.26 Given the tight spaces for works, such as downstream at High Street Bridge, it is anticipated that material may need to be delivered to the site from public roads using mobile cranes/wheeled excavators, as access via turf market will not be suitable.

4.4.27 In such restricted areas, the use of plant will be limited to the size/nature of plant that can access an area.

Construction Traffic

4.4.28 The construction phase of the Proposed Scheme will result in an increase of the number of Heavy Goods Vehicles (HGVs) and Light Goods Vehicles (LGVs) within the towns of G-T. However, it is anticipated that the required traffic management (lane restrictions and closures) will have a more significant impact on traffic than the addition of construction traffic.

4.4.29 Whilst there are numerous potential Works Packages, it is possible that many of these could be ongoing simultaneously and so this section sets out a worst-case scenario of all traffic assessed at one large site.

4.4.30 Estimates of the number of movements for HGV/LGV have been made accounting for the volumes of material proposed to be used in the construction of the scheme. Volumes were estimated based on:

- Typical heights, lengths and widths of walls and embankments
- Lengths of drainage
- Areas of paving and cladding to walls

4.4.31 Additionally, an estimate of the staff and service vehicles to construct the works in included, based on professional judgement including the following assumptions:

- Staff parking will be provided in a limited capacity on-site. It is expected that the majority of staff parking will be at the main site compound and staff will walk to site or use shared construction site transport.

- No more than 50 persons are expected in any of the work areas at any one time.

4.4.32 Deliveries will occur throughout the day, particularly where bulk import of material is required, such as at the storage area. An estimated 12,800m^3 of material is required to construct the storage embankment and assuming a 3 month import window, this equates to an average of 18 movements per day assuming a 10m^3 load. Access to this site is via the regional R703 road.

- Deliveries of concrete, stone, cladding and reinforcing will be scheduled such that HGVs can maneuverer within the urban areas. Concrete will be delivered directly to the site, whilst stone is likely to be stockpiled and brought in by dumpers as needed. A similar approach will apply to paving and cladding which would be delivered to compound and transferred to various works locations as needed by teleporter. An estimated 758 movements are expected over a 3-year period.

- Sheet piles and reinforcing will be delivered to the main site compound and also to works areas where there is sufficient space. Both will be delivered by HGV. An estimated 222 movements are expected to facilitate construction over a 3-year period.

4.4.33 There will be ongoing construction traffic throughout the day between works areas and compounds. It is estimated that circa 3,300m^3 of spoil will be excavated during the course of the works. This equates to 10 movements per day on average across the site, but the majority of these movements will be concentrated in the upstream storage area.

- Average daily movements have been increased by 50% to allow for peaking.

Table 4-6: Peak Traffic Generation (two-way) During Construction

Details	Light Goods Vehicles		Heavy Goods Vehicles			Total	
	Staff	**Service**	**Deliveries**	**Excavation**	**Service**	Vehicles	PCUs
Daily	10 LGV	10 LGV	33 HGV	10 HGV	4 HGV	67	114
Peak (2hrs) (AM /PM)	4 LGV	4 LGV	13 HGV	4 HGV	2 HGV	26	43

PCU=Passenger car units, LGV=Light Goods Vehicles, HGV= Heavy Goods Vehicles.

4.4.34 Traffic will be confined to the WAs, with exception of works at bridges and adjacent to access to residential and commercial properties. However, as outlined in the section below, some road closures are necessary to facilitate construction. Alternative access routes will be agreed with KCC, CCC and An Garda Siochana to minimise impacts as much as possible.

4.4.35 Every effort will be made to carry out the works as quickly as possible in order to minimise impacts on residents in the area. It is envisaged that traffic measures such as a stop-go system, temporary one-way traffic systems or similar will be implemented to allow the

construction works and utility diversions to be constructed and at the same time to manage traffic etc. Traffic movement to and from the site will be planned to ensure they are managed efficiently and in accordance with Health and Safety Requirements. In addition, any impacts on the local environment including local residents, road users and pedestrians will be minimised.

4.4.36 A detailed Construction Traffic Management Plan will be prepared and agreed with KCC and CCC by the Main Contractor in advance of any works taking place on site. Further detail of the measures to be included within the Traffic Management Plan is available in Table 4-7 and Chapter 7 'Material Assets'.

Road Closure Requirements

4.4.37 Road or public way closures can be expected at the following locations.

Table 4-7: Public Road/Access Closures

Area No.	Area Description (Compound No.)	Details of Public Access/Road Closures	Length of Closure to a) vehicles and b) pedestrians
Area 1	Storage Area	Not applicable	Not applicable
Area 2	Well Lane to High Street Bridge	Well Lane	a) 3 months b) 3 months
Area 3	Turf Market	n/a	n/a
Area 4	Turf Market to The Hub	The Dock	a) 3 months b) 0
Area 5	Boat Club	Access road to Boat Club	a) 3 months b) 0
Area 6	Graiguenamanagh Quay	The Quay	a) 6 months b) 0
Area 7	The Dock	The Dock	a) 3 months b) 0
Area 8	The Hub	n/a	n/a
Area 9	Hotel Street	n/a	n/a
Area 10	Tinnahinch Quay	Tinnahinch Quay Waterway Ireland Access Road	a) 3 months b) 0

4.4.38 Details on impacts as a result of road closures have been outlined in Chapter 7 'Material Assets'.

Parking Closure Requirements

4.4.39 Details of anticipated parking closures and durations are included below.

Table 4-8: Parking Space Closures

Area No.	Area Description (Compound No.)	Details of Parking Closures	Length of Closure
Area 1	Storage Area	Not applicable.	
Area 2	Well Lane to High Street Bridge	Not applicable.	
Area 3	Turf Market	Not applicable.	

Area No.	Area Description (Compound No.)	Details of Parking Closures	Length of Closure
Area 4	Turf Market to The Hub	Loss of all informal parking at The Dock.	3 months
Area 5	Boat Club	Loss of all parking whilst access is closed off.	3 months
Area 6	Graiguenamanagh Quay	Loss of all parking during works. Loss of all parking except for 2no. spaces for Proposed Scheme.	6 months Indefinitely
Area 7	The Dock	Loss of all informal parking.	3 months
Area 8	The Hub	Loss of pitches and parking for duration of works.	4 months
Area 9	Hotel Street	Not applicable	
Area 10	Tinnahinch Quay	Loss of all parking nearest quay for duration of works.	3 months

Hoarding

4.4.40 Where possible, a site boundary in the form of hoarding or fencing or similar where appropriate (approximately 2.4 m height), will be established around working areas before any significant construction activity commences.

4.4.41 Construction site hoarding is used to provide a secure site boundary to what can be a dangerous environment for people who have not received the proper training and are unfamiliar with construction operations.

4.4.42 Hoarding works will be of the same nature as that carried out for similar operations at most construction sites. Site hoarding also performs an important function in relation to minimising some of the potential environmental impacts associated with construction, namely:

- Noise;
- Visual impacts; and
- Dust minimisation

4.4.43 Excavation for mounting posts for hoarding will be carried out by a mini-digger, and the posts will be set in concrete.

Site Lighting

4.4.44 Temporary construction lighting will generally be provided by tower mounted 1000W metal halide floodlights, which will be angled downwards to minimise spillage of light from the site. These will be powered by mains supplies in general. Lighting will be provided

on the exterior of hoarding for walkways for public safety where required. Specific lighting requirements which are close to residential properties will be discussed with the residents in advance.

4.5 Detailed Construction Methodology

4.5.1 This section describes the construction activities and sequencing for the Proposed Scheme and outline mitigation measures which have been incorporated into the design, and which will be implemented during the construction phase to ensure the potential impacts of the construction activities on the environment are avoided, prevented and/or reduced.

Instream Works

4.5.2 Instream works are anticipated at the locations listed in Table 4-9 below. Descriptions and examples of the types of works are provided below.

4.5.3 The following standard instream practices/methodologies will be applied to all instream works:

- River diversion will be put in place where needed.
- Methods favouring 'no-dig' solutions have been selected where suitable.

4.5.4 In-stream temporary access platforms will be built where necessary. These shall be lined with terram such that original bed is unaffected and can be reinstated in orderly fashion.

Table 4-9: Instream Works Locations & Descriptions

Area No.	Area Description (Compound No.)	Instream Works
Area 1	Storage Area	Temporary River Diversion Flow Control Structure Flume for Flow Monitoring Temporary River Crossing(s) (culvert stream)
Area 2	Well Lane to High Street Bridge	Debris Trap Wall Improvements at The Globe Temporary Access (culvert stream)
Area 3	Turf Market	Wall construction Bridge replacement Temporary Access (culvert stream)
Area 4	Turf Market to The Hub	Wall construction Temporary Access/crossing (culvert stream)
Area 5	Boat Club	NRV on Outfall Outfall Headwalls

Area No.	Area Description (Compound No.)	Instream Works
Area 6	Graiguenamanagh Quay	NRV on Outfalls
Area 7	The Dock	NRV on Outfalls New outfall from Pumping Station
Area 8	The Hub	Outfall Headwalls New Outfall from Pumping Station
Area 9	Hotel Street	Outfall Headwalls New outfall from Pumping Station
Area 10	Tinnahinch Quay	NRV on Outfalls

Temporary River Diversion

4.5.5 In order to build instream online structures, the River Duiske will need to be temporarily diverted. This will entail constructing a new channel around the works area. The channels will be lined or hydroseeded to reduce sediments entering the watercourse.



Figure 4-14: Example River diversion (on right) with access crossing to allow structure construction in watercourse (left) (Source: https://www.wardandburke.com/project/river-feagle-clonakilty-certified-drainage-scheme/)

Flow Control Structures

4.5.6 The structures will be built inline on the River Duiske. They involve the excavation of the bed of the watercourse to lay concrete structures to control flows. All work will be executed in the dry following a river diversion/ damming.



Figure 4-15: Example storage area with flow control structure in flood conditions (Source: https://www.wardandburke.com/project/river-feagle-clonakilty-certified-drainage-scheme/)

Temporary River Crossing

4.5.7 In order to obtain access to both banks of a watercourse, it will be necessary to provide a temporary access through the river. The river will be culverted for the duration of the works and reinstated afterwards. The temporary culvert will be designed in a manner as not to impede the passage of fish along the river. The typical process would be to lay a terram layer on the riverbed, place pipework, and then backfill with suitable granular material, over which a temporary road is constructed.



Figure 4-16: Example temporary river crossing
(Source: https://www.austieca.com.au/documents/item/319)

Debris Trap

4.5.8 The structure consists of columns constructed instream at a location where they will catch debris for removal by those maintaining the scheme. To construct the columns, the riverbed must be excavated, and the columns inserted.



Figure 4-17: Example Column Debris Trap
(Source:https://www.facebook.com/iominfrastructure/photos/pcb.3489431467799559/3489431287799577/?type=3&theater)

Wall construction/Improvements

4.5.9 There are typically concrete, or sheet piled structure, sometimes with a cladding such as timber, stone or concrete to finish. They can be built on traditional soil bearing foundations or placed on piles.



Figure 4-18: Example wall construction including stone facing.



Figure 4-19: Example Wall Construction/Improvements (relevant to Turf Market and at The Globe)

Bridge replacement

4.5.10 A bridge replacement entails a new bridge to provide flood protection and often include a reinforced parapet wall to contain flood flows. Bridge abutments need to be constructed within the channel in order to secure the bridge.



Figure 4-20: Example Bridge replacement/modifications

NRVs on Outfall

4.5.11 Non-return valves (NRVs) are placed on existing and proposed outfalls to ensure flood water do not back-up and surcharge the pipeline. They typical take the form of flap valves and in-line rubberised valves.

4.5.12 NRVs will be fitted to all outfalls below the design flood level that cannot be raised. Where downpipes at Turf Market can be raised for example, this will be the preferred methodology. NRV will be fitted to all other outfalls.

4.5.13 An underwater installation team will be required to fit NRV on the quays in Tinnahinch and Graiguenamanagh.



Figure 4-21: NRV placed on a pre-existing outfall in Graiguenamanagh.

Structures

4.5.14 Where structures are to be constructed the methodology will be as follows (noting that temporary works are not listed):

- Strip commencing surface to below the formation level where applicable.
- Place and compact blinding layers to require specification or prepare the receiving surface.
- Assemble, cast or install components such as reinforced concrete and steel and precast concrete bridges.
- Backfill works to proposed specification and reinstate surroundings.

Table 4-10: Structures – Construction Issues & Methodology

Defence No.	Description	Key Issue(s)	Methodology
C03_E002 & C03_SG001	Flow Control at Storage Area	Timing (aquatic ecology)	Divert river and construct reinforced concrete flow control structure in a dried out working area.
C03_HW001	Flume at Storage Area	Timing (aquatic ecology)	As above.
C03_B001	Pedestrian Bridge	Timing (aquatic ecology) Underwater Archaeology	For Turfmarket, pipe river and create dry works area. Use piped foundations where needed – micropiling only. Favour pre-cast solutions given short instream seasonal window.
C03_B002	Pedestrian Bridge	Timing (aquatic ecology) Underwater Archaeology	For residential access bridge, utilise existing abutments and modify existing bridge and install steel lightweight gangway to tie in at appropriate levels.

Walls

4.5.15 Walls are to be constructed at the locations in the table below. The methodology will be as follows (noting that temporary works are not listed):

- Strip commencing surface to below the formation level for foundations where applicable.
- Place and compact blinding layers to require specification.
- Assemble, cast or install wall components such as reinforced concrete, hydraulic barriers and glass walls.
- Backfill walls to proposed specification and reinstate surroundings.
- Install French drain along dry side of wall (where required).

Table 4-11: Walls – Construction Issues & Methodology

Defence No.	Description	Key Issue(s)	Methodology
C01_L002_L	Tinnahinch Quay	Access	Access will be cut-off to Barrow walkway and one private dwelling.
C01_L005_R	The Quay Wall	Archaeology	Sheet pile option proposed to avoid deep excavations in

Defence No.	Description	Key Issue(s)	Methodology
		Timing (Tourism)	archaeological rich area, although archaeological testing will still be carried out. Time piling (noisy) works outside main tourist season if possible (works in Oct-March)
C01_L002_R	Boat Club Road Wall	Archaeology Timing (Tourism)	-
C01_L002_R	The Hub Road Wall	Timing (Tourism)	-
C01_L003_L	The Dock	Landowner Interference Timing (aquatic ecology)	Works proximal to historic building. Sheet piling proposed, but vibration monitoring recommended.
C03_L003_L C03_L002_R	Turf Market	Landowner Interference Timing (aquatic ecology)	Works very close to (under) existing building. Landowner access also an issue. Micropiling proposed as cut-off for seepage needed. Use of small plant for excavations. Instream works from dry working area
C03_L006_L	Mass Path	Timing (aquatic ecology) Archaeology	-

Embankments

4.5.16 Embankments are to be constructed at the locations in the table below. The methodology will be as follows (noting that temporary works are not listed):

- Strip topsoil from existing ground below the footprint of the embankment.
- Place and compact earth fill in layers to require specification.
- Place erosion control matting on embankment and tie into anchor detail.
- Place topsoil on embankment and hydroseed.
- Install french drain along dry side of embankments (where required).

Table 4-12: Embankments – Construction Issues & Methodology

Defence No.	Description	Key Issue(s)	Methodology
C03_E001_R	The Hub	Timing and impact on operational activities at Hub Archaeology	-
C01_E002_L	Hotel Street	Archaeology	Risk of incoming drainage pipes. Allow for picking up same.
C01_E004_R	Boat Club	Archaeology	-
C03_E002	Storage Area	-	Establish access from R705 and bring access road and ducting to site. Divert Stream as per Section 4.5.

Drainage (Pumping Stations & Pipework)

4.5.17 Drainage works, pumping stations and some works to existing sewers are anticipated. The methodology will be as follows (noting that temporary works are not listed):

- Establish traffic managements as needed.
- Excavate open trenches/pits as needed, noting need for archaeological mitigation.
- Construct the works to required specification.
- Reinstate original surface or complete public realm works as necessary.

Table 4-13: Drainage – Construction Issues & Methodology

Defence No.	Description	Key Issue(s)	Methodology
C03_SW001_R C03_PP001_R	The Hub	Archaeology	-
C01_PP002_L	Tinnahinch Quay Pipework	Utility Crossings	Works minimise during design to localised manhole works only.
C01_PS002_L	Tinnahinch Pumping Station	Underground Tank	Open excavation, Archaeological monitoring. RC in-situ structure and associated Mechanical & Electrical equipment.
C01_SW001_R	The Dock Pipework	Archaeology	Open excavation, Archaeological monitoring.

Defence No.	Description	Key Issue(s)	Methodology
C01_PS001_R	The Dock Pumping Station	Archaeology	Open excavation, Archaeological monitoring. RC in-situ structure and associated Mechanical & Electrical equipment.

Flood Gates & Barriers

4.5.18 Flood gates will be installed in numerous locations where level access to the quays is needed. A hinged lift and swing gate will be used on the Dock and in Tinnahinch, whilst lift and slide gates will be used on Graiguenamanagh Quay. The default position for the hinged gates will be closed (but not set) where possible (The Dock and the Tinnahinch Quay in Winter). In Summer, the gates at Tinnahinch will be set open as default.

4.5.19 The sliding gates at Graiguenamanagh Quay will remain open as the default position.

4.5.20 All gates will be fixed to reinforced concrete walls/pillars.

Table 4-14: Flood Gates & Barriers – Construction Issues & Methodology

Defence No.	Description	Default Position	Key Issue(s)
C01_FG001_L	Flood Gate – Tinnahinch Tow Path		-
C01_FG003_L to C01_FG011_L	Flood Gates – Tinnahinch Quay	Open (Summer) Closed (Winter)	Conservation.
C01_SL001_R C01_SL002_R C01_SL003_R	Sliding Flood Gates– The Quay	Open	Integration with landscape and UÉ assets
C01_FG012_L	Flood Gate – The Quay/Boat Club Access	Open	-
C01_FG014_L	Flood Gate – Boat Club	Closed	-
C01_FG_002_L to C01_FG012_L	Hinged Flood Gate – The Dock	Closed	Conservation and integration into existing quay walls.
C01_FG007_L	Flood Gate – Hotel Street	Open	-

Defence No.	Description	Default Position	Key Issue(s)
	embankment/Barrow Way		

Land Raising

4.5.21 Land raising is proposed where access must be maintained whilst cutting off flood routes. Land-raising will typically consist of:

- Stripping the existing surface to firm ground.
- Placement of impermeable material and a new surface finish to the design heights.
- Installation of any barriers needed following the change in levels.

Table 4-15: Land Raising – Construction Issues & Methodology

Defence No.	Description	Key Issue(s)	Methodology
C03_R001_R to C03_R003_R	The Hub	-	-
C01_R002_R	Boat Club Car park	-	-
C01_R003_L	Hotel Street	Archaeology	Carry out archaeological test trenching in advance of developing a methodology for land raising.
C03_R004_L	Mass Path	Archaeology	Ensure no works in river. Complete after wall works.

4.6 Construction Stage Risks

4.6.1 The following is a list of construction stage risks with proposed mitigations.

Table 4-16: Mitigation measure for construction stage risk

Risk	Mitigation
Flood Risk Risks (See Section 4.6.2 and 4.6.3).	
Restricted Access into a tight working spaces/corridor for construction plant	Use of small plant needs to be highlighted.
The unknown nature of building foundations at Peg's Lane and Turf Market in particular and the potential de-stabilisation is a risk	Targeted SI in these areas and works are proposed <500mm from observable wall face. Use of driven piles is discounted, but augers/drill piles may be needed where cut-off

Risk	Mitigation
	for seepage is an issue. Vibration/crack monitoring to be considered.
Risk to damage of UÉ sewer line/private services due to plant in the River Duiske	Provide adequate protection of services for plant. Complete outfall survey prior to construction
Build over or near to UÉ sewers/manholes agreements may be needed at Quay, Tinnahinch, Turf Market and at Mass Path.	Engage with Uisce Éireann and obtain agreement.
Landowner access will have to be maintained for residential owners' access at Turf Market and Hotel Street.	Engage with property owners to establish any particular requirements and discuss access options.
Access is desirable from Well Lane to downstream of clapper bridge.	A methodology to traverse over the bridge will need to be agreed with Inland Fisheries Ireland (IFI) and National Monuments Service (NMS). Alternative access route has been allowed for from High Street

Flood Risks During Construction

4.6.2 A common risk where channel works are proposed relates to management of flooding during construction. Working platforms/haul roads will be required in the River Duiske channel some locations. Plant/materials pose a constriction to the channel during a flood event. These risks are limited to the in-stream working season and will not be year-round.

4.6.3 A common residual risk on the Duiske is blockage of the channel due to debris, either from the construction site or other sources. Management of material not already incorporate into the works from a waste and flood perspective will be addressed in the CEMP.

4.7 Programme, Phasing and Sequencing

Programme

4.7.1 Construction works are expected to commence in 2028, and the proposed construction period is an estimated 36-42 months. The construction period has been estimated to allow for poor weather over the winter months, mobilisation between sites and seasonal ecological restrictions. The estimated period for individual locations is presented in Table 4-17 below.

4.7.2 The co-ordination of people and materials on site will be one of the key activities throughout the construction phase. To ensure that construction workers do not create undue disruption, there will be a requirement that the Contractor provides adequate site supervision to co-ordinate, monitor and implement site regulations. Normal construction working hours will be observed. These are 08:00 – 19:00 Monday to Friday; 09:00 – 16:00 on Saturday. It may be necessary in exceptional circumstances to undertake certain types of activities outside of normal construction core working hours. Heavy or noisy construction

activities will be avoided outside normal hours and the amount of work outside normal hours will be strictly controlled. Approval from KCC and CCC will be obtained for works outside normal hours. The planning of such works will have regard to nearby sensitive receptors.

4.7.3 It is envisaged that the average number of construction personnel on site will be circa 50 personnel, but this will vary depending on the construction activities required, seasonal constraints and will likely peak during the summer months when up to 100 construction personnel are envisaged.

4.7.4 In-channel works will be limited to the summer works season as agreed with Inland Fisheries Ireland (IFI). It is expected that up to 2 instream seasons will be required.

Phasing & Sequencing

4.7.5 When constructing flood relief schemes, it is preferable to construct them from upstream to downstream as this minimises the likelihood of increasing flood risk during construction.

4.7.6 Initial Works Packages (WPs), broken down by overarching areas, that should be delivered in the sequence shown are outline in Table 4-17 below. This sequence will ensure there is no increase in flood risk whilst works are ongoing. Commencing works with the upstream storage area has the greatest benefit in case of a flood during construction. WP4A and WP4B can occur simultaneous from upstream to downstream as per the area numbers.

Table 4-17: Works Packages

Works Package No.	Works Package Duration	Works Package Description	Area No.	Site Compound to be Used
WP1	3months	Site set-up, enabling works and early landowner accommodation works.	-	Main Compound (A)
WP2	18 months	Construction of the storage areas to include power supply, access roads, embankment, flow control structure, spillway and associated works.	Area 1	Storage Area (B)
WP3	12 months	Construction of all flood defence walls on the Duiske River, replacement of 2no. Bridges, reinstatement of footpaths and private land and associated works.	Area 2 Area 3 Area 4	Well Lane to High Street Bridge (C)
WP4A	18 months	Construction of all flood defence walls on the River Barrow right bank, including drainage and pumping stations, utility diversions,	Area 5 Area 6 Area 7	Boat Club (D)

Works Package No.	Works Package Duration	Works Package Description	Area No.	Site Compound to be Used
		public realm works, flood barriers, glass wall, boardwalk, public lighting, seating, trees and planters and associated works.	Area 8	
WP4B	18 months	Construction of all flood defence walls and embankments on the River Barrow left bank, including drainage and pumping stations, utility diversions, reinstatement of roads and associated works.	Area 9 Area 10	Hotel Street (E)

Sequencing

4.7.7 The above outlines the various works packages. It is desirable to complete the upstream storage areas on the Duiske prior to commencing works downstream to reduce the risk of flooding in the town as quickly as possible and to reduce flood risk during the works in urban areas on the Duiske.

- WP1 – Site Establishment will take 3 months and can begin immediately.
- WP2 – Upstream Storage Area can commence immediately after WP1, taking 18 months.
- WP3 – Duiske Works can commence after WP2, taking 18 months.
- WP4a can commence after WP1 and will be slotted into the programme to best suit resources. It is anticipated to take 18 months.
- WP4b can commence after WP1 and will be slotted into the programme to best suit resources. It is anticipated to take 18 months.

4.7.8 A programme float for 12 months is also allowed (to assist with inclement weather and any seasonal constraints which might alter start dates of work packages).

4.7.9 An indicative programme is shown below which include a 12-month detailed design period post planning. A 3-year handover period is allowed for, but the scheme would be operation at the end of Stage (iv).

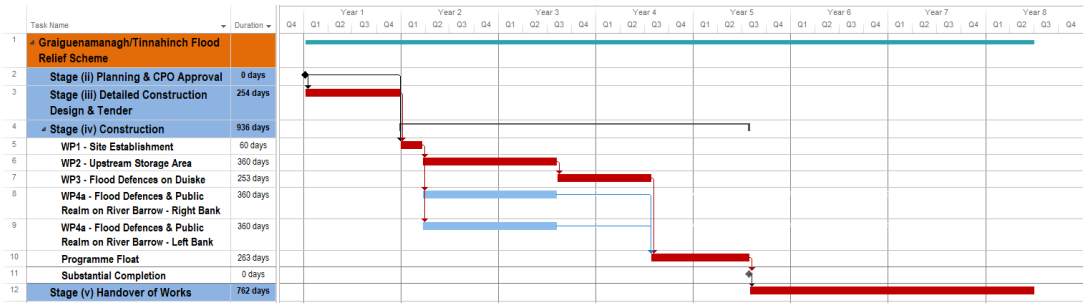


Figure 4-22: Proposed Timeline for works

4.8 Long-term Operations and Maintenance

4.8.1 KCC will be responsible for the maintenance of the scheme within their boundaries, as well as within the boundaries of CCC.

4.8.2 Long-term maintenance will be required to maintain the scheme in good order and ensure it is operational to its design standard.

- Riverbank vegetation will need to be trimmed so that it does not lie within the design flood level.
- Debris trap will be inspected, and debris removed as needed
- Stormwater drains will need to be inspected and cleaned as required.
- Stormwater pumping stations will be inspected and maintained to ensure they remain in proper working order.
- Non-return valves will be inspected and maintained to ensure they remain in proper working order.

4.8.3 In addition, regular inspection of the following scheme elements will be carried out:

- Flood gates and barriers.
- Flood defence wall, including glass panels.
- Flood defence embankments.
- Flow control structure.
- Mechanical & Electrical requirements
- Public Realm elements (e.g., lighting, seating, tree planting).

4.8.4 Further detail on the anticipated maintenance of specific scheme elements is outlined below.

Defence Walls (incl. glass walls and flood gates)

4.8.5 Defence walls of reinforced concrete or metal construction require little maintenance. Table 4-18 below outlined the main requirements. Cut-off under flood defence walls will be unobservable and will not form part of regular maintenance.

4.8.6 Glass walls and flood gates will be maintained as per manufacture recommendation. Table 4-18 below outlined typical maintenance requirements.

Embankments & Land Raising

4.8.7 These defence types require little maintenance to perform, but mowing is expected to be required from the perspective of preserving structural integrity and visual amenity of embankments.

Stormwater Drainage, NRVs and Pumping Stations

4.8.8 The stormwater system will have a gravity discharge, supplemented by a pumping station in the event of a fluvial flood. This has been designed to the 30-year return period. It is expected that the pumping station will be called on average less than once every 2-5 years. The pumps will be electrical and automatically kick-in when needed. All pumps will have a switch to convert to diesel generator in the event of a power outage.

4.8.9 The stormwater pumping stations will require routine and non-routine maintenance of all mechanical, electrical and control equipment. Typically, annual inspections will be carried out to ensure all equipment is functioning as intended and, that pumps are operating properly.

4.8.10 There will be no waste expected from these maintenance events. A telemetry system will monitor the pumping stations and inform operators through an alarm system of any faults such as power failure, pump failure or excess water levels. These alarms will require immediate attention. All non-return valves will require routine maintenance to ensure that any debris is removed from them and that they can operate effectively.

Debris Trap

4.8.11 Maintenance of the debris traps will typically be carried out at times of low river flow and ideally during the summer months (May-September inclusive) except in the case of emergency. The trap will be maintained using a grab arm to dislodge and remove woody debris as needed. Access will be from Well Lane.

4.8.12 Maintenance will typically be on an “as needs” basis as the quantities of gravel and floating debris will be determined by flows in the river. The volume of material to be removed at any one time is not expected to be significant. This material will be removed to a suitable recovery facility.

Riverbank Maintenance

4.8.13 Riverbank maintenance requirement for the scheme will be quite low, owing to the man-made nature of much of the riverbanks in the scheme area. It is expected that works on

the Barrow will not be needed with any level of frequency and will only be in the case of any emergencies arise.

4.8.14 Removal of branches and vegetation impacting on flood flows in the River Duiske will be carried out to maintain the conveyance capacity of the river channel. This will be carried out annually, typically in Autumn prior to the winter flood season, with particular attention place on the storage area and lower Duiske below Turf Market Bridge.

Landscape & Public Realm

4.8.15 There will be periodic inspection of paved areas, footpaths, roads, street furniture, etc. Maintenance will be provided in response to such inspections e.g. cracks in footpaths, potholes in asphalt surfaces, failure of paviours and paving slabs, etc.

Table 4-18: Likely Maintenance Activities and Frequencies

Element	Maintenance Task	Estimated Frequency
Embankments	Mowing including collection or cutting if wildflower mix is used.	Every 6 months,
Toe Drains/ Filter Drains	CCTV Survey	10 years
	Filter Drain Material Replacement	20 years
Flood Walls	Visual Inspection	Annual
	Sealants	5 years
Non-return valves	Inspection	Annual
	Replacement	25 years
Pumping Stations	Inspection & Routine Maintenance	Annual
	Replacement Parts	5 years
Storm Drainage	CCTV Survey	5 years
Flood Gates	Inspection	Annual
	Seals	5 years
Hydraulic Structures	Visual Inspection	Annual
Channel Woks	Visual Inspection	Annual
Bridges	Visual Inspection	Annual
	Bearings	5 years
Trash Screen	Clearing of debris	Quarterly or after a flood event containing debris.
Electrical Installations	Replacement	20 years
Tree Health Survey	Review health of any trees near defences	Annual
Invasive Species Survey	IAS Survey	5 years

Operational Design Intent

4.8.16 In general, the scheme will be passive in nature, although there are some elements where human input is required. Importantly, given the flashy nature of the River Duiske, there is no human input required to operate the defences.

4.8.17 On the River Barrow, there will be a need to complete the following tasks if a flood event is forecast or ongoing. The forecast is expected to come from the National Flood

Forecasting centre or Met Eireann weather warning. Given the nature of the flood hydrograph in the River Barrow there is little risk of urgent intervention being required. There is ample time to implement the following:

- Ensure flood gates on Graiguenamanagh Quay and Tinnahinch Quay are in closed, sealed position.
- Close flood gates at junction of Barrow Lane/The Quay, the Dock and Hotel Street embankment/Barrow Way are closed.

4.8.18 Other than the above, the only operation input from human will be checking that the scheme is performing as intended and monitoring the flood event. Such tasks would include:

- Monitoring the flows at the storage area to ensure it is performing as designed.
- Monitoring the Debris Trap and River Duiske for potential blockages (considered low risk)

Staffing Requirements

4.8.19 It is anticipated that a team of 2no, personnel would be able to operate the scheme. 2no. persons are recommended for safety reasons; however, it is noted that a single individual would suffice if needed.

4.8.20 In the event of a need to remove debris, a grab truck and operator would be required.

Decommissioning of Proposed Scheme

4.8.21 KCC and CCC consider GTFRS to be a key strategic asset in the protection of the scheme area. In the long term, it is not envisaged that the elements of the FRS will be decommissioned as they are necessary for the long-term protection of the settlement.

5 Consultation and Stakeholder Engagement

5.1 Introduction

5.1.1 Consultation is an ongoing part of the EIA process. The EIAR requirements for consultation are defined in the EIA Directive (85/337/EEC) as amended in 2011 Directive 2011/92/EU and 2014 Directive 2014/52/EU under Article 6.

"Article 6 (1) *Member States shall take the measures necessary to ensure that the authorities likely to be concerned by the project by reason of their specific environmental responsibilities are given an opportunity to express their opinion on the information supplied by the developer and on the request for development consent."*

5.1.2 At Project inception and on submission of the EIA Scoping Report, the Statutory Authorities referred to in Article 6 (1) were consulted on the specific characteristics of the GTFRS project, including its location, technical capacity, its likely impacts on the environment, and the planned approach to the EIAR. Also, in accordance with the requirements of the Aarhus Convention, the public, statutory authorities, and relevant stakeholders have been, and will continue to be given the opportunity to participate in the decision-making process, during planned public consultation events.

5.1.3 Further details of the stakeholder consultation undertaken for the project are included in the following sections.

5.2 Project Stakeholder Consultation Overview

5.2.1 Consultation has been carried out with the public and various stakeholders (both statutory and otherwise), the purpose of which was to engage with them, to gather local knowledge on flooding and environmental constraints, and opportunities for addressing flood risk in the area.

5.2.2 Comprehensive communication and engagement plans have been developed and adopted by the team such as a project website, direct emails, local media, and public consultation among other approaches listed in Table 5-1 below. Consultation includes the establishment of a maintained project website and regular project newsletters and is an ongoing process and will continue throughout the lifecycle of the Project. Where stakeholders have provided inputs that have implications on the project environmental constraints, these have been considered.

Table 5-1: Stakeholder Consultation methods

Communication Activity	Purpose / Correspondence
Project website	https://www.floodinfo.ie/frs/en/graiguenamanagh-tinnahinchfrs/home/. The website provides regular updates and information to stakeholders about the scheme. The website provides scheme information, scheme news and updates, a photo gallery, and resources section comprised of FAQ, glossary and contact subsections. Publicly available key project

Communication Activity	Purpose / Correspondence
	documents are provided for direct download from the project website, as they become available. The website is available as Gaeilge and in the English language. Invitation for public participation was also posted on the Kilkenny County Council website and their online consultation portal (Consult.Kilkenny.ie).
Direct Email	A dedicated project email address has been set up as the primary source of contact for all interested Parties (unless otherwise requested by a party): GTFRS@Ayesa.com.
Local authority / community publications such as parish newsletters	Items in local authority / community group newsletters are likely to reach a wide range of citizens. A newsletter is published quarterly by Ayesa to the project website. To initiate the public consultation process, c.1,000 newsletters were circulated in the local area in the vicinity of the scheme (hand delivered to all properties) in October 2020. This process was repeated in 2022 with a further c.500 delivered. Further, notices of the Public Consultation Days (PCDs) were included in the Carlow Nationalist and Kilkenny People.
Social media	Both KCC and CCC advertise any project information on their social media outlets, including Twitter and Facebook
Statutory Consultation	At the beginning of the Project, on the 7th of July 2020, project information letters were sent to 50 relevant authorities and stakeholders. The responses to these letters have been logged and further information is provided in the Public Consultation Report 01 (dated October 2020) and in its Appendix B.
Public Consultation Days / workshop	Consultation exhibitions / events offer a more extensive and open form of engagement on a personal basis. They provide opportunities for members of the public to express views on the consultation subject area, ask questions, and receive feedback on the issues they raise. **Public Consultation Day No. 1 (2020):** The first Public Consultation Day (18th June – 9th July 2020) was held online (on Consult.Kilkenny.ie) due to COVID-19 restrictions. The purpose was to promote awareness of the scheme and to begin initial engagement with all interested parties. A series of public information documentation was presented. and a questionnaire was issued via online survey for any interested parties to complete. Thirteen responses were received. The most comment comments/issues that arose are outlined in Section 3.3.3 below. **Public Consultation Day No. 2 (2022):** The second Public Consultation Day was held on 9th August 2022 in the Barrow Activities Hub in Graiguenamanagh from 2pm – 7pm. The intention of this event was to present the emerging options under review for the Flood Relief Scheme and receive public feedback. A series of public display posters were distributed around the room, presenting the project background, key sensitivities and constraints (i.e., land uses, heritage assets, environmental concerns) and the five

Communication Activity	Purpose / Correspondence
	options that were reviewed for the scheme. Staff from Ayesa and KCC were available to explain the posters and the scheme in general to those who attended. A questionnaire was provided for interested parties to complete. This was available either as a hard copy or online via the scheme website. To inform the public of the PCD No.2, flyers were distributed to all properties within the flood area, and advertisements were provided on the KCC website and social media platforms. **Public Consultation Event No. 3 (2023):** The third Public Consultation Event was held on 23rd January 2025 in The Hub, Graiguenamanagh from 2pm-7pm. The purpose of this event was to present the emerging preferred option, and to provide an opportunity for community members to discuss the scheme and provide feedback. To inform the public of PCE no. 3, flyers and posters for the PCE were placed in in Graiguenamanagh town, advertisements were placed in local and social media, and on the scheme and KCC website. Invitations were also provided to affected landowners via emails and mobile contact. During this event, a series of information posters were available for public viewing. These posters detailed the stages of the schemes, overall targeted areas, in-depth detail designs of each area, planning approach, cultural heritage and archaeology considerations, and environmental and biodiversity considerations. These posters are available of the scheme website. Staff from Ayesa, KCC and TBS were available to explain the posters and the scheme in general to those who attended.

5.3 Public Engagement

Public Consultation Event No. 1 & Stakeholder Questionnaires

5.3.1 The first Public Consultation Event (PCE) took place virtually from 18th June – 9th July 2020. The objective of the public consultation was to make stakeholders and the public aware of the project, to introduce Ayesa as consulting engineers on the project, to provide early engagement and to get feedback on the flooding, environmental and other issues of concern to them.

5.3.2 The public, stakeholders and other property owners and occupiers were invited by public notice to attend. A letter was sent on 19th June 2020 to 50 consultees in relation to the PCE (Ayesa reference no. W3394-ENV-LT-(0001-0087)). This letter gave details of the Proposed Scheme and contained information for attendance to the public consultation event. In addition to the letters issued, notices were erected on social media, as well as on the Kilkenny County Council (KCC), Carlow County Council (CCC) website, local radio and local newspapers.

5.3.3 The online event included a recorded presentation, an information leaflet and an online questionnaire. Information was available to be downloaded and returned by post. A project email address was also provided. The questionnaire was issued via online survey

for any interested parties to complete. The initial questions 1-4 sought personal contact details. Questions 5-17 sought views on various topics. 13no. responses to the questionnaire were received, 6no. of which were submitted via the online platform, and 7no. which were returned manually via post. Other submissions included:

- 1no. response via the Kilkenny consult.ie website
- 4no. submissions from Stakeholders that received letters
- 5no. submissions from people via the project email address
- 1no. further submission via post.

5.3.4 The most common issues that arose during the first Public Consultation held 18th June – 9th July 2020 were (ByrneLooby, 2020):

- Concerns that hard defence walls may "destroy the character of the town and its heritage" and individual defences for properties prone to flooding may be a better option.
- Local people affected by flooding feel they have been ignored in the past and want to be kept informed and have their own input in the flood relief scheme.
- Locals stated there are insufficient storm drains in the area, contributing to the River Duiske and the River Barrow bursting their banks. The River Duiske has storm drains directly discharging into it from a number of houses located alongside its banks.
- Residents of the area requested the possibility of some temporary measures being put in place during the intervening years till the flood relief scheme is complete.

Public Consultation Event No. 2 & Stakeholder Questionnaires

5.3.5 The second Public Consultation Day was held on 9th August 2022 (end of response period was 30th August 2022) between 2pm and 7pm, with the intention of presenting the emerging options for the flood relief scheme and receive public feedback on these.

5.3.6 All interested parties were targeted for invitation, with a focus on residents, landowners, and business owners. This included properties owners who both have and have not been flooded in the past, and non-residents who may have concern for the area. The week ahead of the event, flyers were distributed by hand within the community, particularly targeting locations within the flood risk zone of Graiguenamanagh and Tinnahinch, with details of the upcoming public consultation event. Circa 500 flyers were disturbed within the scheme area. A notice of the PCD was included in the Carlow Nationalist (22nd July 2022) and Kilkenny People (29th July 2022) and, on 3rd August 2022, KCC and CCC published the event details on their social media platforms. Elected members in both Counties were contacted via email on 2nd August 2022 to provide invitation to view the public display material at the PCD event between 12 and 2pm (ahead of the public). A total of 36 attendees were recorded as having attended the event.

5.3.7 During the event, information posters were displayed around the room detailing the background, objectives and nature of the GTFRS, the project-level assessments/reviews already undertaken (hydraulics, hydrology, environmental, heritage & landscape), and five options for providing flood mitigation in the towns. Representatives from the project team (Ayesa, KCC and OPW) were available in the room to provide explanation of the posters, answer any queries and listen to the views of those attending

5.3.8 Questionnaires were made available in hard copy and through an online survey format, to either be filled in on the day or at the individual's convenience. Stamped and addressed envelopes were provided to those who received a hard copy questionnaire. The questionnaire sought to gain an understanding of the individual's experience with flooding, their main concerns with the Scheme, and their preference of flood defence options presented to them. Individuals were given a three-week period to return all questionnaires to the project team (i.e., to 30th August 2022). Questions 1-6 sought to gather information on the individual's relationship to the area, if they were aware of the scheme and/or attended the public consultation in 2020 and specific details of any previous flooding to their property/properties. Questions 7-12 gave opportunity for the individual to state their main interest in the scheme, any ideas and/or concerns, and to comment on the options for flood defence in Graiguenamanagh -Tinnahinch. Details were also sought should the responder wish to partake in further consultation.

5.3.9 The most common comments that arose during this event were (ByrneLooby, 2022):

- Concerns that raised defence walls would reduce the visual amenity, impede views and alter the aesthetics of the town.
- Upstream storage solutions were generally preferred, given that they contributed to a reduction in raised defences required in the towns.
- Residents felt that regular dredging and clearing of obstacles in the River Duiske would reduce flood concern.
- Residents felt that one-way valves and pumping stations would protect housing and businesses on Main Street.
- Residents felt that current levels of flood preparation and maintenance does not provide reassurance to those at risk.

5.3.10 Further discussion on this feedback and how it was considered in the decision-making process for the preferred emerging scheme is outlined in Chapter 3 'Previous Studies, Alternative and Options'.

Public Consultation Event No. 3 & Stakeholder Questionnaires

5.3.11 The third public consultation event was held on the 23rd of January 2025 between 2pm and 7pm in The Hub in Graiguenamanagh. The purpose of the third consultation was to present the preferred option – Option 3 Raised Defences and Storage Area.

5.3.12 Local Councillors, landowners, and interested parties were invited to the event. The event was advertised by Ayesa and KCC. Flyers and posters were displayed in Graiguenamanagh Town's commercial businesses, and an advert was published in the Kilkenny People Newsletter. The event was also advertised across KCC's social media. Landowners impacted by the scheme were contacted directly with information and details of the event. Event display material was uploaded onto the Graiguenamanagh-Tinnahinch Flood Relief Scheme Website and the Kilkenny Online Consultation Portal prior to the event.

5.3.13 Informative posters were displayed around the room detailing the stages of the schemes, overall targeted areas, in-depth detail designs of each area, planning approach, cultural heritage and archaeology, and environmental and biodiversity. Draft Photomontages and Public Realm Drawings were included in the display. Representatives of the project team were available to provide explanation of the posters, answer queries and listen to views and opinions.

5.3.14 An attendance form was provided to document the persons attending and to record any questions raised to allow the project team to respond make consideration of the matters raised when finalising the scheme. An attendance of 27 was recorded at this event. Not all attendees chose to record their presence and observation.

5.3.15 General comments made during the event include (Ayesa, 2025):

- Queries on maintenance of new ground surfaces along the Quays and the Dock.
- Discussions on whether further flood gates can be installed at Boat Club to allow view of the Barrow from inside the Club.
- Concerns whether the one-way system on Graiguenamanagh Quay will allow sufficient turning circle for trailers.
- Whether Nature-based Solutions and tree pits can be implemented into the scheme.
- Concerns if surface drainage, water quality and fish migration will be negatively impacted by the scheme.
- Residents raised if there is any forward planning on disruption of the works for the Scheme.

5.4 Statutory and Non-Statutory Consultation

Initial Consultation

5.4.1 At the beginning of the Project, a stakeholder engagement letter was sent to 78 statutory and non-statutory consultees including public stakeholders on 7th July 2020 (Ayesa reference no W3394-ENV-LT-(001-078)). This letter sought preliminary views on the Proposed Scheme as well as information or environmental data with regards to the scheme area and its surrounding environs. Included in this letter was a PDF drawing of the extent of the scheme area. The letters were issued to the following:

Table 5-2: Statutory Stakeholder Consultees

Stakeholder	Response Received (Y/N)*
An Bord Pleanala	N
An Chomhairle Ealaíon	N
Angling Council Ireland	N
An Taisce - The National Trust for Ireland	N
Badgerwatch	N
Bat Conservation Ireland	N
Birdwatch Ireland	N
Bord Iascaigh Mhara	N
Bord Na Móna	N
Botanical Society of Britain and Ireland	N
Chambers of Commerce	N
Coíllte	N
Commission for Regulation of Utilities	N
Córas Iompair Éireann	N
County Councils (Carlow & Kilkenny)	
Department of Agriculture, Food and Marine	**Y**
Department of Housing, Local Government and Heritage	**Y**
Department of Climate, Energy & Environment	N
Department of Transport	N
Department of Tourism, Culture, Arts, Gaeltacht, Sport and Media	N
Eastern & Midlands Climate Action Regional Office	N
Eircom / Eir	N
Electricity Supply Board	N
Environmental Protection Agency	N
Environmental Science Association of Ireland	N
Failte Ireland, Environment & Planning	N
FISSTA - Federation of Irish Salmon & Sea Trout Anglers, Eastern River Basin District and South-Eastern River Basin District	N
Forest Service	N
Gas Networks Ireland	N
Geographical Society of Ireland	N
Geological Survey of Ireland	N
Health and Safety Authority	**Y**
Heritage Council	N
Inland Fisheries Ireland	N
Institute of Geologists of Ireland	N
Irish Environmental Network	N
Irish Farmers Association (Dublin Region)	**Y**
Irish Heritage Trust	N
Irish Landmark Trust	N
Irish Peatland Conservation Council	N
Irish Planning Institute	N
Uisce Éireann	**Y**
Irish Wildlife Trust	N
Kilkenny An Taisce	N
Kilkenny Archaeological Society	N
Landscape Forum Ireland (Landscape Alliance Ireland)	N
Local Authority Waters Programme	N
National Federation of Group Water Schemes	N
National Monuments Service	**Y**

Stakeholder	Response Received (Y/N)*
National Parks & Wildlife Service	N
Marine Institute	N
National Transport Authority	N
Native Woodland Trust	N
Office of Public Works	N
River Trust	N
Scouting Ireland	N
Southern Regional Assembly	N
Sports Ireland Outdoors (trails office)	N
Sustainable Water Network Ireland (SWAN)	N
Teagasc	N
The Inland Waterways of Ireland	N
The National Water Forum	N
The Irish Meteorological Service	N
Transport Infrastructure Ireland	N
Voice of Irish Concern for the Environment	N
Waterways Ireland	N
Water Policy Advisory Committee	N
Waste Policy & Resource Efficiency.	N
Wildlife Surveys	N
A number of local stakeholders who may be affected by the works, including: • Residential associations. • Tidy Towns groups. • Parklands. • Sporting centres and facilities. • Action groups. • Fishing groups. • Community councils.	Some responded.
*Refers to a formal consultation response advising comments/no objections on the Scheme. Some of these parties did respond with confirmation of receipt, or with automated receipt emails, but this has not been recorded as they do not constitute a formal consultation response. Y = Yes. N = No.	

EIA Scoping Consultation

5.4.2 Statutory consultees were issued an email from Ayesa, on KCC's behalf, on 30th May 2023, including a link to the EIA Scoping Report and an invitation to provide any comment in relation to the scope and level of information to be included in the EIAR as part of an informal scoping process. Consultees were asked to respond by 23rd June 2023, giving sufficient time to ensure clarity and consistency of the consultation, and ensure that all consultees had the opportunity to participate.

5.4.3 The list of statutory consultees who were consulted on the Scoping Report includes:

- Department of Housing, Local Government and Heritage c/o the Development Applications Unit.
- Department of Housing, Local Government and Heritage c/o The National Monuments Service.

- Department of Housing, Local Government and Heritage c/o National Parks and Wildlife Service.
- Department of Climate, Energy & Environment
- Department of Public Expenditure, NDP Delivery and Reform.
- Department of Transport.
- Department of Tourism, Culture, Arts, Gaeltacht, Sport and Media.
- Department of Agriculture, Food and the Marine.
- Environment Protection Agency.
- Transport Infrastructure Ireland.
- Southern Regional Assembly.
- Fáilte Ireland.
- An Taisce.
- The Heritage Council.
- Inland Fisheries Ireland.
- Uisce Éireann.
- Waterways Ireland.
- Graiguenamanagh Rowing Club.
- Graiguenamanagh Boat Club.
- River Trust.
- Landscape Alliance Ireland.
- Local Authorities Water Programme (LAWPRO).
- Sustainable Water Network Ireland (SWAN).
- Teagasc.
- The National Water Forum (An Forám Uisce).
- Water Policy Advisory Committee.
- Eastern & Midlands Climate Action Regional Office.
- Kilkenny County Council (various departments including Heritage Officer, Planning & LEO Office).
- Carlow County Council (various departments including Heritage Officer, Planning & LEO Office).
- Carlow-Kilkenny Environmental Health Service.
- Office of Public Works.

5.4.4 Separately, The KCC Planning Department conducted their own engagement with stakeholders via the medium of the EIA Scoping Report. A response period of 4 weeks was provided. Besides those already listed in Section 5.4.3, additional statutory consultees included:

- The Minister for Communications, Marine and Natural Resources.
- An Bord Pleanála.
- Health and Safety Authority.
- Department of Environment, Climate and Communications – Mineral Exploration and Mining Section.
- Geological Survey Ireland.
- Bord Failte.
- Health Service Executive.

- The Arts Council.

5.4.5 All responses and observations are summarised in Table 5-3 including information as to how these were responded to and incorporated into the EIAR. Original versions of letters and emails received are included in Appendix 5-1.

Table 5-3: Responses to Project-Level Stakeholder Consultation

Organisation	Date	Stage	Type	Summary of Feedback / Observations	How/where this is addressed in this EIAR
The Health and Safety Authority	03/07/2020	Initial consultation	Letter	Based on the information supplied, the Authority has no specific observations to make at this time.	Not required.
Department of Housing, Local Government, and Heritage	26/08/2020	Initial consultation	Letter	The authority recommends that the services of a suitably qualified and experienced underwater archaeologist be engaged to act as Project Archaeologist (PA) for the Proposed Scheme. The PA should be integral to advising on tender documents for the engagement of Consultant Archaeologists either directly by the Council/OPW or the main works contractor and any sub-contractors that may need to be engaged.	The following are appointed in relation to cultural heritage and conservation: • Archaeological Management Solutions (AMS) (Project Archaeologist to OPW). • Courtney Deery (Consultant Archaeologist to Ayesa). • ADCO (Contract Archaeologists appointed by Ayesa). • Chris Southgate (Conservation Engineer). All have provided significant technical expertise to this EIAR and the review of the Proposed Scheme options.
Uisce Éireann	07/09/2020	Initial consultation	Letter	The authority advises that they have assets within the study area. Key comments are: • Requested for continued engagement. • Any proposed works within close proximity to Uisce Éireann assets should be assessed to ensure no impact. • Any impacts caused by potential increase or decrease to the level of overburden on assets, as well as the impact of any increase in river levels on stormwater overflows, WWTP outfalls, etc needs to be taken into consideration. • Any diversion of existing water services shall be submitted to Uisce Éireann.	Ongoing engagement is occurring, and KCC are liaising with Uisce Éireann via their respective consultants on matters relating to drainage along Graiguenamanagh Quay and potential impacts on Uisce Éireann assets. Survey data from the FRS has been shared with Uisce Éireann consultants and geotechnical data provided by Uisce Éireann to the design team. Both Uisce Éireann and KCC have liaised during the scheme development and have co-

Organisation	Date	Stage	Type	Summary of Feedback / Observations	How/where this is addressed in this EIAR
	29/06/2023	EIA Scoping	Letter	• Uisce Éireann should be consulted further to ensure there is no detriment to the performance of their assets and that interface issues are managed appropriately. • All necessary measures to protect and maintain access to Uisce Éireann infrastructure and water sources shall be undertaken and incorporated into the design. • Any potential impact on the contributing catchment of water sources either in terms of water abstraction for the development or the potential of the development to influence/ present a risk to the quality of the water abstracted by Uisce Éireann should be considered. • Any temporary connection throughout the construction phase is subject to agreement with Uisce Éireann. Additional observations were made on the Proposed Scheme at the EIA Scoping phase, including: • A request that the Quay Wastewater Pumping Station is retained and protected. • A request to ensure protection to key infrastructure such as Wastewater Pumping Stations and ESB cabinets. • A requirement that road drainage is considered by i.e. storm pumps to cater for river flood level. • Request that the potential impacts to Uisce Éireann assets as result of flood level rise should be considered as well as identifying proposed mitigation measures. • Uisce Éireann accessing the Quay Wastewater Pumping Station post FRS needs to be considered. • Where the development proposal has the potential to impact Drinking Water Source(s), the applicant shall provide details of measures to be taken to ensure that there will be no negative impact during the	ordinated the detail of project within The Hub areas to allow Uisce Éireann progress with an upgrade of the foul pumping station serving Graiguenamanagh. This includes adjustment to the alignments of defence at the Hub and redesign of the FRS storm drains to make way for a potential future Uisce Éireann storm holding tank. Chapter 7 'Material Assets' identifies where any impact to Uisce Éireann assets are identified.

Organisation	Date	Stage	Type	Summary of Feedback / Observations	How/where this is addressed in this EIAR
				construction and operational phases of the development. • Where the development proposes the backfilling of materials, the applicant is required to include a waste sampling strategy to ensure the material is inert. • Potential impacts on the nearby reservoir as public water supply water source(s) should be assessed, including any impact on hydrogeology and any groundwater/ surface water interactions. • Impacts of the development on the capacity of water services is confirmed by Uisce Éireann in the form of a Confirmation of Feasibility (COF). Pre-Connection Enquiry (PCE) enquiry to be issue where a connection is required. • The applicant shall identify any upgrading of water services infrastructure that would be required to accommodate the proposed development. • The potential impact of surface water discharges to combined sewer networks should be identified and mitigation advised. • Requirement to determine the location of public water services assets, possible connection points and any drinking water abstraction catchments to ensure these are included and fully assessed in any pre-planning proposals. • Any potential impacts on the assimilative capacity of receiving waters in relation to Uisce Éireann discharge outfalls including changes in dispersion / circulation characterises. Hydrological / hydrogeological pathways between the applicant's site and receiving waters should be identified within the report. • Where a development proposes to connect to an Uisce Éireann network and that network either abstracts	

Organisation	Date	Stage	Type	Summary of Feedback / Observations	How/where this is addressed in this EIAR
				water from or discharges wastewater to a "protected"/ sensitive area, consideration as to whether the integrity of the site / conservation objectives of the site would be compromised should be identified within the report.	
Office of Public Works	07/09/2020	Initial consultation	Letter	Based on the information supplied, the Authority has no specific observation to make at this time.	Not required.
Department of Agriculture, Food and the Marine	07/09/2020	Initial consultation	Letter	Comments received outline the licencing process for afforestation and tree felling. A high-level outline of the environmental process was also provided.	Licensing requirements will be fulfilled should afforestation and tree felling be required. This has been outlined as a mitigation item for biodiversity in Chapter 10 'Biodiversity' and Chapter 18 'Summary of Residual Effects and Schedule of Environmental Commitments' and the CEMP.
	25/07/2023	EIA Scoping	Email	Response received from the Environmental Coordination Unit advising that the activity does not fall within the remit of the EIA Regulations under DAFM and therefore, once relevant environmental and planning regulations are met, DAFM has no comment at this stage of the consultation process. However, any hedgerow removal on agricultural land needs to consider the requirement of the EIA (Agriculture) Regulations.	
Department of Housing, Local Government and Heritage c/o the National Parks and Wildlife Service (NPWS)	27/06/2023	EIA Scoping	Email	Response advises that several of the specialist ecological survey methods vary from accepted good practise and take place outside of the optimal survey period and do not meet the required number of survey visits. Further surveys following guidance (email references NRA 2009 Guidance for Ecological Surveying Techniques and NRA 2005 Guidelines for the Treatment of Bats) should be undertaken. If further surveys are not to be carried out, justification is needed.	Additional surveys were undertaken in 2024 to ensure a robust understanding of the ecological sensitivities. These followed the guidelines as outlined by NPWS. Full details is provided in Chapter 10 'Biodiversity'.
Department of Climate, Energy	23/06/2023	EIA Scoping	Email	Response advises that their planning department only provides observations in relation to County Development Plans, Local Area Plans and Strategic Environmental Assessments. They do not provide observations on	Not required.

Organisation	Date	Stage	Type	Summary of Feedback / Observations	How/where this is addressed in this EIAR
and Environment				individual projects and would therefore not be submitting a formal response.	
Department of Tourism, Culture, Arts, Gaeltacht, Sport and Media	02/06/2023	EIA Scoping	Email	Response advises that following the transfer of the Heritage function to the Department of Housing, Local Government and Heritage the Minister is no longer a statutory consultee under planning law. Therefore, a formal response won't be provided.	Not required.
Transport Infrastructure Ireland (TII)	July 2023	EIA Scoping	Letter	In a summary, the responses requests that the developer have regard to the following: • Consultations should be had with the relevant Local Authority/National Roads Design Office. • TII would have concerns to potential significant impacts the development would have on the national road network (and junctions). • The developer should assess visual impacts from existing national roads. • The developer should have regard to any EIA and all conditions/modifications imposed by ABP. • The developer, in conducting EIA, should have regard to TII Publications (i.e., Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes', 'Guidelines for the Treatment of Noise and Vibration in National Road Schemes'). • Where new structures may be proposed on national roads, the developer is reminded of the requirements of the TII Standard: 'Technical Acceptance of Road Structures on Motorways and Other National Roads'. • The developer should also be aware that there are Technical Acceptance requirements relating to the assessment, alteration, modification, strengthening	Due regard has been paid to TII's Environmental Assessment and Construction Guidelines, including the Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (National Roads Authority, 2006) and 'Guidelines for the Treatment of Noise and Vibration in National Road Schemes'). See Chapter 13 'Air Quality' and 15 'Noise and Vibration'. Other similar guidelines have been referred to in the preparation of other EIAR Chapters. Identification of haulage routes and a review of impacts upon local traffic conditions and national roads is included in Chapter 7 'Material Assets', with mitigation recommendations set out. The most notable being the requirement for a site-specific and construction phase Traffic Management Plan, which will need to include a full review of planned traffic calming / diversions etc., along with mitigation to reduce impact, in

Organisation	Date	Stage	Type	Summary of Feedback / Observations	How/where this is addressed in this EIAR
				and repair of all existing road structures (national roads) and same shall be agreed with the Bridge Management Section of TII. • A hydraulic analysis should be undertaken to identify the impact of proposed works on the hydraulic capacity of any TII Structures. • An assessment of scour and other hydraulic actions on national road structures in accordance with UK BD 97/12 should be undertaken where necessary. • It would be important that, where appropriate, a Traffic and Transport Assessment (TTA) be carried out in accordance with relevant guidelines, TII's 'Traffic and Transport Assessment Guidelines' (2014) should be referred to. • The designers are asked to consult TII Publications to determine whether a Road Safety Audit is required. • The EIAR should identify the methods/techniques proposed for any works traversing/in proximity to the national road network. • In relation to haul route identification, the applicant/developer should clearly identify haul routes proposed and fully assess the network to be traversed.	accordance with local guidelines and legislation. TII will be consulted with here.
Carlow-Kilkenny Environmental Health Service	28/07/2023	EIA Scoping	Letter	• A set of standard legislation and guidelines on EIA preparation are cited, and it is requested that the EIAR comply with these. • An outline of what the EIAR should do is prescribed, including the requirement to describe the baseline environment, review the nature and scale of impact, assess the significance of impact, suggest mitigation, and review residual impacts. • There is recommendation that the public are consulted specifically on the public health aspects of the scheme by asking questions (i.e.,) 'what are the	The EIAR has followed all guidelines and methodologies as recommended in this response letter and is prepared in accordance with both national and international best practise methodologies for environmental impact assessment. Respective chapters of the EIAR (i.e., Chapter 6, 8, 13 & 14) have addressed potential opportunities to promote public health as part of their mitigation recommendations

Organisation	Date	Stage	Type	Summary of Feedback / Observations	How/where this is addressed in this EIAR
				potential health benefits/challenges from the scheme' and 'what opportunities can the scheme deliver for health gain'. • There is recommendation that the EIAR assesses the potential opportunities to protect and promote public health. • The response highlights to potential negative impact on the recreational quality of the area during the construction phase. Measures are required to minimise this impact and its period. • Recommendation that opportunities are identified to enhance potential health gain (i.e., enhanced recreational value through cycling/rowing/kayaking). • Recommendation that the EIAR assess the potential effect on the pedestrian and cycling network, the wastewater infrastructure, the water supply infrastructure and waste management. • Recommendation for the inclusion of a CEMP to address mitigation for waste generation during construction, risks to groundwater, dust control, emissions reduction, noise generation, vibration). • Recommendation that the potential for dust generation be included in the assessment of air quality impact. A list of dust suppression measures is provided, with a request that these are included in the CEMP. • Recommendation that the issue of climate change/breakdown is addressed from the two angles of Mitigation and Adaptation. • Recommendation that the EIAR assess a wider range of threats that make people and places vulnerable to climate breakdown (i.e., Floods, dry spells/heat, windstorms). Measures to mitigate vulnerability should	sections. Chapter 6 'Population and Human Health' has outlined measures to enhance potential health gain. Chapter 6 'Population and Human Health' has addressed methods by which the negative impact to recreational quality of the area during construction can be minimised. Chapter 7 'Material Assets' has addressed impact to the pedestrian and cycling network, the wastewater infrastructure, the water supply infrastructure and waste management. A Construction Environmental Management Plan (CEMP) is prepared as an accompanying document to the EIAR (Appendix 4-5), with specific mitigation prescribed for waste generation during construction, risks to groundwater, dust control, emissions reduction, noise generation, vibration. The issue of climate change has been addressed in Chapter 14 'Climate' from two angles: mitigation and adaptation. This chapter also addresses a wider range of threats that make people and places vulnerable to climate breakdown. Measures to mitigate vulnerability are included. Construction hours have been recommended in the CEMP and avoid unsociable hours.

Organisation	Date	Stage	Type	Summary of Feedback / Observations	How/where this is addressed in this EIAR
				be included as should opportunities to deliver health gain. • Recommendation that construction hours are limited as much as possible, in relation to noise nuisance. • Recommendation that the Sendai Framework for Disaster Risk Reduction of 2015 is incorporated into the assessment of disaster risk. • Recommendation that the EIAR include details of the location of all site office, construction compound, fuel storage depot, sanitary accommodation and canteen, First Aid facilities, disposal of wastewater and the provision of a potable water supply to the site canteen.	The Sendai Framework for Disaster Risk Reduction of 2015 has been incorporated into Ireland's National Adaption Framework which underlines this EIAR, as detailed in Chapter 2 'Planning and Policy'. Whilst the Sendai Framework outlines priorities for action, there is no detailed methodology to undertake the risk assessment. Therefore, "A Framework For Major Emergency Management" by the Government of Ireland was deemed to be the most appropriate guidance for assessing disaster risk. Chapter 4 'Description of Proposed Scheme and Construction Methodology' has details on the location of construction compounds. All supporting infrastructure (i.e., site offices, fuel storage depots, sanitary accommodation and canteens) will be located in one or multiple of these as appropriate and as required by the future appointed contractor. The CEMP will include requirements for the provision of potable water supply, ablution facilities, first aid and controls for waste management and fuel storage.

5.5 References

Ayesa, 2025. *Public Consultation Report 03, Summary Report, Report no. W3451-W-R017,* s.l.: s.n.

ByrneLooby, 2020. *Public Consultation Report 01, Report no. W3451-W-PCD02,* s.l.: s.n.

ByrneLooby, 2022. *Public Consultation Report 02, Summary Report, Report no. W3451-PCD-03,* s.l.: s.n.

European Union, 1985. *EIA Directive (85/337/EEC) as amended in 2011 Directive 2011/92/EU and 2014 Directive 2014/52/EU under Article 6.,* s.l.: s.n.

The United Nations Economic Commission for Europe (UNECE), 1998. *UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention),* s.l.: s.n.

6 Population and Human Health

6.1 Scope of the Assessment

6.1.1 This chapter describes the likely impacts of the construction and operation of the Proposed Scheme upon the demographic profile, land use, housing, socio-economic activity, recreation, amenities and tourism.

6.1.2 The following aspects have been considered relevant to the population and human health assessment:

- Design:
    - The proximity, location and design elements of the flood defences and how these may cause impact to population subsets, amenity areas, housing, recreational areas and tourism features.
- Construction:
    - The impact of the construction works upon population subsets with regards to human safety.
    - The impact of the construction works upon population subsets with regards to human health.
    - The impact of the construction phase upon the amenity access of the River Barrow and River Duiske and surrounding recreational/leisure facilities.
    - The impact of the construction phase upon the normal operation of businesses and commercial properties.
    - The impact of the construction phase upon tourism assets.
- Operation and Maintenance:
    - The operational impact of the scheme on both population and human health based on the potential effects of the constructed flood defences, public realm works and the benefits of much reduced flood event frequency and magnitude.
    - The impact of the operational phase upon the amenity access of the River Barrow and River Duiske and surrounding recreational/leisure facilities.

6.1.3 The primary effect of the Proposed Scheme on population and human health is one of a positive nature, given the intrinsic purpose of reducing flood risk for vulnerable receptors. However, negative impacts are also noted and include those which arise principally from the construction phase as a result of exposure to environmental vectors and changes in

community infrastructure. These include the below, which are discussed briefly in this chapter, and assessed in detail in the respective EIAR Chapters:

- The impact of construction works on population subsets, residential properties, community facilities and economic activity with regards to cyclist and traffic movement. This is discussed in Chapter 7 'Material Assets'.
- The impact of construction works on population subsets, residential properties, community facilities and commercial facilities with regards to landscape and visual amenity, and cultural heritage considerations (architecture, archaeology, and intangible cultural heritage). This is discussed in Chapter 11 'Landscape and Visual' and Chapter 9 'Cultural Heritage'.
- The impact of construction works on human health, from the perspective of noise and vibration nuisance, and emissions to air and water from plant and equipment. These are discussed in Chapter 13 'Air Quality', Chapter 15 'Noise and Vibration' and Chapter 8 'Hydrology - Surface Water'.

6.2 Statutory and Policy Context

Legislation

6.2.1 The population assessment has been undertaken with due regard to the overarching EIA guidance, including the EIA Directive 2014/52/EU, the Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2022) and the Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DHPLG, 2018). Regard has also been given to the Fáilte Ireland Guidelines on the Treatment of Tourism in an Environmental Impact Statement (Fáilte Ireland, 2011).

6.2.2 No specific guidance on the definition for Human Health has been defined in the context of EIA to date however relevant guidance that has been considered is included below:

- Institute of Public Health Ireland (2009) Health Impact Assessment Guidance.
- IEMA (2017) Health in Environmental Impact Assessment - A Primer for a Proportionate Approach.
- IEMA 2020 Health Impact Assessment in Planning: Thought pieces from UK practice. Impact Assessment Outlook Journal, Volume 8: October 2020.
- US EPA (2016) Health Impact Assessment Resource and Tool Compilation.

6.2.3 In addressing other factors of community health with regards to noise nuisance, air quality and water quality, specific legislation and guidelines have been used and are outlined in the respective EIAR chapters.

Local Policy

6.2.4 The Graiguenamangh-Tinnahinch (G-T) Joint Local Area Plan 2021-2027 has been prepared by KCC and CCC and sets out an overall strategy for the planning and sustainable development of the town and village. It is built upon the following development principles, all of which are integral to the population's wellbeing and health:

- To promote the role of Graiguenamanagh as a District Town.
- To promote the role of Tinnahinch as a smaller town and village.
- Promotion of heritage and tourism.
- Compact growth and strengthening of links between each settlement.
- Enhance the vitality and vibrancy of the G-T town centre.
- Sustainable modes of transport.
- To encourage economic growth and job creation.
- Liveability and quality of life.

6.2.5 The Joint Local Area Plan for G-T is underpinned by a Strategic Vision which is intended to guide the future growth of the settlement in a sustainable manner, recognising its natural and built assets, and enhancing the character, heritage amenities of the settlement. The Strategic Vision is based on issues raised during the pre-draft public consultation period, detailed analysis of the profile, functions and activities of G-T in line with its position in its respective County's Settlement Hierarchy (KCC & CCC, 2021):

6.2.6 ''This Joint Local Area Plan will promote population growth of G-T, reversing the recent trends of population decline. The plan envisages a consolidated town centre with enhanced east-west connections for pedestrians and cyclists, combined with a range of traffic management proposals which will improve accessibility to and vitality of the consolidated town centre. The Plan will encourage job creation by capitalising on local strengths, including the towns' unique setting, natural and built heritage and by enhancing the interface with the River Barrow, thereby supporting opportunities to sustainably exploit the river as a visual, recreational and tourism amenity. Development will be encouraged in a sustainable manner that promotes a healthy environment and healthy living and improved public spaces, while protecting the unique built and natural heritage of the settlement.''

6.2.7 The importance of access to the River Barrow for the communities of G-T is highlighted in the LAP objectives for Green Infrastructure. The overall strategic objective is:

- "SO4: To support the creation and enhancement of a network of pedestrian walkways, footbridges and open spaces connecting the River Barrow and other recreational and tourist attractions within the settlement."

6.2.8 Further, the Kilkenny County Development Plan recognises the potential of the Rivers Nore, Suir and Barrow to offer "amenity, recreational, biodiversity and tourism benefits for the city and county generally". The Council commits to work with adjoining local authorities, agencies and communities to improve access and facilities along the rivers in appropriate locations subject to the availability of resources. The River Barrow towpath is recognised as a significant amenity resource which runs along the riverbank on the County Carlow side of the river.

6.3 Assessment Methodology

6.3.1 This chapter examines the socio-economic and health characteristics of the Study Area and in particular, the areas of the town vulnerable to flooding, focusing especially on the location and vulnerability of community facilities and on sensitive population subsets. The assessment is guided by the requirements of the EU Flood Directive (2007/60/EC) and by Preliminary Flood Risk Assessment and Flood Risk Management Plans prepared on the basis of guidance supplied by the Office of Public Works.

Study Area

6.3.2 The principal study area is determined by the scheme boundary and generally includes the townlands of G-T and the surrounding environs, the River Duiske and River Barrow, and the environs of the proposed upstream storage area. The study area for the assessment of construction-based population and health impacts is inclusive of the area which is affected by the social or economic impacts arising from the construction of the scheme. This includes areas frequented by people in the immediate environs of the works areas themselves, as well as the location of site compounds and access/haulage routes.

6.3.3 The works are divided into ten (10) areas, as defined on Drawing No. W3451-AYE-DWG-1403 and described in Chapter 4 'Description of Proposed Scheme and Construction Methodology'. The site extents are shown on Drawing No. W3451-AYE-DWG-W-1402, where storage/working areas are included along with access routes from the public road to the works areas.

6.3.4 Construction programming and sequencing is outlined in Section 4.7 of Chapter 4 'Description of Proposed Scheme and Construction Methodology'.

6.3.5 With regards to the operational phase, the study area includes all those who will be impacted by the Proposed Scheme which are, primarily, those who live and work in the area of the scheme infrastructure, but also those who may come in contact with the effect of the scheme, including recreational users of the rivers. The wider study area is also informed by those parts of the town which have previously been affected by flood events where these have impacted on the economic life of the town, for example, by forcing the closure of businesses or access routes, or causing a loss of economic income from tourism, etc.

Assessment of Impacts to Population

6.3.6 This section sets out the methodology used to assess the effects of the Proposed Scheme on population. The fundamental goal of the Proposed Scheme is to protect human beings and their activities from adverse impacts associated with flood events however the impacts associated with the construction and operation of the scheme must be considered. The purpose of the population assessment is to identify the likely significant effects on the local community and users of the local area during both construction and operation, along with the likely economic effects at the local and regional level. The methodology includes the assessment of likely significant effects on:

- General everyday amenity and accessibility.
- Local economic activity and employment.
- Tourism and amenity.

6.3.7 General amenity effects can arise due to any effect that a development may have on residential quality of life, community wellbeing, amenity or recreation due to environmental effects such as noise, visual intrusion or altered amenity access, for which specific significance levels are identified in the respective chapters of the EIAR. There are links also between amenity and tourism, and with social inclusion and health given the priority of protecting sensitive receptors from environmental effects associated with the scheme, but also from environmental events such as flooding. There is also the potential for economic effects. These could arise from the construction employment and purchasing of local inputs, or from the impact of construction works on local economic activity or businesses. In the operational phase, there are potential interactions with other economic activity, or with regard to settlement patterns, population change and tourism.

6.3.8 Likely significant effects are categorised in accordance with the EPA 2022 Guidelines (see Table 6-1). Significant effects are compared between the 'Do-Nothing' and the 'Do-Something' scenarios (split into the construction and operation phases) and arise from direct, indirect, secondary, and cumulative effects on environmental conditions. Significant effects can be positive, neutral, or negative. It usually follows that the significance of an impact depends, among other considerations, on:

- The location and character of the local environment,
- The sensitivity of the local population and its capacity to absorb change,
- The nature of the environmental effect,
- The timing and duration of an effect,
- The scale or extent of the effect in terms of area or population affected,
- The magnitude (duration and frequency) of an effect, and

- The probability of an effect's occurrence.

Table 6-1: Significance Criteria for Likely Significant Effects on Population and Human Health

Significance Level	Criteria
Quality of Effects	
Positive Effects	A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).
Neutral Effects	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
Negative/adverse Effects	A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance).
Describing the Significance of Effect	
Imperceptible	An effect capable of measurement but without significant consequences.
Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Significant Effects	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
Profound Effects	An effect which obliterates sensitive characteristics.

Assessment of Impacts to Health

6.3.9 This section sets out the methodology that has been used to assess the likely significant effects of the proposed development on human health. Directive 2014/52/EU of the European Parliament and of the Council referred to Population and Human Health instead of the Human Beings Chapter previously outlined in Council Directive 85/337/EEC. The EPA guidelines note that *"while no specific guidance on the meaning of the term Human Health has been issued in the context of Directive 2014/52/EU, the same term was used in the SEA Directive (2001/42/EC)".*

6.3.10 As referenced in the 2014 Directive, '*in an EIAR, the assessment of impacts on population and human health should refer to the assessments of those factors under which human health effects might occur, as addressed elsewhere in the EIAR e.g., under the environmental factors of air, water, soil etc'*. This is consistent with the approach adopted for this EIAR, whereby potential effects on human health are primarily considered through an

assessment of the environmental pathways by which health may be affected (i.e., the determinants of health) such as air, noise, waste management and or water. The assessment on human health therefore draws on the findings of other sections of the EIAR as necessary, to ensure that the likely significant effects on human health are considered.

6.3.11 The Institute of Environmental Management and Assessment (IEMA) issued a discussion document on the methodology of the assessment of Human Health in an Environmental Impact Assessment Report in 2017. It is a primer for discussion on what a proportionate assessment of the impacts on health should be in EIA and is a useful document when considering what can and should be assessed in the context of this EIAR. Due regard has been had to the general approach advocated in this document when undertaking this assessment. The IEMA document notes that: *"Public health is defined as the science and art of promoting and protecting health and well-being, preventing ill-health and prolonging life through the organised efforts of society and has three domains of practice: health protection, health improvement and improving services".*

6.3.12 The assessment of significance is a professional appraisal based on the sensitivity of the receptor and the magnitude of the effect. Within any area, the sensitivity of individuals in a population will vary. As such, it would be neither representative of the population, nor a fair representation of the range of sensitivities in a population were an overall sensitivity classification assigned to the population in question. As such, the precautionary principle has been adopted for this assessment, which assumes that the population within the study area is of a uniformly high sensitivity.

6.3.13 Likely significant effects are categorised in accordance with the EPA 2022 Guidelines (see Table 6-1) as outlined in Section 6.3.8 above.

Data Sources

6.3.14 The appraisal of likely significant effects on population and human health was conducted through an initial desk-top review of the current socio-economic environment in the areas adjacent to the Proposed Scheme. Baseline information was sourced from a number of secondary data resources including:

- G-T Joint Local Area Plan 2021-2027 (Kilkenny County Council and Carlow County Council, 2021).
- Kilkenny City and County Development Plan 2021 – 2027 (Kilkenny County Council, 2021).
- Carlow County Development Plan 2022 – 2028 (Carlow County Council , 2022).
- G-T Tourism and recreational project concept study executive summary (Kilkenny County Council).
- Central Statistics Office, Census Data (https://www.cso.ie/en/census/)

- Spatial data, including aerial photography, Google Maps and Google Street view, and Open Street Map.
- Other relevant environmental baseline data gathered and considered as part of this EIAR, especially traffic and air quality and odour, noise, landscape and visual assessments.
- Available community health profiles including the Health Profile completed by the HSE for the area.

Site Visits/Surveys

6.3.15 A number of site visits to the study area were conducted in the period from 2020 to 2024 throughout the EIA process. Specific details were recorded in relation to land use, community, local settlement, amenity, tourism and recreational features, all of which supported in the preparation of the baseline environment section of this EIAR Chapter.

Consultation

6.3.16 Throughout the EIA process, consultations were made to seek opinions and input from statutory bodies, regulators, organisations, research bodies, community groups, business owners and residents that have an interest or who may be affected by the Proposed Scheme. Data/information was also provided by stakeholders in some cases, where relevant, for incorporation into the EIA study. This Chapter has been prepared with consideration of the outcomes of this consultation, which is detailed further in Chapter 5 'Consultation and Stakeholder Engagement'.

6.3.17 A number of items relative to this EIAR Chapter were raised during the three Public Consultation Days (see Section 5.2 of Chapter 5 'Consultation and Stakeholder Engagement'). Most notably the residents of G-T highlighted that in the current scenario, flood preparation and maintenance does not provide sufficient reassurance to those at risk. Moreover, concerns were raised that flood defence walls would impact hugely upon the unique character and aesthetics of the town. The latter point is discussed in greater detail in Chapter 11 'Landscape and Visual Amenity' but alluded to within this chapter also given the intrinsic link of the town to the residential population.

6.3.18 As outlined in Table 5-3 (Chapter 5 'Consultation and Stakeholder Engagement'), the Carlow-Kilkenny Environmental Health Service had several observations for the Scheme in relation to population and human health. To avoid repetition, reference is made to this same table outlines how this EIAR, and in particular this chapter, has responded to these observations.

6.3.19 The Health and Safety Authority, when consulted in 2020 and 2022 had no observations to make on the Scheme.

6.4 Baseline Environment

Settlement Amenities and Character

6.4.1 The settlement of G-T is situated on the River Barrow in the valley between Brandon Hill in County Kilkenny and Mount Leinster in County Carlow. It is a rich cultural town located 33 km from Kilkenny City, 40 km from Carlow, and 19 km from New Ross. The settlement also occupies a bridging point at George Semple Bridge, which divides Tinnahinch from Graiguenamanagh, and which is a superb amenity for boating, fishing and recreational pursuits. The settlement of G-T is renowned for its heritage and tourist attractions which has now evolved the settlement into an attractive tourist destination (Kilkenny County Council and Carlow County Council, 2021). Various recreational facilities and features are located along the rivers such as the Riverside Glamping, Graiguenamanagh Boat and Rowing clubs, South Leinster Way - Graiguenamanagh Trailhead, The Hub Outdoor Activities Centre and Fairview Park.

6.4.2 Graiguenamanagh town has a rich heritage dating back to the founding of Duiske Abbey in 1204. Graiguenamanagh expanded beyond the Abbey as a market town, aided by the development of the Grand Canal and the navigation of the River Barrow, which ultimately connected the town with Dublin, New Ross, Waterford and Carlow. The production of wool was historically important to the town's economy and sheep rearing remains a predominant agricultural activity in the hinterland. Whilst Graiguenamanagh can trace its earliest origins to the Duiske Abbey, Tinnahinch is a comparatively new settlement, with the exception of the area associated with the use of the River Barrow and the main approach roads. Tinnahinch is home to a castle dating from 1615 (Kilkenny County Council and Carlow County Council, 2021).

6.4.3 G-T is centred on the River Barrow and overlooked by Brandon Hill, with a natural setting that is conducive to amenity and recreation, and economic activities associated with tourism (see Figure 6-2). In Graiguenamanagh, much retail and other commercial activity is located along the High Street and Main Street, as well as along the 'The Quay' which stretches 200 m along the right bank of the River Barrow from the bridge to the Graiguenamanagh Boat Club. Many small recreational boats are moored along the entire length adding to the charm of the town, and access to the river is provided via a slipway and concrete tiered steps (see Figure 6-4). The Duiske Abbey and its adjoining graveyard, together with the narrow and, in places, winding streets of the town centre, their interconnection with the Abbey, the medieval bridge, and the relationship of the River Barrow gives Graiguenamanagh a unique visual character. In fact, a large majority of the town is designated as an Architectural Conservation Area (ACA), to ensure the preservation of character of the traditional townscape, while promoting appropriate new development as opportunities arise in a manner that respects and reinforces the special character. The medieval core of the town is complemented by the presence of the River Duiske and Mill Race running to the rear and sometimes beneath properties on Main Street, the Turf Market and Lady's Well, with its remnants of industrial archaeology that includes former warehouses, mills and a dock.

6.4.4 In Tinnahinch, a similar span of quay is present on the left bank of the River Barrow, from the bridge to the end of the River Barrow Mill Race. Land use is largely residential along The Quay, with recreational boats similarly moored along the majority. A public walkway is established along the entire length of The Quay, with pedestrian-only access from the Tinnahinch Castle. Adjacent to this is a set of lock gates, and running alongside The Quay, is the River Barrow Mill Race, all of which lend to the medieval character of the towns.



Figure 6-1: Setting of Graiguenamanagh



Figure 6-2: Tinnahinch Quay



Figure 6-3: Graiguenamanagh Quay



Figure 6-4: Street view of Graiguenamanagh Quay

Demographics

Population Statistics

6.4.5 Table 6-2 below presents the population of the study area (Central Statistics Office, 2022) (Kilkenny County Council and Carlow County Council, 2021). According to the 2022 census, the Graiguenamanagh Electoral Division would have a population density of 58 persons per km^2, and Tinnahinch 44 persons per km^2 (see Table 6-2). The average age of the combined settlement was found to be 43.1 in 2022, in comparison to 39.7 for County Kilkenny, and 38.8 for County Carlow and the State. These statistics show that the study

area has a higher-than-average age profile, and percentage of population ages 65 years and older.

Table 6-2: Census Population Statistics

Census Population	2022	2016	2011	2006	2002	1996
G-T	1,506	1,695	1,791	1,423	1,435	1,374
Kilkenny County	104,160	99,232	95,419	87,558	80,399	75,336
Carlow County	61,968	56,932	54,612	50,349	46,014	41,616

Source: CSO Census of Population 2022, G-T Local Area Plan 2021

Table 6-3: Age Profile of Settlements in the Scheme Area

Age profile (2022)	G-T	State	County Kilkenny	County Carlow
Average Age	43.1	38.8	39.7	38.8
% Aged under 15	16.9	19.5	20.3	19.9
% Aged 15-64	61.3	66.6	63.4	65.1
% Aged 65+ years	21.8	13.8	16.4	15.0

Source: CSO Census of Population 2022

Housing

6.4.6 Table 6-4 below shows the breakdown of the types of housing in the study area. It is anticipated that ca. 137 housing units will be required in Graiguenamanagh and ca. 25 units in Tinnahinch up to 2027 to accommodate population predictions (Kilkenny County Council and Carlow County Council, 2021).

Table 6-4 Households by Type of Accommodation

Settlement Area	Accommodation Type	Permanent Private Households (number)	Number of persons in permanent private households
Graiguenamanagh	1 room	2	4
	2 rooms	20	25
	3 rooms	35	64
	4 rooms	62	128
	5 rooms	218	517
	6 rooms	129	360
	7 rooms	111	327
	8 or more rooms	110	352
	Not stated	30	90
	TOTAL	**171**	**1,867**

Settlement Area	Accommodation Type	Permanent Private Households (number)	Number of persons in permanent private households
Tinnahinch	1 room	0	0
	2 rooms	3	6
	3 rooms	14	25
	4 rooms	27	56
	5 rooms	80	185
	6 rooms	50	134
	7 rooms	35	107
	8 or more rooms	40	132
	Not stated	3	6
	TOTAL	**252**	**651**

Economic Activity

Employment and Unemployment

6.4.7 Employment and labour force participation rate is an indicator of active engagement in the labour market either by working or looking for work. The labour force is the sum total of persons at work, looking for a job or unemployed, while students, homemakers, retired persons and those unable to work are counted as being not in the labour force. The labour force participation rate is the percentage of all adults who are in the labour force.

Table 6-5: Employment status in Scheme area

Settlement Area	Employment Status 2016				
	At Work	Unemployed (incl first time job seekers)	Not in labour force (incl. not stated)	Total	Labour force participation rate
G-T	467	170	568	1205	52.9%

Commercial Activity

6.4.8 The County Development Plans of Kilkenny and Carlow recognise that the identity and economic development of both Counties Kilkenny and Carlow including the settlement of G-T are intrinsically linked to its heritage and acknowledge that their character and culture are vital assets that help each county compete as a tourism destination and a choice for location for investment (Kilkenny County Council and Carlow County Council, 2021).

6.4.9 Inland either side of the river are mainly residential services with a few supporting commercial and community services (such as restaurants, stores, post offices etc.) and further beyond the towns is agricultural land. The CSO data for the settlement shows approximately half the working population engaged in Commerce and Trade, and

Professional Services, with only a small percentage of the population working in agriculture.

6.4.10 There are various businesses based in the study area. Table 6-6 below shows a non-exhaustive list of these businesses displaying the diversity of the economy in the area.

Table 6-6 Businesses in Proposed Scheme area

Local Business Name	Address
Barrow Valley Activities Hub and Motorhome Aire	Old Dock, Graiguenamanagh
Sparkle & Shine Car Valeting	High Street, Graiguenamanagh
Murphy Signs Limited	Main Street, Graiguenamanagh
O'Sheas Hardware	High Street, Graiguenamanagh
Cushendale Woollen Mills	Mill Road, Graiguenamanagh
Kissanes Pharmacy	Lower Main Street, Graiguenamanagh
Waterside Guesthouse	The Quay, Graiguenamanagh
Riverside Glamping	The Quay, Graiguenamanagh
The Duiske Inn	Lower Main Street, Graiguenamanagh
Quirky	The Quay, Tinnahinch
Daisy Chain	Main Street, Graiguenamanagh
The Hooftop Café	The Quay, Graiguenamanagh
Mick Doyles	Lower Main Street, Graiguenamanagh
SuperValu	Lower Main Street, Graiguenamanagh
Barron's Sports & Menswear	Main Street, Graiguenamanagh
Duiske Glass Gift Shop	High Street, Graiguenamanagh
Book Market	Main Street, Graiguenamanagh
Kissanes Pharmacy	Upper Main Street, Graiguenamanagh

Education

6.4.11 There are a number of educational services in the Study Area, including Duiske College (co-educational post primary school), Graiguenamanagh Boys National School, Scoil Mhuire gan Smál (co-educational Primary School to first class). The local population have a high level of education with approximately one third of respondents having Higher Education, as seen in Table 6-7.

Table 6-7 Highest Level of Education in the Proposed Scheme area

Settlement Area	Highest Level of Education	2016	%
G-T	No Formal Education	33	3.2%
	Up to Upper Secondary School	597	58.1%
	Up to Honours Bachelor's Degree, Professional Qualification or both	312	30.4%
	Postgraduate, Doctorate or higher	36	3.5%
	Not Stated	49	4.8%
	Total Respondents	1027	

General Health

6.4.12 Table 6-8 below shows the breakdown of how respondents indicated their general health. The percentage of respondents in the Proposed Scheme area who considered their health to be bad or very bad was 2.6% which is higher than the national average of 1.6%. This high percentage number is likely linked to the aging population living in the Proposed Scheme area.

Table 6-8 General Health of Persons in the Proposed Scheme area

Settlement Area	General Health 2022						
	Very Good	Good	Fair	Bad	Very Bad	Not stated	% Bad/Very Bad Health
G-T	603	479	180	33	6	205	2.6

Tourism and Recreation

6.4.13 As mentioned, the settlement of G-T is renowned for its heritage and tourist attractions which has now evolved the settlement into an attractive tourist destination (Kilkenny County Council and Carlow County Council, 2021).

6.4.14 The tourism sector is seen as the main economic strength of the settlement, and the future development of tourism-related activities is the key objective for generating employment (Kilkenny County Council and Carlow County Council, 2021). The following main assets of the settlement are nationally and internationally renowned:

- Duiske Abbey,
- George Semple Bridge,
- Tinnahinch Castle,
- St. Michael's Well,

- Traditional shops, pubs, cafes and streetscapes,
- Barrow navigation (Blueways),
- Graiguenamanagh Boat Club,
- Barrow recreational amenities,
- Barrow and South Leinster Waymarked Ways,
- River Barrow and River Nore SAC,
- Brandon Hill,
- The woodlands to the north and south of the town, and
- The nearby attractions of Borris and St. Mullins.

6.4.15 G-T is a popular section of the River Barrow for walking and water sports. Existing outdoor recreation activities include boating, rowing, kayaking and open water swim, all focused around the Graiguenamanagh Boat Club (Figure 6-6 and Figure 6-6) (source: County Carlow's Outdoor Recreation Vision for 2040, and our Plan for 2023). The Barrow Way and the South Leinster Way both pass through the Proposed Scheme area along the Graiguenamanagh and Tinnahinch Quays. Further details on the pedestrian and cycling features of the study area are available in Chapter 7 'Material Assets'. Recreational game and coarse fishing take place on the River Barrow. Guesthouses and self-catering cottages provide accommodation to tourists in the area and catering is provided by bars, restaurants and cafes in the area. The Barrow Valley Activities Hub provides a sporting pitch, space for community events and facilities for overnight campervanning (Figure 6-7).

6.4.16 The Kilkenny Leader Partnership instigated the G-T Tourism and Recreational Project Concept Study (2019). This study provides a blueprint for local and community development funding. This includes programmes such as the Social Inclusion and Community Activation Programme and the LEADER rural development programme. The G-T Tourism and Recreational Project Concept Study identifies the potential linkages between the various tourism and recreational assets and amenities in the area, setting out a number of concepts to stimulate sustainable economic development and attract inward public and private investment. Further, the Carlow County Development Plan 2022 – 2028 identifies the opportunity for the outdoors in the county. Specific outdoor recreation developments include the interconnecting network of river routes along watercourses along the River Barrow, River Slaney and River Burren.

6.4.17 The Barrow Valley Activities Hub (also known as 'Barrow Valley Community Development') was established adjacent to the River Barrow in Graiguenamanagh in 2011. Its aim is to 'create an innovative outdoor venue that integrates education, economic and social resources of the Graiguenamanagh and Barrow Valley region by using the local attractive natural environment'' (source: Barrow Activities Hub website, 2020). It provides a range of indoor and outdoor facilities to amenities users from the local communities and beyond,

including an all-weather playing pitch. SLR (2019) report that parking and vehicular access is limited for the facility, and it has not reached its envisaged revenue potential. As mentioned, it also provides parking provisions for short and medium stay campervanners, particularly in the summer months.

6.4.18 G-T benefits from a significant level of green infrastructure, which creates an attractive setting for residents and visitors alike. The green infrastructure within the Proposed Scheme area includes the designated River Barrow/Nore Special Area of Conservation with a restriction on its use in order to protect the river and its banks as a green corridor for wildlife and biodiversity (Kilkenny County Council and Carlow County Council, 2021).

6.4.19 SLR (2019) reports that in August each year, Graiguenamanagh hosts an annual month of festivals comprising the regatta weekend (1st weekend), walking festival (2nd weekend), music festival (3rd weekend), and Town of Books (4th weekend).



Figure 6-5: River Access Adjacent to the Boat Club along Graiguenamanagh Quay



Figure 6-6: Slipway along Graiguenamanagh Quay



Figure 6-7: Barrow Activities Hub

6.5 Sensitive Receptors

Flood Sensitivity

6.5.1 There is a long history of flooding to the two towns from the River Barrow, as well as flooding to Graiguenamanagh specifically from the flashy River Duiske. The most severe recorded flooding occurred in December 2015/January 2016 with flooding on both the Duiske and Barrow (Figure 6-8). The Duiske is restricted by the bankside development causing raised water levels and consequently, out of bank flooding occurs along Main Street and the Quay. A combination of insufficient channel capacity and a bridge restricting flow along the River Barrow also results in out of bank flooding, also putting properties along the Quay's in Graiguenamanagh and Tinnahinch at risk.



Figure 6-8: Flooding of The Quays Graiguenamanagh from the Barrow [Left] and flooding through house on Main St from the Duiske [Right]

6.5.2 The Flood Risk Maps for the 10% and 1% AEP Events (Figure 6-9 and Figure 6-10 respectively) and historical references in the CFRAM reveal that High Street, Main Street and the Quay areas of Graiguenamanagh are mainly affected by flooding, and these are the areas where the majority of commercial activity and social infrastructure (community centre, health centres, leisure clubs) is centred within Graiguenamanagh, as well as a significant number of residential properties. An important local road (R703) and the Graiguenamanagh Bridge, which provides linkage between the town, Tinnahinch and wider areas (i.e., Kilkenny), as also located within the flood risk area. Commercial and residential properties along Turf Market and Well Lane have also been affected by flooding of the River Duiske, particularly during the flood event of November 2018. Much of the flooding here filters into Main Street and onto the Quay due to the sloping topography of the town.

6.5.3 Along Tinnahinch Quay, some businesses (café, takeaway restaurant), residential properties, residential gardens, and historical assets (the Tinnahinch Castle) are located within the flood zone. Areas where flooding occurs in open spaces includes the flood plain on the left bank along Tinnahinch Quay, upstream of the Bridge, the green space of the Barrow Valley Activities Hub and the green space downstream of the lock gate.

6.5.4 The socio-economic status of the neighbourhood invariably means that there will be some population subsets who will be more vulnerable to a flood event, including older people

and those on lower incomes. Properties occupied by elderly people are classified as being of high vulnerability, as well as those with sensitive land uses (i.e., schools and camping sites).

6.5.5 The total number of properties currently at risk includes 31 residential properties, 53 commercial properties and 19 'others' which include car parks, derelict sights and sheds. A series of maps are presented in Figure 6-11 to Figure 6-14 showing the types and vulnerability of properties affected by flooding.

Cross Section Label	10% AEP Flows (m3/s)	10% AEP Level (m OD)
01GRAN01055_3	296.91	10.561
01GRAN01125_3	301.77	10.588
01GRAN01125_Copy_US	250.86	10.588
01GRAN01160_3	261.33	10.687
01GRAN01230_Int	277.54	10.763
01GRAN01260_Copy_DS	0.82	10.702
01GRAN01285	277.49	10.846
01GRAN01285_3	4.01	11.075
01GRAN01480_GEN	288.23	11.014
01GRAN01520	277.51	11.016
01GRAN01605_3	292.28	11.483
01GRAN01680_3	288.16	11.514
01GRAN01755_3	289.41	11.541
01GRAN01845	288.51	11.574
01GRAN01955	277.28	11.62
02GRAN00030	10.21	10.939
02GRAN00075	11.1	10.878
02GRAN00140	11.16	10.812
02GRAN00210	11.25	10.74
02GRAN00310	11.35	10.663
03GRAN00045	9.27	11.021
03GRAN00080	8.65	11.305
03GRAN00170	8.62	12.052
03GRAN00230_Moved_Edit	8.61	13.13
03GRAN00283_GEN	8.81	14.128
03GRAN00340	8.22	14.622
03GRAN00410	8.32	15.365
03GRAN00475	8.31	15.786
03GRAN00560	8.3	16.843
04GRAN00020_Copy_US	0.56	19.481
04GRAN00070	0.56	24.244
04GRAN00165	0.56	24.746
04GRAN00255	0.56	26.113
05GRAN00085	0.02	42.05
05GRAN00200	0.01	47.68
BARR_Weir_US_Edit	280.27	11.075

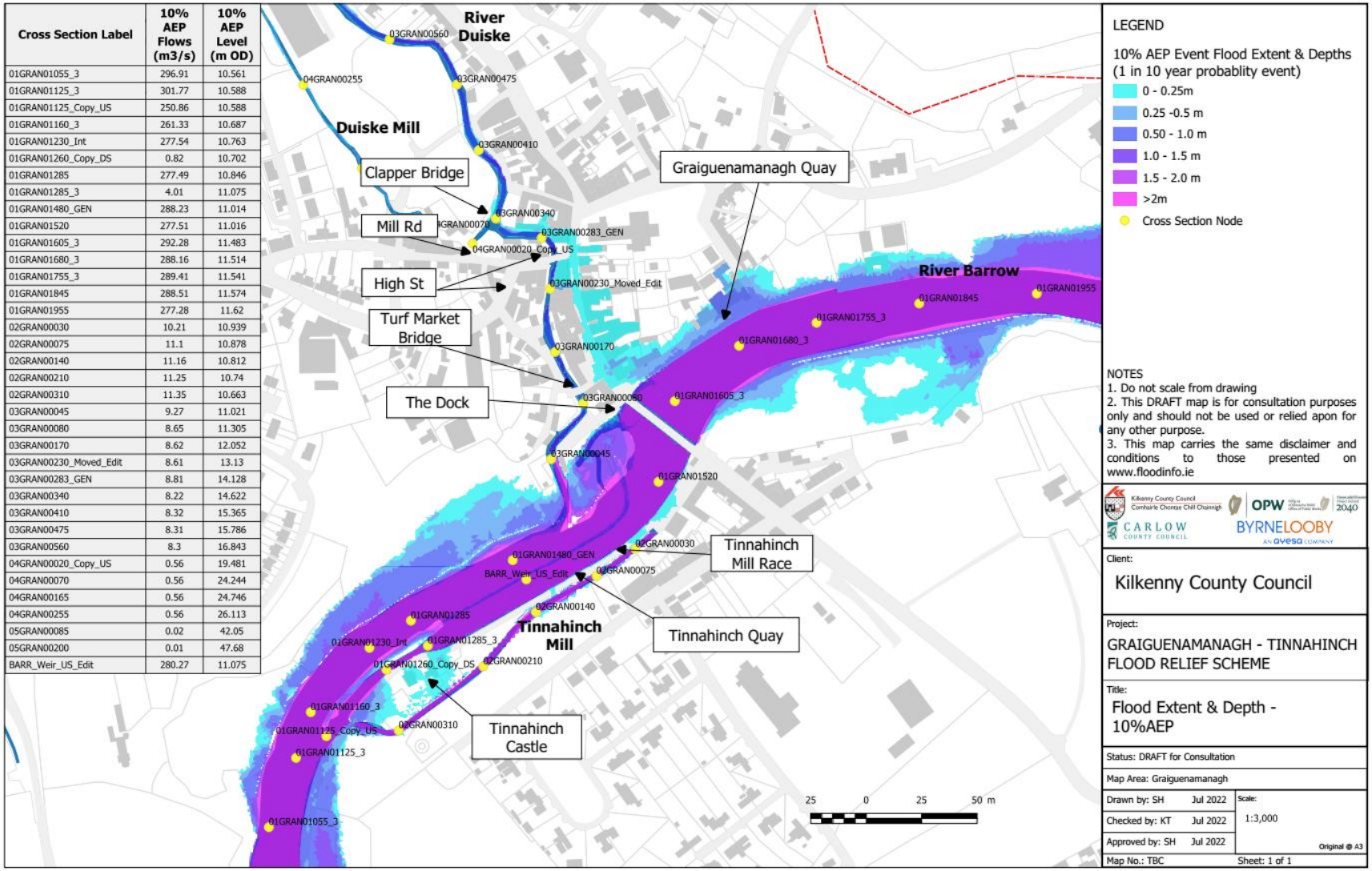


Figure 6-9: 10% AEP Flood Extent

Cross Section Label	1% AEP Flow (m3/s)	1% AEP Level (m OD)
01GRAN01055_3	410.9	11.027
01GRAN01125_3	415.45	11.075
01GRAN01125_Copy_US	333.98	11.075
01GRAN01160_3	350.08	11.196
01GRAN01230_Int	363.48	11.291
01GRAN01260_Copy_DS	4.04	11.24
01GRAN01285	355.29	11.413
01GRAN01285_3	18.37	11.653
01GRAN01480_GEN	387.47	11.599
01GRAN01520	413.41	11.539
01GRAN01605_3	409.43	12.18
01GRAN01680_3	392.68	12.219
01GRAN01755_3	393.06	12.253
01GRAN01845	388.71	12.287
01GRAN01955	372.75	12.338
02GRAN00030	10.58	11.526
02GRAN00075	11.59	11.498
02GRAN00140	12.02	11.466
02GRAN00210	15.66	11.381
02GRAN00310	21.51	11.198
03GRAN00045	11.52	11.603
03GRAN00080	11.25	11.685
03GRAN00170	11.17	12.271
03GRAN00230_Moved_Edit	11.16	13.39
03GRAN00283_GEN	11.84	14.355
03GRAN00340	11.06	14.798
03GRAN00410	11.52	15.526
03GRAN00475	11.5	15.959
03GRAN00560	11.48	17.027
04GRAN00020_Copy_US	0.66	19.528
04GRAN00070	0.66	24.273
04GRAN00165	0.67	24.783
04GRAN00255	0.66	26.143
05GRAN00085	0.02	42.059
05GRAN00200	0.02	47.686
BARR_Weir_US_Edit	397.81	11.653

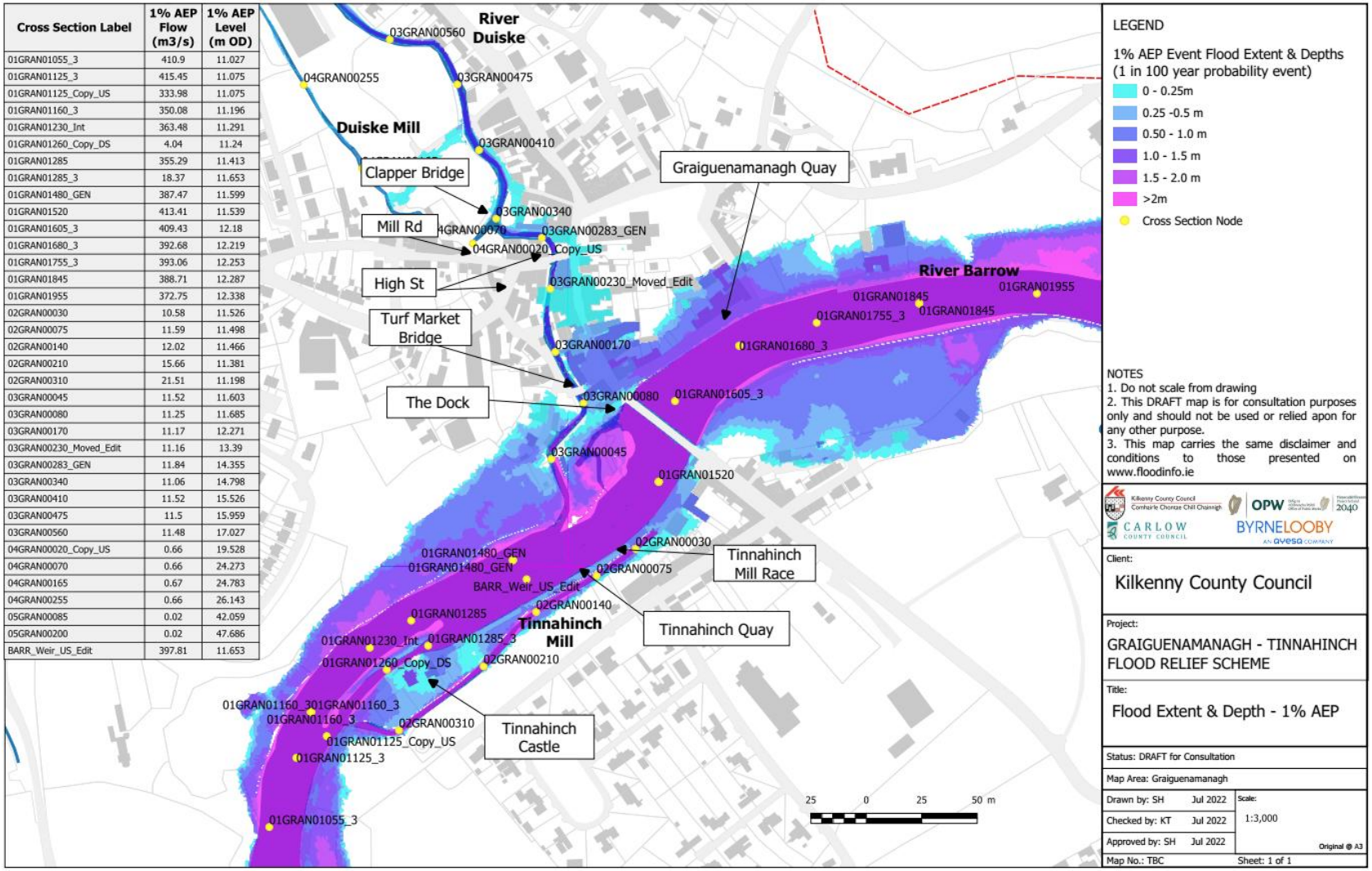


Figure 6-10: 1% AEP Flood Extent

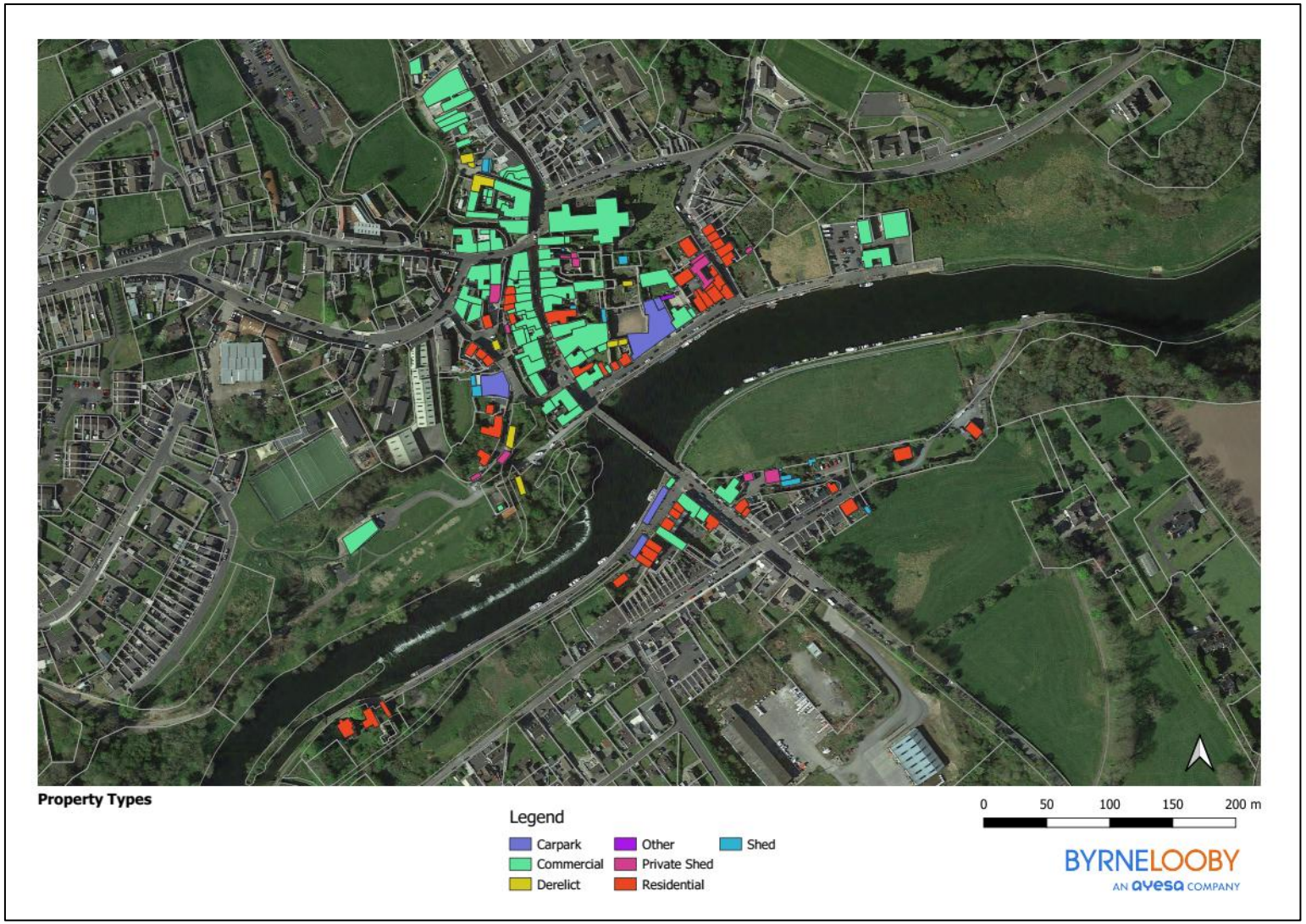


Figure 6-11: Property Types in Flood Extent Area

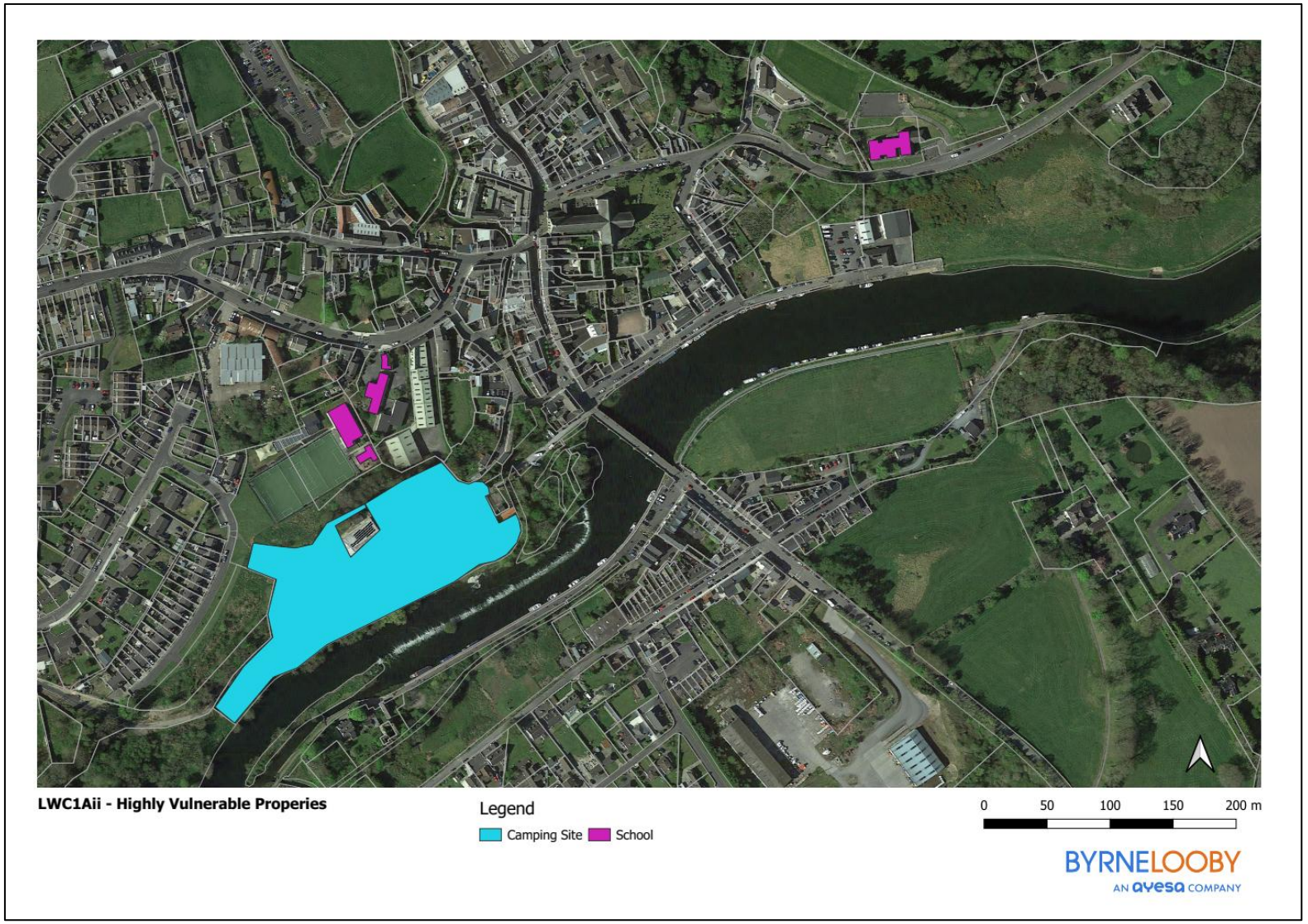


Figure 6-12: Highly Vulnerable Properties in Flood Extent Area

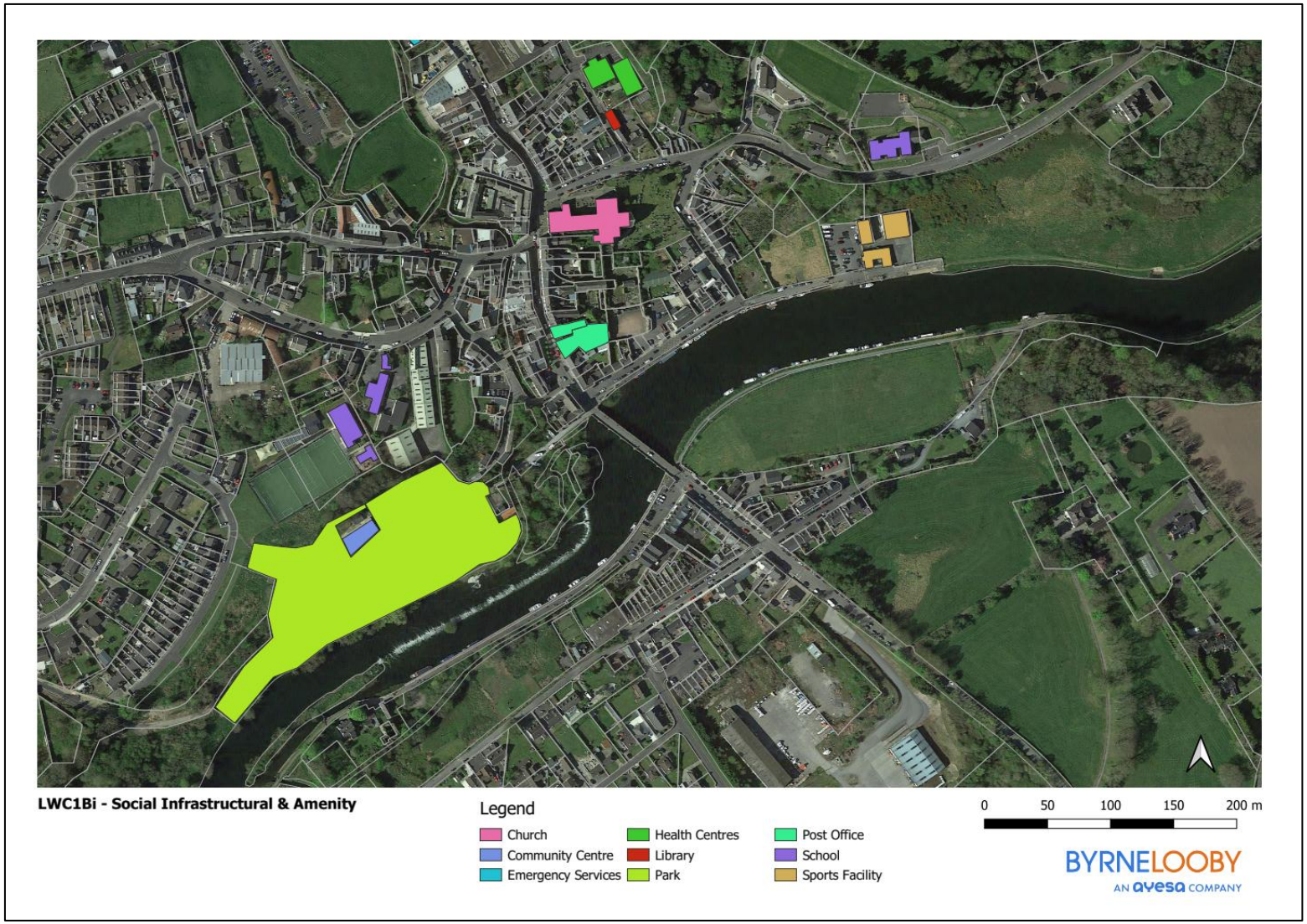


Figure 6-13: Social Infrastructure and Amenity in Flood Extent Area

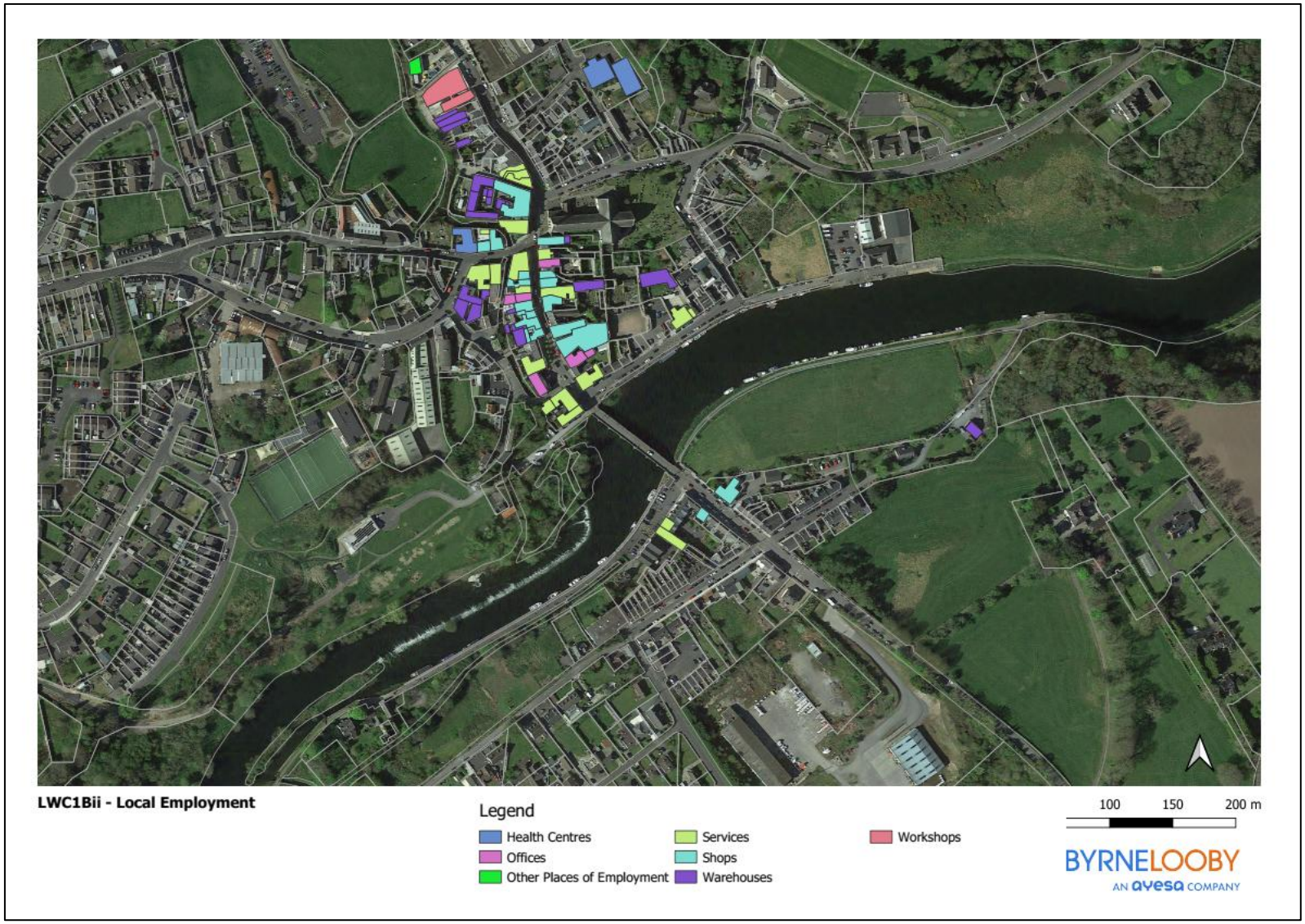


Figure 6-14: Local Services/Employment Types in Flood Extent Area

Sensitive Receptors to Proposed Scheme

6.5.6 The primary receptors with regards to Population and Human Health are residences, public buildings, outdoor spaces and businesses located within the immediate vicinity of where the planned defences are to be constructed. Here, direct impacts of construction (i.e., noise generation, air emissions, visual amenity and traffic) and operation (i.e., visual amenity, reduced flood risk) are likely. However, the population's health and wellbeing can also be indirectly affected through the availability of and access to community assets, a condition which may be altered by both the construction and operation phases.

6.5.7 The functional value of the study area is determined with reference to the importance and sensitivity of the area's population demographics and community assets. 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. The following land use receptors are considered sensitive to change:

- **Residential properties:** Particularly for those located in flood risk areas, in close proximity to the planned works, construction compounds and access/haulage routes. These receptors are considered to be highly sensitive to change. Some properties/housing estates of note to include:
    - Properties along the G-T quays, within the extent of the works.
    - Properties along Hotel Street (Tinnahinch).
    - Properties along Turf Market (Graiguenamanagh).
    - Properties along R703 (Graiguenamanagh).
    - Properties along High Street (Graiguenamanagh).
    - Properties along Lower Main Street (Graiguenamanagh).
    - Properties adjacent to the Upstream Storage Area (<10 properties).
- **Recreational & Tourist land uses:** These are considered important to the community and tourism, and include areas of open space, facilities of recreational amenity (i.e., parks, playgrounds, sporting facilities) and walking/cycling pathways. Their sensitivity to change is considered to be high, particularly given the nature of the River Barrow as a focus of recreational and visual value. Receptors of note include:
    - The mooring facilities along Graiguenamanagh and Tinnahinch Quays.
    - Graiguenamanagh Boat Club.
    - Graiguenamanagh Rowing Club.

- The slipway along Graiguenamanagh Quay.
- Graiguenamanagh Scout Den.
- The river access point opposite the Graiguenamanagh Boat Club.
- The Barrow Valley Activities Hub.
- The Barrow Way and the South Leinster Way.
- The slipway along Graiguenamanagh Quay.

- **Community facilities:** These include schools, hospitals and places of worship that contribute to the community's quality of life. Receptors include:
  - Medical centres/health facilities (i.e., Graiguenamanagh Health Centre, Abbey Hall, Duiske Veterinary).
  - Religious/Worship facilities (i.e., Duiske Abbey, St. Peter's Church).
  - Schools/colleges (i.e., Duiske College, Brandon Community Playgroup, Graiguenamanagh Boys National School, Scoil Mhuire gan Smál).
- **Business and commercial activities:** These are considered important aspects of the local economy as they provide goods, services, and jobs to the local population. These include:
  - Coffee shops (i.e., Quirky, Daisy Chain, The Hooftop Café, Mick Doyles etc.)
  - Petrol stations.
  - Restaurants/pubs (i.e., The Duiske Inn, River Palace)
  - Convenience stores and supermarkets (i.e., SuperValu).
  - Retail/gift shops (i.e., Barron's Sports & Menswear, Book Market, Duiske Glass Gift Shop).
  - Hairdressers/barbers (i.e., Barber shop).
  - Pharmacies (i.e. Kissanes Pharmacy, Brandonvale Pharmacy).
  - Offices (i.e., Law Offices).
- **Cultural Heritage Assets:** These hold huge importance to the community of G-T and form such an important role in shaping the character of the towns. To avoid repetition, sensitivity of these assets is assessed in Chapter 11 'Cultural Heritage'.

6.6 Potential Impacts and Effects

The 'do nothing' scenario

6.6.1 If the Proposed Scheme were not to proceed, the fluvial flood risk currently present will remain as is, particularly given the flashy nature of the River Duiske. A full review of the flooding history and need for the Scheme is included in Chapter 1 'Introduction', and a summary of the flooding sensitivity in Section 6.5 of this chapter.

6.6.2 Flooding can lead to a disruption of normal life and wellbeing and has the potential to compromise human physical and psychological health in a number of ways. This includes possible direct injury during a flood event, destruction of residential and commercial property (resulting in potential dampness, mould and other health concerns), increase in financial pressure and loss of possessions/home. Financial implications to home and business owners are particularly significant given the raised concerns regarding inaccessibility of flood insurance for 'at risk' properties. This in turn gives rise to further psychological health concerns, including stress and anxiety. In addition, flood waters could potentially disrupt movement within the general study area, giving rise to decreased road safety and cause impact to normal operations of community facilities and assets (i.e., schools, hospitals, shops etc.). Further, long term impacts with regards to increased insurance costs and discouragement of future investment into the general area because of flood risk are possible.

6.6.3 In summary, under the 'do nothing' scenario, the impact is assigned as negative, significant. Impacts are both temporary (i.e., direct impact during a flood event), and long-term/permanent (i.e., insurance concerns, mental wellbeing, devalued property etc.).

Construction Phase Impacts

6.6.4 As outlined in Chapter 4 'Description of Proposed Scheme and Construction Methodology', the works are divided into ten (10 nos.) areas (Areas 1 to 10) corresponding to the Proposed Scheme defence locations (see Drawing No. W3451-BLP-DWG-W-1403). There are Nos. 5 site compounds (SC A, SC B, SC C, SC D and SC E) to support these works areas (see Drawing No. W3451-BLP-DWG-W-1402). Site access is within the red line boundary on this same drawing and will include the use of public roads.

6.6.5 Construction works are anticipated to span over 3 years and divided into five (5) works packages (WP 1, WP 2, WP 3, WP 4A and WP 4B), as outlined in Table 4-16. As a result, some associated construction phase impacts are not anticipated to be concentrated over the entire scheme area for the entire construction duration (3 years), rather impacts will be, in some cases, specific to the individual WP and for the associated construction time periods. The location of construction areas, SCs and associated access/haulage routes (i.e., proximity to receptors) and types of activities planned in each will have a large bearing on the overall impact of each WP however, each one will have a limited construction timeframe therefore impacts will be temporary or short-term. An exception, however, would be those receptors located in proximity to those site compounds and access routes

to be used for the duration of the construction period (36-42 months). It is likely that the Main Compound (A) and access routes through the town and across the bridge will be maintained throughout the entire construction programme.

6.6.6 The following sections will look into further detail however to summarise, construction-related activities likely to cause impact to population, human health, socio-economic and commercial activity, and tourism and recreation, include:

- Enabling works:
    - Enabling works will comprise additional SI works as outlined in Chapter 4 'Description and Construction Method', WP 1 and will be required largely at the main compound (A). It will involve the demarcation of accesses, installation of hoarding (typically 2.4m in height), where required, and the clearing of vegetation, trees and topsoil, as necessary. The additional SI and archaeological works likely comprise of trial pits at Hotel Street, Inspection pits at Peg Washingtons Lane and Turfmarket Bridge, slit trenches at the Dock, the Quays and Tinnahinch. These works may give rise to increased traffic movements in areas, and noise and vibration nuisance (i.e., from enabling plant, deliveries, and collections).
- Construction Works:
    - Works areas, and associated construction activities (including temporary and construction works):
        - Depending on the distance of receptors to the works areas, impacts will vary across the study area. Impacts may arise with regards to increased traffic movements in areas, noise and vibration nuisance (i.e., from excavations, sheet piling etc.), generation of dust (i.e., excavations and stockpiling), reduction in surface water quality (i.e., river swimming zones), limitation of river-side amenity access and negative visual impact (i.e., presence of plant/signage/hoarding etc.). Further, some construction areas will require the temporary closure of public roads and parking, particularly where space is limited along the riverbanks.
    - Site compounds (SCs):
        - Depending on the distance of receptors to these sites, the severity and type of impact of the construction compounds will vary across the study area. For example, SC C, SC D and SC E are likely to create the most impact to local residents and visitors from the perspective of noise, visual impact and access closures, whereas SC A, SC B and SC E are located further from densely populated areas and largely hidden from view. Generally, however, site compounds may give rise to increased traffic movements in areas, noise and vibration nuisance (i.e., from vehicle/plant moving in and out, generators, deliveries and collections), generation of dust (i.e., stockpiling,

un-paved haulage routes), generation of odour (i.e., waste management and ablution) and negative visual impact (i.e., presence of hoarding/fencing).

- Haulage / Access Routes:

  - Depending on receptor proximity to the proposed haulage/access roads, individual residential and commercial receptors may be more sensitive to associated impacts of noise, vibration, reduced air quality and reduced accessibility to premises. A wider impact however is anticipated with regards to the general increase in traffic movement throughout the study area where access routes are assigned to local roads, giving rise to nuisance impacts.

6.6.7 The following sections provide an in-depth review of potential impacts to population and human health for the activities proposed during each of the proposed WPs and their associated site compounds and haulage/access routes.

Impacts to Population

6.6.8 Impacts to population are assessed in terms of (i) general wellbeing of the community living in G-T, (ii) ability for the community to maintain normal activities including general access and use of public realm space, traffic movement and use/operation of commercial units and businesses and (iii) implications to amenity, recreation and tourism. The following section considers these impacts from the following perspectives:

Residential Properties

6.6.9 The nature of the project location is such that construction activities will be occurring adjacent to properties. Therefore, impacts of construction related to noise generation, traffic and parking alterations, reduced air quality and reduced visual amenity to these properties is likely. A review of these impacts for each of the proposed Works Packages is included below:

- WP 1 and Main Compound (A):

  - Under this WP, activities are anticipated to be focused largely on the main compound (A), situated in Tinnahinch within a derelict yard site. The intention is that it will contain the main site offices and welfare facilities, but minimal storage of plant and materials. Whilst some of the works related to WP 1 are anticipated to be spread across the study area, the use of the main compound will be consistent throughout the entire construction period (36-42 months). Given its location, there are <5 properties likely to be most affected by its presence.

- Impacts are anticipated to be greatest during the establishment and set-up of the compound, largely related to the generation of noise from vehicles (i.e., trucked deliveries), and plant used in the set-up of offices/welfare facilities. Thereafter, during operation of the main compound over the construction period, possible impacts to residential properties in proximity largely relate to increased traffic movement along R703, the generation of vehicular noise, and possibly some visual impact from back-facing rooms in adjacent properties. Significance of impact is assigned in the individual chapters, however generally, impacts would be considered temporary (3 months only), and the reduction of impact through best practice mitigation is highly plausible.

- WP 2 (Area 1), and SC B:

  - These works are situated at the area proposed for upstream storage, 2.5km north of G-T, within private agricultural lands. In particular, two properties are anticipated to be affected most by the construction works under this WP and the presence of the SC. SC B will contain welfare facilities and store plant and material. It will be in use for the duration of the Works Package (18 months). The main construction works under this WP will include the removal of trees/vegetation, shifting large quantities of earth to create the retaining embankment, concreting works and the installation of utilities (i.e., power supply). Therefore, impacts associated to this WP and SC largely related increased traffic movement along R703, generation of dust during significant earthworks, and the generation of noise and vibration.

  - From a noise and vibration perspective (see further in Chapter 15 'Noise and Vibration'), pre-mitigation construction noise levels at Area 1 have been predicted at 65 L_{Aeq} dB based upon the type of construction equipment to be used and for what percentage of 'on-time' during the construction period. This results in a **short-term significant adverse** impact pre-mitigation.

  - From an air quality perspective (see further in Chapter 13 'Air Quality'), the key impact type for WP2 is the generation of dust from various activities, including but not limited to the required earthworks, site excavation, stockpiling of materials and concrete structural works. A medium risk of dust soiling is assigned for demolition and track-out, and a high risk for earthworks and construction. Based on the type of activities planned for WP2, construction phase impacts would be **moderate adverse** on a **short-term** basis. The generation of pollutant emissions (NO_2, CO) is **imperceptible.**

  - From a landscape character perspective, the key consideration is the introduction of the upstream storage structure and associated infrastructure into a previously open landscape. Whilst large trees on the perimeter of the adjacent residential property are likely to reduce the significance of this

impact, reduced visual amenity is still likely Significance of impact is assigned in Chapter 11 'Landscape and Visual', however generally, impacts would be considered **moderate to significant but temporary** during construction, and **slight to moderate but short-term** during operation, lessening as the existing vegetation matures w.

- WP 3 (Areas 2, 3 and 4) and SC C:
    - Works under this WP are focused within the town area along the River Duiske, within and around Turf Market, Well Lane, Main Street and High Street. SC C is proposed to be located along Mill Road, in a derelict yard site. Impacts to residential properties are likely to be considerable under this WP, largely as a result of the orientation of residential buildings to the River Duiske and therefore where works are proposed in-river. The majority of properties being impacted under this WP are situated directly on the banks of the river, some of which can only access their properties via river crossings. This is particular for those properties between High Street Bridge and Turf Market Bridge. A number of these crossing will be closed for a period during construction under this WP, and two bridges providing residential access will be replaced, including one upstream of High Street Bridge, and one downstream. A total of 30+ nos. properties are anticipated to be affected, in varying degrees, by the construction works. Impacts largely involve the generation of noise and vibration during the construction of defence walls in the Duiske River, reduction in air quality, and alteration of access/vehicular parking during bridge replacements.
    - SC C borders <5 properties and will be used for welfare facilities and the storage of plant and material for the duration of the WP (12 months). Therefore, impacts of the SC itself largely relate to increased traffic movement along Mill Road, Turf Market and High Street, and generation of noise. As outlined in Chapter 15 'Noise and Vibration'. pre-mitigation construction noise levels at Areas 2, 3 and 4 have been predicted at 72-73 LAeq dB based upon the type of construction equipment to be used and for what percentage of 'on-time' during the construction period. This results in a **short-term significant adverse** impact pre-mitigation.
    - From an air quality perspective (see further in Chapter 13 'Air Quality'), the key impact type for WP3 is the generation of dust from the demolition of existing walls/structures, foundation construction, sheet piling, handling of construction materials and concrete structural works. A medium risk of dust soiling is assigned for demolition and track-out, and a high risk for earthworks and construction. Based on the type of activities planned for WP3, construction phase impacts would be **minor to moderate adverse** on a **short-term** basis, but with **imperceptible to short-term slight adverse** impacts post mitigation. The generation of pollutant emissions (NO_2, CO) is **imperceptible.**

- From a landscape character perspective, the flood defences proposed in Areas 2, 3 and 4 within the town centre are anticipated to only impact the immediate surrounding area and localised views via changes proposed to the existing road layout and public realm and the introduction of flood defence structures proposed within areas that contain similar built elements. Further detail is included in Chapter 11 'Landscape and Visual' however during construction, impacts are anticipated to be **moderate to significant but temporary**, and during operation, **slight but permanent.**

- WP 4A (Areas 5, 6, 7 and 8), and SC D

  - This WP includes the construction of flood defences (combination of embankments, concrete walls, glass wall, and flood barriers) and public realm features (including boardwalk, lighting, landscaping, seating etc.) at Area 5 (The Boat Club), Area 6 (Graiguenamanagh Quay) and Area 7 (The Dock). Works under this package will directly impact approximately 10 properties, including most notably those along the Graiguenamanagh Quay. However, another 20+ properties along Barrow Lane and Lower Main Street, are anticipated to be impacted more indirectly. Some of the properties along Graiguenamanagh Quay are commercial in nature, with associated impacts addressed later in this Chapter. SC D is proposed to be located adjacent to the Graiguenamanagh Boat Club and does not directly border any properties. It is intended to be used for welfare facilities and the storage of plant and material for the duration of the WP (18 months).

  - This WP and use of SC D will result in the closure of the quay road to vehicles for 6 months, and removal of all parking spaces for the same period. Access roads to the Boat Club and the Dock will be closed to vehicles for 3 months. This includes parking at SuperValu which may need to be curtailed temporarily to allow streetscaping. Pedestrian access will be maintained at all times for all properties. Noise generated by the driving of sheet piles and other construction activities will cause nuisance to those properties along the Quay, as discussed in Chapter 15 'Noise and Vibration'. Pre-mitigation construction noise levels at Areas 5, 6, 7 and 8 have been predicted at 69-73 LAeq dB based upon the type of construction equipment to be used and for what percentage of 'on-time' during the construction period. This results in a **short-term very significant** impact pre-mitigation, however, is reduced to a **short-term moderate adverse** (Area 7) and **short-term significant adverse** (Areas 5, 6 and 8) impact post-mitigation.

  - From an air quality perspective (see further in Chapter 13 'Air Quality'), the key impact type for WP4A is the generation of dust from various activities including but not limited to utility diversions, demolition, foundation construction, site excavation, sheet piling, stockpiling and concrete structural works. Across all WPs, a medium risk of dust soiling is assigned for demolition and track-out, and a high risk for earthworks and construction. Based on the

type of activities planned for WP4A, construction phase impacts would be **minor to moderate adverse** on a **short-term** basis, but with **imperceptible to short-term slight adverse** impacts post mitigation. The generation of pollutant emissions (NO_2, CO) is **imperceptible.**

- From a landscape character perspective, a number of features are anticipated to impact the landscape character of the town centre, including the introduction of raised defences / raised ground at several locations (i..e, The Boat Club, The Hub, The Dock, the Quay) and alterations to the public realm along the Quay. The introduction of glazed panels and improved public realm will minimise visual and physical impact of the proposed walls, to facilitate views, and assist in retaining the relationship with the river and the open character of the Quay. At some areas, trees will require removal to facilitate construction of defences however tree, hedge and shrub and wildflower planting is proposed where possible. Further detail is included in Chapter 11 'Landscape and Visual' however generally construction phase impacts will be **moderate to significant but temporary**, and operation phase impacts vary. For Areas 5 and 6, impacts are anticipated to be **slight and permanent**, and for Areas 7 and 8 **not significant**, lessening in the long-term as the proposed planting establishes.

- WP 4B (Areas 9, and 10), and SC E

  - This WP includes the construction of flood defences (a combination of embankments, concrete walls and flood barriers) at Area 9 (Hotel Street), and Area 10 (Tinnahinch Quay). Works under this package will directly impact approximately 25 properties along Hotel Street and Tinnahinch Quay, one of which is a block of apartments with 6 units. Some of the properties along Tinnahinch Quay are commercial in nature, with associated impacts addressed later in this Chapter. Indirectly and much less significantly, approximately 40 properties along St. Mullins Road will be impacted by the temporary wayleave for people accessing the Barrow Way. SC E is proposed to be located within an open green space on the left bank of the River Barrow, bordering one property. SC E will be used for the storage of plant and material and will be in operation for the duration of the WP (12 months).

  - This WP and use of SC E will result in the closure of the quay road for 3 months, and temporary removal of all parking spaces for this same duration. Properties located between main street and the mill race will all have access, including vehicular to the carpark behind the apartments. Vehicular and pedestrian access will be impacted along the tow path. Noise generated by the driving of sheet piles (for concrete walls), movement of material (for the embankments) and other construction-related activities will likely cause impacts to those properties along the Quay and Hotel Street. Pre-mitigation construction noise levels at Areas 9 and 10 have been predicted at 58-74 LAeq dB based upon the type of construction equipment to be used and for what

percentage of 'on-time' during the construction period. This results in a **short-term moderate adverse** (Area 9) to **short-term very significant adverse** (Area 10) impact pre-mitigation, however, is reduced to a **short-term slight adverse** (Area 9) and **short-term significant adverse** (Area 10) impact post-mitigation.

- From an air quality perspective (see further in Chapter 13 'Air Quality'), the key impact type for WP4B is the generation of dust from various activities including but not limited to utility diversions, movement of construction traffic, demolition, foundation construction, earthworks, site excavation, sheet piling, stockpiling, and handling of construction materials. Across all WPs, a medium risk of dust soiling is assigned for demolition and track-out, and a high risk for earthworks and construction. Based on the type of activities planned for WP4A, construction phase impacts would be **minor to moderate adverse** on a **short-term** basis, but with **imperceptible to short-term slight adverse** impacts post mitigation. The generation of pollutant emissions (NO_2, CO) is **imperceptible.**

- From a landscape character perspective (see further in Chapter 11 'Landscape and Visual'), the introduction of the flood embankment and removal of trees will alter the landscape character of Areas 9 and 10, however the operational impact is only anticipated to be **slight permanent**, lessening in the long-term as existing vegetation continues to mature and proposed planting establishes. construction phase impacts will likely be **moderate to significant** due to presence of construction machinery, traffic, cranes, lighting and the construction compound, but **temporary.**

6.6.10 Chapter 7 'Material Assets' includes an assessment, from a property ownership perspective, of the land acquisition arising from the implementation of KCC's Compulsory Purchase Order (CPO) for the Proposed Scheme. However, some temporary and permanent effects on local and local amenity and community use will also occur as a result of these land acquisitions.

Local Traffic Movement

6.6.11 This section includes a high-level review of potential impacts that local traffic movements, and more specifically the increase of these during enabling and construction works, will have on the local population. A more in-depth review of traffic and transportation impacts is outlined in Chapter 7 'Material Assets', along with associated pedestrian and cycling impacts.

6.6.12 Overall, some moderate adverse effects are predicted in some locations, particularly along the Quays and Turf Market associated with increased traffic flows throughout the town, road diversions, temporary road and parking closures. This has the potential to lead to some disturbance for drivers, business owners, pedestrians, cyclists and residents. For the duration of construction works (3 years), it is anticipated that there will be constraint upon

the traffic movement across the Graiguenamanagh Bridge, particularly where traversing for Heavy Duty Vehicles (HDVs) is required, given that the bridge is already a very narrow roadway (see Chapter 7 'Material Assets'). Road closures are planned at Well Lane, The Dock, the access road to the Boat Club, Graiguenamanagh Quay, Tinnahinch Quay and the Waterway Ireland Access Road, however all closures are not anticipated for longer than 3 months with the exception of the Graiguenamanagh Quay which will be closed for 6 months. Further, closure of parking is anticipated in a number of key areas in the town, for a maximum of 6 months. These changes are predicted to result in a **temporary slight adverse** residual impact as outlined in Chapter 7 'Material Assets'. On a daily basis, it is predicted that the scheme will contribute 20 Light Goods Vehicles (LGV), 47 Heavy Goods Vehicles (HGV) and 114 Passenger Car Units (PCU), resulting in a **temporary slight adverse** residual impact due to the already constrained nature of the road infrastructure in the towns of G-T.

6.6.13 Enabling works will occur under WP 1, anticipated to last 3 months, and as mentioned, the Main Compound (A) will act as the focal point for the site offices and welfare. In WP 1, traffic movements are not anticipated to contribute to movements far beyond existing baseline levels. The population of G-T will likely be aware of some increased movements of HGVs within the town; however, this change is unlikely to be significant. Further, no public roads are anticipated to be closed during this period. **Temporary slight adverse** residual impacts are assigned, as outlined in Chapter 7 'Material Assets'.

6.6.14 Under WP 2, which includes the construction of the storage area (Area 1), impacts of increased traffic movement will be isolated to R703 where site access will be established to SC B. Given the more remote nature of this WP relative to G-T, impacts resulting from increased traffic are considered to be **imperceptible**.

6.6.15 WP 3, which includes construction within Areas 2 (Well Lane to High Street Bridge), 3 (Turf Market) and 4 (Turf Market to The Hub) is likely to cause more significant impacts to the town community in relation to traffic movement. Here, roads are small and narrow local roads and therefore the introduction of large HDVs, and construction plant will likely cause a slowing and disruption of traffic movement for the duration of the WP. This will be particularly felt by those with commercial and residential properties along Turf Market and High Street. The unmarked road from the bridge to The Hub will be closed for 3 months. The exact timing of this work is not known at this stage. However, the closure is unlikely to cause significant disturbance as another access exists, via R705. Pedestrian access will be maintained at all times. Further, Well Lane will require closure for a period (3 weeks), and two pedestrian access bridges will be blocked to allow for replacement as part of the works (at Well Lane and Turf Market), impacts which are further addressed in Chapter 7 'Material Assets'. As outlined in this Chapter, **temporary moderate adverse** impacts are assigned, however best practice mitigation will reduce this further to **temporary slight adverse** impacts.

6.6.16 WP 4A, which includes construction within Areas 5 (Boat Club), 6 (Graiguenamanagh Quay), Area 7 (The Dock) and Area 8 (The Hub) focuses most of the construction along the

Graiguenamanagh Quay. Further, SC D is proposed to be located adjacent to the Graiguenamanagh Boat Club, with the main access route being along the Quay itself. This WP will temporarily alter traffic movement and parking provisions throughout the town as the Quay, which currently acts as a dual carriage with informal on-street parking, will be closed for 6 months. Of particular impact is the alteration of vehicular access to and parking for the residential and commercial properties along the Quay, such as SuperValu the Waterside Guesthouse and residential properties, addressed in separate sections of this Chapter. Vehicular access to these premises will be temporarily restricted to allow streetscaping and drainage works, but it will not be for the full construction period. Disruption to access will be minimised. This is discussed further in Chapter 7 'Material Assets', but safe pedestrian access will be provided for the South Leinster Way. Overall, a **short-term moderate adverse** impact has been assigned in Chapter 7, and best practise mitigation is likely to reduce this further to a **short-term slight adverse** impact.

6.6.17 WP 4B includes construction within Area 9 (Hotel Street), and Area 10 (Tinnahinch Quay). The Quay will be closed during the works period (3 months), altering vehicular access to and parking for the residential properties along the Quay. Existing off-street parking at the beginning of the Quay will be temporarily removed for the duration of the works period (3 months). This is discussed further in Chapter 7 'Material Assets', but safe pedestrian access will be provided for the Barrow Way. For this WP, SC E will be used resulting in traffic impacts at Main Street Bridge as the vehicles traverse Main Street. Overall, a **short-term moderate adverse** impact has been assigned in Chapter 7, and best practise mitigation is likely to reduce this further to **short-term slight adverse** impacts.

Socio-economic and Commercial Activity

6.6.18 Construction of WP 4A and B will occur close to businesses, including the Waterside Guesthouse, Supervalu, Mick Doyles, and The Globe to name a few, with vehicular access restricted for periods. Safe pedestrian accessways will be provided during this time, particularly along the quays. Well Lane will see a closure to pedestrians for 3 months. Micro piling and other general construction works will involve noise generation, but mitigation proposed in the form of hoarding and low noise equipment should reduce the severity. Predicted pre-mitigation construction noise levels at Areas 5-10 (WPs 4A and 4B) range from 58-84 LAeq dB based upon the type of construction equipment to be used and for what percentage of 'on-time' during the construction period (18 months for each WP). This results in **short-term significant adverse** impacts at Areas 5, 6 and 10, **short-term moderate adverse** impacts at Area 7 and **short-term slight adverse** at Area 9 post-mitigation (residual impacts). The Hot Box Sauna will be impacted by works during WP 4B with access restricted to the sauna and floating dock. This is anticipated to be temporary in nature. Restrictions on car parking, and the removal of all parking spaces along the quays will have an impact on local businesses, although space will be maintained for people with disabilities. It is intended that access for deliveries and pedestrians will remain, although occasional disruption will be possible due to construction traffic.

6.6.19 As mentioned in the previous section, there will be construction traffic movement along the quays, Main Street, High Street, Turf Market, across the bridge, and through site compound access points, associated with site offices, material storage, and movement of equipment, plant and material. This has the potential to impact on business access and have an economic impact, but this is not anticipated to be significant.

6.6.20 Whilst some slower traffic movements throughout the town might be noticeable for pick up and drop off of school children, impacts to education facilities (i.e., schools, pre-schools, playgroups) are considered to be imperceptible. The closest school to construction work is KCETB Duiske College, which is located in relative proximity to the works in Area 3 (Turf Market) and Area 7 (the Dock). Predicted pre-mitigation construction noise levels at Areas 3 and 7 are 63 LAeq dB and are 69 LAeq dB respectively based upon the type of construction equipment to be used and for what percentage of 'on-time' during the construction period. This results in **short-term slight adverse** (Area 3) and **short-term moderate adverse** (Area 7) residual noise impacts post-mitigation (residual impacts).

6.6.21 A positive construction phase impact is predicted, relating to local commercial activity. It is possible that construction workers may utilise local accommodation for the duration of the works and make use of the community-owned facilities within the area (i.e., cafes, restaurants, shops etc). This would lead to a short-term stimulation of the local economy during this period. Direct employment of construction staff, with further opportunity for indirect employment opportunities related to the construction work (i.e., waste collectors, recycling facilities, equipment rentals etc.) will occur.

Local Amenity, Recreation and Tourism

6.6.22 The construction works will impact local amenity, recreation and tourism. As previously mentioned, G-T attracts tourists, interested largely in waterside activities, events and camping, water sports and fishing, and riverside walking. Local Guesthouses and B&B's are overnight options, as well The Hub for campervanners. Both tourists and local amenity users comprise the customers of the cafes and restaurants along High Street, Main Street and Graiguenamanagh Quay. Locals are likely the more frequent users of the Boat Club and tourists are the more frequent customers of the facilities at The Hub, however there will be exceptions, and these facilities may be frequented by both users on occasion.

6.6.23 The works under WP 1 are not anticipated to cause significant change to local amenity, recreation and tourism, with the exception of some small visual alterations with the presence of hoarding, fencing, signage, material storage and site offices in areas designated for SCs, and some increased vehicular movement. Much of this early work will be completed in the Main Compound however, which is located behind Tinnahinch Quay and away from main amenity areas.

6.6.24 The in-river works planned along the River Duiske (WP 2 and WP 3) will occur during the summer months to as a mitigation action for fisheries interest. These works are not anticipated to impact significantly on local amenity, recreation and tourism given that most tourist and amenity facilities/area are focused on the quays and along the River

Barrow. Nevertheless, Well Lane will be closed, currently used as a riverside pedestrian access way resulting in the temporary loss of this amenity (see further in Chapter 7 'Material Assets'). There will be noise and traffic related effects throughout the construction period, potentially impacting those living and working in the area, and walking through the area (see further in Chapter 15 'Noise and Vibration').

6.6.25 Under WP 4A and 4B, most of the planned construction activity is located along the quays, and within existing amenity areas utilised currently as walking/cycling pathways (i.e., Well Lane, the South Leinster Way and the Barrow Way). The quays will be temporarily closed for vehicular access for 6 months during WP4A (Graiguenamanagh Quay) and 3 months during WP 4B (Tinnahinch Quay). Safe pedestrian access will be maintained, however it will likely be fenced and directed through construction areas. From a local amenity perspective, this will result in a significant adverse impact for local residents and tourists, albeit on a short- term basis.

6.6.26 As outlined previously, the River Barrow is used extensively for amenity purposes, including for boating, water sports, fishing and swimming. As a result, there are a number of access points to the river and boat mooring along the length of the quays. In the interest of limiting impact to these amenities and tourism activities/facilities as much as possible, plans will be made, in consultation with Waterways Ireland and other relevant stakeholders, to allow for a certain number of moored vessels to be moored at any one time. Access to The Hot Box Sauna and associated swim platform will also be curtailed during some of the works. During these works, there will be **short-term moderate to significant adverse** noise impact on those staying nearby or moving to and from amenity facilities in the town (see Chapter 15 'Noise and Vibration'), and curtailment to altered traffic movement through the town from increased vehicular presence, road closures, road diversions and parking alterations. Further, the physical presence of construction works along the quays will reduce the amenity and community use of these areas. Safe pedestrian access will be provided along the quays, South Leinster Way, the Barrow Way and the entrance to The Hub via The Dock whilst works are ongoing.

6.6.27 The works under WP 4A and WP 4B will temporarily affect amenity use of the River Barrow and will render the mooring facilities along the quays inaccessible at times. This will require moored vessels to be relocated. This will be done in consultation with stakeholders, as above, to limit impacts where practicable. A **short-term significant adverse** effect on boat users who use the existing moorings is therefore identified during the construction phase of WP 4A and WP 4B. All mooring facilities will be reinstated following completion of construction, and flood gates will allow controlled access to these through the flood defence structures. Impacts are considered for the operational phase in relation to this, as discussed later in this chapter.

6.6.28 As mentioned previously, pedestrian access to the River Barrow is accessible via concrete steps on both Graiguenamanagh Quay (opposite the Boat Club, and opposite entrance to Supervalu carpark) and Tinnahinch Quay (opposite the lock gates). During work under WP

4A and WP 4B, these will be inaccessible. Therefore, a **short-term moderate adverse** effect on amenity is identified as a result of the loss of this river access.

6.6.29 Vehicular and boat access via the slipway on Graiguenamanagh Quay is anticipated to be maintained for the majority of WP4A, however a temporary closure is required to construct the defences in the area, therefore a **temporary, slight adverse impact** is assigned. This would be particular to the Graiguenamanagh Boat Club. As mitigation, the summer months are to be avoided as far as is practicable.

6.6.30 SC D and SC E are proposed in currently open green space however these are not known to be used for amenity purposes. SC A and C are located in brownfield/derelict sites with no existing amenity value, and SC B is located within private agricultural land outside of the town. Besides impact to visual amenity, the SCs are not anticipated to alter the communities use of public realm, recreational facilities or tourist attractions.

6.6.31 The Annual Graiguenamanagh River Regatta takes place annually on the August bank holiday weekend. There are also a number of recreational regattas which take place throughout the year. As mitigation, construction is to be curtailed as far as is practicable on the August bank holiday. Events at The Hub will be able to continue as the building and most of the grounds will not be affected. There will be temporary slight impacts to events in Graiguenamanagh.

Impacts to Human Health

Traffic

6.6.32 As discussed in earlier sections and in Chapter 7 'Material Assets', some t**emporary moderate adverse** effects are predicted in locations (the Quays, Turf Market, Main Street, High Street and the bridge) consisting of increased traffic flows on the network and introduction of diversions and road closures. This has potential to lead to some disruption for drivers, pedestrians and cyclists as well as residents of properties adjoining traffic routes. Disruption however is not in itself a health effect. Further, given the defined duration of the construction phase, and the extensive mitigation outlined in Chapter 7 'Material Assets', the likely effect on human health associated with traffic is **negligible.**

6.6.33 Health concerns in relation to emissions of pollutants from vehicles and construction plant/equipment is discussed below.

Air Quality

6.6.34 Concerns are largely in regard to the temporary generation of particulate matter (dust) during key construction activities, and how this has potential to cause negative effect to the health and wellbeing of those identified as the closest sensitive residential receptors. This is particularly relevant for those receptors in a higher age bracket (i.e., 60+) or with underlying health conditions (i.e., asthma) where changes to air quality could result in respiratory concerns.

6.6.35 Chapter 13 'Air Quality' presents an impact assessment of dust-generating activities, namely demolition, earthworks, construction and track out (in accordance with the Institute of Air Quality Management [IAQM] Guidelines) (IAQM, 2014) and how these activities could impact upon human health. A low risk to human health was identified for demolition and track-out given that minimal demolition is involved in the construction methodology and that most access routes are paved, however a medium risk was assigned for earthworks and construction. This is on account of the activities associated to these elements of construction, notable the movement of earth for the embankment structures (a total of 20,000-100,000 tonnes of material, amounting to 5-10 earth moving vehicles for each embankment)), and the amount of concrete works required for the construction of the flood walls, during the replacement of pedestrian bridges (2 nos.) and for the construction of the flow control structure at the flood storage area (a total of 5,000 tonnes of concrete required across the site). These risks are pre-mitigation however, and extensive mitigation including the implementation of a Dust Management Plan (DMP) and a dust monitoring programme will reduce human health impacts to be **short-term slight to imperceptible adverse**.

6.6.36 The generation of vehicular and construction plant related emissions (SO_2, NO_2 and CO) is not considered a significant concern for the project, as the anticipated quantity of Light Duty Vehicles (LDVs) and HDVs involved in the construction phase does not exceed the criteria outlined by the Environmental Protection UK (EPUK) and IAQM (UPUK & IAQM, 2017) warranting a full air quality assessment. Therefore, **no impacts** to human health are anticipated from vehicular and construction plant related emissions.

Noise and Vibration

6.6.37 Potential for impact arises with regards to the generation of noise and vibration from (i) construction related heavy-goods traffic, haulage, deliveries and collections etc., and (ii) construction related activities, namely excavations and earthworks, sheet piling and concrete pouring. Particularly for those properties located in close proximity to the noise generating activity, the potential for noise related health implications arises (i.e., headache, alteration of sleep, lack of concentration).

6.6.38 As outlined in Chapter 15 'Noise and Vibration', very significant to significant effects are predicted as a result of sheet piling works, particularly for those receptors in Areas 3, 4, 5, 6, 7, 8 and 10. Based on the guidance of BS5228, 75dBA $L_{Aeq,10hr}$ (08:00 – 18:00) is in general the upper trigger value, or threshold above which noise insulation or temporary rehousing should be offered to affected residents. Following implementation of construction noise and vibration mitigation efforts, some impacts will remain. It has been assumed that site hoarding and local barriers (screening) blocking line of site to works will be instated and therefore provide 10dB attenuation as per the guidance of BS 5228 and reduce the noise impact to below the 75dB $L_{Aeq,10hr}$ upper trigger limit. Although these impacts remain in areas close to sheet piling, the activities are temporary in nature and with good communication of activity scheduling the impact can be managed. **Short-term significant adverse** residual impacts of noise remain for Areas 5, 6, 8 and 10, **short-term**

moderate adverse residual impact for Area 7 and **short-term slight adverse** residual impact for Area 1, 2, 3, 4 and 9.

6.6.39 As outlined in Chapter 15 'Noise and Vibration', sheet-piling is proposed during WP 3, WP 4A and WP 4B, to enable the construction of the flood defence walls along the River Duiske and Barrow. An assessment on vibration impacts has been carried out and is presented in the abovementioned chapter however **no impacts** on human health are identified as a result of vibration.

Odour and Pests

6.6.40 If improperly managed, waste can build-up in construction areas and compounds, giving rise to both odour and pest concerns. This is similar for improperly managed ablution facilities and/or temporary septic tanks. An assessment of both elements has been addressed in detail in Chapter 7 'Material Assets' (waste management element) and Chapter 13 'Air Quality' (odour element) however the implementation of mitigation measures outlined in these respective chapters is considered to be sufficient to reduce human health impact to **negligible** in relation to odour and pests.

Water & General Construction Safety

6.6.41 The potential for effects on water and general construction safety during the construction phase of the Proposed Scheme have also been considered. During the construction phase of the Proposed Scheme, life buoys will be required to be relocated along the quays, Well Lane and Turf Market to facilitate construction works, and all works areas will require clear demarcation, signage and fencing to avoid public access. However, access to the river will be significantly curtailed temporarily due the physical presence of the construction works and associated disconnect from the river. A neutral effect on water safety is therefore identified during the construction phase of the Proposed Scheme. A **negligible** effect on general construction safety is identified, as best practise construction will mitigate risk.

Water Contamination

6.6.42 This section specifically addresses possible impacts in relation to the contamination of waterbodies from a human health perspective. Ecology-related impacts of contaminated water is addressed in Chapters 8 'Hydrology' and 10 'Biodiversity'. Contamination of water bodies (namely the River Duiske and River Barrow) is possible via construction-related septic waste and hydrocarbons, possible through accidental overflows, mismanagement, equipment faults, and spillage and because G-T has a direct connection to the rivers, impact of this to human health is possible. Pre-mitigation, the significance of impact from a construction related contamination event (unplanned major accidents are addressed separately in Chapter 17) is considered to be very significant given the nature of the River Duiske as one of high recreational activity. However, as part of best practice construction, the implementation of mitigation regarding the management of septic facilities and hydrocarbons storage, and the maintenance of plant and equipment will reduce this impact to **negligible**.

Operation and Maintenance Phase

Impact to Population

6.6.43 Without intervention, G-T faces the continued onset of a range of issues associated with flooding including flood damages, extensive community disruption and health and safety issues. Further, the existing flood risk in G-T may continue to influence the nature, scale and extent of development in the area. The delivery of the proposed FRS will significantly improve the impacts of recurrent flooding events which have caused widespread damage to public and private property in G-T and will deliver increased resilience for potentially worsening flood events in the future. By providing for a 1 in 100 year 1% AEP the FRS will protect G-T from serious fluvial flooding. The proposed flood defences will also provide for a possible future flood level increases due to climate change. A **permanent very significant positive** impact is assigned.

Residential Properties

6.6.44 Flooding has the potential to cause significant damage to residential properties and result in a loss of possessions, implicating human wellbeing and creating financial pressure. The Proposed Scheme will be designed to provide protection to properties in the study area from the 1 in 100-year flood event (1% AEP). A total of approximately 33 residential properties have been estimated to benefit from the scheme. Therefore, significant positive impacts are predicted, that last into the long-term.

6.6.45 The new flood walls averaging 1.4m and 1m in height along Graiguenamanagh and Tinnahinch Quay respectively are to be constructed and will permit continued views of the river or of the far bank from at least the higher levels of residents' houses and, in many cases, the ground level too. Further detail of visual impact is discussed in Chapter 11 ‘Landscape and Visual’.

6.6.46 The higher environmental quality and reduction in flood risk could potentially encourage new residential development, including on the north bank where flooding impacts on the existing apartment area are more indirect and associated with road access. A **long-term significant positive** effect is therefore identified on future residential opportunities.

Local Traffic Movement

6.6.47 Once the FRS has been constructed, there will be a need for ongoing maintenance works during operation however the traffic impact of this regular maintenance is not expected to be significant (refer to Chapter 7 ‘Material Assets’).

6.6.48 Flooding has the potential to disrupt traffic movement and the safe use of roads within the general study area, causing impact to normal operations of business, community facilities and assets (i.e., schools, hospitals, shops etc.). During operation, the Proposed Scheme will provide protection to road and road assets within the flood risk area during flood

events, namely R703, the quays, Turf Market, High Street and Main Street. Therefore, a **permanent significant positive impact** is predicted.

Socio-economic and Commercial Activity

6.6.49 One of the key long-term benefits of the Proposed Scheme is the avoidance of physical and material damage to commercial businesses, including lost trade in respect of the latter. This includes the avoidance of damage to, or functional loss of, buildings and property, damage or disruption to infrastructure and utilities, loss of earnings, loss of retail or commercial income, travel inconvenience and associated costs. The flood protection measures will also reduce the risk of flood damage to tourism amenities in the area such as shops, cafes, restaurants, hotels and guesthouses. This includes the subsequent cost of clean-up and repair operations. There will also be benefits for residents and businesses from potentially improved access to commercial buildings and property insurance.

6.6.50 A total of approximately 68 commercial properties have been estimated to benefit from the scheme. Therefore, **significant positive impacts** are predicted, that last into the **long-term**.

Local Amenity, Recreation and Tourism

6.6.51 In the long term, in the operational phase, the reduction in flood risk and investment in the public realm will provide a significant positive effect on tourism. Moreover, the operational phase offers the opportunity to protect and promote human health by creating opportunity for recreation and human health through rowing, kayaking, etc. as noted by the Environmental Health Service and outlined in Table 5-3.

6.6.52 The Proposed Scheme and associated flood defences are designed to ensure consistency with the existing land use and zoning of the area and are not planned to cause change to any of the recreational facilities currently present in the area. It is understood however, that there is an intangible connection to the river from a visual and recreational point of view, and the presence of flood defences in certain areas will result in a residual impact.

6.6.53 In the operational phase of the Proposed Scheme, access to, and use of the concrete steps on both Graiguenamanagh and Tinnahinch Quays will be restored. This will have a neutral effect.

6.6.54 To gain access to the mooring facilities and slipway during operation, flood gates are to be established in the flood walls along the quays, and arrangements will be put in place for interested parties. Whilst this is not anticipated to affect the use of the mooring facilities, the ease with which they are used and the contribution to the amenity value of the quays is considered to contribute to a **permanent slight adverse impact**.

6.6.55 The Proposed Scheme includes within its design the provision of an improved public realm offering, particularly along Graiguenamanagh Quay, where a boardwalk and landscaping features. These public realm improvements will contribute positively to both the cultural

and natural heritage appreciation of the river with both tangible and less tangible benefits for local amenity, health and wellbeing (further information is included in Chapter 11 'Landscape and Visual'). However, negative impact to the existing visual amenity of the area is likely to remain, particularly for those properties that currently have a river view or in those areas where viewpoints are considered sensitive to change. G-T, and particularly the quays, would be considered sensitive to visual change, given its current charm and historic character. A full review of visual impact during operation is included in Chapter 11 'Landscape and Visual', however, to summarise a **permanent, negative, slight adverse** impact is assigned.

6.6.56 The use of the South Leinster Way and Barrow Way will be reinstated during the operation of the scheme and will likely be enhanced by the public realm improvements proposed along the quays. Therefore, a **permanent minor positive** impact is assigned.

6.6.57 Taking the above into consideration, the overall impact of the FRS on local amenity, recreation and tourism is **long-term slight adverse**.

Impact to Human Health

6.6.58 Flooding has the potential to compromise human safety, impact negatively upon human psychological health and create significant financial pressure. The Proposed Scheme will be designed to provide protection to properties in the study area from the 1 in 100-year flood event (1% AEP) and is intended to reduce the vulnerability of the affected population to flooding events. Therefore, **long-term significant positive** impacts are available to human health as a result of the development.

6.6.59 As outlined in Chapter 13 'Air Quality', the only operational air emission sources will be from emergency water pumps and associated emergency generator. Whilst this is not envisaged currently, it has been considered as a precaution for future measures. Moreover, there are operational air emissions from the limited operational traffic discussed in Section 6.6.47. As such, the impact on nearby receptors is **negligible.**

6.6.60 As outlined in Chapter 15 'Noise and Vibration', a surface water drainage network and pumping stations will be constructed on the dry side of the flood defence walls along Tinnahinch Quay to prevent flooding occurring from rainwater run-off from hardstanding areas in the flood zones when gravity discharge into the river is prevented by flood events. In total, 30 non-return valves will be installed at the pump stations outlet points. As the pumps will be in operation during emergency flooding events only, their impact on noise at nearby receptors is **negligible.**

6.6.61 With regards to human safety, during the operational phase, lifebuoys will be installed. The long-term positioning of these lifebuoys will be subject to an assessment to ensure they are sufficient.

6.6.62 Taking all into consideration, the overall impact upon human health during the operation and maintenance phase is **long-term, significant and positive.**

6.7 Mitigation Measures

6.7.1 The potential impacts upon population and human health, in large part, relate to other environmental aspects such as air quality, noise and vibration and traffic. Where required, the related mitigation measures are dealt with in the corresponding chapters of this EIAR, as detailed below:

- Chapter 7 'Material Assets'
- Chapter 8 'Hydrology - Surface Water'
- Chapter 9 'Cultural Heritage'
- Chapter 11 'Landscape and Visual'
- Chapter 12 'Land, Soils, Geology & Hydrogeology'
- Chapter 13 'Air Quality'
- Chapter 14 'Climate'
- Chapter 15 'Noise and Vibration'
- Chapter 17 'Major Accidents and Disasters'

6.7.2 From the perspective of the population and human health assessment, the mitigation proposed in these chapters is sufficient to address potential effects on sensitive receptors including pedestrians, cyclists, residents, businesses and visitors, and for amenity activity, especially during the summer and for festivals and tourism events. Additional mitigation measures are recommended that mitigate against impacts other than those outlined in the chapters listed above.

Construction Phase

6.7.3 A CEMP has been prepared alongside the EIAR (see Appendix 4-4) to provide guidance to the appointed contractor(s), setting out the mitigation measures identified in this EIAR as well as general site management best practise. The appointed contractor will be responsible in taking ownership of future iteration of this document and implementing all mitigation measures contained therein. It should be understood and implemented by all construction staff and sub-contractors throughout the construction process.

6.7.4 Prior to the commencement of construction, the appointed contractor will be required to obtain formal agreement from the Local Authority on pollution prevention measures as well the overall approach and emergency procedures for all construction stages.

6.7.5 Potential community safety risks associated with construction will be minimised through the implementation of standard industry best practises, to be outlined in a site-specific and comprehensive Health and Safety Plan/Programme. This is the responsibility of the

appointed contractor(s) to prepare, in line with their respective company health and safety policies as well as the requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. No. 291 of 2013). This Plan will detail measures for the management of both worker and community safety and will be implemented and monitored on site throughout the construction process, overseen by a dedicated Health, Safety and Environment Officer.

6.7.6 These measures will be further outlined in the site-specific detailed CEMP and accompanying Traffic Management Plan (TMP). These documents will be prepared in accordance with relevant environmental legislation as well as specific construction guidance for traffic management, waste management, general site management and health and safety management. The CEMP provided as part of this application, provides guidance for traffic management and preparation of a TMP.

6.7.7 The Contractors CEMP will further include implementation measures outlined within this EIAR for maintaining residential and visual amenity through housekeeping practices, minimisation of noise levels, vibration and air emissions (dust and pollutants) whilst also outlining planned working hours, what consultation will be undertaken to manage disturbance and all security to be in place to avoid trespass into construction areas. Further, the CEMP includes a Pest Control Plan (PCP) under Appendix 4-5 of this EIAR, to be implemented by the contractor(s) during construction).

6.7.8 As standard, the following mitigation measures shall be put into place:

PHH_1: During the pre-construction phase, the Health & Safety Plan/Programme, CEMP and TMP will be finalised. The documents shall reference commitments made as part of this EIAR for the protection of the environment and community throughout the construction process and will be updated as necessary through the entire construction stage.

PHH_2: Alongside the CEMP, appropriate health and safety planning and risk assessments shall be undertaken for the works planned, with appropriate training provided to workers and appropriate mitigation assigned. All construction works will be managed in accordance with these plans, and the Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. No. 291 of 2013).

PHH_3: Safety shall be at the forefront of construction management. A representative in charge of health, safety and environmental shall be appointed to manage all requirements of the Health & Safety Plan and CEMP. It will be their responsibility to ensure that all workers operating on the Proposed Scheme are aware of their requirements with regards to health and safety management both on site, and in the community. Where training is required, this will be provided by this representative, or specialist external parties, as appropriate.

PHH_4: The construction areas, including all laydown areas and haulage routes, will be managed in accordance with best practise safety operations, ensuring that all areas are

demarcated with appropriate fencing and warning signage, kept tidy with a regular housekeeping regime, and restricted for entry to ensure safety of the general public.

PHH_5: The construction sequencing will be subject to review, to ensure that public safety and convenience is maintained, particularly where construction areas intersect with walkways and/or amenity areas. Appropriate diversion or closure of these will be required, completed in a safe manner and to avoid disturbance as much as possible.

PHH_6: The Contractor will be responsible for the security of the site during each phase. The Contractor will be required to:

- Operate a site induction process for all site staff.
- Ensure all site staff shall have current 'safe pass' cards.
- Install adequate site hoarding to the site boundary.
- Maintain site security staff at all times.
- Provision of separate pedestrian access from construction and safe walkway for pedestrians along the main roads in Study Area.
- Ensure restricted access is maintained to the works.

PPH_7: The Contractor(s) will be required to implement the Pest Control Plan (PCP), as detailed in the CEMP.

PHH_8: Accesses shall be constructed, as designed, to ensure existing pedestrian/cycling/vehicular linkages are maintained.

PHH_9: A Public Liaison Officer will be assigned by the Contractor(s) to deal with public queries and relations matters etc. The Public Liaison Officer will hold monthly 'open' evenings for 1 hour for community to offer feedback. They shall manage all consultations with the general public, including the receipt and management of any public complaints/concerns. Appropriate record keeping and response procedures will be required.

Operation and Maintenance Phase

PHH_10: The Project will be subject to safety design review, to ensure all defences have been designed with appropriate public safety measures in mind, particularly given the nature of the area as a public amenity. Any access ways that will be constructed as part of the Project will also be subject to review.

PHH_11: When the Scheme is operational, a maintenance and monitoring schedule will be put in place to verify that the proposed flood defences are operating to the appropriate design standard. Repairs will be made as necessary. This will ensure that there is no risk to

human health as the scheme ages. All mitigation measures outlined for the construction process (PHH1-9) shall apply, where relevant, to the maintenance and monitoring regime.

6.8 Monitoring

6.8.1 In the context of the impact upon population and human health, it is considered that the monitoring measures set out in relation to the other environmental topics assessed within this EIAR are sufficient to address monitoring requirements. As outlined in the CEMP, site specific health and safety requirements will be implemented.

6.9 Residual Impacts and Effects

Construction Phase

6.9.1 During all construction stages and WPs, the individual working areas will result in some restrictions and potential inconvenience to the movement of people and traffic. These restrictions will be temporary or short-term in nature and centred on the immediate vicinity of the proposed working areas. A **short-term slight adverse** residual effect on local traffic movements is therefore identified during the construction phase of the Proposed Scheme.

6.9.2 A range of multi-disciplinary potential impacts were predicted to the health, wellbeing and safety of the identified populations and receptors, the residual effects of which are discussed in respective EIAR chapters, as mentioned throughout this chapter. Of note however are the residual impacts of noise generation during the construction phase, whereby residual impacts of **short-term significant adverse** and **moderate adverse** remain, particularly for those receptors in Areas 5, 6, 7, 8 and 10. Further details are included in Chapter 15 'Noise and Vibration'.

6.9.3 A positive residual impact remains with regards to commercial activity, whereby local economy stimulation may occur during the construction period through use of local accommodation or businesses by construction workers, or through direct and indirect employment opportunities related to the construction process. This impact is assigned as, **temporary slight positive**.

Operation and Maintenance Phase

6.9.4 The intention behind the Proposed Scheme is to offer protection to communities, homes and businesses from fluvial and alluvial flooding events to the design standard which will protect 31 homes that previously would have been subject to disruption within the study area. The installation of the flood defences will significantly reduce human health and psychological concerns around flooding and potentially encourage further development and investment into the area. Impacts identified in Section 6.5 that are of particular relevance from a socio-economic perspective include the avoidance of damage to, or

functional loss of, buildings and property, damage or disruption to infrastructure and utilities, loss of earnings, loss of retail or commercial income, travel inconvenience and associated costs, and potentially the avoidance of the temporary evacuation of residents.

6.9.5 The increased flood protection will contribute to securing businesses and jobs in the area. Existing properties will benefit from the greater flood protection, and this will also contribute towards attracting additional investment and jobs to the area as properties become more attractive to rent or buy. Areas that might previously have been subject to flood risk or consequent development restrictions will potentially be available for new development and investment.

6.9.6 The residual impact to population and human health during the operation of the scheme will be **long-term significant and positive**.

6.9.7 Whilst the design of the Proposed Scheme includes an attractive public realm design, particularly along Graiguenamanagh Quay, and connection to the River Barrow (i.e., glass flood, flood gates), a residual impact remains, as conditions will be altered from baseline. This is particular for those residential properties, amenity areas and businesses where viewpoints are considered sensitive to change. A full review of these impacts is included in Chapter 11 'Landscape and Visual' however a **slight to moderate residual impact** has been assigned, in summary.

6.9.8 **Significant positive impacts** in terms of public health and socio-economic benefits with resultant benefits for human health are predicted on the basis of having an effective flood relief scheme.

6.10 Interactions with other Environmental Effects

6.10.1 Interactions between the Population and Human Health assessment and other environmental parameters is key in providing a full assessment of human health effects, particularly as human health is determined largely on the exposure of populations to environmental conditions, all of which are likely to be altered during the construction and operation of the Proposed Scheme. Key areas of interaction include:

- Impacts to the population with regards to the requirement for infrastructure and services, exposure to increase construction congestion, limitations to access of walkways and cycling routes during construction and exposure to improper construction housekeeping (waste management). All are outlined in Chapter 7 'Material Assets'
- Impacts to the population with regards to reduced visual and landscape amenity in the immediate works are during construction, and with the presence of flood defences during operation. This is outlined in Chapter 11 'Landscape and Visual'.
- Impacts on human health from construction-related air emissions of pollutants and dust. This is outlined in Chapter 13 'Air Quality'.

- Further interactions exist with regards to impact to Climate under the 'do nothing' scenario, whereby continued and worsening flooding will cause further economic and social burden to those communities in the flood risk zone. From the operation phase perspective however, the successful implementation of the Proposed Scheme has significant positive impacts by providing protection against flooding. This is outlined in Chapter 14 'Climate'.

- Impacts on human health from construction-related noise and vibration. This is outlined in Chapter 15 'Noise and Vibration'.

- Impacts on human health in relation to changes in water quality. This is outlined in Chapter 8 'Hydrology – Surface Water'.

- Impacts on tourism and general amenity with regards to any alterations/impacts to specific Cultural Heritage assets, and the historic character of the towns. The settlement of G-T is renowned for its heritage and tourist attractions which has now evolved the settlement into an attractive tourist destination. Main assets that are nationally and internationally renowned include the Duiske Abbey, Tinnahinch Castle and St. Michael's Well. This is further discussed in Chapter 9 'Cultural Heritage'.

6.11 Cumulative Impacts

6.11.1 A full review of the potential cumulative impacts is provided in Chapter 16 'Interactions and Cumulative Effects'. However, in summary, if the construction periods of the identified projects overlap with the GTFRS, there is potential to cause cumulative impacts upon population and human health as a result of:

- Changes to local traffic conditions, including additional volumes of vehicles, and potential for lane closures/diversions etc. from multiple construction processes.

- Generation of vehicular pollutants and dust from the operation and movement of construction vehicles.

- Generation of noise and vibration from the operation and movement of construction vehicles / plant, and construction activities (i.e., earthworks, sheet piling etc.).

6.11.2 The above may impact upon general population wellbeing, population health, tourism, recreation and operation of commercial businesses in the impact zones of these projects. However, the effects will be temporary, limited to the construction periods of each project.

6.11.3 Once operational, the Proposed Scheme, when considered cumulatively with the above developments, will have a positive impact to the population of the study area (and generally to the local authority areas), through improved opportunities for business, recreation and tourism in the area.

6.12 Limitations in Preparing the Chapter

6.12.1 There were no limitations in the preparation of this chapter.

6.13 Summary Table

Table 6-9: Summary of Impacts and Mitigation Measures: Population and Human Health

Location	Receptor/ Population Subset	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
'Do Nothing' Scenario Impacts						
General, Study Area	All, including residents, visitors/, business owners.	Maintenance of current flood risk condition causing disruption and implications for human health and wellbeing.	Negative, significant	Long-term/ permanent in effect, but brief during potential flood events	Mitigation not applicable in 'do nothing' scenario.	Negative, long-term/permanent in effect, but temporary during potential flood events
Construction Phase Impacts						
General, Study Area	All, including residents, visitors/, business owners.	General nuisance impacts from increased traffic movements, annoyance, alteration of journey plans, alteration of pedestrian walkways.	See Chapter 7 'Material Assets'.			
		Health impacts from air emissions (pollutants and dust).	See Chapter 13 'Air Quality'.			
		Noise nuisance, loss of concentration and health implications of vibration annoyance.	See Chapter 15 'Noise and Vibration'.			
		Worsened visual amenity	Chapter 11 'Landscape and Visual'.			

Location	Receptor/ Population Subset	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
		Improper waste management leading to odour and pest issues.	See Chapter 7 'Material Assets' and Chapter 13 'Air Quality'.			
Graiguenamanagh Quay. Tinnahinch Quay. Main Street. High Street.	Business owners, users or commercial properties.	• Use of local accommodation and businesses by contractor staff. • Direct and indirect employment opportunities around the construction phase (i.e., waste collection).	Positive, Slight	Short-term (construction phase)	Not Applicable (positive impact).	Positive, Slight
Graiguenamanagh Quay.	Local amenity users and tourists	Closure of Graiguenamanagh Quay.	Negative, Moderate	Short-term (WP 4A duration of 18 months).	• Maintaining access points. • Appropriate construction sequencing. • Safe pedestrian access. • Limit land grab associated with amenity/green areas. • Avoidance of summer months for closure period.	Negative, Slight
		Closure of concrete steps opposite the Boat Club (recreational river access).	Negative, Moderate	Short-term (WP 4A duration of 18 months).	• Minimisation of closure period through construction sequencing.	Negative, Slight

Location	Receptor/ Population Subset	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
	Boat owners and users	Removal of mooring facilities and required relocation of boats.	Negative, Significant	Short-term (WP 4A duration of 18 months).	• Plan, in consultation with Waterways Ireland and other stakeholders, to ensure some mooring is available for the duration of the works. • Minimisation of closure period through construction sequencing.	Negative, Moderate
	Boat owners and users. Boat Club.	Closure of slipway.	Negative, Slight	Temporary (12 weeks)	• Plan, in consultation with Waterways Ireland and other stakeholders, to minimise impact. • Minimisation of closure period through construction sequencing.	Negative, Not Significant
Tinnahinch Quay.	Local amenity users and tourists	Closure of Tinnahinch Quay.	Negative, Moderate	Temporary (WP 4B duration of 12 months).	• Maintaining access points. • Appropriate construction sequencing. • Safe pedestrian access. • Limit land grab associated with amenity/green areas. • Avoidance of summer months for closure period.	Negative, Slight

Location	Receptor/ Population Subset	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
		Closure of concrete steps opposite lock gates (recreational river access).	Negative, Moderate	Temporary (WP 4B duration of 12 months).	• Minimisation of closure period through construction sequencing.	Negative, Slight
	Boat owners and users	Removal of mooring facilities and required relocation of boats.	Negative, Significant	Temporary (WP 4B duration of 12 months).	• Plan, in consultation with Waterways Ireland and other stakeholders, to ensure some mooring is available for the duration of the works. • Minimisation of closure period through construction sequencing.	Negative, Moderate
General, Study Area	All, including residents, visitors/, business owners.	Safety implications of construction-related presence.	Negative, significant	Short-term (construction phase)	• Implementation of best practise construction methods. • Preparation of Health & Safety Plan / Programme and implementation of best practise safety procedures. • Implementation of CEMP & TMP.	Imperceptible
Site Compound D (Boat Club) Site Compound E (Hotel Street)	All, including residents, visitors, business owners.	Loss of amenity green space.	Negative, Not Significant	Short-term, limited to construction of WP 4A and WP 4B.	• Maintain compounds to the minimum size required.	Imperceptible

Location	Receptor/ Population Subset	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
Operation and Maintenance Phase Impacts						
Flood Risk Zone	All, including residents, visitors, business owners.	Reduced vulnerability of the affected population, commercial businesses/ activity and homes to flooding events.	Positive, Significant	Permanent in effect	Not Applicable (positive impact).	Positive, Significant
General, Study Area	Residents and visitors.	Roads previously vulnerable to flooding no longer subject to closure.	Positive, Significant	Permanent in effect	Not Applicable (positive impact).	Positive, Moderate
The Quays		Altered access to mooring facilities by controlled flood gates.	Negative, Slight	Permanent	Mitigation not possible without alteration in flood defence design (and possible reduction in effectiveness).	Negative, Slight
General, Study Area		Reduction in visual amenity and effect to the intangible connection to the river, particularly for those properties with river view.	See Chapter 11 'Landscape and Visual'.			

6.14 References

Carlow County Council . (2022). *Carlow County Development Plan 2022 – 2028.*

Central Statistics Office. (2022). *Census*. Retrieved 06 15, 2022, from https://www.cso.ie/en/census/

DHPLG. (2018). *Guidelines for Planning Authorities and An Bord Pleanala on Carrying out Environmental Impact Assessment.* Dublin: Department of Housing, Planning and Local Government.

EPA. (2022). *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.*

Fáilte Ireland. (2011). *Guidelines on the Treatment of Tourism in an Environmental Impact Statement.*

IEMA. (2017). *Health in Environmental Impact Assessment - A Primer for a Proportionate Approach. .*

Kilkenny County Council. (2014). *Kilkenny County Council County Development Plan 2014 – 2020.*

Kilkenny County Council. (2021). *Kilkenny City and County Development Plan 2021-2027.* Kilkenny County Council.

Kilkenny County Council and Carlow County Council. (2021). *Graiguenamanagh – Tinnahinch Joint Local Area Plan 2021.* Kilkenny County Council and Carlow County Council.

Kilkenny County Council. (n.d.). *Graiguenamanagh / Tinnahinch Tourism and Recreational Project Concept Study .*

7 Material Assets (Built Services; Roads, Traffic and Transportation; Waste Management)

7.1 Scope of the Assessment

7.1.1 This chapter describes the likely impacts of the construction and operation of the Proposed Scheme upon on material assets including built services and infrastructure and materials and resources. The EPA Guidelines on Information to be Contained in Environmental Impact Assessment Reports (EPA, 2022) divides Material Assets into three typical headings, the first 'road and traffic', the second 'built services' which in turn includes the following typical topics: electricity, telecommunications, gas, water supply infrastructure and sewerage, and the third 'waste management'.

7.1.2 Therefore, this Chapter of the EIAR reviews impacts to the following:

- Roads, traffic and transportation, including:
    - Roads and Traffic
    - Pedestrian and Cycling Network
- Utilities and built services, including:
    - Wastewater Infrastructure
    - Water Supply Infrastructure
    - Electricity Supply
    - Gas Network
    - Digital Infrastructure (telecommunications)
- Waste Management

7.1.3 As outlined in the EPA 2022 Guidelines, concerns regarding land take (and possible change in land use) are to be addressed in the land and soils chapter of the EIAR (Chapter 12). Archaeological and Heritage impacts are addressed separately in Chapter 9 of this EIAR and natural assets in Chapter 8 'Surface Water', Chapter 10 'Biodiversity', Chapter 12 'Land, Soils, Geology and Hydrogeology' and Chapter 13 'Air Quality'.

7.1.4 The following aspects of the Proposed Scheme have been considered relevant to the assessment of impacts to Material Assets:

- Design:
    - Consideration of existing material assets (infrastructure and utilities) in proximity to the Proposed Scheme.
- Construction:
    - Potential for infrastructure and utility diversions.

- Impact of potentially intrusive temporary construction activities occurring in proximity to existing material assets.
- Potential for temporary construction-related traffic generation in the study area and disturbances to normal traffic flow (i.e., diversions, land closures) or parking provisions.
- Potential for temporary access limitations to walkways and cycle paths during phases of the construction process.
- Generation of waste management streams during construction.

- Operation Phase:
  - Proximity of any maintenance works to existing material assets.

7.2 Statutory and Policy Context

Legislation

7.2.1 This Chapter has been prepared with regard to the EIA Directive and EIA Guidelines (EPA, 2022) (DHLGH, 2018), as well as the following:

- Transport Infrastructure Ireland (2014) Traffic and Transport Assessment Guidelines, PE-PDV-02045.
- Transport Infrastructure Ireland. Project Appraisal Guidelines for National Roads Unit 5.3 - Travel Demand Projections – May 2019.
- National Roads Authority (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide.
- Guidance for the Control and Management of Traffic at Road Works – Second Edition 2010, published jointly by the Department of Transport, Health and Safety Authority, National Roads Authority and the Local Government Management Services Board.
- EPA (2021) Best Practise Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects.
- Waste Management Act 1996 (No. 10 of 1996) as amended.
- Environmental Protection Act 1992 (No. 7 of 1992) as amended.
- Litter Pollution Act 1997 (No. 12 of 1997) as amended.
- Planning and Development Act 2000 (No. 30 of 2000) as amended

Local Policy

7.2.2 The Graiguenamanagh Tinnahinch (G-T) Joint Local Area Plan 2021-2027 has been prepared by KCC and CCC and sets out an overall strategy for the planning and sustainable development of the town and village. It is built upon a series of development principles that promote the economic, social, cultural and sustainable progress of the settlements.

7.2.3 The following Strategic Objectives are relevant to aspects of this Material Assets chapter:

- *SO3: To facilitate the development of high quality, integrated neighbourhoods that cater for an appropriate demographic mix and deliver, where possible, community, recreation and amenity facilities in tandem with housing to be encouraged through new development.*
- *SO4: To support the creation and enhancement of a network of pedestrian walkways, footbridges and open spaces connecting the River Barrow and other recreational and tourist attractions within the settlement whilst ensuring the protection and preservation of the natural and built heritage of the area.*
- *SO5: To improve permeability, accessibility and mobility throughout the town of Graiguenamanagh.*
- *SO6: To improve pedestrian and cycling mobility across the River Barrow between Graiguenamanagh and Tinnahinch so as to ensure ease of access to services and amenities.*
- *SO8: To improve the quality of the existing transport network in particular pedestrian connections in the settlement to increase permeability and connectivity in order to provide universal access to key land uses such as community facilities, including schools and sports clubs, and new and existing development lands.*
- *SO9: To phase future growth in line with the capacity of supporting physical infrastructure and to ensure that it occurs in accordance with proper planning and sustainable development.*
- *SO10: To ensure development proposals conform to best practice urban design principles to deliver well planned and integrated development including renewal regeneration that will enhance the settlement and improve the quality of life of its residents.*
- *SO11: To encourage and facilitate regeneration and renewal of existing properties within the settlement to improve place making and quality of life throughout the town together with providing rejuvenation of the town centre with an improved public realm.*
- *SO12: To phase new development as appropriate to ensure that it occurs in an orderly and efficient manner in accordance with proper planning and sustainable development.*

7.2.4 As a response to Strategic Objectives outlined in the LAP regarding traffic and mobility, the Graiguenamanagh-Tinnahinch Mobility Management Study 2021-2026 was commissioned to improve the quality of the existing transport network and pedestrian connections, promote connectivity and permeability and manage provision of parking. The Plan was prepared with consideration of national polities such as the Smarter Travel – A Sustainable Transport Future 2019-2020, National Cycle Policy Framework 2009-2020 and as well as local Development Plans and LAPs. The recommendations made in this Plan are referenced in the impact assessment section of this Chapter.

7.3 Assessment Methodology

Study Area

7.3.1 The principal study area is determined by the scheme boundary and generally includes the townlands of G-T and the surrounding environs, the River Duiske and River Barrow and the environs surrounding the proposal upstream storage area. The wider study area is that area which is affected by possible changes to infrastructure / utility service provision as a result of the Proposed Scheme.

Assessment of Impacts

7.3.2 This EIAR presents the Material Assets Chapter in relation the 'typical topics' outlined in the EPA 2022 Guidelines, including 'road and traffic', 'built services' and 'waste management'. Cultural assets, previously regarded as being included in the assessment of Material Assets as per the Directive 2011/92/EU, is now considered to require an individual assessment. This has therefore been included in Chapter 9 of this EIAR 'Archaeology and Cultural Heritage'.

7.3.3 With regards to roads, traffic and transportation, the assessment presents the baseline transport environment based upon information received from desk-based review. An evaluation of the potential increase in traffic associated with the construction of the Proposed Scheme is then undertaken, assessing the likely change from baseline conditions. The assessment focuses largely on the construction phase (i.e., number of Heavy Good Vehicle (HGV) and Light Goods Vehicle (LGV) trips), but also considers relevant impacts during operation and maintenance phase. As part of this, the pedestrian and cycling network was also reviewed within the study area, and an assessment made with regards to the potential disturbance of these facilities during the construction, operation and maintenance phases.

7.3.4 With regards to built services and utilities, the assessment provides focus upon the potential for disturbance to these facilities both through the construction activities and long-term presence of the defences.

7.3.5 With regards to the waste assessment, a review of the predicted waste generation (including waste types, toxicity and quantities) during the construction was conducted in relation to the Proposed Scheme, and an assessment of the potential environmental impacts followed, relative to this. The assessment focuses on the construction phase of

the Proposed Scheme, as waste generation impacts are not considered relevant during the operation and maintenance of the flood defences.

7.3.6 Likely significant effects are categorised in accordance with the EPA 2022 Guidelines, as outlined in Chapter 1 'Introduction' Significant effects are compared between the 'Do-Nothing' and the 'Do-Something scenarios', the latter split into the construction and operation and maintenance phases. Significant effects can be positive, neutral or negative, and can arise from direct, indirect, secondary and cumulative means.

Data Sources

7.3.7 The appraisal of likely significant effects on material assets was conducted through an initial desk-top review of the land use, built assets and infrastructure in the areas adjacent to the Proposed Scheme. Baseline information was sourced from a number of secondary data resources including:

- Graiguenamanagh Tinnahinch Joint Local Area Plan 2021-2027 (Kilkenny County Council and Carlow County Council, 2021).
- Kilkenny City and County Development Plan 2021-2027 (KCC, 2021).
- Carlow County Development Plan 2022 – 2028 (CCC, 2022).
- Graiguenamanagh-Tinnahinch Mobility Management Study 2021-2026 (Roadplan Consulting, 2021).
- Central Statistics Office, Census Data (https://www.cso.ie/en/census/).
- Uisce Éireann Website.
- EPA database and interactive portal (accessed 2022-2025).
- Aerial photography.
- Urban Wastewater Treatment in 2020 (EPA, 2020).

Site Visits / Surveys

7.3.8 A number of site visits to the study area were conducted in the period from 2020 to 2023 throughout the EIA process. Specific details were recorded in relation to existing infrastructure and utilities, all of which supported in the preparation of the baseline environment section of this Chapter.

Consultation

7.3.9 During the EIA, consultations were made to seek opinions and input from statutory bodies, regulators, organisations, research bodies, community facilities and residents that have an interest or who may be affected by the Proposed Scheme. Data/information was also provided by stakeholders in some cases, where relevant, for incorporation into the EIA study. This chapter has been prepared with consideration of the outcomes of this

consultation, which is detailed further in Chapter 5 'Consultation and Stakeholder Engagement'.

7.3.10 Specific to this Chapter, communications were received from Uisce Éireann regarding the existing assets in the area and the requirement for the Proposed Scheme to be aware of these, to ensure that no negative impact is incurred from the construction and operation of the FRS, and to consider providing protection to those at risk of flooding. A full summary of the correspondence received is included in Table 5-3 in Chapter 5 'Consultation and Stakeholder Engagement'. Information as to how the project team have reacted and responded to these communications is also outlined in the table referenced above. In terms of this EIAR chapter, a review of the potential impact of the FRS upon infrastructure assets is included and mitigation recommendations provided to reduce and/or eliminate impact. These are reflected also in the CEMP for uptake by the construction contractor (see Appendix 4-4).

7.3.11 Further, observations were received from Transport Infrastructure Ireland (TII) highlighting that any impact of the FRS upon national roads or their assets should be fully assessed and communicated to TII through formal channels, and that appropriate measures are put into place to limit impact as far as possible. Further, a request is made that in conducting the EIAR, regard should be given to various TII Publications, including Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes', and 'Guidelines for the Treatment of Noise and Vibration in National Road Schemes'). A full summary of the correspondence received is included in Table 5-3 in Chapter 5 'Consultation and Stakeholder Engagement'. Information as to how the project team have reacted and responded to these communications is also outlined in the table referenced above. In terms of this EIAR chapter, the identification of haulage routes and a review of impacts upon local traffic conditions and national roads is included, with mitigation recommendations set out. These are reflected also in the CEMP for uptake by the construction contractor.

7.3.12 A response from the Carlow-Kilkenny Environmental Health Officer provided general observations on the EIA Scoping Report, recommending that a full review of impacts to the pedestrian and cycling network, the wastewater infrastructure, the water supply infrastructure and waste management are provided, and that appropriate mitigation is outlined to reduce/eliminate impacts identified.

7.4 Baseline Environment

Roads, Traffic and Transportation

Graiguenamanagh-Tinnahinch Mobility Management Study 2021-2026

7.4.1 The Graiguenamanagh-Tinnahinch (G-T) Mobility Management Study 2021-2026 (Roadplan Consulting, 2021) was established in October 2021 with the objective to improve the quality of the existing transport network and increase connectivity to provide universal access to key land uses. This was identified as a key and strategic objective of the Local Area Plan.

7.4.2 A list of suggestions is provided in relation to improved transport mobility within the towns, specifically to increase pedestrian and cycleway mobility, to improve access to bus routes and stops, to improve mobility coordination with the schools in the town, to improve mobility and traffic flow within the settlement centre and to provide alterative and improved parking provisions.

7.4.3 Interactions between the planned mobility alterations within the towns and the Proposed Scheme require huge consideration. Where it has been confirmed a requirement by KCC, the scheme design has taken into consideration the suggestions of the Mobility Management Study, including most notably the alterations of the two-way system and the proposed upgrades and new pedestrian, and cycling pathways on the Graiguenamanagh Quay. A Landscape Designer (TBS) has been brought on board to coordinate the efforts of the design of the flood defences together with the provision of public realm considerations and mobility requirements. Further information is included in Chapter 11 'Landscape and Visual'.

7.4.4 The following section provide a summary of the road, transport, pedestrian and cycling infrastructure existing in G-T.

Roads Network

7.4.5 All roads in the scheme study area are maintained by the respective County Councils, however any modifications to National Primary and Secondary roads would require consultation with Transport Infrastructure Ireland (TII). As of March 2023, there are no major roads projects on TII's Major Roads Project Active List proposed within the vicinity of the study area (TII, 2024).

7.4.6 The study area is served by the road network with regional ('R') roads the greatest capacity roads present in the vicinity of the Proposed Scheme. These include the R703 connecting Thomastown with Ballymurphy and the R702 and the R705 connecting Leighlinbridge with The Rower via Bagnalstown and Borris. The R703 is the main road that runs east to west between Tinnahinch and Graiguenamanagh and crosses the Barrow River via a bridge. It is also the road which will provide access to the proposed upstream storage area, along with the local ('L') road L4209. The R705 runs north to south and intersects the R703 at the Harristown Roundabout. It provides an alternative route into Graiguenamanagh from surrounding towns (i.e., New Ross).

7.4.7 Along the Quays and in parts of the town of Graiguenamanagh, traffic movement is relatively constrained by narrow roads and provisions of roadside and quayside parking.

7.4.8 The principal traffic infrastructure in the G-T LAP is summarised as follows (Roadplan Consulting, 2021),:

- Signalised shuttle traffic management system of Lower Main Street with perpendicular and parallel side streets consisting of:
    - R703 Upper & Lower Main Street (Northeast & Southwest).

- R705 Borris Road (North) & R705 Graiguenamanagh Relief Road (West).
- Secondary perpendicular streets: The Quay (North), Main Street (North), High Street (North), Mill Road (North), Bray Lane (North), Fairview (North), The Quay (South) & Mill Road (South)
- Secondary parallel streets: Barrow Lane (East), Convent Lane (East), Fairview (East), Turf Market (West) & Mill Road (West)

- Current one-way only streets within the joint settlement are as follows:
  - Fairview (Abbey/Community Hall Section)
- There are no priority-yield streets within G-T.
- Pedestrian crossings existing at various locations around the town and the majority are uncontrolled crossings.

7.4.9 The majority of the existing junctions within the joint settlement are priority-controlled junctions. However, to the north and southwest of Graiguenamanagh town centre there are two roundabout junctions at the extremities of R705 Graiguenamanagh Relief Road (Roadplan Consulting, 2021):

- R705/R703 Upper Main Street, Harristown Roundabout.
- R705/Brandondale Road, Brandondale Roundabout.

7.4.10 The speed limit within the built-up area of the joint settlement is generally 50km/h with 60km/h and 80km/h zones on the approaches.

7.4.11 Graiguenamanagh Bridge provides road and pedestrian access between Graiguenamanagh and Tinnahinch and it is the only bridge crossing the River Barrow until:

- the R705 crosses the River Barrow into Factory Cross, Co. Carlow, at c. 7.1 km north of Graiguenamanagh Bridge.
- the R700 crosses the River Barrow into MacMurrough Island, Co. Wexford, at c. 21.7 km south of Graiguenamanagh Bridge.

Traffic

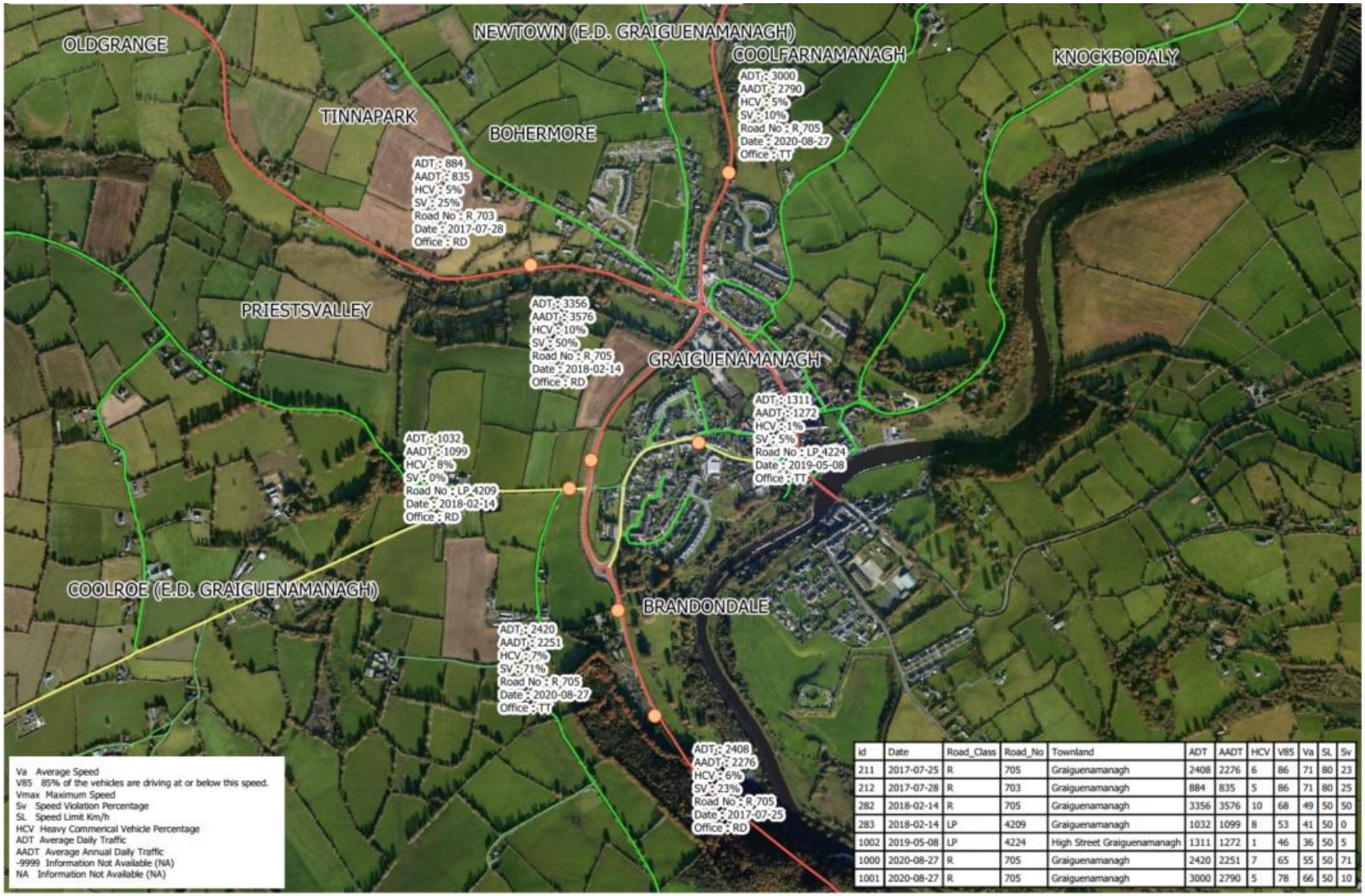
7.4.12 Table 7-1 presents data of 7-day traffic counts undertaken in Graiguenamanagh town between 2017 and 2020. Annual Daily Traffic (ADT) ranges from 884 to 3356 and Annual Average Daily Traffic (AADT) between 835 and 3576, with the highest traffic counts recorded on Road No. 705 and the lowest on Road No. 703. The highest vehicle speeds are also recorded on both of these roads, with a moderate to high percentage of speed violations recorded (especially on Road No. 705). Generally, the percentage of Heavy Commercial Vehicles (HCV) travelling through the town is low, ranging from 10 – 1%, with Road No. 705 illustrating the highest percentage.

7.4.13 The data in Table 7-1 has been represented on a map in Figure 7-1, illustrating the location of the counts and data compiled for each location. Traffic data for Tinnahinch has been requested and was not available at the time of writing.

Table 7-1: Graiguenamanagh Traffic Counts

Date	Road Class	Road No.	Town	ADT	AADT	HCV %	V85 (km)	Va (km)	SL (km)	Sv %
25-07-17	R	705	Graiguenamanagh	2408	2276	6	86	71	80	23
28-07-17	R	703	Graiguenamanagh	884	835	5	86	71	80	25
14-02-18	R	705	Graiguenamanagh	3356	3576	10	68	49	50	50
14-02-18	LP	4209	Graiguenamanagh	1032	1099	8	53	41	50	0
27-08-20	R	705	Graiguenamanagh	2420	2251	7	65	55	50	71
27-08-20	R	705	Graiguenamanagh	3000	2790	5	78	66	50	10
08-05-19	LP	4224	High Street Graiguenamanagh	1311	1272	1	46	36	50	5

Abbreviations:
ADT: Annual Daily Traffic
AADT: Annual Average Daily Traffic
HCV: Heavy Commercial Vehicles
V85: 85% if the vehicles are driving at or below this speed
Va: Average Speed
SL: Speed Limit
Sv%: Speed Violation Percentage.
Source: pers comm. KCC, November 2020.



id	Date	Road_Class	Road_No	Townland	ADT	AADT	HCV	V85	Va	SL	Sv
211	2017-07-25	R	705	Graiguenamanagh	2408	2276	6	86	71	80	23
212	2017-07-28	R	703	Graiguenamanagh	884	835	5	86	71	80	25
282	2018-02-14	R	705	Graiguenamanagh	3356	3576	10	68	49	50	50
283	2018-02-14	LP	4209	Graiguenamanagh	1032	1099	8	53	41	50	0
1002	2019-05-08	LP	4224	High Street Graiguenamanagh	1311	1272	1	46	36	50	5
1000	2020-08-27	R	705	Graiguenamanagh	2420	2251	7	65	55	50	71
1001	2020-08-27	R	705	Graiguenamanagh	3000	2790	5	78	66	50	10

Figure 7-1: Graiguenamanagh Traffic Counts, Nov 2020

Parking

7.4.14 The majority off-street parking is located in close proximity to the centre of G-T. In total there are approximately 231 parking spaces in the main off-street carparks (Roadplan Consulting, 2021). In Graiguenamanagh, there is a small parking along Turf Market (<20 spaces), and at the rear of Supervalu along the Quay (<25 spaces). A larger parking lot (Fair Green Car Park) is located on Upper Main Street. For Tinnahinch, there is parking provision along the Quay.

7.4.15 Informal on-street parking occurs along both/either sides of Chapel Street, Barrow Lane, Bray Lane, Convent Lane, Graiguenamanagh Quay and Mill Road despite the narrowness or residual width of those streets. Consequently, there does not appear to be acute demand for on-street parking in the centre of the joint settlement for the majority of the year. However, the key exception to that observation is the fact that during the summer months the demand for all motorised vehicle parking becomes critical due to the high annual influx of tourists and leisure activity patrons to G-T and its environs (Roadplan Consulting, 2021).

7.4.16 Parking in G-T is free and parking time limits do not apply to any of the on-street and off-street parking (Roadplan Consulting, 2021).

Bus Network

7.4.17 The joint settlement of Graiguenamanagh/ Tinnahinch is served by public bus transport only, including the '881' bus which connects the town to Kilkenny City (and Kilkenny train station) via Borris, Goresbridge and Gowran, and the '481' and '486' buses which are pre-booked routes through various neighbouring towns (Roadplan Consulting, 2021). A dual informal bus stop for the respective bus services is situated adjacent to the Garda Station and Bank of Ireland on Upper Main Street.

Pedestrian and Cycling Network

7.4.18 Throughout the settlement, the majority of streets are flanked by footways on both sides. However, these are very narrow, in a poor state of repair and connected via inconsistent pedestrian crossings some of which are listed below. The exception being Graiguenamanagh Lower Main Street where the entire streetscape from its junction with Chapel Street/Upper Main Street to The Quay was upgraded as part of town renewal scheme a few years ago. On the regional and local road approaches to the town centre the existing footways are discontinuous, narrow and lack accessible pedestrian crossing facilities. Controlled pedestrian crossings are present at the following locations (Roadplan Consulting, 2021):

- Upper Main Street, adjacent to Bank of Ireland (1 no. Zebra Crossing);
- High Street, adjacent to Duiske College (1 no. Zebra Crossing);
- Aldi Access (1 no. Zebra Crossing).

7.4.19 There is a high dependency on simple uncontrolled courtesy pedestrian crossings throughout G-T where pedestrians do not have priority to cross (Roadplan Consulting, 2021).

7.4.20 The town is located along the route of two significant 'Waymarked Ways'; the Barrow Way and the South Leinster Way. Figures showing the routes are provided in Figure 7-2.

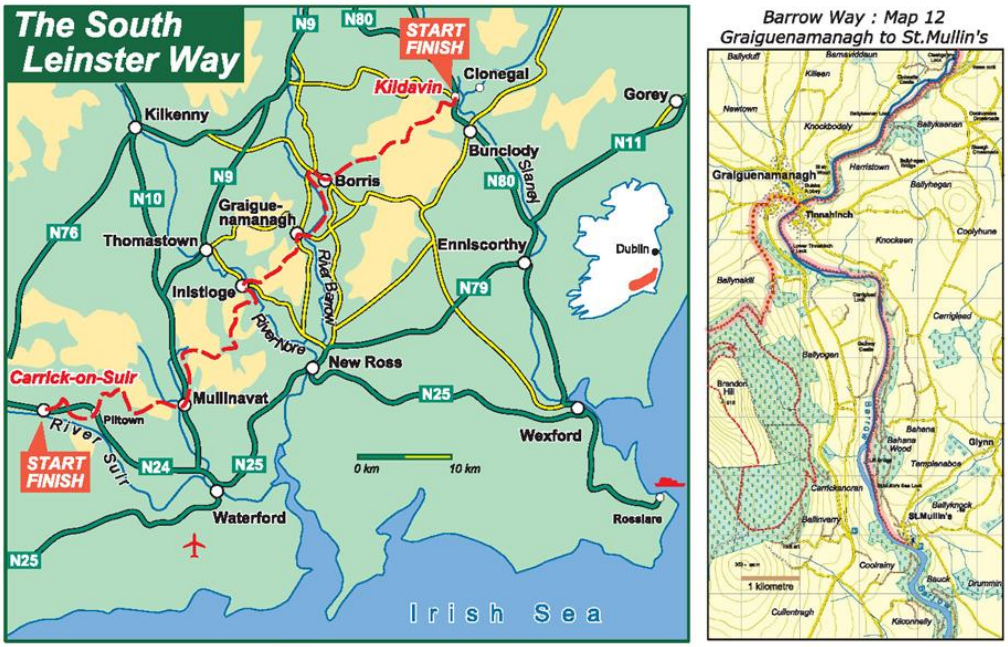


Figure 7-2: The South Leinster Way and The Barrow Way

7.4.21 The South Leinster Way extends 102 km from Kildavin in County Carlow to Carrick in Suir in County Tipperary via G-T (Figure 7-2). The Barrow Way is a 113 km national waymarked trail from Robertstown, County Kildare, to St. Mullin's (County Carlow). The trail follows the towpath, originally a patch alongside the River Barrow where horses pulled barges and goods for transport, and a pathway of cultural heritage interest. G-T are located between stage 5 and 6 of the trail, which passes through the study area adjacent to the river in Co. Carlow (source: Carlow tourism website). The promotion and development of this trail as an attraction forms part of the County Carlow Tourism Strategy and Action Plan 2020 – 2025, particularly through the 'Room to Breathe' and 'Do It the Barrow Way' initiatives. The plan seeks to capitalise on the natural environment of County Carlow, and to create opportunities for visitors to purchase more saleable experiences based on that environment.

7.4.22 Shorter walking routes are available in Graiguenamanagh including the Silaire Wood Loop Walk (2 km loop located the north of the town along the western bank of the River Barrow) and the Heritage Trail of Graiguenamanagh (1 km) (SLR, 2019).

7.4.23 Waterways Ireland has responsibility for the management, maintenance, development, and restoration of the River Barrow, principally for recreational purposes. Waterways Ireland's Barrow Blueway project to develop a hard-surface tow path for increasing footfall and cyclists is effectively on hold at the time of writing following refusal of permission of the submitted scheme from An Bord Pleanála in in spring 2019 (Department of Housing, Local Government and Heritage, 2024).

7.4.24 At the time of writing, no further information is available with regard to pedestrian and non-vehicular users of the study area (for example cyclists and equestrians). This data has been requested and will be considered as the scheme progresses.

7.4.25 There are no existing dedicated cycle lanes in G-T and there is a general absence of bicycle parking throughout the settlement. Some bicycle parking has been provided as part of recent commercial developments such as Aldi (Roadplan Consulting, 2021).

Utilities and Services

Wastewater Treatment Plants

7.4.26 The towns of G-T are served by Graiguenamanagh Sewerage Scheme and Wastewater Treatment Plant (including storm water overflow) with a capacity PE of 3000. The treatment process includes preliminary treatment (screens), secondary treatment (aeration) nutrient removal (biological Nitrogen & Phosphorus removal) and discharges treated effluent into the Barrow and occasionally transfers liquid sludge to Kilkenny Main Drainage.

7.4.27 Tinnahinch is served by the existing sewage treatment facility Graiguenamanagh. The sewage treatment has capacity for further development, both residential and industrial, and can readily be upgraded to cater for extended development beyond the planned period. Kilkenny County Council and Carlow County Council (2020a) report that loading of the Graiguenamanagh WWTP is c. 3,000 PE. The 2018 figures from Uisce Éireann indicate that the wastewater treatment plant in Graiguenamanagh has capacity for up to 350 housing units (Kilkenny County Council and Carlow County Council, 2020a).

7.4.28 EPA data indicates that downriver of the scheme boundary, at Ballyogan (c. 4.3 km south of G-T), the River Barrow becomes the Barrow Estuary and is classed as an Urban Waste Water Treatment Directive Sensitive Area between this location and New Ross.

7.4.29 EPA licenced waste water treatment facilities within 10 km of G-T and the sub-catchment are described in Table 7-2 and their locations shown in Figure 7-3.

Table 7-2: Wastewater treatment Facilities in Vicinity of Proposed Scheme

Facility name (registration no.)*	County	Facility Type	Treatment Type	Location of Outfall
Goresbridge Wastewater Treatment Plant (D0529-01)	Kilkenny	Sewage Treatment >500pe	Tertiary nitrogen and phosphorus removal	Outfall to the River Barrow at Barrowmount, Goresbridge, Co. Kilkenny (emission ID TPEFF1500D0529SW00)
Borris Wastewater Works (D0248-01)	Carlow	Sewage Treatment >500pe	Tertiary nitrogen and phosphorus removal	Primary emission into Mountain River, tributary of the River Barrow upstream of study area, at Borris Wastewater Works (Emission ID: TPEFF0100D0248SW001)
Skeaghvosteen Wastewater Treatment Plant (A0057-01)	Kilkenny	Sewage Treatment <500pe	Secondary treatment	7.5 km north of Graiguenamanagh. Plant discharges to ground.
Graiguenamanagh Sewerage Scheme and Wastewater Treatment Plant (D-0155-01)	Kilkenny	Sewage Treatment >500pe	Tertiary nitrogen and phosphorus removal	Emission into River Barrow at Graiguenamanagh Tinnahinch treatment plant (emission ID TPEFF1500D0155SW001)
St Mullins Wastewater Treatment Plant (A0085-01)	Carlow	Sewage Treatment <500pe	Secondary Treatment	Emission into River Barrow downstream of study area, at St Mullins Wastewater Treatment Plant (emission ID TPEFF0100A0085SW001)
Glynn Wastewater Treatment Plant (A0225-01))	Carlow	Sewage Treatment <500pe	Primary	Emission potentially into unnamed waterbody within the subcatchment feeding into the River Barrow at St. Mullins, downstream of the study area, at Glynn Wastewater Treatment Plant (emission ID: TPEFF0100A0225SW001)
* The lead water services authority for all facilities listed in this table is Uisce Éireann. Note: a sewage treatment facility (<500pe) and three discharge locations at Inistoige are not included as these do not occur within the sub-catchment. A sewage treatment facility (<500pe) and one discharge location at Dungarvan are not included as they are located on the boundary of the study area and are unlikely to interact with the sub-catchment in the scheme area (cathchments.ie).				

Data source: EPA online data for Licensing and Permitting

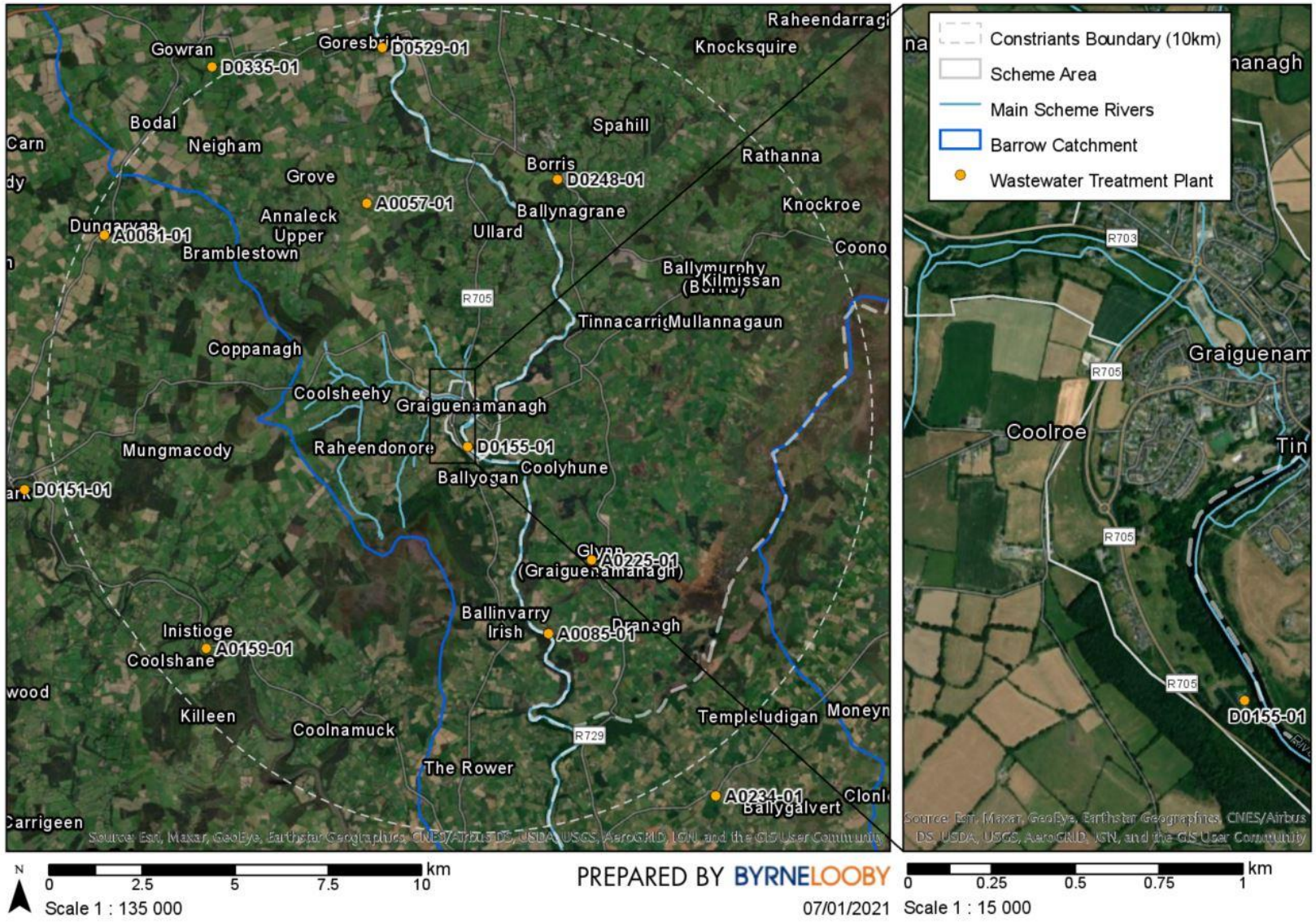


Figure 7-3: Wastewater treatment Facilities in Vicinity of Proposed Scheme
Data Source: EPA online data for Licensing and Permitting

Foul and Storm Water Sewers

7.4.30 The foul network is operated and maintained by Uisce Éireann. Data provided by Uisce Éireann has been used to identify existing foul networks.

7.4.31 Murphy Surveys undertook Lot 5 utilities surveys as part of the GTFRS in 2020. Ground penetrating radar was used to identify the locations of underground utilities, including foul and storm networks in the scheme area. A map of the surveyed network is provided in Figure 7-4. Both foul networks for Tinnahinch and Graiguenamanagh go to the local wastewater treatment plant. Two pumping stations are present in the scheme area at the quay in Graiguenamanagh (ca. 26 m north-east of the bridge) and the quay at Tinnahinch (ca. 25 m south west of the bridge) respectively.

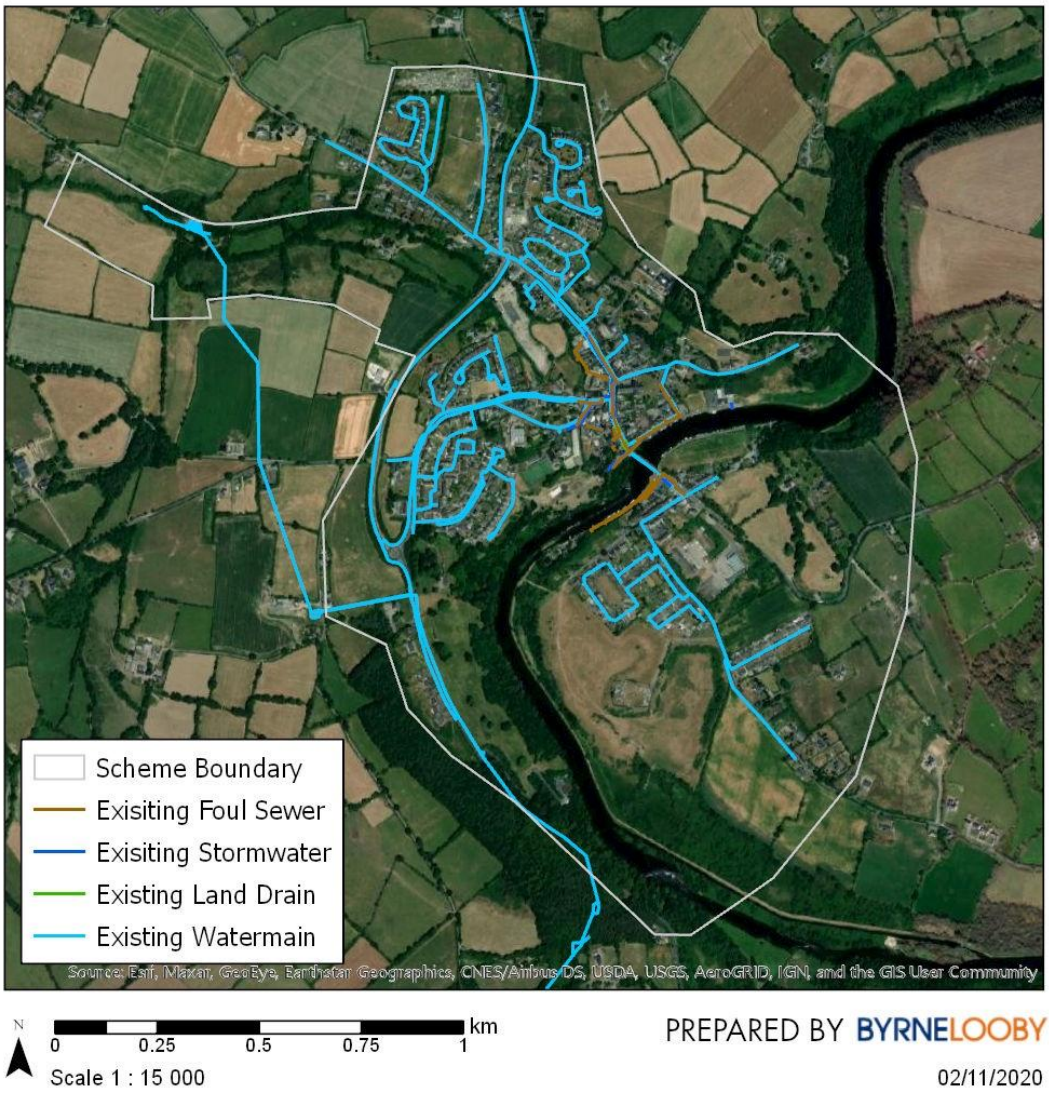


Figure 7-4 Surveyed Foul and Sewer Lines

7.4.32 Stormwater outfalls regarding this scheme discharge to the River Barrow and River Duiske and are shown in Drawing numbers W3451-AYE-DWG-W-1437 to W3451-AYE-DWG-W-1440.

Water Utilities

7.4.33 The Graiguenamanagh public water supply scheme (scheme code: 1500PUB1008) serves a population of 1,630 people in G-T with a volume of approximately 490 m^3 per day. The supply was developed in the 1950s and much of the infrastructure dates back to that time. The GSI Public Supply Source Protection Areas are located on Brandon Hill, approximately 2km from the centre of Graiguenamanagh. The water supply for Tinnahinch is supplied from Graiguenamanagh by Kilkenny County Council.

7.4.34 The supply is sourced from two sources located within County Kilkenny; the River Duiske and two combined spring sources from Brandon Hill, which are located 100m from each other (EPA, 2015). The volume supplied from the spring sources and the Duiske River is approximately a 50:50 split. Raw water from the River Duiske is fed into slow sand filters prior to being fed into a package treatment plant comprised of pressure filters and UV disinfection. The water is then pumped to the Coolroe Water Treatment Plant (WTP). Raw water from the spring sources is fed to the Coolroe WTP where it is treated by pressure filters and UV disinfection. Chlorination and pH correction is undertaken at the Coolroe water treatment plant prior to storage in the reservoir (source: EPA data, EPA Drinking Water Audit Report, 2015 and 2018).

7.4.35 The springs are detailed further in Chapter 12 'Land, Soils, Geology and Hydrogeology'.

Electricity networks

7.4.36 The Electricity Supply Board (ESB) Networks maintains the distribution electricity infrastructure. Figure 7-5 (overleaf) shows the layout of the network, with one piece of High Voltage 110kV overhead lines. The rest of the infrastructure is network with a mix of overhead and underground lines. The Medium Voltage lines are either 20kV or 20kV while the Low Voltage lines are 230V for single phase and 400V for three phases. The nearest transition lines are located 5km to the east of Graiguenamanagh. These are 220kV overhead lines maintained by EirGrid.

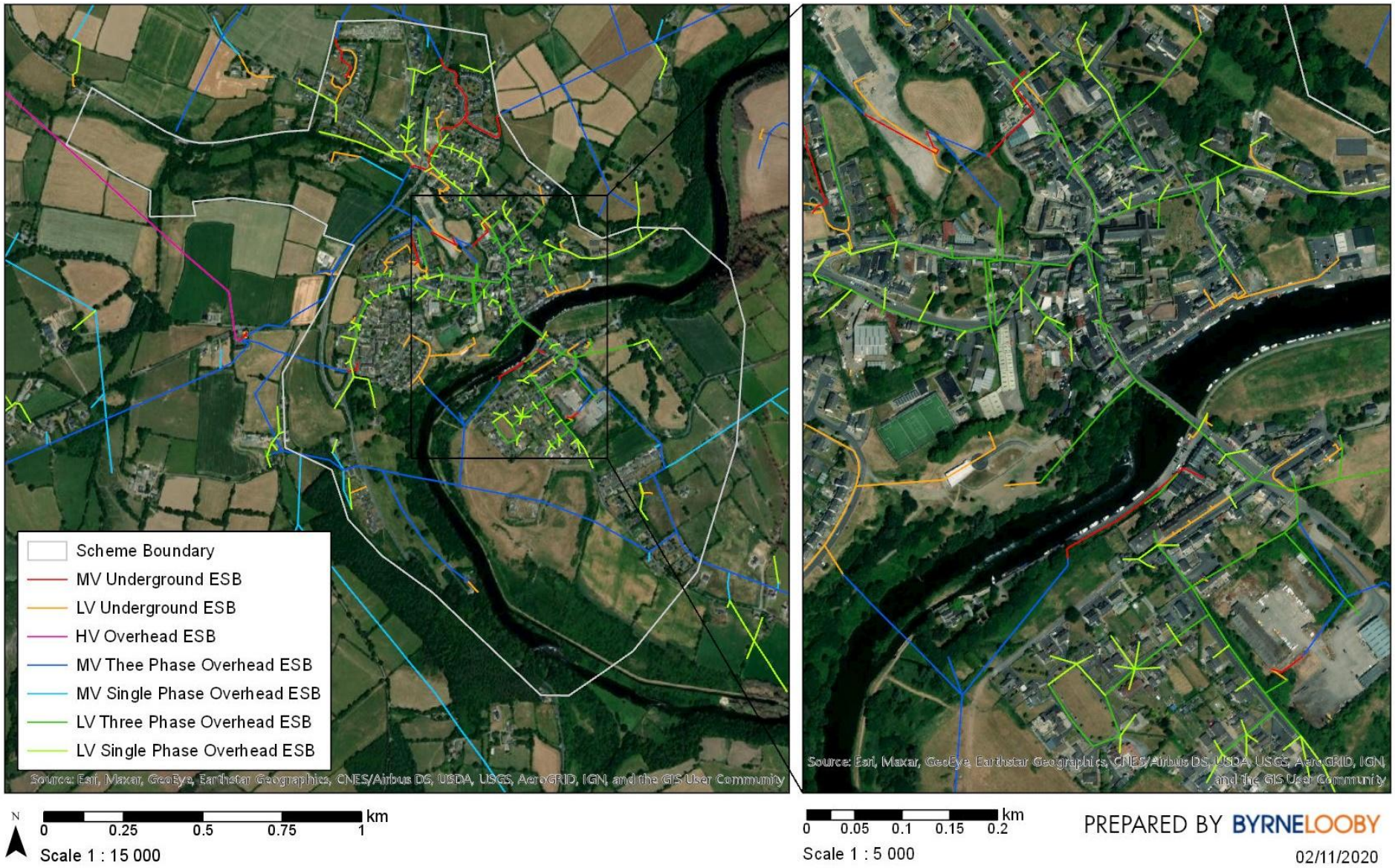


Figure 7-5: Electricity infrastructure in the scheme boundary and vicinity

Gas Infrastructure

7.4.37 There is no gas distribution or transmission infrastructure reported within the scheme boundary or close vicinity.

Digital Infrastructure (telecommunications)

7.4.38 With regards to the Department of the Environment, Climate and Communications' National Broadband Plan Map, the study area includes areas classed as National Broadband Plan Map developed using GeoDirectory Q1 2022 data on Gov.ie website):

- target areas for the State intervention of the National Broadband Plan;
- areas where commercial operators are delivering or have indicated plans to deliver high speed broadband services.

7.4.39 Internet and landline services are provided by several commercial operators with available internet speeds averaging from 75 Mb to 1000 Mb through 'part fibre' technology (source: switcher.ie).

7.4.40 Eircom Limited ('Eir') own and maintain the telecoms network for the Area Mobile phone coverage for 2G, 3G, and 4G is provided by commercial operators in the study area with coverage classed as ranging from good to very good by the Commission for Communication Regulation (coveragemap.comreg.ie).

Waste Management

7.4.41 The EPA data map viewer for waste indicates that there are no licensed waste management facilities or dump sites present within at least 10 km of the study area. The closest licenced 'Industrial Emissions Licensing facility' is operated by Runtalrad Ltd in Thomastown who produce radiators and are located c. 14 km west of the study area.

7.4.42 Domestic, commercial and industrial waste are collected by private operators and disposed of mainly at the council's centre landfill site at Powerstown and in County Kilkenny. Recycling and domestic waste services are provided by commercial operators within the study area. There is a bring bank located in Graiguenamanagh.

7.4.43 An indicative breakdown of the composition of C&D waste in Ireland in 2018 is set out in Table 7-3**.** These figures should be considered as a guide only as C&D waste can vary significantly from one project to another, depending on the nature of the development and the waste management practices employed on-site. Soil, stones and dredged material accounted for 77% of the total quantity of figures published by the EPA relating to construction and demolition (C&D) waste are for the year 2018 with 6.2Mt (million tonnes) of C&D generated in Ireland. C&D waste collected in 2018 and as such is the largest component of C&D waste nationally.

Table 7-3: Material categories of C&D waste collected in Ireland, 2018 (Source: EPA)

Material from construction and demolition sources	Quantity (tonnes)	% of material stream in reference to total
Soils, stones & dredging spoil	4,786,162	77.0%
Concrete, bricks, tile and gypsum	755,525	12.1%
Mixed C&D waste	414,983	6.7%
Metal	179,043	2.9%
Bituminous mixtures	60,759	1.0%
Segregated wood, glass and plastic	23,068	0.4%
Total	**6,219,540**	**100.0%**

7.4.44 Final treatment operations (recycling, backfilling, energy recovery, disposal) varies greatly between material streams. By far the biggest amount of C&D waste was used for backfilling (a recovery operation), which mainly reflects the dominance of waste soil, stones, concrete, bricks and tiles in the overall composition mix. Recycling was the dominant treatment activity for the smaller metal, plastic, glass and wood fractions of C&D waste, while disposal was mainly used for C&D waste treatment residues.

7.4.45 Under the Waste Framework Directive (2008/98/EC) there is a target for Member States to achieve 70% material recovery of non-hazardous, non-soil and stone C&D wastes by 2020. Ireland achieved 77% material recovery of non-hazardous, non-soil and stone C&D waste in 2018, surpassing the 2020 EU target.

7.4.46 The construction sector also generates hazardous waste such as hazardous soils, lead-acid batteries, waste electrical and electronic equipment, asbestos, solvent-based paints and varnishes, pesticides and waste oils. The EPA reports that in 2019, 46,191 tonnes of hazardous soil was exported from Ireland for treatment.

7.5 Sensitive Receptors

7.5.1 The primary receptors with regards to Material Assets are roads and transportation, and utilities within the immediate vicinity of where the planned defences are to be constructed. Here, direct impacts from the construction (increase in traffic, lane/road closures to vehicle and pedestrian access, impacts to utilities and services) and operation (reduced flood risk, changes in road system) will occur. Waste management is also a sensitive receptor during the construction phase as the construction will result in an increase of waste.

7.5.2 The following receptors are considered sensitive to change:

- **Roads, Traffic and Transport:** Particularly the roads that will experience an increase in traffic, particularly where they are an access route for construction compounds. Some roads of note include:
    - Main Street (R703) which is the main thoroughfare for all works areas and construction compounds

- G-T Quay road access and parking
- The entrance to The Hub

- **Utilities and Services**: All utilities with the scheme area are a particular sensitivity, particularly where excavation is required during the construction period.
- **Waste management**: the increase in waste, particularly during the construction period will be a key sensitivity in the scheme.

7.6 Potential Impacts and Effects

The 'do nothing' Scenario

7.6.1 The 'do-nothing' scenario represents the scenario whereby the Proposed Scheme does not proceed as planned. Under this scenario, the existing material assets within the study area will remain as described under Section 7.4. In addition, flooding of land and properties would continue to occur causing recurring damage to existing services and utilities. In summary, under the 'do nothing' scenario, the impact is assigned as negative, significant. Impacts are both temporary (i.e., direct impact during a flood event), and long-term/permanent (i.e., repetitive damage or shutdown of utilities and services).

Construction Phase

Roads, Traffic and Transportation

7.6.2 Roads, traffic and transportation impacts are likely to arise from the following construction activities:

- Enabling works:
  - Including the delivery of construction equipment/plant, portacabins, ablution facilities etc. to construction compounds and individual works areas. This is likely at the beginning of the overall construction programme, but also at the start of each works package (construction sequencing).
- Daily access/haulage to construction compounds and work areas:
  - Including the daily access and egress of HGVs, LGVs and personal vehicles into the construction compounds and work areas. Depending on the distance of receptors to the access/haulage routes, the impact of the construction compounds will vary across the study area.
- Demobilisation:
  - Including the removal of construction equipment/plant, portacabins, ablution facilities etc. from construction compounds and individual works areas. This is likely at the end of the overall construction programme, but also at the end of each works package (construction sequencing).

7.6.3 The construction will be sequenced into different works packages (see details in Chapter 4 'Description of the Proposed Scheme and Construction Methodology') and, as a result, roads/traffic/transportation construction phase impacts are not anticipated to be concentrated over the entire scheme area for the entire construction duration (36-42 months), rather impacts will be isolated to the individual construction areas for limited time periods. The location of these construction areas, compounds and associated access/haulage routes (i.e., proximity to receptors) and types of activities planned in each will have a large bearing on the overall impact of each construction package however, each one will have a limited construction timeframe therefore impacts will be temporary. An exception, however, would be those receptors located in proximity to construction compounds. It is likely that these will be maintained throughout the entire construction programme and therefore traffic impacts are likely for the entire duration and will possibly cause a slightly longer-term impact.

Planned Road Usage / Haulage / Access

7.6.4 The Proposed Scheme consists of the construction of flood defences (including a combination of flood walls and embankments) on the left and right banks of the River Barrow and River Duiske (see Appendix 4-1 for illustration of the defence locations). To facilitate access to these locations, some localised and residential roads will need to be utilised for access by construction staff and heavy vehicles. Further construction compounds are planned to be distributed across the scheme area, with individual access established for these.

7.6.5 The planned location of access routes to both construction compounds and construction areas are detailed in Chapter 4 'Description of the Proposed Scheme and Construction Methodology', with drawings included under Appendix 4-1. In summary however, the following roads are identified as being subject to potential use during the construction phase, and therefore where traffic associated impacts are assigned.

Table 7-4: Planned Use of Public Roads

Road Name and No.	Locality	Planned Use during Construction
R703/Main Street	Tinnahinch	Access to The Quay/ haulage of construction materials / removal of waste streams.
R703/Main Street	Tinnahinch	Access to Hotel Street -Site compound, Area haulage of construction materials/ removal of waste streams.
R70 Main Street/ Tirlán Farmlife Graiguenamanagh	Graiguenamanagh	Tirlán Farmlife Graiguenamanagh - Access to site compound
R703/Main Street/ The Quay	Graiguenamanagh	Access to The Quay/ site compounds, haulage of construction materials / removal of waste streams.
R703 Main Street/ Peg Washington's Lane	Graiguenamanagh	Access to Peg Washington's Lane/ haulage of construction materials / removal of waste streams.
High Street/ Turf Market Junction	Graiguenamanagh	Access to River Duiske and Turf Market haulage of construction materials / removal of waste streams.

Road Name and No.	Locality	Planned Use during Construction
Upper Main Street/ R703	Graiguenamanagh	Haulage of construction materials / removal of waste streams.

Lane / Road Closures

7.6.6 Certain construction areas are likely to require closure of single lanes for temporary time periods, to allow road-side activities to be undertaken safely. Areas where this is likely includes:

Table 7-5: Public Road/Access Closures

Area No.	Area Description (Compound No.)	Details of Public Access/Road Closures	Length of Closure to a) vehicles and b) pedestrians
Area 1	Storage Area	Not applicable	Not applicable
Area 2	Well Lane to High Street Bridge	Well Lane	a) 3 months b) 3 months
Area 3	Turf Market	n/a	n/a
Area 4	Turf Market to The Hub	The Dock	a) 3 months b) 0
Area 5	Boat Club	Access road to Boat Club	a) 3 months b) 0
Area 6	Graiguenamanagh Quay	The Quay	a) 6 months b) 0
Area 7	The Dock	The Dock	a) 3 months b) 0
Area 8	The Hub	n/a	n/a
Area 9	Hotel Street	n/a	n/a
Area 10	Tinnahinch Quay	Tinnahinch Quay Waterway Ireland Access Road	a) 3 months b) 0

Alternative Parking

7.6.7 There is off-street residential parking at some of the construction areas. If works require closure of these roads, parking will need to be diverted, and alternative spaces provided for those affected. Appropriate construction phasing will be important to limit impact in this regard. Areas where this is a potential include:

Table 7-6: Parking Space Closures

Area No.	Area Description (Compound No.)	Details of Parking Closures	Length of Closure
Area 1	Storage Area	Not applicable.	
Area 2	Well Lane to High Street Bridge	Not applicable.	
Area 3	Turf Market	Not applicable.	
Area 4	Turf Market to The Hub	Loss of all informal parking at The Dock	3 months

Area No.	Area Description (Compound No.)	Details of Parking Closures	Length of Closure
Area 5	Boat Club	Loss of all parking whilst access is closed off	3 months
Area 6	Graiguenamanagh Quay	Loss of all parking during works Loss of all parking except for 2no. spaces for Proposed Scheme	6 months Indefinitely
Area 7	The Dock	Loss of all informal parking.	3 months
Area 8	The Hub	Loss of pitches and parking for duration of works	4 months
Area 9	Hotel Street	Not applicable	
Area 10	Tinnahinch Quay	Loss of all parking nearest quay for duration of works	3 months

Predicted Construction Traffic / Trip Generation

7.6.8 Traffic generation during the construction of the Proposed Scheme fall under two distinct categories: staff trips to and from the site, and HGV trips for delivery and removal of material.

7.6.9 It is anticipated that the construction phase of the scheme will take approximately 36-42 months. This phase will give rise to additional traffic on the local road network to and from the site. This will include:

- Enabling works:
  - Heavy Goods Vehicles (HGVs) importing construction materials, construction equipment/plant, supporting infrastructure (i.e., portacabins, ablution units) and site boundary fencing to construction compounds.
  - HGVs importing the abovementioned to construction areas (in sequence).
  - Light Goods Vehicles (LGVs) transporting staff to and from the enabling works areas.
- Construction compounds (during construction period):
  - HGVs importing construction materials (i.e., soils) for temporary stockpile.
  - HGVs delivering equipment/plant and fuel.
  - HGVs exporting waste streams/materials.
  - LGVs transporting construction staff.

- Work areas (during construction period):
    - HGVs importing soil material to areas where embankments/infilling is required. Exports of soil is anticipated to be limited, as excavated materials will be reused, where possible, in situ.
    - LGVs transporting construction staff.

7.6.10 Staff numbers will vary throughout the construction phase; however, the maximum numbers are estimated at 100.

7.6.11 Normal construction working hours will be observed. These are 07:00 – 19:00 Monday to Friday; 09:00 – 16:00 on Saturday. It may be necessary in exceptional circumstances to undertake certain types of activities outside of normal construction core working hours. Heavy or noisy construction activities will be avoided outside normal hours and the amount of work outside normal hours will be strictly controlled. Approval from KCC and CCC will be obtained for works outside normal hours. The planning of such works will have regard to nearby sensitive receptors.

7.6.12 The number of Heavy Goods Vehicle (HGV) trips has been developed based on the total cut and fill volumes required and an assumed capacity of $10m^3$ per truck. Whilst the total construction phase duration is 36-42 months, it has been assumed that the majority of these trips will take place during the first 12 months, and therefore for robustness the total number of HGV trips have been spread evenly across the 36 months and a 10-hour working day. In reality, it is likely that HGV movements will tend to avoid the peak hours due to traffic through the town. The total number of HGVs travelling to and from the site per day is estimated at 10, leading to a total of 26 HGV movements on average, of which 19 will occur in each direction in each of the peak hours.

Table 7-7: Peak Traffic Generation – Construction Phase

Details	Light Goods Vehicles		Heavy Goods Vehicles			Total	
	Staff	**Service**	**Deliveries**	**Excavation**	**Service**	Vehicles	PCUs
Daily	20 LGV	10 LGV	33 HGV	10 HGV	4 HGV	77 veh	134 pcu
Peak (2hrs) (AM /PM)	14 LGV	4 LGV	13 HGV	4 HGV	2 HGV	36 veh	53 pcu

PCU=Passenger car units, LGV=Light Goods Vehicles, HGV= Heavy Goods Vehicles.

Impacts during Works Packages

7.6.13 The following sections presents the Proposed Scheme and likely changes to the existing transport networks as needed for construction each Works Package as outlined in Chapter 4 'Description of the Proposed Scheme and Construction Methodology'.

Works Package 1:

7.6.14 Construction works are for a duration of 3 months during this works package (WP). The main site compound (A), located just off the R703 in Tinnahinch, will be utilised during this WP. Works will consist of site set-up and enabling works. Works will include site clearance such as vegetation removal which are largely in green space and way from public roads. Establishment of site access and compounds, as well as the demolition of existing structures. These works will be adjacent to public roads (as outlined in Table 7-4).

7.6.15 The additional exploratory trial pits and slit trenches will be undertaken within the footprint of the proposed embankment and therefore will not impact upon the roads. Further inspection pits and slit trenches will be undertaken at Turfmarket bridge, the Dock and the Quays.

7.6.16 Utility diversions will also be undertaken as part of this works package. At Area 1, this will occur within the agricultural land. Within Areas 5-7, utilities will be diverted within the footprint of the public paths and roads.

7.6.17 These WP1 works will be temporary in nature. Road closures are not anticipated for the completion of these works, but vehicular traffic management measures will be required temporarily. These will be outlined in the Contractor's Traffic Management Plan (TMP). There will be an increase in traffic within the townlands of G-T, but these are not anticipated to be significant. Pedestrian access can be maintained.

Works Package 2:

7.6.18 The works at Area 1 (Storage Area) will be undertaken as part of WP2. The construction phase will result in an increase in LGV and HGV traffic along the R703 for the duration of the works package, anticipated to be 18 months. However, no road closures will be required to complete WP2, nor will there be impacts upon parking or pedestrian movement.

Works Package 3:

7.6.19 WP3 will entail the construction of all flood defences on the River Duiske within Areas 2-4. These works are anticipated to take 12 months. These works will be largely instream but will result of the closure of Well Lane to vehicular access for a duration of 3 months, and the closure of The Dock to vehicular access and the removal of the informal parking for a duration of 3 months. Pedestrian access will also be closed at Well Lane for the duration of 3 months.

7.6.20 There are alternative routes for the movement of vehicles and pedestrians along Main Street. With the closure of The Dock Road, access to The Hub will be maintained from the western access point. Further, pedestrian access to Aldi via Keating's Well can be maintained via access from Main Street

7.6.21 There will be an increase in vehicular movements along the R703/Main Street as a result of this works package. There will be a further increase in vehicular movements on High Street/Mill Road as Site Compound C will be required to complete these works.

Works Package 4A:

7.6.22 WP4A will entail the construction of all flood defences on the right bank of the River Barrow within Areas 5-8 within the footprint of Graiguenamanagh townlands. These works are anticipated to take 18 months.

7.6.23 The construction phase will result in the road and parking closure of the access road to the Boat Club for a period of 3 months, Graiguenamanagh Quay for a period of 6 months, and the closure of The Dock for 3 months, in addition to the closure at this location as part of WP3.

7.6.24 As during WP3, with the closure of The Dock Road to complete construction at Area 7, access to The Hub will be maintained from the western access point. However, parking with the Hub, in the area of the works, will be closed for a duration of 4 months the facilitate construction. This will be done in coordination with The Hub.

7.6.25 Upstream of Graiguenamanagh Bridge, construction of Area 5 and 6 will require the closure of all vehicular access, including parking. This will be a maximum of 6 months as the works can occur concurrently at this location. This road is not a through-road and does not inhibit the movement of vehicles through G-T. This will impact upon businesses on Graiguenamanagh Quay, and associated tourism in the town. These impacts are discussed in Chapter 6 'Population and Human Health'.

7.6.26 Pedestrian access to Graiguenamanagh Quay, and the associated walking path upstream of the Boat Club will be maintained but there may be minor restrictions due to the present of Site Compound E.

7.6.27 There will be an increase in vehicular movements along the R703/Main Street as a result of this works package. Vehicular traffic management measures will be required temporarily to facilitate this works package. These will be outlined in the Contractor's CSTMP.

Works Package 4B:

7.6.28 WP4B will entail the construction of all flood defences on the left bank of the River Barrow within Areas 9 and 10 within the footprint of Tinnahinch townlands. These works are anticipated to take 18 months.

7.6.29 The construction phase will result in the road and parking closure of the road to Tinnahinch Quay and the Waterways Ireland Access Road for a period of 3 months. This road is not a through-road and does not inhibit the movement of vehicles through G-T. This will impact upon businesses on Tinnahinch Quay, and associated tourism in the town. These impacts are discussed in Chapter 6 'Population and Human Health'. Emergency and local access will be maintained throughout. Pedestrian access will also be maintained.

7.6.30 Pedestrian access to Tinnahinch Quay, and the associated Barrow Way walking path will be maintained but there may be minor restrictions due to the present of Site Compound F on the upstream side of George Bridge.

7.6.31 There will be an increase in vehicular movements along the R703/Main Street as a result of this works package. Vehicular traffic management measures will be required temporarily to facilitate this works package. These will be outlined in the Contractor's CSTMP.

Impact Assessment: Roads, Traffic and Transport

7.6.32 Three key impacts of the construction phase upon roads, traffic and transportation have been identified and assessed below.

Impact of lane / road closures and diversions:

7.6.33 With respect to where road closures and diversions are required, it is anticipated that the construction will be undertaken in line with a CSTMP) and that appropriate construction phasing will be planned carefully in relation to these requirements. It is further assumed that the CSTMP will detail all safety procedures in relation to the protection of road uses, including appropriate measures for the closure or roads and provision of diversions, where needed. However, this impact assessment has been made on the assumption that these mitigation measures are not implemented. Post-mitigation: impacts during each Work Package are assessed in the Residual Impacts and Effects section of this Chapter.

7.6.34 With this in mind, general nuisance to road uses is anticipated. The existing traffic infrastructure in the town of Graiguenamanagh is constrained by narrow roads and parking provisions along the Quay. During construction, lane closures are highly likely, particularly for those works occurring along the Quays and along Turf Market and along parts of Main Street. Therefore, general movement of traffic through the town will be slower as a result of lane closures or operation of traffic management measures (i.e., stop lights). Further, longer diverted journeys will likely be required to facilitate traffic movement during lane closures. Overall, **a negative, moderate impact** is assigned. Impacts will be **temporary and localised** (not encompassing the entire study area) depending on the location of works at any one time.

Impact of parking alterations:

7.6.35 It is assumed that, where parking changes are required, that this will be coordinated closely with KCC, CCC, An Gardai Siochána and associated residents, with an agreeable approach to alterative parking provided. However, closure of parking provisions whilst work is occurring along the Quays is very likely which will most severely impact those residential and commercial properties situated along them, but also visitors to the town. Further, some alterations to the provisions of parking along Turf Market and Main Steet will likely be altered whilst construction works is ongoing at these locations. Most impact will be felt to those living in these areas. There is a **negative, moderate** impact assigned, specific to those receptors most affected by this change. Impacts will be **temporary, and localised** (not encompassing the entire study area) depending on the location of works at any one time.

Impact of trip generation and increased traffic volumes:

7.6.36 As outlined in the preceding sections, the construction phase of the scheme is anticipated to generate a further 47 HGVs and 20 LGVs daily on the local road network. Considering the existing baseline conditions (from visual monitoring), this is anticipated to cause a moderate change and cause additional congestion and/or nuisance, largely on account of the already constrained nature of the road infrastructure in the towns. A **negative, moderate** impact is assigned. Impacts will be temporary, and localised (not encompassing the entire study area) depending on the location of works at any one time.

Bus Network

7.6.37 The Proposed Scheme is not anticipated to cause disruption or effect to the bus systems during construction. Therefore, **no impacts** have been predicted.

Pedestrian and Cycling Network

7.6.38 In some areas along the riverbanks where defence structures are to be constructed (see Appendix 4-1) are located directly adjacent to walkways and cycling networks. It is likely that during construction, some of these areas will require either complete or partial closure during works, to maintain safety of the community. Areas of concern include:

- Graiguenamanagh Quay
- The Dock (with access provided to the Hub from the East)
- George Semple Bridge and Tinnahinch Hotel Street
- Tinnahinch Quay and the Barrow Way and South Leinster Way walking routes

7.6.39 However, impacts will be temporary in nature, lasting only a part of the duration of the construction phase (i.e., most locations will not be disrupted for the entire 36-42 months of construction). In summary, the impact is assigned as **likely, negative, slight and temporary**.

Impact Assessment: Utilities and Services

Wastewater Treatment Plants

7.6.40 The G-T WWTP and discharge are located >500m downstream of the closest proposed flood defence works and on the opposite bank of the River Barrow. All other WWTP's are located outside of the Scheme Area and will not be impacted. Therefore, **no impacts** have been assigned.

Foul and Storm Water Sewers

7.6.41 A number of stormwater outfalls and sewer lines intersect with areas proposed for flood defence, as outlined in Section 7.4.31. It is possible that some or all of these assets will require shut down and/or isolation for periods of time to allow construction works to proceed or to allow for relocation agreed at the detailed design stage. Any potential disruption to services in the vicinity of the works will be of a temporary nature and limited to the period of construction within that particular works area. Design and pre-construction due diligence, including appropriate coordination with service providers, will limit impact and provide opportunity for alternative solutions. Therefore, the impact is considered **not significant.**

Water Utilities

7.6.42 As outlined in Sections 7.4.33 and 7.4.34, the Graiguenamanagh public water supply scheme (scheme code: 1500PUB1008) has two sources located within County Kilkenny; the River Duiske and the Ballyogan springs sources from Brandon Hill. The abstraction on the River Duiske is located downstream of the works at Area 1, and upstream of the remainder of the works.

7.6.43 Potential impacts to surface water and hence drinking water abstractions are considered as part of the works. There is potential for silt-laden run-off to enter the watercourses from areas of incomplete excavations, stockpiles and/or areas of loose material (i.e., tracked haulage routes), particularly during events of rainfall and/or flood. Dewatering of excavations gives further cause for in-river sedimentation, whereby direct pumping from sumps into the river may result in sedimented dewater effluent, if not appropriately monitored. Moreover, there is potential for accidental releases of oils, fuels, wastewater and cementitious material into waterbodies. These incidents may result in a short-term reduction of water quality in the immediate work area and would have a **significant negative short-term** impact on water quality at the drinking water abstraction point on the Duiske, without mitigation.

7.6.44 Whilst unlikely, it is possible that utilities within the works area are damaged during the construction process, or more likely, require shut down and/or isolation for periods of time to allow construction works to proceed or to allow for relocation. Any potential disruption to services in the vicinity of the works will be of a temporary nature and limited to the construction stage of the scheme. Design and pre-construction due diligence, including

appropriate coordination with service providers, is anticipated to limit impact. Therefore, the impact is considered **not significant.**

Electricity Networks

7.6.45 The works are in built up areas which are serviced by utilities such as water, storm foul, storm drains, electricity, and telecom etc. However, electricity utility diversions will be required in just a few of the working areas, predominantly the Upstream Storage Area. This diversion is a major diversion but has been agreed with ESB Networks and will be undertaken by their construction partners should planning be granted. It is possible that a temporary disruption to some services may occur when the diversions are taking place. However, it is not considered that these disruptions will result in significant negative impacts on customers. All utility diversions will be carried out in consultation with relevant utility organisation. The Contractor will be required to submit diversion proposals to relevant utility organisation for their approval prior to works being carried out. It is therefore expected that this impact will be **negative, slight and temporary**

Gas infrastructure

7.6.46 There is no gas distribution or transmission infrastructure reported within the scheme boundary or wider vicinity, therefore **no impact** is assigned.

Digital Infrastructure

7.6.47 Whilst unlikely, it is possible that nearby digital utilities be damaged during the construction process, or more likely, require shut down and/or isolation for periods of time to allow construction works to proceed or to allow for relocation. Any potential disruption to services in the vicinity of the works will be of a temporary nature and limited to the construction stage of the scheme. Design and pre-construction due diligence, including appropriate coordination with service providers, is anticipated to limit impact. Therefore, the impact is considered **not significant.**

Waste Management

Impact Assessment: Waste Management

Site Clearance & Demolition

7.6.48 Prior to commencing work, the contractor will need to undertake vegetation removal and stripping of topsoil as required in the relevant working areas. Further, minor demolition will be undertaken as part of the enabling works for the Proposed Scheme. The demolition works will include the following:

- Establishment of site access
- Establishment of compounds
- Demolition of existing structures

7.6.49 Approximately 3300m^3 of demolition waste will be generated as a result of the demolition works to facilitate the Proposed Scheme. This material will be predominantly comprised of excavated soils/subsoil and concrete.

7.6.50 The use of surplus material and management of these waste streams includes:

- Where naturally-occurring material is excavated, this will be reused within the construction works as required and provided it is suitable for its proposed use.
- Surplus materials or by products generated as a result of the Proposed Scheme which are not naturally-occurring and which will be reused within the scheme will be notified to the EPA in accordance with Article 27 of the European Communities (Waste Management) Regulations, 2011 as a by-product, provided it meets the requirements of that clause.
- Where surplus materials or by products are generated as a result of the Proposed Scheme and which will be reused within other schemes, these will be notified to the EPA in accordance with Article 27 of the European Communities (Waste Management) Regulations, 2011 as a by-product, provided it meets the requirements of that clause.
- Where surplus materials are generated which cannot be reused within the scheme or other construction works these will be waste and will be delivered to facilities authorised in accordance with the Waste Management Act, 1996 as amended and which hold a Certificate of Registration, Waste Facility Permit or EPA Licence.

7.6.51 Given the quantities anticipated, the effect of site clearance and demolition waste prior to mitigation measures being implemented is expected to be **negative, moderate and temporary** (limited to the clearance / demolition activities only).

Excavation

7.6.52 Excavated material as part of the construction works will generally consist of:

- Topsoil and subsoil.
- Made ground.
- Quaternary sediments.

7.6.53 The following activities will result in the generation of excavation material during the construction phase of the Proposed Scheme:

- Laying of foundations
- Utilities diversion
- Site Clearance
- Installation of site drainage and stormwater utilities
- Completion of temporary river diversion

7.6.54 The total quantity of excavated materials from the Proposed Scheme is estimated to be 3,300 m^3. A breakdown of the quantity of this material that will be generated from the different elements of the scheme works is presented in the table below.

Table 7-8: Excavation Quantities

Material Type	Excavation Quantity (m^3)
Soil	1,900 m^3
Concrete (demolition)	1,400 m^3

7.6.55 The most environmentally sustainable means of managing excavated material is its prevention and minimisation. Prevention and minimisation are inherent in the design of the Proposed Scheme.

7.6.56 The use of surplus material and management of these waste streams includes:

- Topsoil, soil, rock and naturally occurring material excavated in the course of construction activities will be reused within the Proposed Scheme where feasible, subject to further testing to determine if materials meet the specific engineering standards for their proposed end-use. This is not deemed to be a waste in accordance with Article 2 of the Waste Directive 2008/98/EC, the European Communities (Waste Directive) Regulations, 2011 and Section 3 of the Waste Management Acts, 1996-2011 as amended.
- Surplus materials or by products generated as a result of the Proposed Scheme which are not naturally occurring and which will be reused within the scheme will be notified to the EPA in accordance with Article 27 of the European Communities (Waste Management) Regulations, 2011 as a by-product, provided it meets the requirements of that clause.
- Where surplus materials are generated which cannot be reused within the scheme or other construction works these will be waste and will be delivered to recovery and disposal facilities authorised in accordance with the Waste Management Act, 1996 as amended and which hold a Certificate of Registration, Waste Facility Permit or EPA Licence.

7.6.57 Given the quantities anticipated and planned use of surplus material (not considered to be a mitigation measure, rather a design intention), the effect of excavation waste prior to mitigation measures being implemented is expected to be **imperceptible and temporary.**

General Construction Waste

7.6.58 Construction works, site offices and temporary works facilities are also likely to generate waste. General construction waste can vary significantly from site to site. The construction waste that will be generated in the various work packages during the construction of the Proposed Scheme, along with estimates of their quantities are presented in Table 7-9. General construction waste will also include surplus and damaged products and materials

arising in the course of construction work or used temporarily during the course of on-site activities.

Table 7-9: Construction Waste Quantities

Waste Type	Quantity (tonnes)
Excavated soil	7,750 tonnes
Excavated Rock Material	2,000 tonnes
Excavation of lean mix concrete surround around existing services	80 m^3
General waste	800 tonnes
Timber Waste (recycled)	200 tonnes

7.6.59 The most environmentally sustainable means of managing general waste is its prevention and minimisation. Prevention and minimisation are inherent in the design of the Proposed Scheme.

7.6.60 The use of surplus material and management of these waste streams includes:

- Surplus construction materials will be reused within the Proposed Scheme or at other construction sites. The feasibility of reuse as a by-product will be investigated by the contractor and undertaken where feasible in accordance with Article 27 of the European Communities (Waste Management) Regulations, 2011.
- The contractor will ensure that the appropriate waste authorisation is in place for all facilities that the material is delivered to (i.e., EPA Licence, Waste Facility Permit or Certificate of Registration).

7.6.61 Given the quantities anticipated and planned use of surplus material (not considered to be a mitigation measure, rather a design intention), the effect of general waste generation is expected to be **imperceptible and temporary**.

Operation and Maintenance Phase

Roads, Traffic and Transportation

7.6.62 The FRS has been designed in a coordinated manner, with considerations of the Mobility Management Plan 2021-2026 taken into account to ensure effective flow of traffic through the areas where flood defence is proposed. Where required, access ramps have been provided to facilitate throughways over embankments, and flood gate.

7.6.63 As a result of the construction of the flood defences set back from the existing Graiguenamanagh Quay wall, a one way-system will be in place from Main Street, until the junction at Barrow Lane during the operation and maintenance phase of the Proposed Scheme. This will require a slightly longer route to access back to Main Street but can be travelled via Barrow Lane and Abbey Street/Wood Road (L8221). There will also be a loss of all parking along Graiguenamanagh Quay as a result of the Proposed Scheme. This

change in the traffic system and parking in a small section of the overall Proposed Scheme area will have a **permanent, slight-moderate and negative** impact.

7.6.64 Minor maintenance works will be required during the operation of the FRS, as outlined in Chapter 4 'Project Description and Construction Methodology'. Given the nature of these maintenance works as being small in nature, minimal plant/vehicle access requirements and public disturbance is anticipated.

7.6.65 A **permanent significant positive** impact is assigned overall, despite the slight-moderate impact from the change in access route at Graiguenamanagh Quay, where road infrastructure is afforded protection during flood events, thereby maintaining the connectivity of G-T, and enabling normal flow of traffic throughout the settlement areas which previously would have been flooded.

Utilities and Services

7.6.66 Minor maintenance works will be required during the operation of the FRS, as outlined in Chapter 4 'Project Description and Construction Methodology'. Given the nature of these maintenance works as being small in nature, minimal to no disruption on existing services is anticipated.

7.6.67 A **permanent positive** impact is assigned where utilities and services are afforded protection during flood events, thereby maintaining the connectivity of services that might have previously been shut off during flood events.

Waste Management

7.6.68 Some minor waste streams may be generated through routine maintenance works at operation phase however these are considered to have **imperceptible** impacts given the likely nature (inert, likely limited to soils, aggregates, general litter debris and vegetation debris) and small quantities.

7.7 Mitigation Measures

Construction Phase

7.7.1 A CEMP has been prepared alongside the EIAR (see Appendix 4-4) to provide guidance on the implementation of the mitigation measures to the appointed contractor(s), setting out the measures identified in this EIAR as well as general site management best practise. The appointed contractor will be responsible in taking ownership of this iterative document and developing it into a dedicated and site-specific CEMP to be considered a 'live' document understood and implemented by all construction staff and sub-contractors throughout the construction process.

Roads, Traffic and Transportation

7.7.2 The following mitigation is proposed with regards to road, traffic and transportation impacts:

RTT_1: The appointed contractor will be required to prepare a Traffic Management Plan (TMP) for the construction phase, in accordance with appropriate guidance and requirements of the Department of Transport, National Roads Authority and the Local Government and Transport Infrastructure Ireland (TII). The "Guidance for the Control and Management of Traffic at Road Works – Second Edition 2010", published jointly by the Department of Transport, National Roads Authority and the Local Government Management Services Board should be referenced, in particular. The plan shall include an overview of the works sequence and vehicle requirements, provisions for managing access around construction sites and through residential/commercial areas and managing road safety with regards to the operation of construction vehicles in residential areas. The TMP will clearly identify the routes to be used to access the site for different types of traffic as appropriate, i.e. haul routes and construction staff access routes, as well as those sections of road which are not to be used. Access routes to and from the site, delivery times and off-loading proposals will be formally agreed with the Local Authority as part of the CSTMP. In developing the construction and logistics plans, the Contractor will fully include representatives of the Kilkenny and Carlow County Councils Roads Department, and other interested parties, in a consultation process to ensure that intentions are properly communicated, agreed and do not unduly affect the surrounding residential and retail properties. The contractor will ensure that all relevant mitigation measures identified in the EIAR and as part of the consenting process (e.g. planning conditions) are, where relevant, included in the plan.

RTT_2: A system of clear signage relating to the project, both temporary and permanent, will be agreed with the planning authority. These signs will also identify those roads to be used (and not to be used) for accessing the site in line with the objectives of the TMP. All signage will be provided as per Chapter 8 of the Traffic Signs Manual and the "guidance for the Control and Management of Traffic at Roadworks 2010. Temporary signage will be provided as per TS-3 1986 Specification for the Construction of Traffic Signs. All signage is to be easily visible at night, kept in a clean and legible condition and located facing approaching traffic.

RTT_3: The appointed contractor will provide a competent person with responsibility for traffic management coordination for the duration of the project. This person will be the main point of contact for all matters relating to traffic management on the project.

RTT_4: All workers will receive a comprehensive site induction which shall include, as appropriate, a section on traffic management and clear guidance on the routes which shall and shall not be used. All workers will be aware of the requirements of the TMP.

RTT_5: Where static lane and full road closures are anticipated, these will be appropriate for works where minimum lane widths can be maintained, and crews will be working progressively along the pipeline route. Static land closures will be undertaken to a specific safety methodology (to be outlined in the TMP) including use of stop/go traffic signals, provision of adequate warning signage and cones, limiting of lane closure lengths and maintaining temporary lane widths. Full lane closures will be undertaken to a specific safety methodology (to be outlined in the TMP) including provision of advanced signage in verges to allow positioning of crew, provision of road traffic cones and appropriate road

closure signage at the location of the closure, conduct regular inspections of the road closure signage during works, and removal of signage and cones in a reverse manner.

RTT_6: Prior to any works commencing, all notifications required under the contract requirements and/or road opening license conditions shall be provided to the public.

RTT_7: Any location where removal of parking is required will be discussed appropriately with the local Gardai and Kilkenny and Carlow County Council's Roads Department. Public notice will be provided.

RTT_8: Steel tracked excavators will be moved to and from the Site on low-loaders and will not be permitted to drive onto the adjacent roadway.

RTT_9: Pedestrians will be diverted around the works area. Barriers will be erected, and a footpath will be available for pedestrians, at all areas except Area 2 (Well Lane to High Street Bridge), where pedestrian access will be closed off for approximately 3 months.

RTT_10: Adequate parking and set-down areas will be provided for personnel and deliveries to avoid queuing at the site entrances and prevent disruption to neighbouring business and local traffic.

RTT_11: Public roads outside the Site shall be regularly inspected for cleanliness, as a minimum on a daily basis, and cleaned as necessary. A road sweeper will be made available to ensure that public roads are kept free of debris.

RTT_12: The contractor will confine his activities to the area of the Site occupied by the works and the builders' compound, as far as practicably possible, during any particular phase of the works.

RTT_13: All construction workers will be encouraged to use public transport, and also to car share where appropriate. On site staff car parking will also be provided to ensure no construction workers will be required to park on adjacent roads or streets.

RTT_14: Construction work will be limited to normal working hours; that are 08.00 – 19.00 on weekdays and 08.00 – 14.00 on Saturdays. All deliveries of materials, plant and machinery to the Site and removals of waste or other material will take place within the permitted hours of work. Vehicle movements will be planned to ensure arrival and departure times are maintained inside the agreed working hours.

RTT_15: Deliveries will be co-ordinated to prevent queuing of vehicles adversely affecting traffic flow and to minimise disruption to local traffic. They will be timed and coordinated to avoid conflict with collection of waste, other deliveries (particularly to adjoining owners), and rush hour traffic. Large deliveries will be scheduled outside peak traffic hours to minimise disruption. The Contractor will consider out of hours deliveries and collections to facilitate the smooth continuation of works and minimise disruption.

RTT_16: Properly designed and designated access and egress points to the construction site will be used to minimise impact on external traffic.

RTT_17: Attention will be given to the loading of lorries carrying bulk materials into the Site and spoil from the Site to ensure that these will not be overloaded or are loaded in such a way that spillage is avoided.

RTT_18: All open load trucks entering and exiting the site will be covered with a tarpaulin.

RTT_19: The Contractor is required to ensure that the condition and surface of the existing roads within the works area are not affect by works vehicle. Cleaning systems and wheel wash systems are to be agreed with the Client.

RTT_20: All site staff including delivery drivers are required to abide by the normal rules of the road.

RTT_21: All vehicles entering site will be restricted to suitable speed limits and will be directed to the relevant area by signage, flags persons or security personnel.

RTT_22: All deliveries of materials, plant and machinery to the site and removals of waste or other material, will take place within the permitted hours of work. Vehicle movements will be planned to ensure arrival and departure times are maintained inside the agreed working hours. No day-time or night-time parking of vehicles will be permitted outside agreed areas.

RTT_23: Contractor staff who direct vehicle movements will be trained and authorized to do so.

RTT_24: The Contractor will provide induction training for drivers, workers and visitors and send relevant instructions out to visitors before attending site. The Contractor will make sure that all the drivers and supply chain personnel are competent and have relevant training and certification appropriate for their job.

Pedestrian and Cycling Networks

P&C_1: Where pedestrian and cycling paths are required to be closed, specific pedestrian management plans will be developed, and any footpath closures will need to be approved by the council area engineer and the local Garda. Appropriate signage will be placed to advise of closure and/or diversion and warning will be provided to the public ahead of these works commencing.

P&C _2: All cycling and footpaths shall be kept entirely free of excavated materials, debris and rubbish. All shall be regularly inspected for cleanliness, as a minimum on a daily basis, and cleaned as necessary. A sweeper will be made available to ensure that pathways are kept free of debris.

P&C _3: Footpaths will not be blocked resulting in pedestrians having to step onto roads. If a pedestrian access is required to be provided, firm, level, and well-drained pedestrian walkways will be provided.

Utilities and Services

U&S_1: All utilities and services located within the area are to be considered as part of the engineering design of the Proposed Scheme, including where diversion or alterative provisions are required, and where flood protection is to be provided. Consultation with the affected utility providers / operators will be undertaken during this process.

U&S_2: All utilities and service diversions will be agreed in coordination with the design/engineering team, KCC, CCC and any operators (i.e., Uisce Éireann, Electricity Supply Board, Gas Networks Ireland etc.) and undertaken as part of the enabling works in advance of the commencement of construction activities.

U&S_3: The contractor will take all actions to avoid unplanned disruptions to any services during the construction phase of the project through identifying the location of all utility infrastructure within the work areas, ensuring that all works undertaken in and around known utility services are be carried out using strict and robust Method Statements and that the major services suppliers will be contacted in advance of ground works proceeding in an area.

U&S_4: Services disruptions impacting on residents or commercial outlets will only happen where unavoidable. In this scenario, residents and commercial outlets will be given advanced warning of the date, time and expected duration of the disruption. The contractor will be responsible for all underground services for which diversions are not required.

U&S_5: Provision of utilities will be carried out in accordance with the recommendations of the relevant statutory bodies (ESB, Gas Networks Ireland, Uisce Éireann, EIR, Virgin, County Councils etc.).

Waste Management

WM_1: The contractor(s) will prepare a Waste Management Plan (WMP) for the construction process, in order to define the main guidelines and procedures to be adopted for the effective reduction, management and disposal of waste material generated. A dedicated Waste Manager will be appointed to oversee and have overall responsibility of waste management during the construction phase however it will be the responsibility of all personnel working on site to understand the waste management requirements and implement recycling, separation etc. and all other methods described within the WMP.

WM_2: The following methods will be implemented for general best practise management of waste:

- Contractor will appoint a dedicated Waste Manager responsible for the implementation of the WMP, provision of waste training and keeping of all records associated to waste.
- Provision of toolbox talks and awareness training to staff regarding waste management, particularly hazardous waste.

- Provision of appropriate waste management infrastructure on site including receptacles for construction and demolition waste, general inert waste, recyclable waste and hazardous waste.
- For the collection and movement of waste offsite, specialist waste service contractors will be engaged to transport material to appropriately certified and permitted facilities.
- Maintain logs of all waste removed off-site to a licensed transfer station.
- Conduct regular inspections and audits to monitor the effectiveness of the waste management programme.

WM_3: The following methods will be implemented to minimise waste:

- Completion of scheme design with the prevention of waste as a core principle, considering options for material reuse (i.e., excavated soils).
- Order materials and resources onto site on an 'as needed' basis through proper resource management and planned sequencing of works, to avoid wastage.

WM_4: The following methods will be implemented to recycle and reuse waste:

- Implement an achievable system of recycling on site through provision of appropriate training and collection infrastructure.
- Reuse materials on site, where possible.

WM_5: Hazardous waste materials arisings are not anticipated however should they arise during construction; the following methods will be implemented to manage hazardous waste:

- Hazardous waste materials will be removed from site on a regular basis.
- Only store approved quantities of hazardous waste on site and separated from other waste streams.
- Ensure that all materials are appropriately stored in accordance with the Material Safety Data Sheet (MSDS), with relevant risk measures put into place (i.e., warning signage, fire safety equipment, spill kit and procedures).
- All hazardous wastes will be in sealed labelled drums and stored in lockable chemical cabinets. Wastes will not come into contact with soils, and will be stored either in drums or on hardstand areas.
- The Contractor will ensure that all hazardous waste producers keep specified records of any hazardous waste arising from the site / premises. These records will set out the quantity, nature and origin of the waste, any treatment carried out and the quantity, nature, destination, frequency of collection and mode of transport of any hazardous waste transferred to another person.

- Appropriate completion of the Waste Transfer Form (Department of Environment, Community and Local Government under Legislation S.I. No. 324 of 2011 European Communities Shipments of Hazardous Wate Exclusively within Ireland). Waste producers and collectors need to keep copies of the completed forms for at least five years.

Operation and Maintenance Phase

MA_1: Any lighting removed as part of the construction works will be reinstated or replaced during operation.

MA_2: Maintenance of flood defence measures that intersect with built services (i.e., roads & pathways) are to be inspected and maintained in accordance with the Operations & Maintenance Plan to avoid any impact to these services.

7.7.3 The mitigation measures outlined for the construction phase will be applicable for any waste streams generated through routine maintenance works at operation phase.

7.8 Monitoring

7.8.1 Most of the monitoring under this Chapter will be completed through routine site inspections undertaken by the contractor(s) QHSE Team, whereby the implementation of associated mitigation measures outlined in the CEMP will be verified, and areas of improvement identified. Specifically appointed staff will ensure appropriate monitoring of respective measures, including those assigned to manage traffic management and those assigned to manage waste management.

7.8.2 Contracting staff's adherence to measures outlined in the TMP (i.e., use of safety belts, adherence to speed limits, use of haulage routes) will be monitored by the appointed traffic management officer through routine checks. Public roads, cycling paths and walkways outside of the site compounds shall be regularly inspected for cleanliness, as a minimum on a daily basis, and cleaned as necessary. A sweeper will be made available to ensure that these are kept free of debris.

7.8.3 The management of waste during the construction phase will be monitored by the Contactor's appointed Waste Manager to ensure compliance with the above-listed mitigation measures, and relevant waste management legislation and local authority requirements, including maintenance of waste documentation. Waste generation and associated collection shall be recorded throughout the construction process, with all collection receipts and transfer notes maintained on site for record.

7.9 Residual Impacts and Effects

The 'do nothing Scenario

7.9.1 The intention behind the Proposed Scheme is to offer protection to communities from fluvial and alluvial flooding events, including the built services and utilities located within the study area. If the defences are not implemented, flooding is likely to cause disturbance to these services leading to potential outages and maintenance/repair requirements.

Under the 'do nothing' scenario, the impact on material assets is likely to be negative and significant, with temporary impact during flood but permanence of effect (reoccurring impact).

Construction Phase

Roads, Traffic and Transportation

7.9.2 The implementation of appropriate design and construction phase mitigation is anticipated to reduce the magnitude of impact with regards to roads, traffic and transportation, however it is anticipated that there will still be **temporary slight adverse** residual impacts, largely on account of the constrained nature of the road system within the town of Graiguenamanagh and limitations of existing parking. The complete avoidance of impacts is unlikely in this regard.

7.9.3 The table below outlines the residual effect as a result of each of the Work Packages as outlined in Chapter 4 'Description of the Proposed Scheme and Construction Methodology'.

Bus Network

7.9.4 No impact has been predicted to this asset.

Pedestrian and Cycling Network

7.9.5 Temporary closure or diversion of walkways and cycling pathways during construction of defences remains a residual impact. However, any closures or diversions will be temporary and last for the duration of the construction phase (i.e., most locations will not be disrupted for the entire 36-42 months of construction). The residual impact is therefore considered to be not significant.

Utilities and Services

7.9.6 Residual impact to WWTPs and gas networks are not identified, as no impact has been assigned to these assets. It is anticipated that the implementation of appropriate mitigation through consultation and due diligence will reduce the magnitude of impact with regards to the possible relocation and/or temporary isolation/closure of utilities and services during construction, including foul and storm water sewers, digital and electricity infrastructure. The residual impact is therefore considered to be **not significant**.

Waste Management

7.9.7 It is anticipated that the adoption of appropriate waste management mitigation outlined in the CEMP and site-specific Waste Management Plan (WMP) will reduce the magnitude of impact. The residual impact is there considered to be imperceptible.

Operation and Maintenance Phase

7.9.8 There are positive impacts to roads, utilities and the water treatment plant outlined in Section 7.5 that will be **permanent positive** residual impacts.

7.9.9 No other impacts have been predicted with regards to material assets during operation, therefore **no residual effects** exist.

7.10 Interactions with other Environmental Effects

7.10.1 Interactions exist between the Material Assets assessment and other environmental parameters. Key areas of interaction include:

- Impacts to the health, safety and general wellbeing of the population with regards to the requirement for infrastructure and services, exposure to increase construction congestion and traffic (and the secondary impacts of this with regards to pollutant and noise generation), limitations to access of walkways and cycling routes during construction and exposure to improper construction housekeeping (waste management). This is linked with Chapter 6 'Population and Human Health'.
- The effects of air pollution and noise generation with regards to the road, traffic and transportation impacts. These are outlined in Chapter 13 'Air Quality' and Chapter 15 'Noise and Vibration'.
- Effects to assets of cultural heritage nature, outlined in Chapter 9 'Cultural Heritage'.
- Effects to assets of natural origin, outlined in Chapter 10 'Biodiversity'.
- Effects of continued and worsening flooding under the 'do nothing' scenario will cause further damage and economic stress to infrastructure in the flood risk zone. From the operation phase perspective however, the successful implementation of the Proposed Scheme has significant positive impacts by providing protection against flooding. This is outlined in Chapter 14 'Climate'.

7.11 Cumulative Impacts

7.11.1 A full review of the potential cumulative impacts is provided in Chapter 16 'Interactions and Cumulative Effects'.

7.11.2 However, in summary, if the construction periods of the identified projects overlap with the GTFRS, there is potential to cause cumulative impacts upon material assets as a result of:

- Changes to local traffic conditions, including additional volumes of vehicles, and potential for lane closures/diversions etc. from multiple construction processes.
- Generation of vehicular pollutants and dust from the operation and movement of construction vehicles.
- The potential for multiple utilities and services to be impacted by various construction activities, resulting in potential multiple diversions and reduces service provision.

- Generation of waste streams, and the pressure this may put onto local construction waste sorting, recycling and disposal facilities.

7.11.3 The above may impact upon the transportation infrastructure, services and utilities and waste facilities, as well as the general population (i.e., increased traffic volumes, changes to traffic flow & outages or changes to services). However, the effects will be temporary, limited to the construction periods of each project.

7.11.4 Once operational, the proposed FRS, when considered cumulatively with the above developments, will have a positive impact to the material assets associated to them (i.e., utility provisions, new roads/accesses/ new cycle lanes (i.e., pedestrian bridges).

7.12 Limitations in Preparing the Chapter

7.12.1 There were no limitations in the preparation of this Chapter.

7.13 Summary

Table 7-10: Summary of Impacts and Mitigation Measures: Material Assets

Receptor	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
'Do Nothing' Scenario Impacts					
Existing infrastructure, services & utilities	Maintenance of current flood risk condition causing disruption and damage to infrastructure and utilities.	Negative, Moderate to Significant	Temporary during potential flood events, but permanent in effect.	Mitigation not applicable in 'do nothing' scenario.	Negative, Moderate to Significant
Construction Phase Impacts					
Local Road Users, Residents and transportation networks	Lane/Road Closures	Negative, Moderate	Temporary	• Implementation of best practise traffic management, as outlined within a CSTMP. • Appointment of person responsible for traffic management. • Construction phasing/planning. • Clear signage system. • Appropriate consultation and notice provision to the public, the Local Authority and Gardai.	Negative, Slight
	Parking changes	Negative, Moderate	Temporary	• Appropriate consultation and notice provision to the residents the Local Authority and Gardai. • Provision of suitable and convenient alternative parking.	Negative, Slight

Receptor	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
	Trip generation and impact on existing road traffic.	Negative, Moderate	Short Term	• Implementation of best practise traffic management, as outlined within a CSTMP. • Appointment of person responsible for traffic management. • Construction phasing/planning. • Implementation of traffic safety measures.	Negative, Slight
Pedestrian and Cycling	Complete or partial closure of walkways, pedestrian access routes and/or cycling routes during period of the construction phase.	Negative, Slight	Temporary	• Minimisation of walkway/cycling route closure, where possible. • Appropriate placement of compounds/laydown areas. • Appropriate construction phasing / sequencing. • Provision of safe alternative routes/diversions to minimise nuisance.	Negative, Not Significant
Utilities and services	Disruption to WTP and WWTPs.	Positive Significant Impact.	Temporary	• Water quality monitoring before and during construction – Refer EIAR Chapter 8.	No residual impact
	Disruption to gas networks.	No impact.	Not applicable	Not applicable.	No residual impact
	Disruption to foul and storm water sewers.	Negative, Not Significant	Temporary	• Design and pre-construction due diligence. • Coordination with utility network providers.	Negative, Not Significant
	Disruption to water utilities.	Negative, Not Significant	Temporary		Negative, Not Significant

Receptor	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
	Disruption to electricity supply.	Negative, not significant	Temporary	• Adoption of appropriate construction phasing to limit impact of utility shutdowns.	Negative, Not Significant
	Disruption to digital infrastructure.	Negative, Not Significant	Temporary		Negative, Not Significant
Waste Management	Site Clearance & Demolition Waste	Negative, not significant	Temporary	• Adoption of Waste Management Plan (WMP). • Appointment of Waste Manager. • Provision of waste management infrastructure and appointment of regular collection services. • Retention of collection receipts and record keeping of where wastes are being transported and disposed of. • Implementation of waste segregation practises. • Implementation of waste re-use and recycling practises. • Implementation of appropriate hazardous waste management.	Negative, Not Significant
	Excavation Materials	Negative, not significant	Temporary		Negative, Not Significant
	General Construction Waste	Negative, Not Significant	Temporary		Negative, Not Significant
Operation and Maintenance Phase Impacts					

Receptor	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
Graiguenamanagh Quay road system and parking	One way-system and loss of all parking along Graiguenamanagh Quay.	Negative, Moderate	Permanent	Not applicable.	Negative, Moderate
Roads, traffic and transportation	Protection during flood events, resulting in little to no disruption to normal traffic flow and/or use of transport and road infrastructure.	Positive, moderate	Permanent	Not applicable.	Positive, moderate
Utilities and services	Protection during flood events resulting in little to no disruption to normal use of utility services.	Positive, moderate	Permanent	Not applicable.	Positive, moderate
Waste Management	Generation of solid, liquid and hazardous waste streams.	Imperceptible	Brief	Adoption of construction phase mitigation in the management of waste streams.	No residual impact

7.14 References

ByrneLooby. (2021). Environmental Constraints Study Report , W3451-BL-ENV-R001.

CCC. (2022). Carlow County Development Plan 2022 – 2028.

Department of Housing, Local Government and Heritage. (2024). myplan.ie - National Planning Application Database. Retrieved from myplan.ie/national-planning-application-map-viewer

DHLGH. (2018). Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment .

EPA. (2020). Urban Waste Water Treatment in 2020. Retrieved from https://www.epa.ie/publications/monitoring--assessment/waste-water/Urban-Waste-Water-Treatment-in-2020-report.pdf

EPA. (2022). Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.

KCC. (2021). Kilkenny City and County Development Plan 2021-2027.

Kilkenny County Council and Carlow County Council. (2020a). Environmental Report (SEA) of Graiguenamanagh-Tinnahinch Draft Joint Local Area Plan 2020- 2026. Kilkenny County Council and Carlow County Council.

Kilkenny County Council and Carlow County Council. (2021). Graiguenamanagh – Tinnahinch Joint Local Area Plan 2021. Kilkenny County Council and Carlow County Council.

Roadplan Consulting. (2021). Graiguenamanagh-Tinnahinch Mobility Management Study 2021-2026.

SLR. (2019). Graiguenamanagh / Tinnahinch Tourism and recreational project concept study executive summary. SLR.

TII. (2024). *Major Roads Projects Active List.*

8 Hydrology - Surface Water

8.1 Scope of the Assessment

8.1.1 This chapter describes the likely significant effects associated with the construction, operation and maintenance of the Proposed Scheme on surface water quality and the existing hydrological regime.

8.1.2 Groundwater features of relevance and hydrogeology have been considered separately in Chapter 12 'Land, Soils, Geology and Hydrogeology' and should be read in conjunction with this chapter as well as Chapter 10 'Biodiversity' due to the interdependencies of these disciplines.

8.1.3 The following aspects have been considered relevant to the surface water assessment:

- Design:
  - Design features of the flood defences (flood defence walls, embankments and gates) that will result in flood protection from 1% AEP fluvial flood events.
  - Design features of the proposed flood defences (flood defence walls, embankments and gates) that may cause direct impact to surface water bodies in the Study Area.
- Construction:
  - Considerations of working within/near to waterbodies, including the potential for sedimentation into surface waterbodies, release of unplanned spillages / discharges and implications of dewatering activities.
- Operation and Maintenance:
  - Consideration of maintenance activities including clearing of debris and vegetation on the riverbanks.
  - Considerations of hydro-morphological changes where in-river works are proposed.

8.2 Statutory and Policy Context

8.2.1 This assessment has been undertaken with due regard to the overarching EIA guidance (described in Chapter 2 'Planning and Policy'). Other important pieces of EU and national legislation pertaining to the hydrological environment include:

- S.I. 722 of 2003, European Communities (Water Policy) Regulations, as amended.
- 350 of 2014, European Union (Water Policy) Regulations 2014.

- The EU Floods Directive 2007/60/EC.
- S.I. 122 of 2010 European Communities (Assessment and Management of Flood Risks) Regulations.
- S.I. 81 of 1988, European Community Environmental (Quality of Surface Water Intended for Human Consumption) Regulations 1984 as amended.

8.2.2 Regard was also given to the following guidance documentation and legislation in this assessment:

- National Roads Authority (NRA)1 Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Scheme (2008).
- Inland Fisheries Ireland (2016) Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters.
- Office of Public Works (OPW) Environmental guidance: Drainage Maintenance and Construction (2019).
- The Planning System and Flood Risk Management; Guidelines for Planning Authorities (2009).
- NIEA (2014) River Hydromorphology Assessment Technique – Training Guide

Water Framework Directive (WFD)

8.2.3 A significant legislation piece that drives the impact assessment of this Chapter is the Water Framework Directive (WFD). The WFD aims at improving the water environment in the EU and requires all Member States to protect and improve water quality in all waters so that they achieve good ecological status at a minimum by 2015 or, at the latest, by 2027. It applies to all waters including rivers, lakes, estuaries, coastal waters and groundwater, and their dependent wildlife/habitats under one piece of environmental legislation.

8.2.4 Initially, a set of River Basin Management Plans (RBMPs) were prepared to protect and improve Ireland's water environment, reviewed and updated every six years. The first RBMPs covered the period 2009 to 2014 and identified the waterbodies that may not meet the environmental objectives of the WFD by 2015. The second RBMPs (for 2018 to 2021) were published in April 2018, and these set out the actions to improve water quality and achieve 'good' ecological status in water bodies (rivers, lakes, estuaries and coastal waters) by 2027.

8.2.5 The Water Action Plan 2024: A River Basin Management Plan for Ireland was published September 2024 (Department of Housing, Local Government and Heritage, 2024). This RBMP covers the period 2022-2027. This plan outlines the new approach that Ireland will

[1]Transport Infrastructure Ireland (TII)

take as it works to protect and restore its rivers, lakes, estuaries and coastal waters over the third cycle of the WFD. The key objectives outlined in the Water Action Plan are:

- to prevent the deterioration of water bodies and to protect, enhance and restore them with the aim of achieving at least good status; and
- to achieve compliance with the water standards and objectives for designated protected areas.

8.2.6 The WFD has been transposed into Irish law by means of the following main Regulations.

- European Communities (Water Policy) Regulations, 2014 (S.I. No. 350 of 2014)
- European Communities (Drinking Water) Regulations 2014 (S.I. No. 122 of 2014).
- European Communities Environmental Objectives (Surface Waters) (amendments) Regulations, 2019 (S.I. No. 77 of 2019).
- European Communities Environmental Objectives (Groundwater) (Amendments) Regulations, 2016 (S.I. No. 366 of 2016).
- European Communities (Good Agricultural Practice for Protection of Waters) (Amendments) Regulations, 2020 (S.I. No. 40 of 2020).
- European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations, 2011 (S.I. No. 489 of 2011).

8.2.7 The Department of Housing, Local Government and Heritage held a public consultation with regards to the 'Designation of Ireland's Heavily Modified Water Bodies arising out of the 2024 Water Action Plan', published on 27th March 2025 and closed on 23rd May 2025. The watercourse present within the Study Area (Barrow_230) is listed as a candidate Heavily Modified Water Body (HMWB). These are waterbodies that have been physically modified in the past to serve a specified use, such as navigation as is the case with the River Barrow (Barrow_230). HMWB's have an alternative environmental objective of Good Ecological Potential (GEP), as opposed to an environmental objective of Good Ecological Status (GES). This takes account of the changes in aquatic ecology caused by the physical modification.

The European Union Environmental Objectives (Surface Water) (Amendment) Regulations, 2019

8.2.8 The European Union Environmental Objectives (Surface Water) (Amendments) Regulations 2019, provide a more complete and stringent set of surface water quality regulations which address the requirements of the WFD and Council Directive 2006/11/EC on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community. These regulations specify the conditions and physio-chemical concentrations that should be considered in the assessment of surface water

quality. These regulations also give effect to Council Directive 2008/105/EC on environmental quality standards in the field of water policy.

European Communities (Quality of Salmonid Waters) Regulations, 1988

8.2.9 Legislation for salmonid waters was first established under Council Directive 78/659/EEC on the quality of freshwaters needing protection or improvement in order to support fish life (the Freshwater Fish Directive). The Directive was given effect in Ireland through the S.I. No. 293/1988 - European Communities (Quality of Salmonid Waters) Regulations, 1988. The Freshwater Fish Directive was subsequently superseded by Water Framework Directive, but the Irish Regulations remain in force. The Regulations defined freshwaters as being waters capable of supporting Salmon (S*almo Salar*), Trout (*Salmo trutta*), Char (*Salvelinus*) and whitefish (*Coregonus*) and are designated as Salmonid waters.

Local Policy

8.2.10 The Graiguenamanagh-Tinnahinch Joint Local Area Plan (LAP) 2021-2027 is jointly prepared by the KCC and CCC and sets out an overall strategy for the planning and sustainable development of the town and village. The management of surface water and protection of groundwater is part of KCC and CCC's sustainable water services policy where intentions to "maintain and enhance the existing surface water drainage systems in Graiguenamanagh-Tinnahinch (G-T) and to protect surface and ground water quality in accordance with the requirements of the Water Framework Directive" are outlined under the Infrastructure and Environment objective No. 2 (SNF2) and related objective INFO2.2 which states desire to protect surface water (and groundwater sources) in conjunction with the EPA and WFD. Kilkenny County Council, Carlow County Council and the Environmental Protection Agency carry out water quality monitoring in the waterbodies of the South Eastern River Basin District for the purpose of the Water Framework Directive.

8.2.11 The LAP also highlights the use of Sustainable Drainage Systems (SuDS) as a means of contributing to surface water retention and helping in the reduction and prevention of flooding, by mimicking the natural drainage of a site. Intentions in this regard are outlined under the Infrastructure and Environment objective No. 2 (SNF2) and related objective INFO2.1.

8.2.12 With specific focus on 'Flood Risk Management', the G-T Joint LAP set an objective of the Plan:

"INFO3.1: To support and co-operate with the OPW and other stakeholders in delivering Graiguenamanagh-Tinnahinch Flood Relief Scheme under the South Eastern CFRAM Programme, whilst ensuring heritage considerations inform the design of proposed works and to ensure development maximises the protection of the integrity of the historical settlement."

8.2.13 The Carlow County Development Plan 2015 -2021 (Section 10.4 and policy 7 therein) outlines the policy of CCC to protect existing and potential water sources for the county through the following measures:

- Actively participate in the implementation of the Water Framework Directive.
- Implement the South Eastern River Basin District Management Plan and the Program of Measures.
- Increase public awareness of water quality issues.
- Ensure the sustainable and economic provision of an adequate supply of good quality water for industrial, domestic and other beneficial uses, including the propagation of healthy fish stocks.
- Ensure the protection of sources of potable water and monitoring the quality of water resources.
- Prevent industrial water pollution requiring that wastewater treatment facilities are adequate.
- Protect existing and potential water resources for County Carlow, in accordance with the EU Water Framework Directive (2000/60/EC), the South- East River Basin Management Plan 2009-2015 and any updated version, the Pollution Reduction Programmes for designated shellfish waters, the provisions of Groundwater Protection Scheme for the County and any other protection plans for water supply sources.
- Ensure that developments permitted comply with the requirements of the EU Water Framework Directive, the relevant River Basin Management Plans and the Habitats Directive.
- Promote compliance with the requirements of the European Communities (Surface Waters) Regulations 2009 and the European Communities (Groundwater) Regulations 2010 and any other relevant legislation.
- Continue to improve water quality by implementing the measures outlined in the Nitrates Directive (91/676/EEC) and the national Nitrates Action Programme.
- Ensure that development permitted would not have an unacceptable impact on water quality and quantity, including surface water, ground water, designated source protection areas, river corridors and associated wetlands, estuarine waters, coastal and transitional waters.
- Implement the EPA Code of Practice for Wastewater Treatment Systems serving Single Houses (2009) in order to protect water quality.
- Prevent pollution of water by means of development management and enforcement measures.

- Ensure that developments that may adversely affect water quality will not proceed unless mitigatory measures are employed, such as settlements ponds, interceptors, etc.

- Support the protection of groundwater resources and dependent wildlife/habitats in accordance with the Groundwater Directive 2006/118/EC and the European Communities Environmental Objectives (groundwater) Regulations, 2010 (S.I. No. 9 of 2010) or any updated legislation.

8.2.14 The Kilkenny City and County Development Plan 2021 – 2027 includes a strategic aim to provide a framework for the protection of the environment, including water quality and the avoidance of flood risk. The Council has responsibilities for the protection of all waters including rivers, lakes, estuarine waters and groundwater. The work includes implementation of pollution control measures, licensing of effluent discharges, implementing and monitoring compliance with environmental legislation, and drawing up pollution contingency measures. The Council participate in the implementation of the Water Framework Directive. The plan states that the Council will continue to take appropriate measures in relation to all development in order to prevent ground and surface water pollution and will implement the National River Basin Management Plan.

8.3 Assessment Methodology

Study Area

8.3.1 A hydrological analysis was carried out as part of the development of this Scheme (Report No. W3451-W-R002) (ByrneLooby, 2022). This analysis established flows in the catchment and determined the requirements, design and viability of the Scheme. A subsequent hydraulic analysis established flood risk. This defines the areas at risk and the basis for implementing a scheme. The Study Area thus comprises all surface water features that could potentially impact on and/or could potentially be impacted by the Proposed Scheme. These primarily include the River Duiske and the River Barrow (see Figure 8-1) as those which would have most direct impact. The wider Study Area relating to hydrology and water quality is generally the area included within the catchment of the River Barrow and River Duiske, shown in Figure 8-1, and those areas where Natura 2000 Sites (Special Areas of Conservation and Special Protection Areas) have hydrological connection (see further in Chapter 10 ‘Biodiversity’).

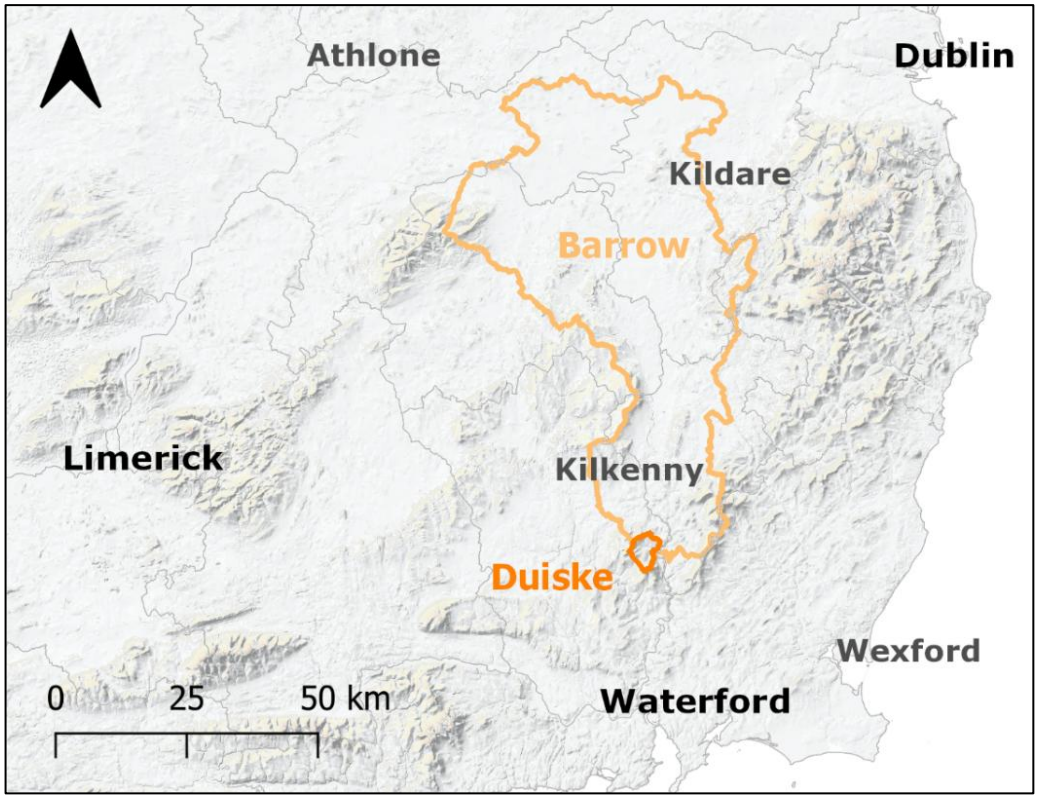


Figure 8-1: River Barrow and River Duiske Catchment

Assessment of Impacts

8.3.2 The hydrological assessment has considered the likely significant impacts of the Proposed Scheme on surface watercourses and hydrological features within and in proximity to the Proposed Scheme during construction and operation. It also considers the impact of flooding (flood risk) from the river on the adjacent lands, as outlined in initial flood risk assessment and hydrology reporting carried out by Ayesa (formerly ByrneLooby) (ByrneLooby, 2022). The flood risk assessment has been considered for the likely significant impacts of the Proposed Scheme on sources of flooding and the pathways which flood waters might reach receptors during construction.

8.3.3 The likely significant effects have been assessed by classifying the importance of hydrology, flood risk and water quality, and quantifying magnitudes of any likely significant effects on these attributes. For the purpose of this assessment, the following guidance was used specifically in the assessment of impacts:

- NRA (2009) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.
- EPA (2022) Guidelines on the Information to be contained in Environmental Impact Assessment Reports.

8.3.4 A further assessment was undertaken to assess the potential impacts the construction and operation of the Proposed Scheme will have on hydromorphology. This assessment was

carried out using the guidance of the River Hydromorphology Assessment Technique (RHAT) developed by the Northern Ireland Environment Agency (NIEA, 2014).

8.3.5 The rating of potential environmental impacts on the surface water environment is based on the matrix presented in the table below, which takes account of the quality, significance, duration and type of impact characteristic identified (NRA, 2008).

Table 8-1: Rating of Significant Environmental Impacts (NRA, 2009)

Importance of Attribute	**Magnitude of impact**			
	Negligible	**Small**	**Moderate**	**Large**
Extremely High	Imperceptible	Significant	Profound	Profound
Very high	Imperceptible	Significant/ Moderate	Profound/ Significant	Profound
High	Imperceptible	Moderate/ Slight	Significant/ Moderate	Profound/ Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/ Moderate

Table 8-2: Criteria for Rating (NRA, 2009)

Importance	**Criteria Description**	**Typical Examples**
Extremely High	Attribute has a high quality or value on an international scale.	River, wetland or surface water body ecosystem protected by EU legislation e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very high	Attribute has a high quality or value on a regional or national scale.	River, wetland or surface water body ecosystem protected by national legislation – NHA status. Regionally important potable water source supplying >2500 homes Quality Class A (Biotic Index Q4, Q5) Flood plain protecting more than 50 residential or commercial properties from flooding. Nationally important amenity site for wide range of leisure activities.

Importance	Criteria Description	Typical Examples
High	Attribute has a high quality or value on a local scale.	Salmon fishery. Locally important potable water source supplying >1000 homes. Quality Class B (Biotic Index Q3-4). Flood plain protecting between 5 and 50 residential or commercial properties from flooding. Locally important amenity site for wide range of leisure activities.
Medium	Attribute has a medium quality or value on a local scale.	Coarse fishery. Local potable water source supplying >50 homes. Quality Class C (Biotic Index Q3, Q2-3). Flood plain protecting between 1 and 5 residential or commercial properties from flooding.
Low	Attribute has a low quality or value on a local scale.	Locally important amenity site for small range of leisure activities. Local potable water source supplying <50 homes. Quality Class D (Biotic Index Q2, Q1). Flood plain protecting 1 residential or commercial property from flooding. Amenity site used by small numbers of local people.

8.3.6 The significance ranking is initially determined pre-mitigation (i.e. prior to the introduction of mitigation measures) and residual impacts are ranked based on the assumptions that all mitigation measures are adopted.

Data Sources

8.3.7 The appraisal of likely significant effects on hydrology was conducted through an initial desk-top review of the existing conditions within the Study Area. Baseline information was sourced from a number of secondary data resources including:

- Aerial Photography: Bing Maps and Google Maps (accessed 2025).
- EPA Maps (accessed 2025).
- Water Framework Directive (EDEN project: accessed 2025).
- Catchments.ie (accessed 2025).

- Public Consultation on the Designation of Heavily Modified Water Bodies for Ireland's third cycle River Basin Management Plan (gov.ie).Latest EPA water quality monitoring data for watercourses in the area.
- Water Action Plan 2024: A River Basin Management Plan for Ireland.
- Kilkenny City and County Development Plan 2021-2027.
- Carlow County Development Plan 2022-2028.
- Office of Public Works flood mapping data (www.floodmaps.ie).

8.3.8 Further, relevant scheme-specific documentation and assessments consulted as part of this assessment included the following:

- ByrneLooby (2020). Hydrological Method Statement, W3451-W-R001.
- ByrneLooby (2022). Hydrology Report, W3451-W-R002.
- ByrneLooby (2020). Hydromorphology Baseline Report, W3451-W-R005.
- McCloy Consulting, working with ByrneLooby (2024). Hydraulics Report, M02136-03_DG011.
- Ayesa (2025). Options Report, W3451-W-R009, Rev07.
- Ayesa (2024). Hydromorphology Report and Impact Assessment, W3451-ENV-R014.

Site Visits / Surveys

8.3.9 A number of site visits to the Study Area were conducted in the period from 2020 to 2024. Site specific details were recorded and included logging of springs, drainage details and surface water levels.

8.3.10 In terms of project-specific surveys, a Biological River Quality Classification System (or Q Value) Survey and kick sampling (macroinvertebrates) was undertaken by Aquafact on behalf of Ayesa (formerly ByrneLooby) in 2020 and by APEM Ltd. in August 2023 (upstream storage area). The results are described in more detail in Section 8.4 'Baseline Environment'. Further, a series of terrestrial biodiversity surveys have been undertaken during the period 2020 – 2024, including habitat mapping, invasive alien species surveys, species of interest surveys etc. These are detailed in Chapter 10 'Biodiversity' with much of the information relevant to this chapter also.

8.3.11 On 5th December 2023 a site walkover was undertaken by Ayesa. This site visit allowed for a RHAT survey to be undertaken on the upstream storage area. During this site visit, ground truthing of previous findings from 30th July 2020 and 16th February 2021 (summer and winter periods) site visits followed where the banks of the Barrow River and River

Duiske were surveyed. The results are discussed in Section 8.4 'Baseline Environment' and further in Section 8.5 'Potential Impacts and Effects'.

Consultation

8.3.12 Throughout the EIA process, consultations were made to seek opinions and input from statutory bodies, regulators, organisations, research bodies, community facilities and residents that have an interest or who may be affected by the Proposed Scheme. Data/information was also provided by stakeholders in some cases, where relevant, for incorporation into the EIA study. This chapter has been prepared with consideration of the outcomes of this consultation, which is detailed further in Chapter 5 'Consultation and Stakeholder Engagement'.

8.3.13 Specific to this chapter, communications were received from Uisce Éireann and the Environmental Health Officer (see also in Table 5-2 in Chapter 5). Consultation observations from Uisce Éireann in relation to infrastructure and assets related to storm water, wastewater, drainage etc. have been outlined and addressed in reference to Chapter 7 'Material Assets'. However, one aspect of Uisce Éireann's observations which is applicable also to this chapter is in relation to drinking water abstraction and how construction activities upstream of these may cause impact to water quality.

8.3.14 A response from the Carlow-Kilkenny Environmental Health Officer provided general observations on the EIA Scoping Report, recommending that a full review of impacts to water quality is provided, and that appropriate mitigation is outlined to reduce/eliminate impacts identified.

8.3.15 Consultation relevant to biodiversity and soils/geology/hydrogeology (Chapters 10 and 12 respectively) has also been considered in the preparation of this chapter, due to the interdependencies of these parameters with surface water concerns.

8.4 Baseline Environment

The Barrow Catchment

8.4.1 All rivers in the Study Area are located within the River Barrow catchment. The total population of the Barrow catchment is approximately 188,117 with a population density of 62 people per km^2. The catchment is underlain in its flat northern area by limestones of varying purity which continue down the western side of the catchment. On the eastern side of the catchment, granites dominate, culminating in the summits of the Blackstairs Mountains (source: catchments.ie website).

8.4.2 EPA data indicates that tidal and/or river tidal effects do not occur in the Study Area. Lakes, transitional waters and coastal waters are not present in the Study Area. A review of OPW arterial drainage schemes indicate there are no arterial drainage schemes, local authority drainage districts or benefitting lands within the model catchment and townlands of G-T (source: floodinfo.ie interactive drainage map).

Water bodies in the Study Area

River Barrow

8.4.3 The River Barrow is one of the constituents of a group of three rivers called 'the three sisters' along with the River Nore (which has a tributary with the River Barrow north of New Ross near the Barrow Bridge) and the River Suir (which has a tributary with the River Barrow at Cheekpoint, near the Port or Waterford). Both tributaries occur downriver and south of the Study Area. The River Barrow's total length is c.192 km and its total catchment area is c 3,015 km^2. The source of the river is at Glenbarrow in the Slieve Bloom Mountains, County Laois, to the north of the Study Area.

8.4.4 The overall direction river flow is broadly south and within the Study Area the River Barrow meanders south east though G-T and to the south west once south of the town. A bridge crosses the River Barrow at G-T. A tributary with the River Duiske occurs downriver of the bridge on the bank in Kilkenny.

Ecology

8.4.5 The river is overlapping/partly within the protected areas of the Barrow River and River Nore Special Area of Conservation (SAC) in the scheme area. This site consists of the freshwater stretches of the Barrow and Nore River catchments as far upstream as the Slieve Bloom Mountains, and it also includes the tidal elements and estuary as far downstream as Creadun Head in Waterford. The larger of the many tributaries include the Lerr, Fushoge, Mountain, Aughavaud, Owenass, Boherbaun and Stradbally Rivers of the Barrow, and the Delour, Dinin, Erkina, Owveg, Munster, Arrigle and King's Rivers on the Nore.

8.4.6 Species that are qualifying interests for the SAC are outlined in Chapter 10 'Biodiversity', but include a host of freshwater fish, as well as Freshwater Pearl Mussel (*Margaritifera margaritifera*), Desmoulin's Whorl Snail (*Vertigo moulinsiana*), Otter (*Lutra lutra*), White-clawed Crayfish (*Austropotamobius pallipes*), Killarney Fern (*Trichomanes speciosum*), Nore Pearl Mussel (*Margaritifera durrovensis*). The Barrow River also supports other protected fish species, and Duck Mussel (*Anodonta anatina*).

Water Framework Directive

8.4.7 New modifications to rivers such as flood schemes need to consider the potential impacts of the works on waterbody status under the Water Framework Directive (WFD). This includes potential effects of works on hydromorphology (river flows and physical forms); biology (such as macrophytes, fish and invertebrates), and physio-chemical conditions (nutrient and acidification levels, turbidity and others), in addition to the WFD monitoring stations on the River Barrow and the River Duiske (described below).

8.4.8 WFD requires regular examination of the biological, chemical and hydromorphological status of all waterbodies in the European Union. Under the WFD, a waterbody must receive high status in biology, chemistry and hydromorphology is it is to be considered a of High Ecological Status. If all other quality elements are at high status, but hydromorphological

status is not high, then a waterbody is classified as Good Ecological Status (GES), rather than High. In some instances, water bodies have been physically modified in the past to serve a beneficial specified use such as; a drinking water abstraction, a hydroelectric scheme, a flood protection scheme or a drainage scheme aimed at improving agricultural production. In the process of modifying a water body, the natural flow, form or function (hydromorphology) have been altered to the extent that it has impacted the natural aquatic ecology of the water body. In such cases, the water bodies may be designated as Heavily Modified Water Bodies (HMWB).

8.4.9 There is currently a public consultation on the designation of Irish waterbodies as HMWB. A designation of a waterbody as a HMWB means that instead of having an environmental objective of Good Ecological Status (GES), which applies to natural water bodies, an alternative environmental objective of Good Ecological Potential (GEP) applies to these water bodies. GEP is an alternative objective, which takes account of the changes in aquatic ecology caused by the physical modification (Government of Ireland, 2025).

8.4.10 The WFD surface water monitoring programme 2016-2021 reported that the ecological status or potential of the portion of the River Barrow (BARROW_230) located in the Study Area is considered to be 'poor', with high levels of Ammonium, Phosphorous conditions, Orthophosphate recorded, and moderate levels of Nitrate and Nitrogen recorded. The chemical surface water status listed as having 'failed' due to high levels of Benzo (g, h, i) perylene which is a polycyclic aromatic hydrocarbon which can be naturally occurring but also man-made, associated to the burning of coal, oil, gas and waste.

8.4.11 The most recent published WFD 'River Waterbody Approved Risk' classification assigned to the Barrow River in the scheme area ('BARROW_230') reports the waterbody as 'At risk' due to its less than 'Good' ecological status. Significant pressures identified in the sub catchment are urban wastewater (with pressures including agglomeration PE of 1001 to 2000) and hydromorphology, particularly where this is influenced by dams, barriers, locks and weirs (EPA, 2024)The WFD cycle 2 report notes that a wastewater treatment plant is impacting the water quality of 'BARROW_230' while in-channel barriers may be impacting fish status (WFD Application, 2018).

Table 8-3: Summary of WFD Surface Water Status (2016 – 2021)

WFD Surface Water Status (2016-2021)		
Ecological Status or Potential	Chemical Surface Water Status	WFD Risk Status
Poor	Fail	At Risk

8.4.12 Pressures recognised in WFD cycle 2 as acting on waterbodies located within the Barrow catchment include:

- agricultural run-off, including diffuse phosphorus loss to surface water;
- hydromorphological pressures, including extensive modification due to channelisation, the presence of barriers (e.g. weirs), and bank erosion resulting for animal access in some parts of the catchment (e.g. at Mountain River, Carlow);

- Urban Waste Water Treatment Plants. EPA data indicates that downriver of the scheme boundary, at Ballyogan (c. 4.3 km south of G-T), the Barrow River becomes the Barrow Estuary and is classed as an Urban Waste Water Treatment Directive Sensitive Area between this location and New Ross.
- Peat and peat extraction, where excessive sedimentation and elevated nutrient concentrations occurs;
- Diffuse urban pressures, caused by misconnections, leaking sewers and runoff from paved and unpaved areas;
- Forestry, primarily from clear-felling and associated sediment release;
- Industry, with elevated orthophosphate and total ammonia are the predominant issues associated with these industrial discharges;
- Domestic wastewater has been identified as a significant pressure in one river water body in the catchment, the Aughavaud River, County Carlow. This occurs outside and downriver of the scheme area;
- Aquaculture, a fish farm located on the Pollmounty River, Wexford, has been recognised as having an impact. This occurs outside of the scheme area.

8.4.13 As outlined in Section 8.2.7, the River Barrow has been recommended for a designation as a HMWB as per the Water Action Plan 2024 and the recent public consultation on the designation of HMWB (Government of Ireland, 2025). This designation has been recommended on the basis of the rivers use for navigation. If confirmed as a HMWB, the River Barrow will no longer have to reach GES but rather would set an objective of GEP. The targets for GEP would remain the same as the targets for GES for invertebrates and nutrients, but an achievable target for fish as a result of the specified use would be set. When setting an objective of GEP for a HMWB there remains the requirement to ensure that those elements which are not sensitive to hydromorphological impacts but sensitive to other pressures such as nutrient or organic enrichment are considered.

River Duiske

8.4.14 The River Duiske is 12.23km in length and flows in a broadly south east direction through the town of Graiguenamanagh where it joins the River Barrow at the Old Dock downriver of the bridge.

Ecology

8.4.15 The Duiske River lies within the River Barrow and River Nore Special SAC, see Sections 8.4.5 to 8.4.6 above for description.

Water Framework Directive

8.4.16 WFD surface water monitoring programme 2016-2021 reported that the Ecological Status or Potential in the River Duiske (DUISKE_020) was classed as 'Moderate'. Supporting

Chemistry Conditions were classified as 'Pass' with nutrient conditions classed as 'Moderate' and ammonium, phosphorous levels (including orthophosphate) classed as 'High'.

8.4.17 The most recent WFD 'River Waterbody Approved Risk' classification assigned to the waterbody is 'At risk' due to its less than 'Good' ecological status. Significant pressures identified in the sub catchment are urban run-off with run-off from diffuse sources and agriculture, with further pressures from hydromorphology (EPA, 2024). However, in the river's upper sections (code: IE_SE_14D040100), broadly this comprises sections of the river to the west of where it is crossed by the L8243 road, the River Duiske is classified as 'Not at risk' in the most recent WFD 'River Waterbody Approved Risk' classification.

Table 8-4: Summary of WFD Surface Water Status (2016 – 2021)

WFD Surface Water Status (2016-2021)		
Ecological Status or Potential	Chemical Surface Water Status	WFD Risk Status
Moderate	Pass	At Risk

River Infrastructure

8.4.18 A description of the built structures associated with the River Barrow and River Duiske in the scheme area are provided in Table 8-5 below.

Table 8-5: List of bridges and in-river built structures within the scheme area

River	Structure Type	Name	Description	Location (ITM)
River Barrow	Bridge	Graiguenamanagh Bridge	Masonry Arch Road Bridge	670932.669, 643644.820
River Barrow	Weir	Graiguenamanagh Weir	'L' shaped weir c.1 m in height	670891.036, 643562.545
River Barrow	Millrace	Tinnahinch Mill Race	Mill Race (see section 0)	670907.268, 643537.020
River Barrow	Lock Gates	Tinnahinch Lock Gates	A section of two lock gates	670692.412, 643428.229
River Duiske	Millrace	Valley Mills Mill Race	Mill Race (see section 0)	669798.787, 644155.321
River Duiske	Bridge	R705 Road Bridge	Precast concrete road bridge access to Aldi	670572.345, 644097.332
River Duiske	Bridge	Aldi Bridge	Precast concrete road bridge	670610.756, 644085.809
River Duiske	Bridge	Well Lane Bridge	Steel Pedestrian foot bridge	670755.481, 643915.807
River Duiske	Bridge	Clapper Bridge	Stone foot bridge	670782.740, 643831.797
River Duiske	Bridge	High Street Bridge	Masonry Arch Road Bridge	670836.269, 643795.120

River	Structure Type	Name	Description	Location (ITM)
River Duiske	Bridge	Residential access bridges	A series of flat concrete and steel accessways to residential properties	670828.339, 643733.662
River Duiske	Bridge	Turf Market Bridge	Masonry Arch Road Bridge	670828.339, 643733.662
River Duiske	Bridge	Dock Bridge	Masonry Arch Road Bridge	670832.923, 643612.480
Killeen	Culvert	Killeen Culvert	300m culvert out falling to the River Duiske	670592.789, 644120.627
Relief Road	Culvert	Relief Road Culvert	20m culvert out falling to the River Duiske	670533.314, 644099.810

Mill Races

8.4.19 There are two millraces present in the scheme area; the Tinnahinch Millrace (Tinnahinch) and the Valley Mills Millrace (Graiguenamanagh) (see Table 8-5). The Tinnahinch mill race is situated on the left bank of the River Barrow and flows parallel to the river for c.350 from Graiguenamanagh Wier and adjacent to Tinnahinch Castle before re-joining the River Barrow downstream of the lock gates. There are no active mills or associated infrastructure present on the mill race. The Valley Mills Millrace is on the River Duiske and is c.1 km in length and flows parallel with the Duiske from its upper catchment to the Graiguenamanagh town. The Valley Mills currently operate a small hydroelectric plant (HEP) on the millrace to the west of Graiguenamanagh town. Downflow of the HEP, the waterbody pass through Cushendale Mills, adjacent to Mill Road, Graiguenamanagh, before re-joining the Duiske c. 50 m to the east of the mill. The is no turbine or wheel structures at Cushendale Mills but there is a mill drop. Several overflow weirs are used along the mill race to maintain water levels and excess water flows to the River Duiske.

Hydrogeomorphology

8.4.20 A geomorphology study was completed (ByrneLooby, 2020) to evaluate the current bed morphology, sediment processes and patterns in the River Barrow and River Duiske and an assessment of how these will be impacted by the proposed works as part of the G-T flood relief scheme. The study included a geomorphology walkover survey of the Rivers Barrow and River Duiske combined with a desk study of the wider catchment.

8.4.21 This geomorphology study was updated when Ayesa undertook an RHAT survey on the upstream storage area (Ayesa, 2024). This survey was used to ground truth the results of the previous geomorphology survey as well as to review the baseline hydromorphological conditions of the proposed works areas. The RHAT survey method classifies river hydromorphology based on a departure from naturalness. The results of these site walkovers and surveys are outlined below. It is important to note that these results represent a small percentage of the overall river.

- Sediment deposition and erosion:
    - The Boy's Sandy on the River Barrow is a hydrogeomorphological feature of local cultural significance. It is a traditional swimming area on the River Barrow that is located on lands known as the 'Inch Field'. Although it is not classed as a designated bathing area it is recognised as an important amenity for the people of the town and visitors to the area, particularly for young families owning to the shallow water and clean sandy riverbed. Lifeguards have been deployed at the Boy's Sandy since the mid 1970's and Water Safety have also provided training classes at the Boy's Sandy for the local community from around the same period.
    - Long term sediment deposition has taken place on the right bank of the River Barrow downstream of Graiguenamanagh Bridge, both in the historical dockyard area and downstream of the L-shaped weir. Deposition is also occurring on the right bank downstream of the weirs upstream of the bridge on Mill Road where the River Duiske's channel turns east.
    - The River Duiske flowing through the upstream storage area is in a largely natural state but is currently being impacted by the riparian land-use as semi-improved grassland, as well as the impact of bank poaching that is changing sedimentation and bank stability. It is noted in the aquatic ecology survey that the conditions are largely similar upstream and downstream of the surveyed area, with the flow being riffles, pools, glides, and mixed juvenile habitats which would be consistent with the channel conditions found during the RHAT survey.
    - Defence works along Graiguenamanagh and Tinnahinch Quays are anticipated to be entirely on the dry side of the existing quay walls. No instream works are proposed on the River Barrow for the flood relief scheme and therefore no short- or long-term impacts to sediment deposition and erosion are anticipated as a result of the scheme development.
    - Instream works will take place on the River Duiske at location where urban development has previously occurred and the stream has already been significantly altered. No long-term impact to hydrogeomorphology is anticipated to arise from the development of hard defences on the River Duiske.
- Barriers:
    - Weirs and bridges with abutments and/or pillars that act as physical barriers to decreases channel conveyance are present on both rivers in the scheme area, this includes Graiguenamanagh Bridge on the River Barrow. Multiple bridges are present over the River Duiske including bridges that provide access to properties.

- The Barrow navigation includes a series of canals and locks adjacent to weirs on the main body of the River Barrow. At Tinnahinch Docks an in-river island has developed at the upper end of the L-shaped weir, and this is reinforced with walls in some section to support the canal and gates. The island represents a physical barrier to flow but is now an environmental habitat.
- There are no man-made barriers in the upstream storage area, but there are a number of areas where woody debris is reducing the flow. However, these natural weirs are likely temporary and will be dislodged in high flow.
- In river barriers such as bridges and weirs will not be removed for the development of the flood relief scheme and therefore no change is anticipated.

- Vegetation
  - Reeds and macrophytes are present in the area, particularly the River Barrow where reeds are particularly developed adjacent to the river banks and immediately downstream of the abutments and pillars of Graiguenamanagh Bridge.
  - Trees and scrub are generally common on the banks/riparian habits of both rivers, however, there is limited space for development of these on the banks of the River Duiske in the town due to urban development. Mature trees have been recognised in the scheme area such as the historical dockyard area on the right bank immediately downstream of Graiguenamanagh Bridge has been a site of deposition and colonisation by trees. The historical dockyard area includes mature trees approximately 68-year-old. Silaire Wood is adjacent to the River Barrow on the right bank upstream of where it flows into the urban centre of the town.
  - The RHAT in the upstream storage area was surveyed at suboptimal time for vegetation surveying. However, further detail has been gathered on this during the habitats and species survey, as discussed in Chapter 10 ‘Biodiversity’. Further, a tree survey has been carried out that noted the presence of largely native vegetation including oak, alder, ash, horse chestnut, goat willow, hawthorn etc. in the riparian zone of the surveyed area, Creating a variety of canopy layers. Moreover, upstream on the left bank, there is a thinned forest with oak, beech, ash and holly present, and an un-thinned forest of ash oak, hazel and goat willow on the right bank. The aquatic ecology survey also noted the presence of instream macrophytes, as well as Himalayan Balsam on the banks of the survey area. Banktop vegetation ensures sufficient shading to support life in the river in the summer months. This vegetation will also help to keep the ecological conditions that would enable the reintroduction of white-clawed crayfish, for which the Duiske is a suitable river.

Water Quality Monitoring

National Water Quality Monitoring and Hydrometric Stations

8.4.22 National waterbody monitoring stations and hydrometric gauges are present on rivers within the Study Area with water monitoring taking place through national water monitoring plans, chiefly the EPA-led Water Framework Directive monitoring programme (Environmental Protection Agency, 2006). Through these programmes recent and location specific surface water quality data is available for rivers in the Study Area.

8.4.23 EPA records indicate that there are seven active hydrometric stations in the Study Area and wider vicinity (Table 8-6, Figure 8-2). The Graiguenamanagh U/S Station (ID: 14029) is considered to be a useful dataset, given both its quality of data and location, and has been used to supplement the hydrology analysis conducted for the Proposed Scheme (ByrneLooby, 2022).

Table 8-6: Active Hydrometric Stations in the Study Area and Wider Vicinity

EPA Registration No.	Name	River	Coordinates (E,N)	Status
14023	Coolroe	Barrow	268435, 144418	Inactive
14029	Graiguenamanagh U/S	Barrow	271231, 143739	Active (Recorder)
14049	Priestvalley Intake u/s	Duiske	269753, 144236	Inactive
14051	Ballykeenan	Barrow	272451, 145046	Inactive
14122	Turf Market	Duiske	270890, 143687	Active (Recorder)
14123	Graiguenamanagh D/S	Duiske	272349, 141996	Active (Recorder)
14119	Graignamanagh	Barrow	271163, 143725	Active

Source: EPA Geo Portal 'Water Quality and Monitoring' (2022).

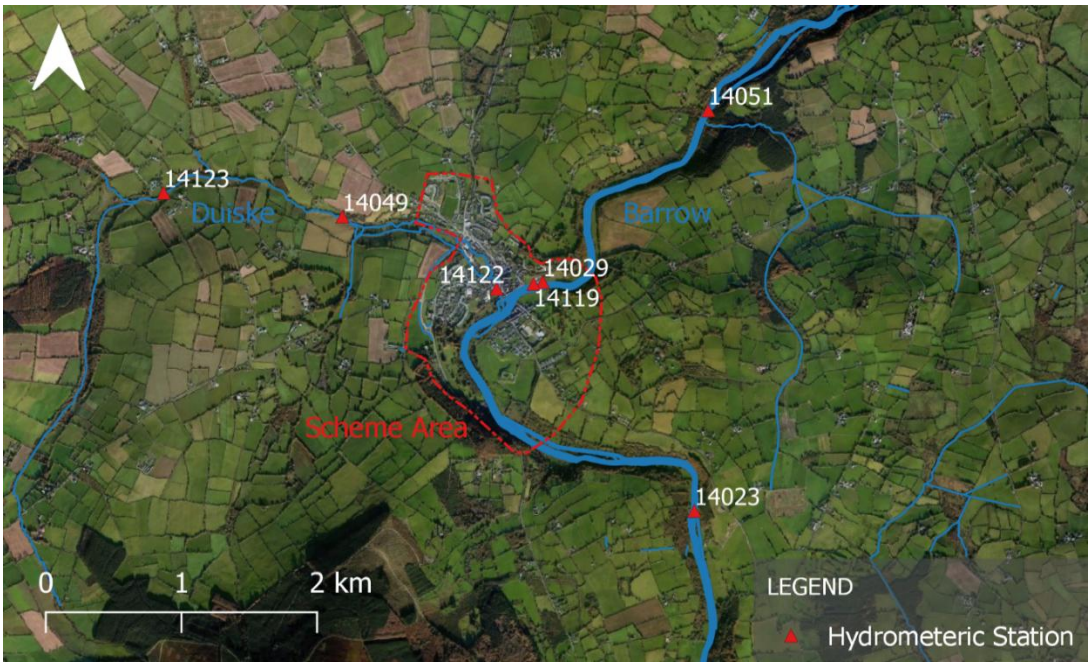


Figure 8-2: Locations of Hydrometric Gauges
Data source: EPA Geo Portal 'Water Quality and Monitoring' (2022).

8.4.24 Of the sections of river where the FRS works are proposed, there are nos. 14 National Water Quality Monitoring Stations present, outlined in Table 8-7 and illustrated in Figure 8-2.

Table 8-7: Active National Water Quality Monitoring Stations in Works Area

Map Label	EPA Registration Number	River	Status
01	RS14D040100	Duiske	Operational
02	RS14D040150	Duiske	Operational
03	RS14D040170	Duiske	Pre-WFD
04	RS14D040180	Duiske	Pre-WFD
05	RS14D040200	Duiske	Operational
06	RS14B013500	Barrow	Surveillance and Operational
07	RS14B013490	Barrow	Investigative
08	RS14B013480	Barrow	Investigative
09	RS14B013450	Barrow	Investigative
10	RS14B013504	Barrow	Investigative
11	RS14B013510	Barrow	Investigative
12	RS14B013514	Barrow	Investigative
13	RS14B013520	Barrow	Pre-WFD
14	RS14B013400	Barrow	Pre-WFD

Source: EPA Geo Portal 'Water Quality and Monitoring' (2022).



Figure 8-3: Locations of National Water Quality Monitoring Stations
Data source: EPA Geo Portal 'Water Quality and Monitoring' (2022).

8.4.25 Recent and publicly available surface water quality data is available for the study areas from the catchments.ie website. Physicochemical surface water data is available from the following monitoring station codes in the scheme area and vicinity: RS14B013500, RS14M010200 and RS14D040150 (catchments.ie). Due to the size of these datasets (data spanning from 2007 to 2022, only 2021 and 2022 data from stations RS14B013500 (River Barrow, at the Graiguenamanagh Bridge) and RS14D040150 (River Duiske) have been included in Appendix 8-1, the former due to proximity to planned works and the latter, as this is the only dataset available for the Duiske River in the vicinity of the works.

Project Specific Q Value Monitoring

8.4.26 In aquatic systems, as levels of pollution increase, so invertebrates react to this variable. Taxa are either highly intolerant, moderately tolerant or very tolerant to different levels of pollution and those that fall into the highly intolerant. By taking a sample of benthic invertebrates and identifying the biological material to a taxonomic level of family, it is possible to determine the likely quality of the water in terms of pollution. This is called The Biological River Quality Classification System or Q value (Q-Scheme) includes the sampling of The System has undergone a number of modifications since then and has been included in the Local Government (Water Pollution) Act, 1977 (Water Quality Standards for Phosphorus) Regulations, 1998.

8.4.27 It is routinely employed by the Environment Protection Agency (EPA) to determine the biological quality of the river, the Q-scheme index is used whereby the analyst assigns a Biotic Index value (Q-Value) based on the results of the identification and enumeration of macroinvertebrate samples collected in different parts of the aquatic system. The Biotic Index is a quality measurement for freshwater bodies that range from Q1 – Q5 with Q1 being of poorest quality and Q5 being pristine/unpolluted (see below).

Q Value*	WFD Status	Pollution Status	Condition **
Q5, Q4-5	High	Unpolluted	Satisfactory
Q4	Good	Unpolluted	Satisfactory
Q3-4	Moderate	Slightly polluted	Unsatisfactory
Q3, Q2-3	Poor	Moderately polluted	Unsatisfactory
Q2, Q1-2,	Bad	Seriously polluted	Unsatisfactory

EPA Data

8.4.28 EPA Q-Value reporting for 2022 is available via the EPA Data Portal. The survey station at Graiguenamanagh Bridge (RS14B013500) for the River Barrow includes results up to 2014 only where a result of Q4 (good, unpolluted status) was recorded. The survey station at the bridge on Peg Washington's Lane for the Duiske River (RS14D040200) includes results up to 2020 only where a result of Q3-4 (moderate, slightly polluted status) was recorded. A survey station upstream on the River Duiske (RS14D040100) recorded a Q value of 4-5 (high, unpolluted status) in 2020.

Field Surveys (2021 & 2023)

8.4.29 Project-specific Biological River Quality Classification System (or Q Value) Surveys and kick sampling (macroinvertebrates) were undertaken by Aquafact and APEM on behalf of Ayesa (formerly ByrneLooby). The two surveys were undertaken:

- Within watercourses (River Duiske and River Barrow) within the towns of G-T in February 2021 (Aquafact International Services Ltd, 2021).
- Within the watercourse (River Duiske) at the proposed upstream storage area in August 2023 (APEM, 2023).

Survey of 2021 (River Duiske and River Barrow in the town area):

8.4.30 Five locations (see figure Figure 8-4) were sampled for Q value analyses, three in the River Duiske and two in the River Barrow. The two-minute kick and one minute stone wash sampling method was employed to collect samples of macroinvertebrates for analysis. This involved placing a standard hand net of pore size 500µm in the river, facing upstream and disturbing the riverbed in front of the net mouth. The surveyor, Mr. Kevin McCaffrey, then moved in a diagonal direction upstream to ensure that different micro-habitats were included in the sample. The kick method dislodges macroinvertebrates from the substrates and submerged plant material. This was continued for approximately two minutes and followed by one minute of stone washing. The resulting sample was transferred from the net to a plastic bucket and fixed using a 70% ethanol solution (Toner *et al*., 2005). The samples were then transported to the Aquafact laboratories where the macroinvertebrates were removed and identified using stereoscopic microscopes and the appropriate keys by Mr. McCaffrey who is a qualified freshwater taxonomist. The resulting species list was then used to assign a Biotic Index value (Q-Value) to the sampled streams.

Table 8-8: Coordinates of Q value testing sites

Station	Longitude	Latitude	Width (m)	Depth (cm)	Substrate	Flow
ST 1	-6.95895	52.54344	2.8	49	Cobbles	Flood
ST 2	-6.95689	52.54182	3.4	44	Cobbles	Flood
ST 3	-6.95589	52.54024	5.2	36	Cobbles	Flood
Upstream	-6.95353	52.53971	63	>120	Mud	Flood
Downstream	-6.95653	52.53854	56	>120	Mud	Flood

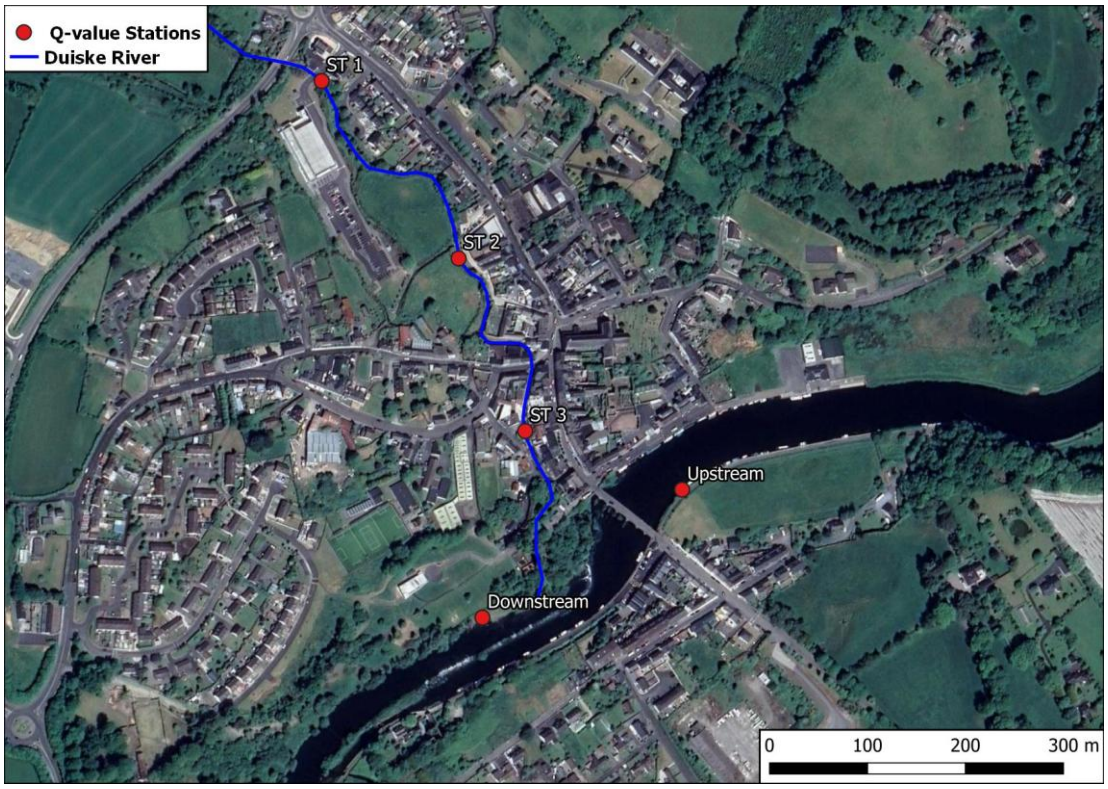


Figure 8-4: Q Value Sampling Locations

Table 8-9: Results of Q-Value Survey

Station	Q-Value
ST 1	Q4
ST 2	Q3-4
ST 3	Q3-4
Upstream	Q3
Downstream	Q3

8.4.31 The Duiske River received a quality status of unpolluted as it entered Graiguenamanagh. Stations 2 and 3 located further downstream in the town were classified as slightly polluted. Although Stations 2 and 3 received a lower Q-value than station 1 they both recorded more sensitive species. Station 2 recorded three pollution sensitive species and Station 3 two sensitive species, while Station 1 only recorded one such species. However, Stations 2 and 3 also contained a higher abundance and diversity of pollution tolerant species.

8.4.32 Both of the stations located within the Barrow River were classified as moderately polluted. However, due to the depth of the river and it being in flood, these stations could not be sufficiently sampled for health and safety reasons. The upstream station was sampled from the riverbank while the only location that could be sampled downstream was on a flooded grassy bank. As such, many of the habitats within the river could not be sampled and so sensitive species are likely to have been missed. One minnow was recorded in the upstream sample, while three minnows and two sticklebacks were recorded at the downstream sample.

Survey of 2023 (River Duiske at upstream storage area):

8.4.33 Three locations (see figure below) were sampled for water quality assessment. Field measurements were taken in situ, using a multimeter probe, and water samples were additionally collected for laboratory analysis. Each sample was collected in a pre-sterilised sampling bottle, prerinsed with river water. Water samples were taken from just below the surface, ensuring that the riverbed was not disturbed. Once sample bottles were filled, they were transported to an INAS accredited laboratory for analysis within the recommended holding time for the selected water quality parameters.

8.4.34 Readings were similar across all three sites and showed a general absence of negative water quality impacts, with high oxygen saturation and moderate conductivity levels. BOD and ammonia, both indicators of organic pollution, were low across all sites. Suspended solids were also comparably low at all sites. The results show no adverse water quality impacts and little difference between the samples taken upstream, within, and downstream of the Site. Table 8-10 and Table 8-11 below outline the results of the physicochemical readings and water quality parameters tested.

Table 8-10: Summary of physicochemical readings recorded in situ August 2023

Parameter	Unit of Measurement	Site 1 - downstream of works area	Site 2 – within area of works	Site 3 – upstream of works area
Time of reading	HH:MM	07:50	08:45	09:50
Temperature	°C	14.8	14.7	14.7
Dissolved Oxygen	% Saturation	95.3	94.3	96
Dissolved Oxygen	mg/l	9.66	9.54	9.54
pH	-	7.57	7.56	7.55
Conductivity	µS/cm	182.6	180.8	168.40

Table 8-11: Summary of laboratory water quality parameters from samples August 2023

Parameter	Unit of Measurement	Site 1 - downstream of works area	Site 2 – within area of works	Site 3 – upstream of works area
Biochemical Oxygen Demand	mg/l	<1	<1	<1
Chemical Oxygen Demand	mg/l	<10	<10	<10
Suspended Solids	mg/l	2	<2	<2
Total Nitrogen as N	mg/l	2.44	2.39	2.37
TON as N	mg/l	2.64	2.64	2.63
Nitrate as NO_3	mg/l	12.4	11.7	11.7
Nitrate as NO_2	mg/l	<0.017	<0.017	<0.017
Ammonia as N	mg/l	0.029	0.025	0.027
Total Phosphorus as P	mg/l	<0.05	<0.05	<0.05
Orthophosphate as PO_4- P	mg/l	0.012	0.043	0.020
TPH (>C5-C44) by GC-FID	µg/l	<20	28*	35*
Alkalinity, total by titration	mg/l $CaCO_3$	52	48	48
Iron, total	µg/l	115	103	106
Iron, dissolved	µg/l	22	23	20
Copper, dissolved	µg/l	<1	<1	<1
Arsenic, dissolved	µg/l	1	1	1
Zinc, dissolved	µg/l	8	5	7
Dissolved Organic Carbon (DOC)	mg/l	2.75	2.32	1.93

**Unknown pattern: indicates the presence of naturally forming hydrocarbons in the sample that cannot be attributed with a known 'fingerprint' such as diesel or kerosene.*

Discharges and Extractions

8.4.35 Details on existing discharges and licensed extractions are outlined in Chapter 7 'Material Assets'.

8.5 Sensitive Receptors

8.5.1 The sensitive receptors in this assessment are those surface waterbodies located within the Study Area, which includes the River Duiske and the River Barrow. The wider sensitive receptors considered in the assessment are those Natura 2000 Sites with hydrological connection, which includes only the River Barrow and River Nore SAC (Proposed Scheme is occurring within this SAC).

8.5.2 Other Natura 2000 Sites are located within 15km of the Proposed Scheme but would not be considered a sensitive receptor from a hydrological perspective, given that no hydrological link exists. These include the Backstairs Mountains SAC (7.32 km from the Proposed Scheme), the Thomastown Quarry SAC (12.45 km from the Proposed Scheme), the Slaney River Valley SAC (13.43 km from the Proposed Scheme) and the River Nore SPA (8.78 km from the Proposed Scheme).

8.5.3 Following NRA (2009) guidelines on the evaluation of hydrological features, the River Barrow and River Duiske are considered to be of 'high' importance which means the attribute has a 'high quality or value on a local scale'. This is obtained from the attributes outlined in Table 8-2, whereby the rivers would have a Quality Class B status (Q values of Q3-4) and be a locally important amenity site for a wide range of leisure activities. The SAC and SPA have hydrological connection to the scheme and are considered to be of 'extremely high' importance due to the fact, as outlined in the attributed in Table 8-2 (NRA, 2009), they have designated under EU legislation.

8.6 Potential Impacts and Effects

The 'do nothing' Scenario

8.6.1 The do-nothing scenario refers to what would happen if the Proposed Scheme was not implemented, and appropriate flood risk management measures were not provided for the GTFRS. As outlined in Chapter 1 'Introduction' the need for flood risk management measures in the study area has been well documented in national, regional and local policy as well as legal cases. Without intervention, the area faces the continued onset of a range of issues associated with flooding which are described below.

8.6.2 Flooding events have the potential to cause short-term but significant effects to the quality of the surface water through impacts of sedimentation/erosion resulting in increased turbidity both locally and in downstream river portions and potential capture and run-off of hydrocarbon pollutants present on surfaces (i.e., roads, fuel depots) and general debris/litter etc. during flood events. All have the potential to reduce the quality of the surface water and contribute to a long-term worsening, or maintenance of the WFD moderate and poor statuses afforded to the River Duiske and River Barrow and their tributaries.

8.6.3 For these reasons, the 'do-nothing' scenario arising from a flood event is considered likely to have a **negative** effect with regards to water quality, potentially further impacting upon

the EU surface water environmental objectives. This will be a '**significant/moderate'** effect, with both **short- and long-term** implications.

Construction Phase

8.6.4 As outlined in Chapter 4 'Description of Proposed Scheme and Construction Methodology', the works are divided into 10 nos. areas (Areas 1 to 10) corresponding to the Proposed Scheme defence locations (see W3451-AYE-DWG-W-1403). There are Nos. 5 site compounds (SC A, SC B, SC C, SC D and SC E) to support these works areas (see Drawing No. W3451-BLP-DWG-W-1402). Site access is within the red line boundary on this same drawing and will include the use of public roads.

8.6.5 Construction works are anticipated to span over 36 to 42 months and divided into five (5) works packages (WP 1, WP 2, WP 3, WP 4A and WP 4B), as outlined in Chapter 4 'Description of Proposed Scheme and Construction Methodology'. As a result, some associated construction phase impacts are not anticipated to be concentrated over the entire scheme area for the entire construction duration (36 to 42 months), rather impacts will be, in some cases, specific to the individual WP and for the associated construction time periods. In-channel construction will only take place during the appropriate season.

8.6.6 The River Barrow and Duiske are afforded a 'Extremely high' importance, on account of the criteria outlined in NRA (2009), given that the areas that will receive direct impacts are within the River Barrow and River Nore SAC. The magnitude of impact is considered '**significant**', as a vast majority of flood defences are located within or directly adjacent to the SAC. Therefore, the overall significance is '**significant/moderate**' pre- mitigation, but on a **temporary/short-term** basis (for duration of the construction works). The phasing will mean localised impacts are temporary, but the hydrological connection of all the works areas mean some impacts are short-term for the length of the construction period (36-42 months).

8.6.7 The following sections provide an in-depth review of potential impacts to hydrology and surface water for the activities proposed during each of the proposed WPs and their associated site compounds and haulage/access routes.

8.6.8 There are a number of impacts that are applicable across all WPs in the Proposed Scheme. These impacts include:

- There is potential for silt-laden run-off to enter the watercourses from areas of incomplete excavations, stockpiles and/or areas of loose material (i.e., tracked haulage routes), particularly during events of rainfall and/or flood. Dewatering of excavations gives further cause for in-river sedimentation, whereby direct pumping from sumps into the river may result in sedimented dewater effluent, if not appropriately monitored. Moreover, there is potential for accidental releases of oils, fuels, wastewater and cementitious material into waterbodies. These incidents may result in a short-term reduction of water quality in the immediate work area and would have a **significant negative short-term** impact on water quality, without mitigation. The presence of suspended soils in the runoff has

depending on their size and the velocity of flood in the river, the potential to settle out in the riverbed. The impacts of this on aquatic habitats will be examined in Chapter 10 'Biodiversity'.

- WP 2 and 3 will require the placement of a temporary river crossing to facilitate construction works. The temporary river crossings will require the placing of culverts in both the river diversion channel and the permanent channel and WP 2, and within River Duiske at WP 3. This will impact on the surface water quality due to riverbed disturbance/silt mobilisation, and dust, debris, oil, or contaminated runoff falling into the river. Moreover, the hydrology will be changed as the river enters and passes through the culvert. The impacts will be localised and will have a **significant temporary negative** effect.

8.6.9 The following section considers impacts to hydrology during the individual WPs. The cumulative impacts will be examined in Chapter 16 'Interactions and Cumulative Effects'.

- WP 1 and Main Compound (A):
    - Under WP1, works impacting hydrology will consist of the placement of construction compounds proximal to the river, the stockpiling of materials in compounds and the removal of vegetation on the riverbank to facilitate construction of the flood defences. There is also potential for impact from the accidental release of wastewater from temporary ablution facilities self-contained above ground septic systems
    - The overall significance is considered to be 'moderate/slight' to 'significant/moderate' but on a temporary basis (for the immediate duration of the spill until it becomes diluted). When considering the River Barrow and River Nore SAC wider impact area, the same magnitude of impact is assigned, however the 'extremely high' receptor importance results in a 'significant' to 'profound' overall significance pre-mitigation. As mentioned however, the impact is likely to be temporary, resulting in a significant temporary negative impact.
- WP 2 (Area 1 and SC B):
    - Under WP2, works impacting hydrology will consist of the temporary diversion of the Duiske river to facilitate the construction of the flow control structure.
    - The diversion of the river will have a potentially significant short-term negative impact on the river. The release of the sediments from the river basin into the water column will have a significant negative impact on water quality. The resuspension of nutrients will cause an additional impact. Moreover, temporarily diverting the river will have a significant short-term negative impact on fish that live in the river, but this can be overcome by ensuring design of the diversion does not affect the mobility of fish. The reduction in

the overburden over the bedrock will place increasing vulnerabilities on the groundwater and leave it more susceptible to pollutants.

- The excavation of the foundations of the headwall has the potential to leak pollutants to the water. Any spillage of diesel or hydraulic oil to the river will cause a significant short-term negative impact on water quality, when the river channel is re-watered, with the possibility of fish kills particularly during the summer months when river levels are low.

- The pumping of concrete to construct the headwall has the potential to pollute the river. The spillage of uncured concrete into a waterbody will cause a rise in the pH of the water (an increase in hydroxyl ions). This will cause a significant short-term negative impact on water quality. This portion of the work will be carried out in the summer season when generally water levels are low. The impact of a spillage of concrete into the river when flows are low would be even more significant and could result in fish kills. A concrete spill would also increase the suspended solids levels in the river which would have a significant short-term negative impact on fish and macroinvertebrates.

- The permanent loss of aquatic habitat and riparian habitat at the site of the proposed wing walls and sluice will have a significant medium-term negative impact on fish and mammals that use the banks of the River Duiske as a foraging corridor, given the small-scale nature of the structure. This impact will be examined in Chapter 10 'Biodiversity'.

- The land for the proposed site of the embankments to be constructed alongside the headwall has been used in the past for arable farming and coniferous forestry. Fertiliser, pesticide and herbicide applications would have been applied to these crops in the past. Depending on the level and frequency of applications the soil may contain some residual fertilisers or organic chemical (pesticides and herbicides). The typical fertiliser would be nitrogen, phosphorus, and potassium-based fertiliser with trace amounts of other nutrients and heavy metals. The silt laden runoff to the river from the excavated areas would also contain these chemicals. The presence of pesticides and herbicides in the soil would have a **significant medium-term negative** impact on water quality in the river.

- WP 3 (Areas 2, 3 and 4 and SC C):

  - In WP 3, where all flood defence walls on the Duiske will be constructed, impacts on hydrology and surface water will be largely from in-stream works for the improvement and construction of flood defences, with a temporary access and associated culvert, the placement of the debris trap and the replacement of the bridge.

  - The placement of the Debris Trap in Area 2 will require the excavation of the riverbed and the placement of vertical columns as Described in Chapter 4

'Description of the Proposed Scheme and Construction Methodology'. The construction of the debris trap will have a **significant temporary negative** impact on the hydrology.

- The replacement of the bridge in Area 3 will require the construction of bridge abutments, which have the potential to impact on the surface water as the other in-stream works, with potential for spillage and sediment loading during construction. As above, the construction will have a **profound temporary negative** impact on the hydrology. Pre-cast solutions will be utilised with only micro-piling for the foundations. The river will be piped to create a dry works area, with electrofishing to be carried out as required before the dewatering, as discussed in Chapter 10 'Biodiversity'. River channel will be reinstated to original flow once bridge is completed.

- In Area 4, instream works are from working platform between The Hub and Turf Market. To facilitate this platform, the river will be piped, and the channel temporarily backfills to create a level working platform. This is in place for the duration of the works. Terram geotextile will be installed under the fill to allow a separation upon decommission of the working platform. The construction will have a **moderate temporary negative** impact on the hydrology.

- The pumping of concrete to construct the flood defence walls has the potential to pollute the river. The spillage of uncured concrete into a water body will cause a rise in the pH of the water (an increase in hydroxyl ions). This will cause a **moderate short-term negative** impact on water quality. This portion of the work will be carried out in the summer season when generally water levels are low. The impact of a spillage of concrete into the river when flows are low would be even more significant increasing the suspended solids levels in the river which would have a **significant negative** impact on water quality.

- WP 4A (Area 5, 6, 7 and 8 and SC D):

  - In WP 4A, where all flood defence walls on the Graiguenamanagh side of the River Barrow will be constructed, impacts on hydrology and surface water will be largely from the construction of flood defence walls and embankments and the placement of non-return valves on outfalls, which is the only element on in-stream works in this WP.

  - For the construction of earth embankments, fill material will be imported to the work area, temporarily stockpiled and manipulated at the planned defence site, during which sediment may be released into the river. This could have a **profound temporary negative** impact**.**

  - Accidental spillages may result in localised contamination of surface water. Pollution events have the potential to effect flora and fauna whereby changes in pH of the waterbody can have direct impact upon water dependant species

(discussed further in Chapter 10 'Biodiversity') and also those who use the river for amenities or abstract water industrially (e.g. Uisce Éireann Registered Abstractions). This could have a **profound temporary negative** impact**.**

- NRVs will be placed on existing and proposed outfalls to ensure flood waters do not back up and surcharge the pipeline. The placement of the NRVs will result in a **temporary negligible** impact.

- WP 4B (Area 9 and 10 and SC D):
  - In WP 4B, where all flood defence walls on the Tinnahinch side of the River Barrow will be constructed, impacts on hydrology and surface water will be largely from the construction of flood defence walls and embankments and the placement of non-return valves on outfalls.
  - The walls will be sheet piled potentially causing an increase in suspended solids in the river from the soil disturbance. This has the potential to have a **significant temporary negative** impact on the hydrology and surface water.
  - The impacts from this WP are similar as those with WP 2 and WP3.

Operation and Maintenance Phase

8.6.10 Once the scheme is built and operational, assuming that the scheme functions as intended, the following impacts were identified:

- Raised walls and embankments have the potential to increase the water level and velocity in the river during flood events, having secondary impacts on hydromorphology in areas downstream and consequently impacting the physical riverine habitat.
- Potential for sedimentation during maintenance activities, whereby riverbank clearance (vegetation and debris collection) is planned. No dredging is included in the maintenance plan for the GTFRS.
- The operation of Non-return Valves (NRVs) will have **imperceptible permanent** impact. All NRVs will require routine maintenance to ensure that any debris is removed from them and that they can operate effectively. This maintenance will have an **imperceptible temporary** impact.
- In the preliminary design process, during consultation with Uisce Éireann, a defensive structure was realigned at The Hub to protect a UÉ foul pumping station. The embankment alignment at The Hub was also updated to allow for the installation of a stormwater overflow tank to reduce spills from the foul pumping station into the River Barrow. These realignments prevent the pumping station from flooding for the 1% AEP event and results in the avoidance of a significant potential pollution source to the River Barrow SAC. This can be considered a **very significant long-term positive** impact.

- Further, UÉ own and operate a water treatment plant with abstraction point on the bank of the Duiske as identified in Section 7.48.3.13 of this EIAR. This station is above the 1% AEP flood level, but the storage area will reduce the risk of flooding and storm event maintenance issues for UE. This will lead to better water quality and can be considered a **very significant long-term positive** impact.

- Overall, the implementation of the flood defences will prevent flood waters flowing through properties and roads and washing contaminants into the river. This will significantly improve water quality on both Barrow and Duiske rivers and can be considered a **moderate long-term positive** impact.

- Additionally, a large number of the defences of the scheme are set back from the riverbank and into the floodplain, meaning that they will only interact with the active river body during flood events. Therefore, there is little interaction and influence on water level/bed shear stress.

- Modelling was completed for the post-scheme scenario to investigate water levels in surrounding areas. The modelling results show marginal increase in water level on the River Barrow in the post-scheme scenario. Further, the modelling results show a decrease in water level in the River Duiske due to the storage capacity of the upstream storage area. This means the change in situation between the pre- and post-scheme design is minimal in terms of defence elevation, but clearly provides a significantly improved standard of protection when integrity of the defence is considered.

8.6.11 During the operation of the Proposed Scheme, Site Compounds will no longer be in use. The enabling works of WP1 have been reviewed in the previous section. The following sections review the impacts of the remaining WPs 2, 3, 4A and 4B.

8.6.12 The following section considers impacts to hydromorphology during the individual WP. The cumulative impacts will be examined in Section 8.11.

- WP 2:

    - An assessment of geomorphological characteristics (RHAT) assessment was carried out to determine the likely significant effects of the scheme on the hydromorphology or the River Barrow and River Duiske. The report is provided in Appendix 8-2. The report assesses the impact of the temporary river diversion on the River Duiske for the construction phase as well as the potential impact of the permanent works.

    - The Proposed Scheme would result in a change to the hydromorphology on the River Duiske upstream due to the construction of a hydraulic structure and downstream where new walls will be constructed and a debris trap implemented. The impact would be to the localised erosion and deposition processes resulting from the reprofiling, with some possible loss of natural river-bed features. Medium to long-term impacts are not anticipated. The

impact to the geomorphology this watercourse is therefore classed as **significant temporary negative impact**.

- The operation of the upstream storage area from WP2 will have an impact on the hydromorphology of this section of the Duiske river. The concrete structure will alter the riverbank, although over a short distance. The existing surface water drainage pathways on the site will be altered as a result of the development and as a result, the impact is deemed to be slight. Morphological adjustments can take time to transpire in the system (>10 years), with the reaches downstream of the flow structure potentially experiencing a minor sediment deficit in the absence of mitigation measures as the river adjusts to a new equilibrium. It is worth noting that future channel adjustment will occur in the context of Climate Change that may also alter catchment-scale hydrology and sedimentation. The short-term storage of the flood water in the reservoir will cause it to accumulate nutrients (nitrogen and phosphorus) from the soil and any other herbicides that may have been used on the crops. The flood water will also accumulate suspend solids and silt from the land. This will have the effect of increasing the loading of these chemicals and pollutants to the river. After a flood event the river water will be naturally turbid and will contain suspend solids and silt from the surrounding land in the catchment. However, the discharge from the storage reservoir will be to the extent that loading and will add additional suspended solids and silts to the river. This will have a **moderate short-term negative impact** on the water quality in the river.

- Based on the design outlined in Chapter 4 'Description of the Proposed Scheme and Construction Methodology', during times of flood, the area upstream of the dam will be inundated with water up to the maximum design level. The flow control structure will discharge at a rate of $3m^3/s$ during the design scenario. This could have a significant impact locally on bed and bank erosion. The scouring will result in the re-suspension of sediments and silts into the water that will be carried downstream. The rate of deposition of this material will be dependent upon its size and the velocity in the river, but it is expected that the majority of the material will settle out within the riverine system. It will have a **localised moderate negative** impact on the water quality in the river. The impacts of the operation of the flow control structure on species inhabiting the river are discussed in Chapter 10 'Biodiversity'.

- WP 3:

  - Flood protection measures deepen the active channel through raising of bank levels and reducing floodplain storage, both of which have the potential to increase stream power and shear stress on the bed of the river. Increased shear stress on the bed (a function of water depth) impacts sediment transport, erosion, and deposition. The impact to water levels as a result of the scheme was investigated through a modelling exercise completed during

the options assessment stage of the scheme which determined that the scheme would result in a imperceptible increase on water levels in the River Barrow.

- The operation of the flood defences walls in the lower reaches of the Duiske river will have a negligible effect on the hydromorphology and hydrology of the river as baseline conditions were of a highly modified river. However, the placement of the debris trap has the potential to slightly alter the hydrological flow of the river, but will be placed in such a way that the impacts will be lesser than a conventional debris trap. The potential for scour has been assessed as there may be high turbulence and increased velocities at the banks as debris becomes trapped. Maintenance of the debris trap will be carried out during the summer months and will generally involve the removal of woody debris using machinery on the bank edge. There is considered to be a minor environmental risk of fugitive emissions (e.g. oil spills) from malfunctioning machinery.

- The introduction of the debris trap will also have positive impacts by reducing fluvial flood risk downstream on the Duiske river by reducing the risk of blockage of the downstream bridges by floating debris. Further to this, the implementation of maintenance works will be essential throughout the lifespan of the scheme and overall will contribute to a moderate positive long-term effect on hydrology through the removal of blockages within the system. Therefore, there will be a **moderate long-term beneficial** impact.

- WP 4A:

  - The operation of the flood defences in the lower reaches of the Duiske river will have a localised **imperceptible long-term** impact on the hydromorphology and hydrology of the river as the flood defences are set back from the river and thus will only come into operation during a large flooding event. Moreover, baseline conditions were of a highly modified river.

  - The outfall from the pumping station (PS1) will discharge to the Duiske river, and the outfall from PS2 will discharge to the Barrow river. The pumping stations will be active, on average, less than once every 2-5 years. The pumping station will connect with existing stormwater system, which will undergo a replacement of the drainage pipes. The storm water will contain contaminated suspended solids. The storm water may also contain hydrocarbons particularly from nearby roads and carparks. These discharges will have a **localised temporary significant negative** impact at the outfall locations.

  - Most of the defences on the River Barrow are set back from the riverbank/Quay wall, meaning they will only interact with the active river body during flood events.

- WP 4B:
    - The operation of the flood defences on the River Barrow at Tinnahinch Quay will have a localised **imperceptible long-term** impact on the hydromorphology and hydrology of the river as the flood defences are largely set back from the river and thus will only come into operation during a large flooding event.

Sedimentation during Maintenance

8.6.13 The maintenance plan for the GTFRS includes the following:

- Riverbank vegetation will need to be trimmed so that it does not lie within the design flow conveyance area.
- Debris trap will be inspected, and debris removed as needed
- Stormwater drains will need to be inspected and cleaned as required.
- Stormwater pumping stations will be inspected and maintained to ensure they remain in proper working order.
- Non-return valves will be inspected and maintained to ensure they remain in proper working order.

8.6.14 In addition, regular inspection of the following scheme elements will be carried out:

- Flood gates and barriers
- Flood defence wall, including glass panels
- Flood defence embankments
- Flow control structures
- Mechanical and electrical requirements
- Public realm elements (eg, lighting, seating, tree planting)

8.6.15 During these activities, which are largely to be focused along the riverbanks and, in some cases in the river, sedimentation and/or run-off may be generated through vegetation clearing and resulting soil disturbance on the edges of the river. As mentioned, excessive sedimentation in-river can result in a temporary reduction in water quality and impact to supported flora and fauna. However, whilst the importance of the receptor is considered 'high' (NRA, 2009), the magnitude of impact is 'small', resulting in a **'moderate / slight' impact**, but on a **short-term basis.**

WFD Assessment

8.6.16 The following sections contain the WFD assessment. This has been carried out to assess the overall on impacts of the scheme on the achievement of the WFD objectives.

8.6.17 Objective 1: To prevent deterioration in the ecological status of the waterbody:

- BARROW_230 – As the river is a candidate HMWB and given the existing poor ecological status of the waterbody, the operation and maintenance of this Scheme will not result in a deterioration in status.
- DUISKE_020 – The current 'moderate' status will not be impacted by the implementation of the scheme as the majority of works on this waterbody will take place in an area of low habitat potential. The upstream area will impact upon a very small section of the overall waterbody.

8.6.18 Objective 2: To prevent introduction of impediments to the attainment of Good WFD status for the water body:

- BARROW_230 – The Proposed Scheme has the potential to introduce impediments during the construction stage, but these impacts would only be temporary/short-term. The operation of the scheme would prevent the introduction of impediments as it reduces the extents of the pollutants entering the river during flood events.
- DUISKE_020 – The Proposed Scheme has the potential to introduce impediments during the construction stage, but these impacts would only be temporary/short-term. The operation of the scheme would prevent the introduction of impediments as it manages storm water and prevents foul water that currently enter the river during times of flood.

8.6.19 Objective 3: To ensure that the attainment of the WFD objectives for the waterbody are not compromised:

- BARROW_230 – The WFD objective requires that the status of the water body improved to at least good by 2027. The elements that are causing the water body to fail include hydromorphology. As noted in the hydromorphology impact assessment, the River Barrow is a low energy river with minimal geomorphological activity occurring under current conditions. The Proposed Scheme would not result in long term changes to the River Barrow. The Boy's Sandy will not be impacted. Temporary works to facilitate wall improvement etc. may be needed, but the anticipate duration is not expected to impact the hydromorphological regime in the River Barrow. The post construction scenario will not have a long-term impact on the River Barrow as the majority of defences are set back from the river and any vegetation clearance will be replaced by native planting, where possible.
- DUISKE_020 – The WFD objective requires that the status of the water body improved to at least good by 2027. The elements that are causing the water body

to fail include hydromorphology, urban run-off and agriculture. As noted in the hydromorphology impact assessment, the River Duiske is constrained by urban development with heavily modified river bank throughout much of the area where works can be expected. The Proposed Scheme would result in a change to the hydromorphology on the River Duiske upstream due to the construction of a hydraulic structure, and downstream where new walls will be constructed and a debris trap implemented. The impact would be to the localised erosion and deposition processes resulting from the reprofiling, with some possible loss of natural river bed features. Whilst such an outcome may temporarily pose a risk to WFD status by impacting on river bed morphology and ecology, medium to long term impacts on WFD status or objectives are very unlikely given the overall current status for both sections of the river is 'Moderate'.

8.6.20 Objective 4: To ensure the achievement of the WFD objectives in other waterbodies within the same catchment are not permanently excluded or compromised:

- BARROW_230 – The overall impacts will be **slight, short-term negative**, in terms of sedimentation, and **imperceptible, long-term negative** for hydromorphology. However, the scheme will have a **long-term, positive impacts** on water quality by reducing the effects of flooding. Therefore, the achievement of the WFD objectives in hydrologically connected waterbodies are not compromised.

- DUISKE_020 – The overall impacts will be **slight, short-term negative**, in terms of sedimentation, and **slight, long-term negative** for hydromorphology. However, the scheme will have a **long-term, positive impacts** on water quality by reducing the effects of flooding. Therefore, the achievement of the WFD objectives in hydrologically connected waterbodies are not compromised.

8.7 Mitigation Measures

Construction Phase

8.7.1 A CEMP has been prepared alongside the EIAR (see Appendix 4-4) to provide guidance to the appointed contractor(s), setting out the mitigation measures identified in this EIAR as well as general site management best practise. The appointed contractor will be responsible in taking ownership of future iteration of this document and implementing all mitigation measures contained therein. It should be understood and implemented by all construction staff and sub-contractors throughout the construction process.

8.7.2 During the construction phase, there will be consideration for the standard best international practice including but not limited to:

- CIRIA, (2001), Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors, (C532) Construction Industry Research and Information Association.

- CIRIA (2005), Environmental Good Practice on Site (C650); Construction Industry Research and Information Association.
- BPGCS005, Oil Storage Guidelines.
- CIRIA 697 (2007), The SUDS Manual.
- UK Pollution Prevention Guidelines, (PPG) UK Environment Agency, 2004.
- Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters. Inland Fisheries Ireland, 2016.
- Fishery guidelines for Local Authority works. Department of Marine and Natural Resources 1998.

8.7.3 The adopted construction techniques will comply with the requirements of statutory bodies (Health and Safety Authority and the Office of Public Works) and the Employer.

8.7.4 During construction, the following generic measures will be used to avoid or reduce the significance of potential impacts:

Treatment of Invasive Flora Species

8.7.5 Specific mitigation measures regarding the careful application of herbicide to treat Invasive Alien Plant are presented the Invasive Alien Plant Species Management Plan in the CEMP.

Sedimentation and Surface Run-off

SW_1: In order to further reduce any potential effect of the works on occurring fish species in the area (Brown Trout, Atlantic Salmon), instream works will only be carried out between July and September.

SW_2: The choice of construction methodology will emphasise the requirement to avoid direct contact with the waterbodies in the study area.

SW_3: Excavated and imported soil materials will be stockpiled away from watercourses. Where stockpiles are located near watercourses, appropriate protection will be provided to avoid run-off (i.e., blanketing with geotextile layer, inclusion of run-off sumps).

SW_4: Wet stockpiles will include appropriate drainage sumps to avoid run-off of silt-laden material into watercourses.

SW_5: All works undertaken near the riverbanks will be fully consolidated to prevent scour and run-off of silt. Consolidation may include use of protective and biodegradable matting or geotextiles on the banks and the sowing of grass seed on bare soil.

SW_6: A silt fence will be included around the site perimeter in the vicinity of earth works, where possible, to retain silts onsite. Otherwise, silt fences will be placed along the riverbank to avoid run-off.

SW_7: If ponding occurs onsite during periods of heavy rainfall, water will be pumped into a pond or sedimentation tank to allow settling of fine sediments prior to pumping to the local stormwater system.

SW_8: All earthworks will aim to be carried out in periods of dry weather (from April to September inclusive) to avoid potential for suspended sediment runoff.

SW_9: An appropriate dewatering methodology will be selected for works. This will consider the risk of any ground instability arising from dewater activities to potentially sensitive receptors in proximity to the works area.

SW_10: If required, dewatering will be achieved using a series of sump and submersible pumps and discharging through a suitably sized propriety sediment removal system. The contractor will regularly maintain the sedimentation tank to ensure that it is not full of sediment. This aims to prevent pollution of the river through the release of sediments.

SW_11: A suitably qualified Environmental Clerk of Works shall be appointed to oversee and monitor all measures taken to protect the aquatic environment.

Accidental Releases / Spillages

8.7.6 Refer to Chapter 12 'Land, Soils, Geology and Hydrogeology' and the mitigation measures proposed for the prevention and management of accidental releases / spillages.

Operation and Maintenance Phase

SW_12: A regular maintenance regime will be implemented by the developer to ensure that all environmental protection measures are maintained at the development, that all infrastructure is kept in good working condition, and that the surface water and drainage networks are tended to as appropriate to avoid flood risk. Planned maintenance activities are outlined in Chapter 4 'Description of the Proposed Scheme and Construction Methodology' under the 'Maintenance Methodology' Section.

SW_13: The river flow will be maintained at the upstream storage area to allow Qmed (or near to it) flow through the dam at all times. This is the largest flood that occurs every 2 years statistically. This will maintain sediment equilibrium within the river channel.

SW_14: Should aggradation occur in the vicinity of the river flow control structures, removal of gravel will be carried out when river level is low. There will be no instream works. The top of the accumulated gravels will be removed leaving the low water channel unaffected. All gravels removed will be made available to IFI for use in fisheries enhancement elsewhere in the catchment and will be stored on site for this purpose. It is not anticipated that this maintenance will be required on a regular basis.

8.7.7 The measures outlined for the construction phase are sufficient to ensure protection of water quality during maintenance events (i.e., riverbank clearing, debris removal etc).

8.8 Monitoring

8.8.1 Routine site inspections will be undertaken during the construction phase and during maintenance activities by a Health, Safety & Environmental Officer to determine compliance with the suggested mitigation measures described in Section 8.7.

8.8.2 Site records will be inspected to determine history of any contamination / spillages and how these were addressed. Improvements and lessons learnt may be a useful tool to ensure effectiveness.

8.8.3 A water quality monitoring regime will be established and agreed with the NPWS and IFI in advance of works commencing. Monthly water quality sampling will take place for a minimum of 12 months pre-construction. The following parameters will be recorded in surface waters:

- Suspended solids
- Dissolved oxygen
- Temperature
- pH
- Turbidity
- BOD5
- Orthophosphate
- Dissolved inorganic nitrogen.

8.8.4 Appropriate monitoring locations would be:

1. upstream of the construction area for the proposed upstream storage area on the River Duiske,
2. within the river channel where the proposed flow control structure is to be located,
3. upstream of the proposed debris trap,
4. within the River Duiske in Graiguenamanagh town,
5. upstream of the proposed works on the River Barrow,
6. within the River Barrow from Graiguenamanagh bridge, and
7. downstream of the proposed works on the River Barrow.

8.8.5 The reporting procedures will be agreed with the National Parks and Wildlife Service (NPWS) and Inland Fisheries Ireland (IFI) before commencement of the work. All

monitoring records will be maintained by the Project Manager or their nominated assistant.

8.9 Residual Impacts and Effects

The 'do nothing' Scenario

8.9.1 In the absence of any mitigation under this scenario, the residual impact will therefore remain as **'Significant/Moderate'** with **both short-and-long-term** implications.

Construction Phase

8.9.2 Prior to mitigation, potential impacts to the surrounding waterbodies and sensitive receptors ranged from 'moderate/slight' to 'profound' owing largely to the nature of the receptors and importance designation under NRA (2009). However, the vast majority of the potential impacts are able to be mitigated through simple best-practises during construction (see Section 8.7), reducing the significance of effect to 'imperceptible' in all cases, except for those impacts related to the uncontrolled siltation/sedimentation into the waterbodies. In many cases, defences are located in-river or directly on the riverbank (e.g. within the River Duiske), and therefore some sedimentation is unavoidable. The residual impact ranges from **'imperceptible' to 'moderate/slight'** for the River Duiske and Barrow, **and 'significant'** for the SAC.

Table 8-12: Residual Impacts of the Proposed Scheme

Source	Receptors Considered	Significance Rating (NRA, 2009) before mitigation	Significance Rating (NRA, 2009) after mitigation
Uncontrolled spillage of herbicides.	River Barrow and River Duiske	Receptor Importance: **High.** Magnitude: **Small.** Significance of Impact: **Moderate / Slight.**	Receptor Importance: **High.** Magnitude: **Negligible.** Significance: **Imperceptible.**
	River Barrow and River Nore SAC	Receptor Importance: **Extremely High.** Magnitude: **Small.** Significance: **Significant.**	Receptor Importance: **Extremely High.** Magnitude: **Negligible.** Significance: **Imperceptible.**
Uncontrolled siltation / sedimentation	River Barrow and River Duiske	Receptor Importance: **High.** Magnitude: **Moderate.** Significance of Impact: **Significant/Moderate.**	Receptor Importance: **High.** Magnitude: **Small.** Significance: **Moderate / Slight.**

Source	Receptors Considered	Significance Rating (NRA, 2009) before mitigation	Significance Rating (NRA, 2009) after mitigation
	River Barrow and River Nore SAC	Receptor Importance: **Extremely High.** Magnitude: **Moderate.** Significance: **Profound.**	Receptor Importance: **Extremely High.** Magnitude: **Small.** Significance: **Significant.**
Uncontrolled spillage / leakage of hydrocarbons, lubricants, oils, wastewater and/or concrete residue.	River Barrow and River Duiske	Receptor Importance: **High.** Magnitude: **Small to Moderate** Significance of Impact: **Moderate / Slight to Significant/Moderate.**	Receptor Importance: **High.** Magnitude: **Negligible.** Significance: **Imperceptible.**
	River Barrow and River Nore SAC	Receptor Importance: **Extremely High.** Magnitude: **Small to Moderate.** Significance: **Significant to Profound.**	Receptor Importance: **Extremely High.** Magnitude: **Negligible.** Significance: **Imperceptible.**

Operation and Maintenance Phase

8.9.3 Long-term hydromorphology and water level changes were perceived to have an '**imperceptible**' significance and have therefore not been considered further.

8.9.4 Overall, the scheme will result in the loss of a small amount of habitat in the rivers and the streams, but in general the habitat will remain largely unchanged.

8.9.5 Impacts assigned at the maintenance phase were assigned as 'moderate/slight' however in this case mitigation is entirely possible to eliminate impacts almost entirely, and therefore the residual impact is assigned as '**imperceptible**'.

8.10 Interactions with other Environmental Effects

8.10.1 A full review of the potential interactions with other environmental effects is provided in Chapter 16 'Interactions and Cumulative Effects'.

8.10.2 The most significant interactions for the assessment of hydrology impacts are those associated with biodiversity/ecology (Chapter 10 'Biodiversity') particularly where hydrological connection between the proposed development at surrounding Designated Sites is present. A reduction in water quality at these Designated Sites has the potential to cause effect to the Conservation Objectives (COs) for the Qualifying Interests (QIs) of the sites, including both sensitive habitats and species.

8.10.3 Other interactions exist between the impacts identified to hydrology – surface water and those identified to land, soils, geology and hydrogeology (Chapter 12). A potential effect

on the hydrology environment includes the excavation of made ground and overburden which could potentially increase the sediment loading to the surface water environment. Further, contaminated or imported soil has the potential to run off during the construction phase and have negative impacts on surface water environments. Further, contaminated imported soil has the potential to run off during the construction phase and have negative impacts on surface water environments.

8.10.4 Interactions also exist with Chapter 14 'Climate' as surface water bodies in the study area will be directly affected by climate change through sea level rise and changes to precipitation patterns, which is projected to cause increased water levels, and higher frequency of intense storms.

8.10.5 Archaeological test trenching and excavation form an important part of pre-construction mitigation for Cultural Heritage (Chapter 9), in order to identify any archaeological finds/features. Test-trenching and excavation presents potential for silt-laden run-off to enter the watercourses, particularly during events of rainfall and/or flood. Dewatering of trenches and/or excavations gives further cause for in-river sedimentation, whereby direct pumping from sumps into the river may result in sedimented dewater effluent, if not appropriately monitored.

8.11 Cumulative Impacts

8.11.1 A full review of the potential cumulative impacts is provided in Chapter 16 'Interactions and Cumulative Effects'.

8.11.2 Cumulative impacts are those which accrue to key hydrological receptors as a result of incremental changes caused by other existing and proposed plans or projects together with those caused by the Proposed Scheme.

8.11.3 Cumulatively, the identified projects in Chapter 16 'Interactions and Cumulative Effects', in combination with the Proposed Scheme may create added pressure upon the waterbodies present in the study area (where hydrological connection exists), however the combined impact is unlikely to be significant given the nature and scale of the identified projects and ability for all impacts to be sufficiently mitigated through best-practise construction techniques.

8.12 Limitations in Preparing the Chapter

8.12.1 There were no limitations in preparing the Chapter.

8.13 Summary

8.13.1 As mentioned in Section 8.3, the assessment of impacts to hydrology have been conducted in line with the significance ranking methodologies in NRA 2008 Guidelines. The summary table of impacts, importance ranking, magnitude ranking, effect significance, mitigation and residual significance is outlined below.

Table 8-13: Summary of Impacts and Mitigation Measures: Hydrology (NRA, 2008 – see Table 8-2)

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation and Monitoring	Impact Significance Post-Mitigation
'Do Nothing' Scenario Impacts						
Maintenance of flood risk and resulting water quality impacts	River Barrow and River Duiske.	High	Moderate	Short and long-term Significant / Moderate Negative	Not applicable.	Significant / Moderate
Construction Phase Impacts						
Uncontrolled spillage of herbicides (for treatment of invasives)	River Barrow and River Duiske.	High	Small Adverse	Temporary Moderate / Slight Negative	Implementation of measures to ensure the careful use of herbicides, as outlined in the Invasive Alien Species Management Plan (see CEMP).	Imperceptible
	River Barrow and River Nore SAC	Extremely High	Small Adverse	Temporary Significant Negative		Imperceptible
Uncontrolled siltation / sedimentation	River Barrow and River Duiske.	High	Moderate	Short-term Significant Negative	• Instream works will only be carried out between July and September. • Construction methodology to avoid direct contact with the	Moderate / Slight

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation and Monitoring	Impact Significance Post-Mitigation
	River Barrow and River Nore SAC	Extremely High	Moderate	Short-term Profound Negative	waterbodies as much as possible. • Stockpile away from watercourses. Where stockpiles are located near watercourses, appropriate protection will be provided to avoid run-off. • All works undertaken near the riverbanks to prevent scour and run-off of silt. • A silt fence will be included around the site perimeter. • Allow settling of fine sediments prior to pumping to the local stormwater system/river. • All earthworks to be carried out in periods of dry weather. • An appropriate dewatering methodology will be selected. • Dewatering to suitably sized propriety sediment removal system. • Ecological Clerk of Works to oversee and monitor all measures taken to protect the aquatic environment.	Significant

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation and Monitoring	Impact Significance Post-Mitigation
Uncontrolled spillage / leakage of hydrocarbons, lubricants, oils, wastewater and/or concrete residue.	River Barrow and River Duiske.	High	Small to Moderate	Temporary Moderate / Slight to Significant/ Moderate Negative	Refer to Chapter 12 'Land, Soils, Geology and Hydrogeology' and the mitigation measures proposed for the prevention and management of accidental releases / spillages.	Imperceptible
	River Barrow and River Nore SAC	Extremely High	Small to Moderate	Temporary Significant to Profound Negative		Imperceptible
Operation and Maintenance Phase Impacts						
Increased Water Levels and Velocity	River Barrow and River Duiske	High	Negligible	Imperceptible	Appropriate design of flood defence measures.	Imperceptible
Changes to Hydro-morphology	River Barrow (Barrow_230)	High	Moderate	Temporary Slight Negative	Not applicable.	Temporary Slight Negative
	River Duiske (Duiske_020)	High	Moderate	Moderate Negative	Not applicable.	Moderate Negative
Sedimentation during Maintenance	River Barrow and River Duiske	High	Small	Moderate / Slight Negative	Mitigation measures outlined for the control of sedimentation during	Imperceptible
Uisce Éireann assets	WWTP Foul Pumping Station and Abstraction Points	High	Major Beneficial	Significant Positive	Not applicable.	Significant Positive
Water Quality improvements as a result of flood defences preventing negative impacts	River Barrow (Barrow_230)	High	Major Beneficial	Significant Positive	Not applicable.	Significant Positive
	River Duiske (Duiske_020)	High	Major Beneficial	Significant Positive	Not applicable.	Significant Positive

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation and Monitoring	Impact Significance Post-Mitigation
with current flooding events	River Barrow and River Nore SAC	Very High	Major Beneficial	Profound Positive	Not applicable.	Profound Positive

8.14 References

APEM. (2023). Graiguenamanagh-Tinnahinch Flood Relief Scheme - Aquatic Ecology Surveys Report - P00012428.

Aquafact International Services Ltd. (2021). Graiguenamanagh Q-Value.
Ayesa. (2024). Graiguenamanagh-Tinnahinch Flood Relief Scheme, Hydromorphology Report and Impact Asessment, W3451-ENV-R014.

ByrneLooby. (2020). Graiguenamanagh-Tinnahinch Flood Relief Scheme, Hydrological Method Statement, W3451-W-R001.

ByrneLooby. (2020). Graiguenamanagh-Tinnahinch Flood Relief Scheme, Hydromorphology Baseline Report, W3451-W-R005.

ByrneLooby. (2022). Graiguenamanagh-Tinnahinch Flood Relief Scheme, Hydrology Report, W3451-W-R002.

Department of Housing, Local Government and Heritage. (2024). The Water Action Plan 2024: A River Basin Management Plan for Ireland. Government of Ireland.

Environmental Protection Agency. (2006). EU Water Framework Directive Monitoring Programme - EPA. Retrieved October 2020, from https://www.epa.ie/pubs/reports/water/other/wfd/

EPA. (2024). Cycle 3: HA 14 Barrow Catchment Report, May 2024. Environmental Protection Agency.

Government of Ireland. (2025). Public Consultation on the Designation of Heavily Modified Water Bodies for Ireland's third cycle River Basin Management Plan. Retrieved from gov.ie: https://www.gov.ie/en/department-of-housing-local-government-and-heritage/consultations/public-consultation-on-the-designation-of-heavily-modified-water-bodies-for-irelands-third-cycle-river-basin-management-plan/

NIEA. (2014). River Hydromorphology Assessment Technique - Training Guide. Northern Ireland Environment Agency.

NRA. (2008). Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

P. Toner, J. Bowman, K. Clabby, J. Lucey, M. McGarrigle, C. Concannon, C. Clenaghan, P. Cunningham, J. Delaney, S. O'Boyle, M. MacCárthaigh, M. Craig and R. Quinn . (2005). Water Quality in Ireland 2001-2003: Appendix 1. Published by the Environmental Protection Agency, Ireland. .

WFD Application. (2018). WFD Cycle 2: Catchment Barrow - Subcatchment Barrow_SC_130 Code 14_7. Environmental Protection Agency via catchments.ie.

9 Cultural Heritage

9.1 Scope of the Assessment

9.1.1 This chapter of the EIAR describes the baseline archaeological, architectural and cultural heritage environment and identifies the likely significant impacts (positive and negative) on this environment, associated with the site preparation, construction and operations phases of the Proposed Scheme. All proposed works to take place within a riverine, wetland, dryland and built environment have been appropriately assessed and where required archaeologically investigated in order to inform this study.

9.1.2 Chapter 4 'Description of the Proposed Scheme and Construction Methodology' provides a full description of the Proposed Scheme and the construction aspects of the scheme.

9.2 Statutory and Policy Context

Legislation

9.2.1 This assessment has been undertaken with due regard to the overarching EIA guidance (described in Chapter 2 'Planning and Policy').

- The Cultural Heritage chapter will be guided by the methodologies and recommendations outlined in 'Archaeology and Flood Relief Schemes: Guidelines' (NMS 2023).

9.2.2 A full list of legislation, standards and guidelines that were consulted to inform the assessment are contained in Appendix 9-1 in Volume III of this EIAR along with excerpts from the principal legislation governing archaeology, the National Monuments Acts 1930-2014. The Historic and Archaeological Heritage and Miscellaneous Provisions Act 2023 was enacted in October 2023 and this this Act is now law. The Minister for Housing, Local Government and Heritage commenced certain provisions, the latest in May 2024 (S.I. No. No. 88 of 2025), however until the Act is fully commenced, the National Monuments Acts have therefore not yet been repealed and remain in force.

9.2.3 The Kilkenny Development Plan (2021-2027) outlines specific policies and objectives for the cultural, archaeological and architectural heritage in the county, these are outlined in Appendix 9-2 in Volume III of this EIAR.

9.2.4 The Carlow Development Plan (2022-2028) outlines specific policies and objectives for the cultural, archaeological and architectural heritage in the county, these are outlined in Appendix 9-2 in Volume III of this EIAR.

Local Policy

9.2.5 Graiguenamanagh-Tinnahinch (G-T) Joint Local Area Plan (LAP) 2021-2027 is committed to *enhancing and protecting the built and natural heritage of the settlement by promoting the enhancement, management and understanding of these assets whilst encouraging sensitive and sustainable development so as to ensure its survival for future generations* through policies and objectives listed in Appendix 9-2 in Volume III of this EIAR. The

heritage map created by Kilkenny County Council and Carlow County Council shows the LAP boundary, the Architectural Conservation Area, the Zone of Archaeological potential, The Record of Monuments and Places (RMP) locations and Record Protected Structures (RPS).



Figure 9-1 Graiguenamanagh/ Tinnahinch Joint Local Area Plan 2021, Map 2: Heritage

9.2.6 An objective of the plan is:

INFO3.1: To support and co-operate with the OPW and other stakeholders in delivering Graiguenamanagh-Tinnahinch Flood Relief Scheme under the South Eastern CFRAM Programme, whilst ***ensuring heritage considerations inform the design of proposed works and to ensure development maximises the protection of the integrity of the historical settlement.***

9.2.7 This chapter and supporting investigations and reports detailed in the appendices are a response to this objective, where the protection of heritage assets and the maintaining and enhancing the historic sense of place at G-T is central to designing a flood solution for the historic towns.

9.3 Assessment Methodology

Study Area

9.3.1 The Study Area is split into two separate locations. The first (Area 1) is related to the proposed upstream storage area and measures approximately 8.2 hectares and extends for approximately 670m along the River Duiske, comprising portions of 14 fields. It is located in the townlands of Tinnapark, Priestsvalley, Coolroe and Oldgrange, 1.5km northwest of the town of Graiguenamanagh, Co. Kilkenny.

9.3.2 The second location is centred around the historic town of Graiguenamanagh in County Kilkenny and historic settlement of Tinnahinch in County Carlow, where the flood relief works will occur and is divided into nine areas (Area 2- Area 10).

9.3.3 G-T are situated in a steep sided river valley between Brandon Hill and Mount Leinster, located on the R705 regional road. The settlements occupy a bridging point where the Duiske (referred also as Douske) tributary enters the River Barrow.

9.3.4 Graiguenamanagh is on the northern side of the river (Area 2 - Area 8) and Tinnahinch is on the southern side (Area 9 - Area 10).

9.3.5 The historic layout and built form of Graiguenamanagh has been strongly influenced by its surrounding topography and the bridging of the River Barrow. Whilst Tinnahinch was developed more recently on the south bank of the river, it too developed because of the river. The Duiske River and a millrace associated with the historic milling of the town runs through Graiguenamanagh on the western side of the main street and issues into the Barrow at the former dry docks on the west side of the bridge. A mill race is also present adjacent to the quay at Tinnahinch. The study area includes townlands of Tinnapark, Ballynakill, Graiguenamanagh, Bohermore, Newtown, Brandondale, Tinnahinch, and Coolfarnamanagh.

Assessment of Impact

9.3.6 The methodology has been designed so a full understanding of the potential effects on the character of the historic landscape can be assessed. The purpose of the cultural heritage assessment is to avoid, prevent, reduce, and/or offset/remedy significant adverse effects on cultural heritage (as per EIA Directive), and compliance with national legislation and policy. A detailed archaeological and historical background has been included which describes the character of the immediate and wider historic landscape, as well as the individual heritage assets, and highlights the potential to reveal subsurface features. The methodology used is based on the EPA Guidelines (EPA 2022), and both direct physical effects, as well as impacts to the setting of individual heritage assets, have been assessed. The assessment of the Proposed Scheme includes a comprehensive consideration of the potential direct, indirect, residual and cumulative impacts and includes, where applicable, an assessment of visual impacts on cultural heritage constraints (see photomontages, Appendix 4-3) and section 9.4.63 and Appendix 9-12 Conservation Strategy by Chris Southgate Associates (2025).

9.3.7 The EPA (2022) includes under the heading of Cultural Heritage:

- Archaeology,
    - Known archaeological monuments,
    - Areas of archaeological potential (including unknown archaeology), and
    - Underwater archaeology.
- Architectural Heritage
    - Designated architectural heritage, and
    - Other significant architectural heritage.
- Folklore and History
    - Designations or sensitivities.

9.3.8 Cultural heritage as set out in the Environmental Protection Agency (EPA) Guidelines on Information to be Contained in Environmental Impact Assessment Reports (hereafter referred to as the EPA Guidelines) (EPA, 2022) includes archaeology, architectural heritage, folklore and history. It is a broad term that includes a wide range of tangible and intangible cultural considerations. Cultural heritage can relate to settlements, former designed landscapes, buildings and structures, folklore, townland and placenames, and historical events, as well as traditions (e.g. mass paths and pilgrim ways) and traditional practices (e.g. saints' pattern days).

9.3.9 Cultural heritage is part of our cultural identity and contributes to defining a sense of place. The value of a strong sense of place is likely to become more important as the world grows increasingly homogenised. Recognising the unique sense of place in our towns and villages, whilst also respecting the individual heritage assets, is critical.

9.3.10 Cultural heritage assets are valued for the important contribution they make to the understanding of the history of a place, an event or people. Sites of cultural heritage interest are often afforded protection as recorded archaeological monuments (on the Record of Monuments and Places (RMP)/ or as protected structures (on the Record of Protected Structures (RPS) in the relevant City or County Development Plan). Cultural heritage assets are also recorded on the Sites and monuments Record (SMR) or as structures within the National Inventory of Architectural Heritage (NIAH).

9.3.11 Each of these provides a unique cultural record and acts as a carrier of memory, meaning and cultural value. When considered in its wider context, they can form an essential component in the mechanism for analysing the broader cultural character and context of an area. Together, these can assist in mapping the changes that have led to the development of the modern environment. Such analysis provides insight into the communication, trade, transport, growth and associations of past societies.

9.3.12 Archaeological sites are considered to be a non-renewable resource and are generally considered to be location sensitive. In this context, any change to their environment, such as construction activity, ground disturbance works and changes to setting, could adversely affect these sites. The likely significance of all effects is determined in

consideration of the magnitude of the effect and the baseline rating upon which the impact has an effect (i.e., the sensitivity or value of the cultural heritage asset). Having assessed the potential magnitude of effect with respect to the sensitivity/value of the asset, the overall significance of the effect is then classified as not significant, imperceptible, slight, moderate, significant, very significant, or profound.

9.3.13 A glossary of impact assessment terms, including the criteria for the assessment of effect significance, is contained in Chapter 1 'Introduction'.

Data Sources

9.3.14 This study availed of the following data sources:

- UNESCO World Heritage Property (WHP) and Tentative World Heritage Sites and those monuments on the tentative list.
- National Monuments in State care, as listed by the National Monuments Service (NMS) of the Department of Housing, Local Government and Heritage (DHLGH),
- Sites with Preservation Orders.
- Sites listed in the Register of Historic Monuments.
- Record of Monuments and Places (RMP) and the Sites and Monuments Record (SMR) from the Archaeological Survey of Ireland; The statutory RMP records known upstanding archaeological monuments, their original location (in cases of destroyed monuments) and the position of possible sites identified as cropmarks on vertical aerial photographs. Archaeological sites identified since 1994 have been added to the non-statutory SMR database of the Archaeological Survey of Ireland (National Monuments Service, DHLGH), which is available online at www.archaeology.ie and includes both RMP and SMR sites. Archaeological sites identified since 1994 are placed on the SMR and are scheduled for inclusion on the next revision of the RMP.
- Record of Protected Structures (RPS) in the Kilkenny Development Plan (2021-2027) and Carlow Development Plan (2022-2028).
- County Councils Architectural Conservation Areas (ACAs) and their statements of character.
- National Inventory of Architectural Heritage (NIAH) Building Survey (NIAH ratings are international, national, regional, local and record, and those of regional and above are recommended for inclusion in the RPS),
- National Inventory of Architectural Heritage (NIAH) Garden Survey (paper survey only).
- A review of artefactual material held in the National Museum of Ireland.
- Archaeological Inventory of County Kilkenny.

- Cartographical Sources, OSi Historic Mapping Archive, including early editions of the Ordnance Survey including historical mapping (such as Down Survey 1656 Map).
- The Database of Irish Excavations Reports (DIER) – www.excavations.ie (Appendix 9-4).
- Place names; Townland names and toponomy (logainm.ie).
- National Folklore Collection (Duchas.ie).
- A review and interpretation of aerial imagery (OSI Aerial Imagery 1995, 2000, 2005, Aerial Premium 2013-2018, Digital Globe 2011-2013, Google Earth 2001–2023, Bing 2023) to be used in combination with historic mapping to map potential cultural heritage assets.
- Collation of information from similar or other infrastructure projects in proximity to the Proposed Scheme, for example EIS/EIARs, SEAs, conservation plans, archaeological test assessments and excavations (Appendix 9-4).
- A review of existing guidelines and best practice approaches.

9.3.15 Previous phases of the proposed FRS involved the compilation and mapping of available cultural heritage data sets (Deery 2021, O' Brien 2023). The outputs of the project included GIS layers and the creation of a database for archaeology, architectural heritage and as far as possible, cultural heritage, as well as associated mapping. This forms a permanent renewable database that can be utilised by multiple specialist users to provide information for the project design and the EIA process. This phase of the project has updated the GIS and mapping for the project with the latest data from statutory authorities and the design team, as well as additional features identified through further desk-based study and fieldwork.

9.3.16 The locations for all cultural heritage assets identified in the course of the assessment have been mapped and are shown on map figures throughout this chapter and are all shown in Appendix 9-17. The coordinates for each asset are provided in Irish Transverse Mercator (ITM) in the inventory of archaeological and cultural heritage sites in Appendices 9-5 to 9-8 in Volume III of this EIAR.

Site Visits / Surveys

9.3.17 Surveys and investigation that were undertaken to inform this study include:

- Appendix 9-9, TerraDat 2024 Geophysical Survey Report (Licence 24R0041) Areas A-E.
- Appendix 9-10, ADCO 2022 Underwater Archaeological Impact Assessment (UAIA) (Licence 21D0047 and 21R0082) for the River Duiske and River Barrow.
- Appendix 9-11, ADCO 2024 Underwater Archaeological Impact Assessment (UAIA) (Licence 24D0149, 24R0195) Upstream Storage Area.

- Appendix 9-12, Southgate Associates January 2025 Conservation Strategy Report.
- Appendix 9-13, ACSU 2024 Archaeological Monitoring of Geotechnical Site Investigations (Licence 21E0256).
- Appendix 9-14, CDHC 2024 Archaeological Testing Report – Pre-planning Graiguenamanagh Quay, Co Kilkenny, Excavation Licence No. E005772, R000749, Ministerial Consent C001049.
- Appendix 9-15, CDHC 2023 Archaeological Baseline Report Graiguenamanagh-Tinnahinch Flood Relief Scheme, Upstream Storage Area.
- Appendix 9-16, Philips & Associates 2024 Rectified Imagery (Orthophotography) of Wall and Building Elevations Along the River Duiske.

9.3.18 Fieldwork was undertaken on 7th March 2023, 13th of March 2024, 13th August and the 7th September 2024 by Yolande O'Brien and Lisa Courtney of Courtney Deery Heritage Consultancy. The aim was to assess the character and setting of the recorded cultural heritage features, and to identify undesignated cultural heritage features, in order to assess the potential impact from the proposed FRS.

9.3.19 A geophysical survey was conducted by TerraDat in 2024 under Detection Device Consent Licence Ref. 24R0041. The work included an archaeological magnetic gradiometry survey and an electromagnetic induction survey and centred on two locations. Areas A-D were located adjacent to the river in Graiguenamanagh. Area E is associated with a proposed embankment and the upstream storage area approximately 1.5 km northwest of the town. Due to access restrictions, Area C was unavailable for geophysical survey. The total size of the surveyed area measured ~4.8ha (TerraDat 2024). The report is contained in Appendix 9-9.

9.3.20 The Archaeological Diving Company Ltd (ADCO) has carried out an Underwater Archaeological Impact Assessment (UAIA) (ADCO 2022) under consent from the Department of Housing, Local Government and Heritage, licence numbers 21D0047 and 21R0082. The work comprised a non-disturbance walkover inspection along the riverbanks, a waded inspection along the course of the Duiske River, and an underwater inspection within the River Barrow. Site work extended along the lower section of the Duiske River from a point behind Main Street above Keating's Well to its confluence with the Barrow, and from a point on the River Barrow upstream of the Rowing Club to a point downstream of the town approaching Lock 21. Full access to the riverbed and project area was possible and no constraints were encountered. Metal-detection was focused on locations where soft sediment was encountered within the town area. The report is contained in Appendix 9-10.

9.3.21 An Underwater Archaeological Impact Assessment (UAIA) (Licence 24D0149, 24R0195) was carried out by the ADCO along the Duiske River (also known as the Douske River) to inform the proposed Graiguenamanagh–Tinnahinch Flood Relief Scheme for the proposed upstream storage area component in 2024 (ADCO 2024). The report is contained in Appendix 9-11.

9.3.22 A preliminary building and conservation strategy was undertaken by Southgate Associates (Southgate Associates 2022) and this report was finalised to assist and inform the EIAR process in January 2025. The final report is contained in Appendix 9-12. For the Proposed Scheme, Southgate Associates created localised conservation design interventions and solutions in relation to heritage buildings and features to ensure that at a local level the individual heritage asset is protected and that the broader heritage aesthetic and appeal of the heritage town is maintained and enhanced where possible, by the flood relief scheme works. Building surveys took place and a laser scan of the buildings and features that align the River Duiske was carried out to the specification of Southgate Associates.

9.3.23 Geotechnical site investigations were archaeologically monitored under licence and Ministerial Consent by ACSU (Licence Ref. 21E0256) (ACSU 2024). The report is contained in Appendix 9-13. Archaeological test trenches were opened up under Ministerial Consent (Excavation Licence No. E005772, R000749, Ministerial Consent C001049) along Graiguenamanagh Quay within the precinct of Duiske Abbey (a National Monument) by Courtney Deery Heritage Consultancy (2024) and the report is contained in Appendix 9-14.

9.3.24 An orthophotographic survey took place along the Duiske River to assess the walls and structures as well as existing vegetative growth that aligns the channel and to assist with the Conservation Strategy undertaken by Southgate Associates. A full set of images are included in Appendix 9-16.

9.3.25 For a full review of all planning drawing numbers and description accompanying the application, please refer to Appendix 4-1. All archaeological, architectural and cultural heritage drawings are presented in Appendix 9-17.

Consultation

9.3.26 Throughout the EIA process, consultations were made to seek opinions and input from statutory bodies, regulators, organisations, research bodies, community facilities and residents that have an interest or who may be affected by the Proposed Scheme. Data/information was also provided by stakeholders in some cases, where relevant, for incorporation into the EIA study. This chapter has been prepared with consideration of the outcomes of this consultation, which is detailed further in Chapter 5 ‘Consultation and Stakeholder Engagement’.

9.3.27 Specific to this chapter, an onsite meeting took place with members of the Underwater Archaeological Heritage Unit and Planning and Licensing Unit from the National Monuments Service and the National Built Heritage Service of the Department of Housing, Local Government and Heritage and the design team on the 13th of August 2024.

Work Packages

9.3.28 The Proposed Scheme has been divided into 10 Work Packages (WPs), the location and type of works proposed for each area is described in Chapter 4 ‘Description of the Proposed Scheme and Construction Methodology’, Table 4-1.

9.4 Baseline Environment

9.4.1 This section presents the findings of a detailed desktop study as well as a site and riverine inspection of the study area, in order to assess and illustrate the archaeological, architectural and cultural heritage potential of the area.

9.4.2 The desktop study includes a review of literary and cartographic sources, results of previous archaeological investigation, the Archaeological Survey Inventory (ASI) Archives and the topographical files of the National Museum of Ireland (NMI). While from an architectural heritage perspective Protected Structures, structures and historic gardens of an architectural heritage interest (NIAH), structures of industrial heritage interest as well as ACAs were assessed and reviewed in relation to the scheme.

9.4.3 The results of the wade surveys, archaeologically monitored SI test excavations and architectural heritage surveys are also included in order to fully understand and assess the impact of the scheme on the receiving cultural heritage environment, sense of place and individual heritage assets.

9.4.4 A description outlining the chronological development of the study area from the prehistoric to modern period is provided.

Archaeological Background and Historic Character of the study area

Prehistoric Period (c.7000 BC-400 AD)

9.4.5 There are no prehistoric sites recorded in the study area at Graiguenamanagh and Tinnahinch or the wider area surrounding the proposed upstream storage area. The nearest recorded prehistoric presence is located at a height in the hills that form a backdrop to the towns at a distance of 8km, these monuments include several cairns (KK029-032001, KK033-008002, KK033-015), a standing stone (KK029-043), rock art sites (KK033-050, CW022-046, CW022-073), hillfort (KK033-008001), several undated hut sites (KK033-049-KK033-006001-). The cairns, standing stone, and rock art sites indicate a firm and visible monumental presence in the area dating back to at least the Bronze Age and possibly even the Neolithic.

9.4.6 In terms of archaeological potential, Graiguenamanagh and Tinnahinch are both located at the edge of the River Barrow and the base of a substantial summit in the form of Brandon Hill, this would have been an attractive area for prehistoric activity and early settlements. Rivers in general, are typically areas of prehistoric activity, due to the availability of food resources, and it is common to find early settlements and cooking sites within riverine locations. There is the potential for features associated with the exploitation of the River Duiske, such as *fulachtaí fiadh* (cooking sites), to survive within the site boundaries of the proposed upstream storage area.

Early Medieval Period (400AD-1200AD)

9.4.7 There are two enclosures within 1km of the proposed upstream storage area (RMPKK029-007; SMR KK029-044) and such features are often found to be ringforts of early medieval date. These earthen banked enclosures would have contained dwellings and ancillary structures, and they normally occur on good agricultural land with a southeasterly aspect.

Medieval Period (1200AD-1600AD) and Duiske Abbey

9.4.8 The arrival of the Anglo-Normans in the 12th century brought with it new types of fortification, nucleated settlement and religious orders. The town of Graiguenamanagh developed around the former Cistercian Duiske Abbey (RMP KK029-018001). The abbey gave the town its name, which translates as 'the grange of the monks'. The name of the abbey itself, which means 'of the water or rivers', refers to the location of the abbey near the Duiske tributary, at the confluence of the Blackwater River and the Barrow River (Anon. 1892).

9.4.9 The Cistercian abbey of Duiske was established in the early years of the thirteenth century by a group of Cistercian monks from Stanley in Wiltshire, under the patronage of William Marschall, Earl of Pembroke and Lord of Leinster. The foundation charter was given in 1207, however there was Cistercian occupation at the site for a several years prior to this (Carville 1979). The initial land grants made in 1207 included properties around Duiske itself, as well as lands at Anamult and at Tulachany, all in Co. Kilkenny, amounting to approximately 15,000 acres (Bradley and Manning 1981: 398). It is thought that the monks came to Ireland between 1202 and 1204 and first settled at Loghmere (Loughmerans) near Kilkenny, moving to Anothmolt (Annamult) and lastly to St. Saviour (Graiguenamanagh). In 1227, Duiske was combined with the nearby Cistercian house of Kilkenny, which had become insolvent, this began a dispute between the Jerpoint Cistercian house over land claims which would last almost 60 years (Bradley et al 1981).

9.4.10 Generally Cistercian abbeys in Ireland were built as near to water as possible, on a solid foundation, which was necessarily above flood level. The abbeys required water for both domestic use and as a power source for their mills, and sophisticated water management and use of water power are identifying characteristics of Cistercian houses across Europe. It is in this context that the use of the River Barrow and the River Duiske would have played a significant role in abbey life at Graiguenamanagh. Access to the River Barrow would have afforded the abbot access to a navigable trading route.

9.4.11 Each of the abbeys was built to a relatively uniform plan consisting of a quadrangle of buildings arranged around an open space. An arcaded gallery or cloister surrounded the central space with the church itself positioned on the north side of the quadrangle. The monk's dormitory was located on the east side, the lay-brethren dormitory on the west side and the refectory and kitchen on the south.

9.4.12 Duiske Abbey is the largest example of a Cistercian abbey built in Ireland (Carville 1979). The abbey church was built in a slightly elevated area which overlooks the tributary of the River Barrow and a small stream, the Duiske (an *Dubh Uisce*- black or dark water). The local granite and slate of the district was used for building the abbey: rough mortared granite courses formed the walls, with a horizontal slate course at regular intervals (approximately every eighteen inches).The stone for the abbey was quarried from the area now known as the Fair Green, while the source of the slate for Duiske Abbey may have been the Flag Mount quarries (Carville 1979: 31–2). The almost identical dimensions and layout of the abbey of Strata Florida, Wales suggests that the plans for Duiske Abbey were brought from Strata Florida by John St Aubyn, a Welsh monk who was involved in the construction of the former (Carville 1979).

9.4.13 In addition to their farming and landholdings, Duiske also engaged in sheep farming, cattle herd maintenance, milling, and fishery. The River Duiske was exploited by the Cistercian community for milling. A borough was founded, presumably to act as the marketplace for the produce of these lands and by the end of the 13th century the town had its own provost and in 1305 the justiciar held court in Graiguenamanagh.

9.4.14 Bradley and Manning (1980: 399) note that by the middle of the fifteenth century there were indications that the fabric of the building had fallen into disrepair. In 1450 the abbey petitioned the Pope, saying that all of the monastic buildings were threatened with ruin because of the incursions of the native Irish. Much of the Cistercian's income was based on the selling the next years wool production and the exportation of wool throughout Ireland and the continent (Hayter 2013). However this, combined with the 100 Years' War, severely disrupted trading networks and led to a severe deficit in finances. The financial strain led to the leasing of monastic grange land to tenants and this led to the rapid shift into land and settlement secularization (Hayter 2013). Letters to the pope in 1450 noted all monastic building at the site were at risk of ruin due to repeated raids and monetary demands from Norman earls and Gaelic families.

9.4.15 In 1536 the abbey was dissolved, and five years later it was granted, together with its land, to James Butler, ninth Earl of Ormond. The Butler family, unlike many of those who benefited from the redistribution of ecclesiastical property at the time, did not develop the abbey into a personal residence. Indeed, there are indications that they may have supported a small religious community at the abbey for some time after the Dissolution, though for how long this may have persisted is not clear (Carville 1979). The estate remained in the hands of this family until the Williamite wars, at the end of the seventeenth century, when it was forfeit because the third Viscount of Galmoy (a Butler) was a Jacobite. In 1703 the lands were purchased by James Agar of Gowran, ancestor of the Clifden family from whom the church and cemetery were later leased (Bradley and Manning 1981: 399).

9.4.16 In 1754 the church ruins were converted into a modern place of worship. By 1813 the local Catholic community had taken over the abbey. Over the next 160 years, the church served the parish.

9.4.17 According to Rev. Carrigan (Carrigan 1905), the precinct of the abbey, covering an area of half an acre, was surrounded by an enclosure with a fosse 3m wide and 2.4m deep. In the mid-nineteenth century this enclosure was levelled and the fosse filled in.

9.4.18 Outside of the town, it is evident that there was early Anglo-Norman activity in the vicinity of the proposed upstream storage area. A motte (RMP KK029-006) is located 240m to the west of the site location. These monuments are the earliest type of Anglo-Norman fortification and comprised of timber castles on top of earthen mounds. They were located in strategic locations at boundaries or overlooking routeways. The presence of a motte suggests a strategic importance to this location, possibly related to the River Duiske and the easterly views it afforded towards Graiguenamanagh. The church and graveyard at Oldgrange (RMP KK029-005001/002) are probably associated with this motte. The fact that there is no circular enclosure, saint's name, or holy well associated with this church would indicate that it is not an early medieval site, and English name suggests it is of medieval date. It is likely to have been one of the granges associated with Duiske Abbey, as it is noted

by Gwynn and Hadcock (1970) that there were several associated with the abbey. Additionally, it is possible that it was established at the same time as the motte which would predate the abbey by several decades. This would account for the 'Old' prefix of the townland name.

9.4.19 There are records to a Duiske Wood (Healy 1893) associated with Duiske Abbey and this would most likely have been in the environs of the river of that name in the vicinity of the proposed storage area. Even as late as 1567, there were 25 acres of wood recorded in the townland of Coolroe (Comerford 1886). There were also at that time two mills and three eel-weirs recorded in that townland (ibid.). This would suggest that the tradition of milling associated with Duiske Abbey extended as far as Coolroe and potentially the proposed site location. It is also likely that there would have been regular movement between the site of the motte and the town along the River Duiske, and features such as jetties associated with boating activity may have been constructed along this section of the watercourse.

The Development of Graiguenamanagh

9.4.20 The medieval town of Graiguenamanagh initially developed to the northwest of the abbey precinct. From the time of the Dissolution of the Monasteries in 1536 it began to slowly encroach on the abbey precinct.

9.4.21 In 1536 the abbey was dissolved, and five years later it was granted, together with its land, to James Butler, ninth Earl of Ormond. The Butler family, unlike many of those who benefited from the redistribution of ecclesiastical property at the time, did not develop the abbey into a personal residence. In fact, there are indications that they may have supported a small religious community at the abbey for some time after the Dissolution, though for how long this may have persisted is not clear (Carville 1979). The estate remained in the hands of this family until the Williamite wars, at the end of the seventeenth century, when it was forfeit because the third Viscount of Galmoy (a Butler) was a Jacobite. In 1703 the lands were purchased by James Agar of Gowran, ancestor of the Clifden family from whom the church and cemetery were later leased (Bradley and Manning 1981: 399).

9.4.22 The earliest documentary evidence for structural change to the abbey after the Dissolution is from 1728. James Agar had been in possession of his great estate for twenty-five years when a mass house was built by the people beside the south transept. It was in a spot that was bordered on three of its four sides by walls. It was a very modest building and tradition relates that it had a thatched roof. By 1812 it had probably been slated and extended from its original size. Part of the west end of the nave was re-roofed for use as a Protestant church in 1754 but it does not seem to have functioned as such for long (Joyce 2000: 103). It returned to Roman Catholic use in 1812. It was restored around 1886 and later in the 1970s.

9.4.23 In 1813, most of the picturesque church ruin which for so long had dominated the townscape—was roofed over. Part of the nave walls were rebuilt, a low pitched roof and ceiling were added, galleries were installed, and the building was converted into what looked like a typical nineteenth-century chapel. The little mass house that had served the people for 85 years was vacated (Joyce 2000: 64). In the late nineteenth century, restoration work was carried out on the west end of the church. A further programme of restoration was undertaken in the 1970's.

9.4.24 A number of burials (KK029-01806) were uncovered at the junction of Chapel Street and Barrow Lane in road widening and repair schemes in the mid-nineteenth century and onwards. According to a local man the burials had been aligned north-south instead of the usual east-west orientation associated with Christian burials. However, their close proximity to Duiske Abbey graveyard may suggest that the original graveyard extended in an easterly direction beyond the present boundary.

The Medieval Development of Tinnahinch

9.4.25 The name Tinnahinch (*Tighe na hinse*) means the 'House of the Island' or 'River Meadow' reflecting its riverine location. Tinnahinch Castle (CW024-026), located on the River Barrow adjacent to Lock 20, was built in 1615 by James Butler. It was an important defensive measure in the prolonged struggle between the Butlers and the Kavanaghs in order to control access to a wooden bridge (KK029-042), built in 1540, that served as a link between Tinnahinch and Graiguenamanagh.

9.4.26 It comprises a rectangular building (10.7m N-S, 6.9m E-W) of three storeys, with stair tower at southwestern corner. Constructed of rubble with split stone laid in mortar with ashlar quoins. Its entrance is on the north side of projecting stair tower protected by machicolation on third floor of tower, which originally carried wooden stairs. There is a bartizan at north-eastern corner of main tower. A deer park associated with the castle was also constructed on Brandon Hill. The castle was further strengthened in the seventeenth century and was held by the Confederates in the Cromwellian wars. Butler lost his lands because of his involvement in the confederate war of 1641.

9.4.27 Approximately 330m to the southwest of the castle is a church and graveyard in Tinnahinch (CW024-027). It is marked on the 1837 OS map as St Michael's Church (in ruins) and is depicted as being within a circular enclosure. It is sited in an elevated position, possibly on a rock outcrop in otherwise very low-lying land overlooking the river Barrow to the west. Approximately 180m to the south-southeast of the church is a holy well, St Michaels Well (CW024-028). According to the RMP, the well is protected by a corbelled dome, it is located in a low-lying flood plain in an overgrown area and is difficult to locate. Though at a remove from one another these features are directly associated.

9.4.28 The medieval settlement of Tinnahinch is connected to Graiguenamanagh by an attractive George Semple bridge built between 1764-1767. During the 1798 Rebellion it suffered damage when a number of the arches were destroyed by a Crown Force initiated explosion to prevent access across the River Barrow from County Carlow to County Kilkenny.

Post Medieval - Industrial Heritage

9.4.29 The River Barrow at Graiguenamanagh/Tinnahinch has a long history of milling, dating back to the 13th century with the establishment of Duiske Abbey. Milling intensified during the 18th and 19th centuries due to the construction of the Grand Canal and Graiguenamanagh became an important port on its route. Shipping and milling were successful in the area until the establishment of roadways in the 1950s, when it was rendered obsolete and was ultimately closed.

9.4.30 Graiguenamanagh first saw an immense increase in size and growth during the 18th century, and as revealed by the historic sources and maps, manufacturing industries predominated in the town with numerous manufacturing mills developed along the River Barrow and the Duiske, including wool, barley, corn, and flour mills. Mills were used to process and transform raw materials into usable forms and finished products. The Valuation Mill Books confirm this lean towards manufacturing with three mills recorded i.e. two corn and one flour mill. Associated with these were stores and for packaging and storing etc. In 1837, Lewis described Graiguenamanagh as having a population of 4745 inhabitants, 2130 of whom lived in the town, and a brewery, malthouse, and a flour and three grist-mills.

9.4.31 Industries of textile production in the town was, and still is, conducted by the Cushon family, who a rented mill in the St Mullins and later purchased one of the original monastic mills, dating to the 11th century, in 1925.

9.4.32 The importance of the Duiske River in the industrial development of the down cannot be underestimated. Today the buildings, remnants of mills and footbridges that align the river as it enters the town all indicate how important the river was in the 18th and 19th century.

9.4.33 A complex of surviving mill buildings, known as Doyle's Woollen mills, is located across from the abbey within the centre of the town. With the complex of buildings, fronting the lane way to the north there are former assembly rooms which were the 18th century for social gatherings and Sunday services for the small Protestant population.

9.4.34 There was a starch works and mill race in Tinnahinch on south side of the bridge, it was developed in the late 19th century. Mill structures survive adjacent to modern buildings and very likely to the rear of these buildings along with its mill race. The mill race runs parallel to the canal and then runs to rear of Tinnahinch Castle and canal lock house and flows into the River Barrow crossing a footbridge carrying the canal tow path.

9.4.35 The development of the Barrow Navigation bolstered the towns industrial development. In 1705, the first Parliamentary Committee was established to work towards making the Barrow navigable however it was not until the Burgess of Carlow petitioned Parliament to make the Barrow navigable from Monasterevin to St. Mullins in 1759 that action was taken. In 1761, work to expand the canal system to link the River Barrow and the South-East region with the Grand Canal and Dublin began. Work commenced over the next twenty years and Graiguenamanagh became an important port along the river. The canal and the tow path and lock in Tinnahinch is a local amenity today.

9.4.36 Toll collectors for the canal and a dry-dock for repairing ships were set up at Graiguenamanagh which led it to become the "the largest non-corporate town in the county with 370 houses" (Tighe 1998).

9.4.37 On the northern banks of the River Barrow in Graiguenamanagh to the west of the bridge is the silted-up remains of the former dry dock, the sidewalls of which are still visible, a former boat house, a foot bridge and weir. There are also industrial buildings and a footbridge over the Duiske River, and ruined structures leading down to the former dock. The present quay structure in Graiguenamanagh dates to the 18th century, and prior to its

construction the original river bank was probably situated much nearer the abbey precinct.

9.4.38 According to the Schools Collection (National Folklore Collection, UCD) granite was cut on the Quay of Graiguenamanagh by a man named Gorman. It was sent to New Ross in boats, and then sent to Newfoundland to build the St. John's Cathedral. This granite was got in Killeen on the outskirts of Graiguenamanagh.

9.4.39 On the opposite side of the quay in Tinnahinch the river is bound by green areas and fields. There is a milestone (undesignated site) marking the river, it has a benchmark on it, but the carved detail is worn away.

9.4.40 The advent of railways in the mid-19th century signalled the beginning of the decline of the canals for foot passenger transport and by 1852 only trading boats remained on the canals. Trade along the Barrow was relative successful and efficient until the development of road transport. In 1950 the Grand Canal Company was taken over by CIE and all barges were withdrawn from the canal in 1959. The waterway, now, however is a significant industrial heritage amenity for the public.

Previous excavations

9.4.41 There have been several archaeological excavations and surveys focused on Graiguenamanagh ZAP and in the vicinity of Duiske Abbey. These have produced evidence of industrial activity occurring within the town during the 18th and 19th centuries along with remains associated with Duiske Abbey.

9.4.42 An excavated trench along the south wall of Duiske Abbey in 1990 revealed the disturbed remains of the tiled floor and seven east-west oriented graves containing poorly preserved skeletons of medieval date (Hayden 1990).

9.4.43 In addition, a detailed survey of the surviving remans of the abbey was undertaken by the National Monuments Service in 1967 (Bradley and Manning 1981, Figure 9-2). This indicated the survival of a substantial part of the eastern boundary wall of the precinct and the fragmentary remains of a number of abbey buildings including part of the eastern range.

9.4.44 Archaeological assessment (Bolger 2002) was undertaken in connection with a refused planning application for the now Supervalu carpark site at Quay Street (Planning Ref. P.03/1659). As part of a Request for Further Information under Ministerial Consent (CO42, Planning Ref. 05/7668) (O'Meara, 2006) further archaeological investigation took place and identified archaeological features and deposits. The remains consist of remnant foundations—heavily robbed of their stone, floors and/or yard surfaces, and mixed, unstratified 'made ground' that may relate to flood reclamation activity and to former gardens. The archaeology identified—including a burial—is significant as evidence of the medieval Duiske Abbey, a National Monument, and perhaps also as evidence for the early post-medieval history of the abbey. The excavations and investigations are summarised the Ministerial Consent report in Appendix 9-14.

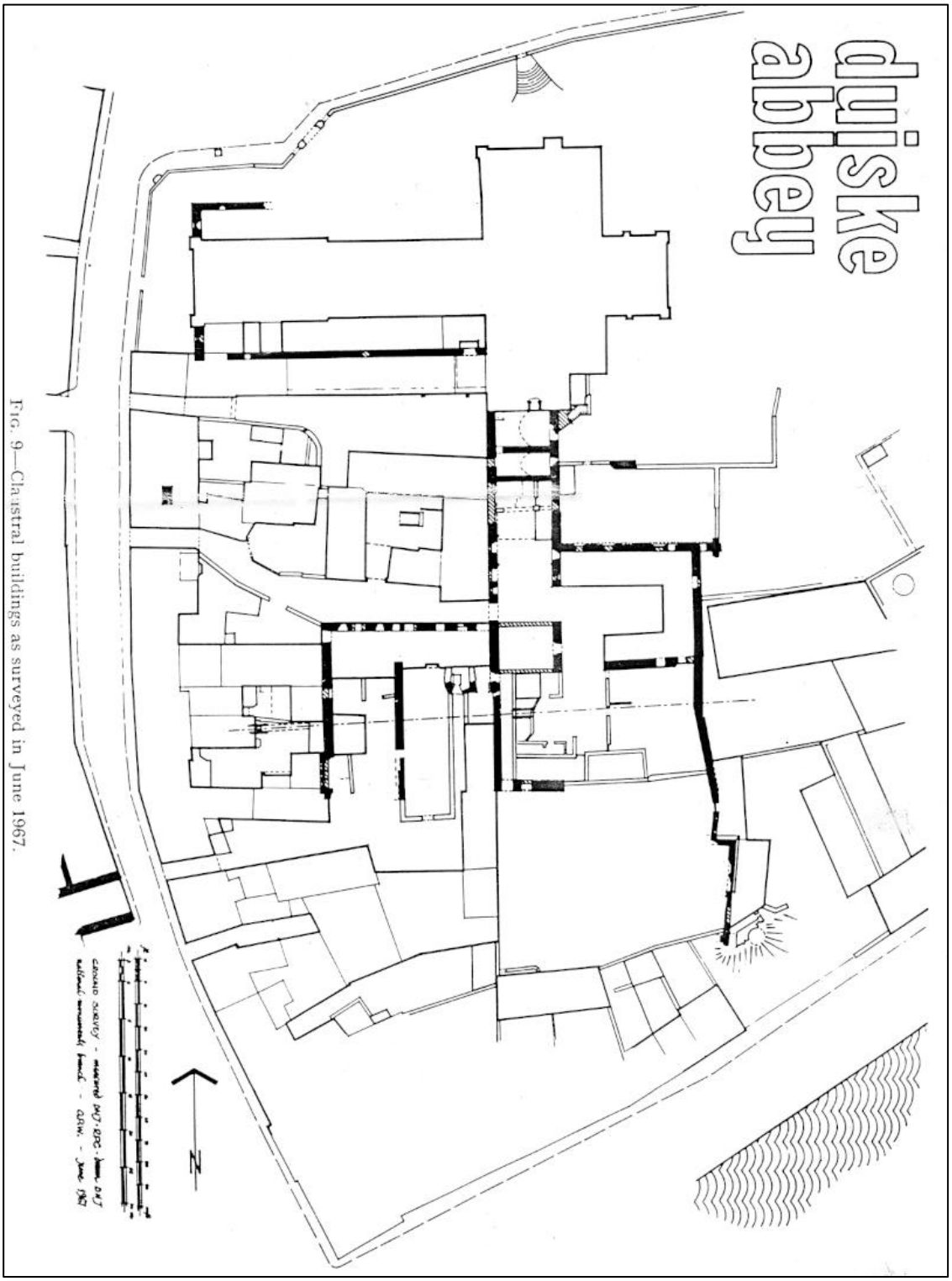


Figure 9-2 Plan layout of Graiguenamanagh Abbey after Bradley and Manning – Duiske Abbey Excavations (June 1967)

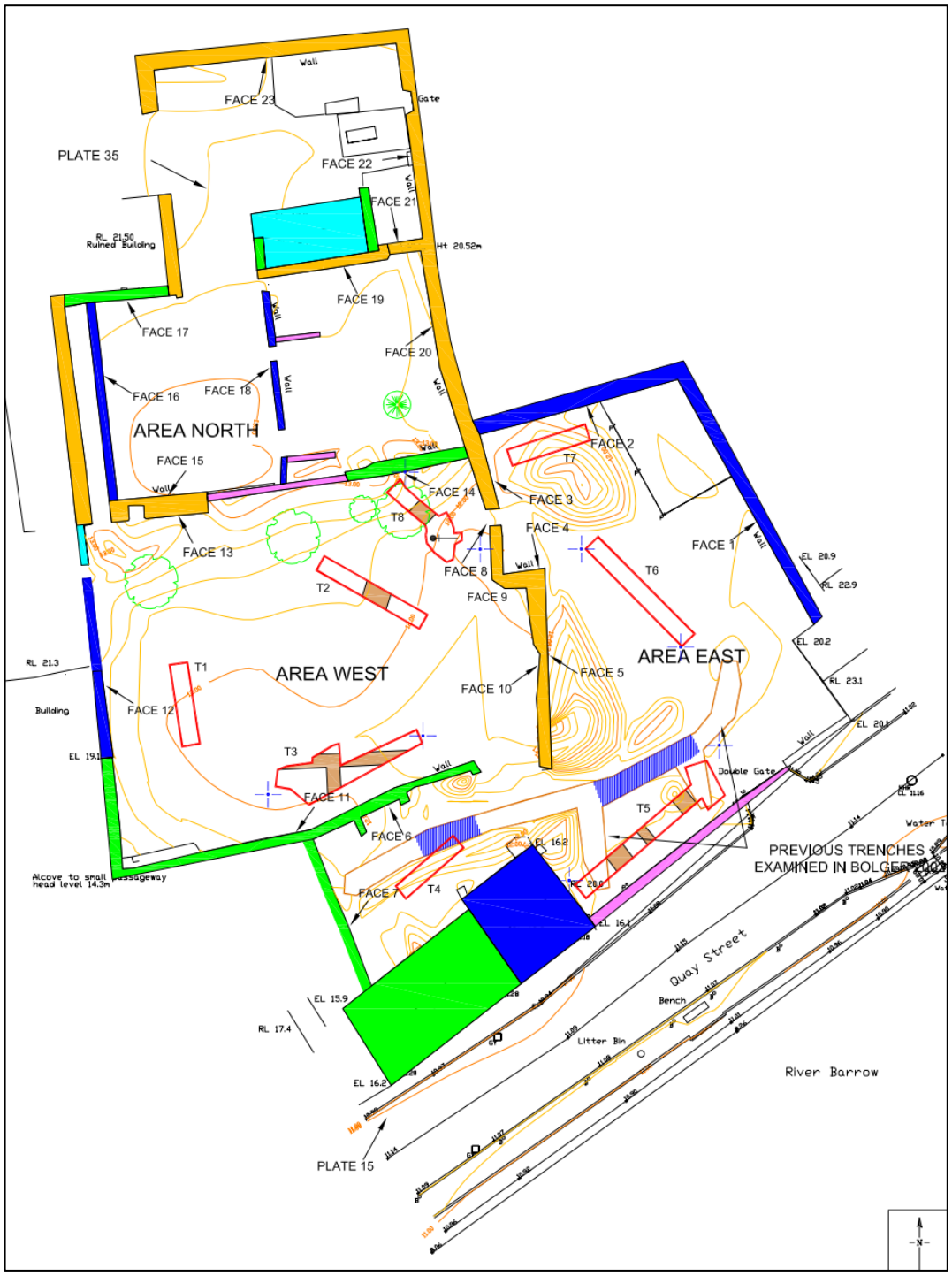


Figure 9-3 Archaeological test excavation (O'Meara 2006) & Bolger 2002)

Stray Finds

9.4.45 There are four small finds noted within the study area, all of which are tiles that relate to the structure of Duiske Abbey. These finds (NMI Ref: 1936:1913; 1986:89; 1986:88; 1986:86-87 A-D) are fragments of floor, roof, and encaustic tiles laid during the initial construction of Duiske Abbey. As described above, there is a record of skeletons (NMI Ref: 1931) identified on Chapel Street by workmen during the laying of pipes in connection with the new water works. It appears that the Abbey graveyard extended over the present roadway before Chapel Street came into existence.

Designated Archaeological Assets

World Heritage Sites

9.4.46 There are no world heritage sites in the vicinity of G-T.

National Monument and Preservation Order Sites

9.4.47 There is one National Monument within Graiguenamanagh, this is the (Cistercian) Abbey, (Duiske) which is in the ownership of the State (KK029-018001- 620), it is also on the list of National Monuments with a preservation order (1/1968). The precinct area associated Duiske Abbey is partly located within the redline boundary for the project where it extends to Graiguenamanagh Quay.

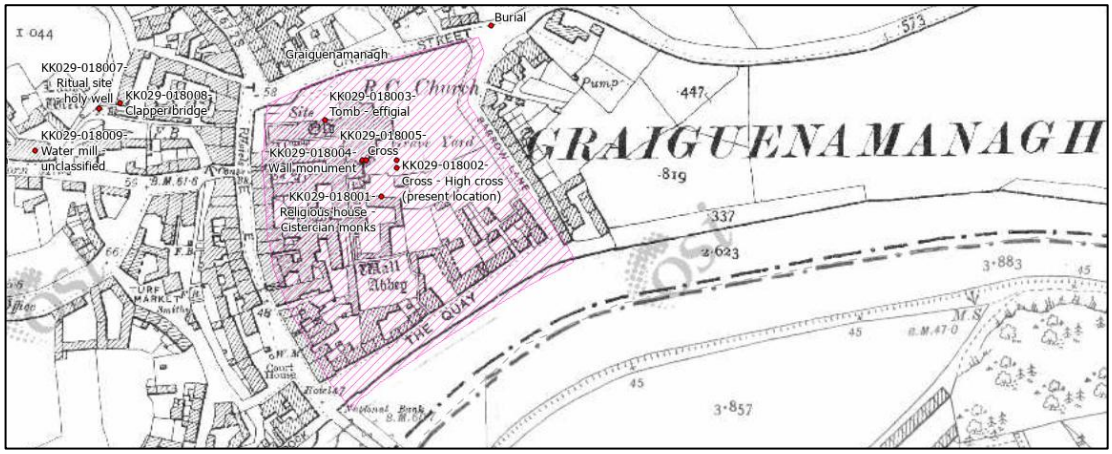


Figure 9-4 Duiske Abbey Precinct Area

The Zone of Notification (ZON)

9.4.48 The medieval core of Graiguenamanagh is a designated Zone of Notification (ZON) (KK029-018). Within the G-T area there are sixteen recorded archaeological monuments listed in the RMP, most are located within the ZON and focused on the Duiske Abbey precinct, there are four RMP sites located outside of the ZON on the Tinnahinch side of the River Barrow (Appendix 9-5 and Appendix 9-8).

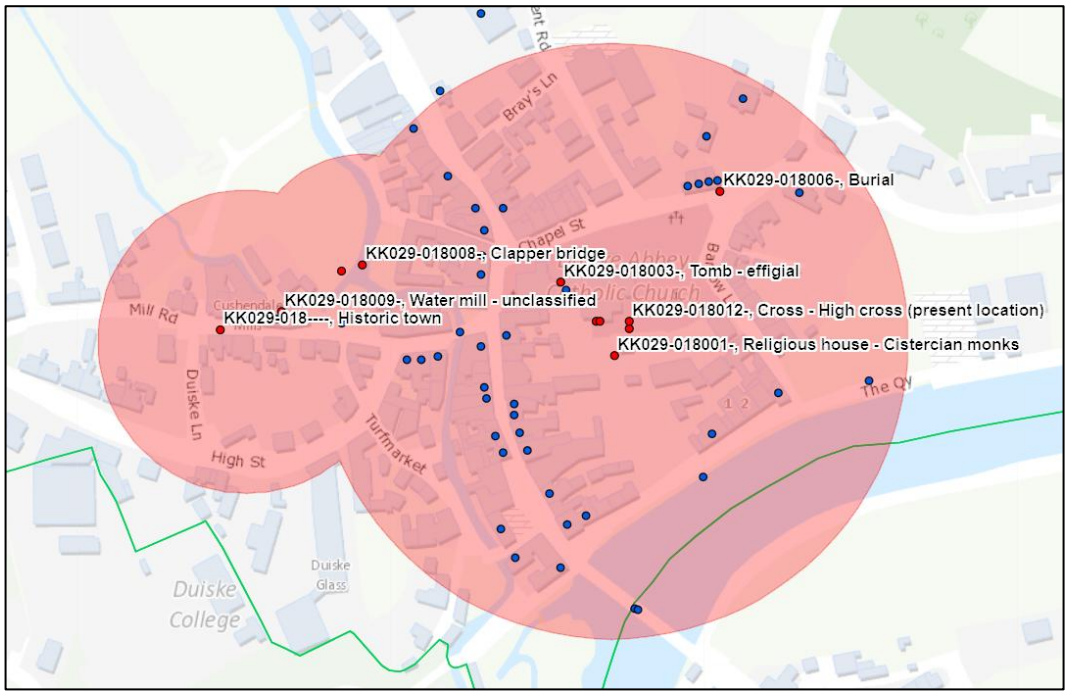


Figure 9-5 Zone of Notification for the Historic Town of Graiguenamanagh as shown on the HEV

Record of Monuments and Places and Sites and Monuments Record Sites (RMP/ SMR sites)

9.4.49 The Record of Monuments and Places (RMP) of the Department of Housing, Local Government and Heritage (DHLGH) records known upstanding archaeological monuments, their original location (in cases of destroyed monuments) and the position of possible sites identified as cropmarks on vertical aerial photographs. Archaeological sites identified since 1994 have been added to the non-statutory SMR database of the Archaeological Survey of Ireland (National Monuments Service, DCHG), which is available online at www.archaeology.ie and includes both recorded monuments and SMR sites. Those sites designated as SMR sites have not yet been added to the statutory record but are scheduled for inclusion in the next revision of the RMP.

9.4.50 The table below lists the archaeological sites within or in proximity to the red line boundary. The sites included are the Historic Town of Graiguenamanagh and six monuments associated with the religious house of Duiske Abbey. Individual monuments include the Clapper Bridge, a holy well known locally as Lady's Well and the site of a water mill now occupied by Cushendale Mills. All these sites and monuments are described, and the impact is assessed in the cultural heritage inventory (Appendix 9-8).

Table 9-1: Recorded monuments within or adjacent to the red line boundary for the project.

RMP Number	Site Type	Townland	ITM
KK029-018----	Historic town	Graiguenamanagh, Kilkenny	670854,643824
KK029-018001-	Religious house - Cistercian monks	Graiguenamanagh, Kilkenny	670919, 643782
KK029-018002-	Cross - High cross (present location)	Graiguenamanagh, Kilkenny	670925, 643809

RMP Number	Site Type	Townland	ITM
KK029-018003-	Tomb - effigial	Graiguenamanagh, Kilkenny	670887, 643828
KK029-018004-	Wall monument	Graiguenamanagh, Kilkenny	670901, 643821
KK029-018005-	Cross	Graiguenamanagh, Kilkenny	670901, 643821
KK029-018007-	Ritual site - holy well	Graiguenamanagh, Kilkenny	670772, 643828
KK029-018008-	Clapper bridge	Graiguenamanagh, Kilkenny	670783, 643831
KK029-018009-	Water mill - unclassified	Graiguenamanagh, Kilkenny	670741, 643814
KK029-018012-	Cross - High cross	Graiguenamanagh, Kilkenny	670922, 643808

Undesignated Assets

9.4.51 A field inspection and desk study of the FRS scheme identified a number of undesignated cultural heritage sites (CH) and areas of archaeological potential (CHZ, cultural heritage zones) which lie within the flood relief measures. These features comprise rubble stone walls, stone buildings, bridges, memorials, greenfield areas etc, the full description of each feature and area is provided in an inventory in Appendix 9-8. The following table (Table 9-3) lists each of the undesignated heritage assets that were observed within the study area for the project.

9.4.52 The 'Other No' column refers to previous reports and how the asset/ site was identified. ADCO reference numbers are taken from the *Graiguenamanagh-Tinnahinch Flood Relief Scheme Underwater Archaeological Impact Assessment Duiske and River Barrow 21D0047, 21R0082* report issued in 2021. The 'SA' numbers are from the *Conservation Strategy for Graiguenamanagh/ Tinnahinch Flood Relief* issued in by Southgate Associates in 2025.

Table 9-2 Undesignated assets within or adjacent to the redline boundary for the project

CH No	Other No	Description	Townland/ Location	ITM
CH01	ADCO 1 SA 1	Stone wall. A substantial enclosing structure formed around an internal courtyard and a collection of stone building located on the northern and eastern bank of the River Duiske.	Graiguenamanagh, River Duisk	670795 643836
CH02	ADCO 2 SA2	Stone walls that form the southern boundary of two separate buildings, possibly former stables for the Bianconi coaches.	Graiguenamanagh, River Duiske	670810 643824
CH03		River walk	Graiguenamanagh, River Duiske	670801 643821
CH04	ADCO 6 SA9	Bridge. A road bridge that is shown on the first edition 6-inch (1838)	Graiguenamanagh, River Duiske	670851 643675

CH No	Other No	Description	Townland/ Location	ITM
		and revised 25-inch OS (1902) maps. The bridge provides access from the Turf Market to the Main Street.		
CH05	ADCO7	Stone walls	Graiguenamanagh, River Duiske	670858 643664
CH06	ADCO8 SA11	Stone façade fronting onto the laneway. Collection of former stone buildings	Graiguenamanagh, River Duisk/ Turf Market	670834 643637
CH07	ADCO8 SA11	Stone store/ warehouse – former industrial use	Graiguenamanagh, River Duiske/ Turf Market	670824 645313
CH08	-	Peg Washington's Lane	Graiguenamanagh, River Duiske/ Turf Market	670720 643808
CH09	-	Gated Private Property and surrounding stone wall	Graiguenamanagh, Turf Market	670814 643618
CH10	ADCO9 & 10 SA12	Stone Bridge. Narrow, hump-backed stone bridge over the River Duiske, now used for pedestrian access only. Side walls and sluice gate.	Graiguenamanagh, River Duiske/ The Hub	670832 643617
CH11	-	Entrance Gate and Pillars	Graiguenamanagh, River Duiske/ The Hub	670660 643690
CH11A	-	Vernacular Cottage (Fenlon's)	Graiguenamanagh, River Duiske/ The Dock	670843 643612
CH12	ADCO12	Gateway and stone seating	Graiguenamanagh, River Duiske/ The Quay	671179 643786
CH13	ADCO13	Boundary wall – Former building	Graiguenamanagh, River Duiske/ The Quay	670720 643808
CH14	ADCO14	Tow Path and milestone	Tinnahinch	671267 643269
CH15	ADCO18	Mill Race	Tinnahinch	67092 64358 to 670649 643376
CH16	-	Memorial	Tinnahinch	670941 643572
CH17	ADCO17	Quay	Tinnahinch	670958 643617 to 670731 643442

9.4.53 The following table (Table 9-4) lists the areas of cultural heritage and archaeological potential (CHZ) within the study area for the project and Appendix 9-8 describes these areas in detail.

Table 9-3 Undesignated areas of cultural heritage potential within the redline for the project

CHZ No	Other No	Description	Townland	ITM
CHZ01	-	River Duiske – Upstream Storage Area – Riverine potential	Tinnapark and Priestvalley	66931 644393
CHZ02	ADCO22	Duisk River – Graiguenamanagh Town – Riverine potential	Graiguenamanagh, River Duiske	670785 643871 (Debris trap)

CHZ No	Other No	Description	Townland	ITM
				670840 643555 (River Barrow)
CHZ03	-	The Dock Road	Graiguenamanagh	670853 64361
CHZ04	-	The Quay - Proposed Flood Embankment and compound - Green field potential	Graiguenamanagh,	671185 643787
CHZ05	-	Proposed Compound - Green field Potential	Graiguenamanagh	671061 643785
CHZ06	-	Greenfield area – proposed embankment, storm drainage and a compound	Tinnahinch	671000 643639
CHZ07	-	Compound B - Tirlán Farmlife	Tinnahinch – R703	671071 643446
CHZ08	-	The Hub Greenfield Potential	Graiguenamanagh	670800 643603
CHZ09	-	Greenfield potential - upstream storage area	Tinnapark and Priestvalley	669432 644301

Architectural Heritage

9.4.54 Graiguenamanagh is an Architectural Conservation Area (ACA). The ACA has been defined in order to ensure the preservation of the character of the traditional townscape, while promoting appropriate new development as opportunities arise in a manner that respects and reinforces the special character. It is an objective of the Kilkenny County Council to preserve and enhance the character of the town centre by protecting historic buildings, groups of buildings, the existing street pattern, plot sizes and scale, while encouraging the development of appropriate mixed-use development where suitable in the town centre.

9.4.55 The ACA character appraisal for Graiguenamanagh is stated as follows in the Local Area Plan (2021-2027):

9.4.56 Duiske Abbey and its adjoining graveyard, together with the narrow and in places winding streets of the town centre, their interconnection with the Abbey, and the relationship of the River Barrow, gives Graiguenamanagh a unique visual character. The compact form of Main Street, containing many traditional three and four storey buildings with ground floor shops and businesses, contrasts with the higher buildings of various types and the open waterfront character of The Quay. The traditional features of buildings in the town centre contribute to its coherent townscape character, such as consistent roof profiles, roof coverings, chimney stacks, rendered facades, door and window proportions and surrounds, and decorated shop and pub fronts. The medieval core of the town is complemented by the presence of the River Duiske and Mill Race running to the rear and sometimes beneath properties on Main Street, the Turf Market and Lady's Well, with its remnants of industrial archaeology that includes former warehouses, mills and a dock.

9.4.57 The Council considers that the medieval core of the town, and incorporating the industrial heritage of the Turf Market and Lady's Well, has special architectural and townscape qualities which derive from the traditional layout, design and unity of character of the area,

such that the inclusion of the area in an ACA is necessary for the conservation of its special character.

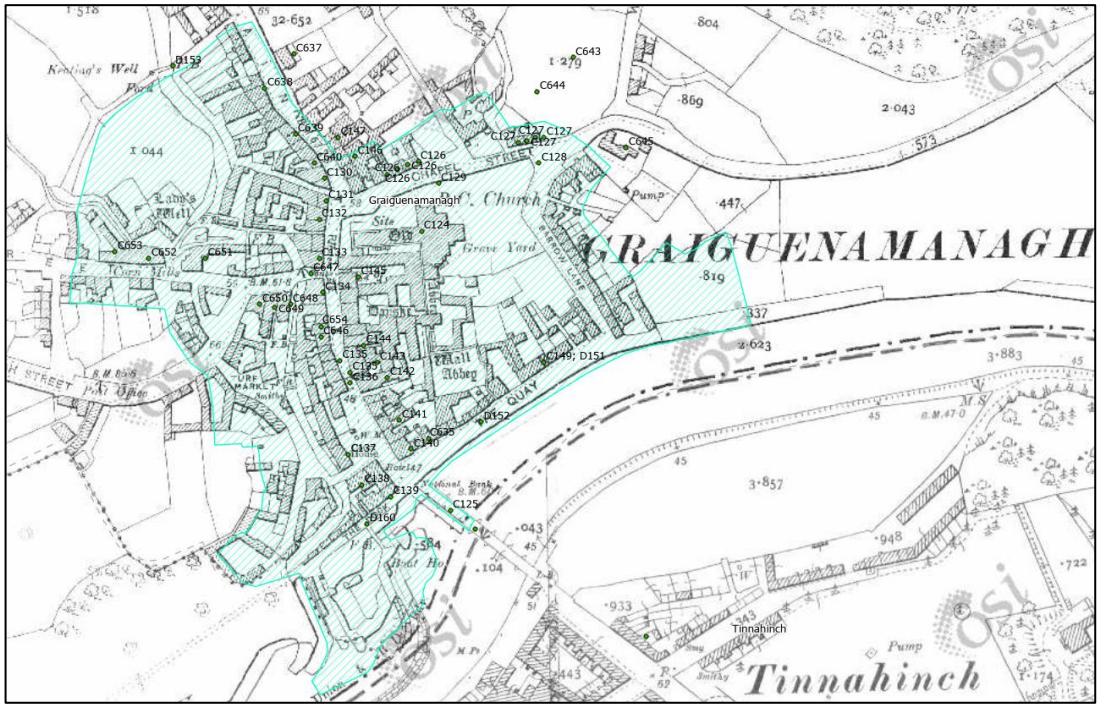


Figure 9-6 Graiguenamanagh ACA

Designated Architectural Heritage Assets – Protected Structures and NIAH Sites

9.4.58 There are no protected structures (RPS sites) or National Inventory of Architectural Heritage sites (NIAH sites) within the proposed upstream storage area. One NIAH site is located within 1km; Coolroe House (NIAH 12318056) is located approximately 700m to the south in Coolroe. The three-bay two storey house dates to c. 1825 and it is depicted on the First Edition 6-inch OS map within a modest estate with a gate lodge.

9.4.59 There are 33 properties that are protected structures listed in the Record of Protected Structures (RPS sites) in the general area of Graiguenamanagh-Tinnahinch, these are all listed in Appendix 9-6 and have been discussed in the Constraints Report. Listed below are the 23 protected structures that are located within or adjacent to the redline boundary for the proposed flood relief project and have been assessed in terms of impact assessment (Appendix 9-8), (Duiske Abbey built heritage assets are located within a defined complex and are counted as a single site). Only properties located in Tinnahinch, Co Carlow are located outside Graiguenamanagh ACA (Tinnahinch (CW496 and CW501). As Graiguenamanagh is an historic town, the setting of these structures and the historic townscape have been taken into consideration when assessing the impact of the project on the historic built environment.

9.4.60 The NIAH sites within the study area that are on the RPS are indicated in Table 9.5 and Appendix 9-6. The NIAH sites not yet added to the RPS record listed in Table 9.6. There are 24 properties in the wider Graiguenamanagh area. 21 properties of these structures are also designated as RPS and have been listed in Table 9-5. Three structures on Graiguenamanagh Quay are listed only in the NIAH and are listed in Table 9-6. All NIAH

structures that will be affected by the Proposed Scheme are assessed in the cultural heritage inventory in Appendix 9-8.

9.4.61 Where features, structures have been assessed by the conservation engineer and included in their report (Southgate 2025), the reference number has been included in the tables below.

Table 9-4: Protected Structures within or adjacent to the red line application

RPS Reference	NIAH Reg No & Other No	Name/ Street	Location	Description
CW496 and C125	10302404 and 12318004	Graiguenamanagh Bridge	Graiguenamanagh and Tinnahinch	Seven-arch shale-built hump-back road bridge over river, c. 1765. A section of the bridge was blown up on 13 June 1798 by Crown Forces during the 1798 Rebellion to prevent the insurgents crossing into Co. Kilkenny. One of a number of bridges in Co. Kilkenny rebuilt following the "Great Flood" of 1763 and has associations with the 1798 Rebellion.
CW501	10302405	Tinnahinch Estate Cottage	Tinnahinch, Co. Carlow	Detached three-bay two-storey granite ashlar Tudor Revival estate cottage, c. 1835
D152	12318002	The Quay	Graiguenamanagh Co. Kilkenny	Section of random rubble stone retaining wall which formed part of the quay, c.1900.
D153	KK029-018008	Bridge (Footbridge)	Over Duiske River	Simple 5-span stone footbridge over Duiske River. (Clapper Bridge).
C14 D151	12318006	Waterside Guesthouse, The Quay	Graiguenamanagh, Co. Kilkenny	Detached seven-bay four-storey part double-pile salt house, dated 1871, probably incorporating fabric of earlier building, pre-1840. Operated as a salt house throughout the nineteenth and early twentieth centuries.
C140	12318008	F.J. Murray, Lower Main Street, corner of the Quay	Graiguenamanagh, Co. Kilkenny	Terraced four-bay three-storey house, c.1800, possibly originally two separate two-bay three-storey houses with three-bay three-storey side (south) elevation. Renovated, c.1875, with pub front inserted to ground floor.
C141	12318009	O'Shea Russell, Main Street	Graiguenamanagh, Co. Kilkenny	Terraced four-bay two-storey house, c.1825, with square-headed carriageway to left ground floor. Extensively renovated and timber shopfront added, c.1925
C124 C128 C129	12318015	Duiske Abbey Catholic Church	Graiguenamanagh, Co. Kilkenny	C124: Catholic abbey church of national importance originally forming the centrepiece of an extensive ecclesiastical complex founded by William The Elder Marshall (c.1146-1219), Earl of Pembroke, in 1204-12 for the Cistercian order. Dissolved, 1536. In ruins, pre-1774-post-1810. Reconstructed 1812, to accommodate use as church. Restored, 1974-80. C129: Graveyard to site with various cut-stone markers, pre-1536-present. C128: Gateway, built 1812

C132	12318024	M. Doyle, main Street Upper	Graiguenamanagh, Co. Kilkenny	Terraced four-bay three-storey house, c.1875, possibly incorporating fabric of earlier house, pre-1840, on site with square-headed carriageway to left ground floor. Renovated, c.1900, with pub front/shopfront added to ground floor.
C133	N/a	Main St Upper (W)	Graiguenamanagh, Co. Kilkenny	''The Globe'', three bay, three storey house with white lettering.
C134	12318039, SA4	Hughes, Main Street	Graiguenamanagh, Co. Kilkenny	End-of-terrace five-bay three-storey house, c.1850, on a corner site possibly incorporating fabric of earlier house, pre-1840, on site. Renovated, c.1900, with shopfront inserted to ground floor. Now disused to ground floor.
C137	12318044, SA8	Graiguenamanagh Market House, main Street	Graiguenamanagh, Co. Kilkenny	Attached five-bay two-storey Classical-style market house with attic, c.1800, originally detached with three-bay two-storey pedimented breakfront. Extensively renovated, pre-1973, to accommodate commercial use. Extensively renovated, post-1973.
C138	12318045, SA10	Lower Main Street (off)	Graiguenamanagh, Co. Kilkenny	‘Step House’, end-of-terrace two-bay two-storey over raised basement granite ashlar house, c.1825.
C139	12318046	Manning, Lower Main Street	Graiguenamanagh, Co. Kilkenny	‘Bank House’, end-of-terrace two-bay three-storey office building, c.1900, on a corner site with shopfront to ground floor, and single-bay three-storey side (south) elevation. Attached two-bay two-storey gable-fronted residential house, c.1900, to west with two-bay two-storey linking range to right.
D160	12318047, ADCO 11 & SA 13	Dry Dock	Right bank of the Barrow	Silted-up remains of former dry dock on right bank of Barrow, the sidewalls of which are still visible.
C647	12318032, SA7	Bridge	Hight Street	Single-arch rubble stone road bridge over river, c.1750. Sited spanning Douske River.
C648	12318033, SA5	Former house, retail - Coffee on High,	High Street	End-of-terrace three-bay two-storey house, c.1850. Renovated, c.1875, with shopfront inserted to ground floor. Reroofed, c.1950. Part refenestrated, c.1975.
C646	12318040, SA6	Angler's Rest	Main Street	Terraced two-bay three-storey house, c.1825. Extensively renovated, c.1900, with pub front inserted to ground floor. Pub front renovated.
C654	12318041, SA6	Blanchfield	Main Street	Terraced two-bay three-storey house, c.1825. Extensively renovated, c.1925, with shopfront inserted to ground floor. Shopfront renovated, c.1975.

C651	12318936	Warehouse, Well Lane, Mill Road	High Street	Attached five bay, four-storey warehouse, c .1850. Originally detached with two-bay three-storey side elevations. Now disused and derelict. Associated with Reg 12318037. Now the proposed site for a compound.
C652	12318037	Warehouse, Mill Road	High Street	End-of-terrace four-bay three-storey warehouse, c.1850, originally attached on a slightly cranked plan with two-bay two-storey end bay to right having square-headed carriageway to ground floor. Extensively renovated, c.1975. Part reroofed. Now disused.
C653	12318038	Cushendale Woollen Mills, Mill Road	Graiguenamanagh	Terraced eight-bay three-storey warehouse, c.1850, originally attached with square-headed carriageway to ground floor. Extensively renovated, c.1975. Now in use as woollen mill.
C650	12318035	T. O'Shea, High Street	Graiguenamanagh	End-of-terrace two-bay three-storey house, c.1850, on a corner site possibly incorporating fabric of earlier house, pre-1840. Extensively renovated with replacement pub front inserted to ground floor.

Table 9-5: NIAH Sites within the Study Area that are not on the RPS list

NIAH Reg No	Name/ Street Other No.	Location	Description	NIAH Rating
12318003	Gateway, The Quay	Graiguenamanagh, Co. Kilkenny	Road fronted gateway with cast iron and unpainted rendered piers, c.1900.	Regional
12318005	Barrow Lane, The Quay	Graiguenamanagh, Co. Kilkenny	Attached three-bay two-storey house, c.1875, possibly incorporating fabric of earlier house, pre-1840. Part renovated, c.1975.	Regional
12318007	F.J. Murray, The Quay	Graiguenamanagh, Co. Kilkenny	Terraced three-bay two-storey house, c.1775.	Regional

Key Strategies

9.4.62 As a result of interrogating the afore mentioned data, the proposed works were divided into character areas according to their geographical locations with the principal of minimum interference to preserve the historic character of the individual built heritage features and the setting, town and riverine scape of Graiguenamanagh (drawing 1441).

9.4.63 The 2013 ICOMOS Charter for the Conservation of Places of Cultural Heritage Significance, *the Burra Charter*, sets out the principles for assessing the cultural significance of an historic site. This charter defines cultural significance as 'the aesthetic, historic, scientific or social values for past, present or future generations'.

9.4.64 A key principle of the Burra Charter (2013) is that 'conservation is based on a respect for the existing fabric, use, associations and meanings of a place, and should involve the least possible physical intervention'. It recognises that 'change is inevitable, and that conservation is about managing that change in a way that retains the cultural significance'.

9.4.65 The Burra Charter's approach to analysing heritage significance in terms of location, form, function and fabric provides a clear and structured methodology for understanding and managing cultural heritage ensuring that decisions about conservation are based on a thorough understanding of a place's significance and this methodology has been used on the Proposed Scheme to design mitigation measures for the minimal residual impacts.

9.4.66 A conservation strategy for the Proposed Scheme including a condition survey of 14 heritage structures in the River Duiske character area (Southgate Associates January 2025) is included as Appendix 9-12.

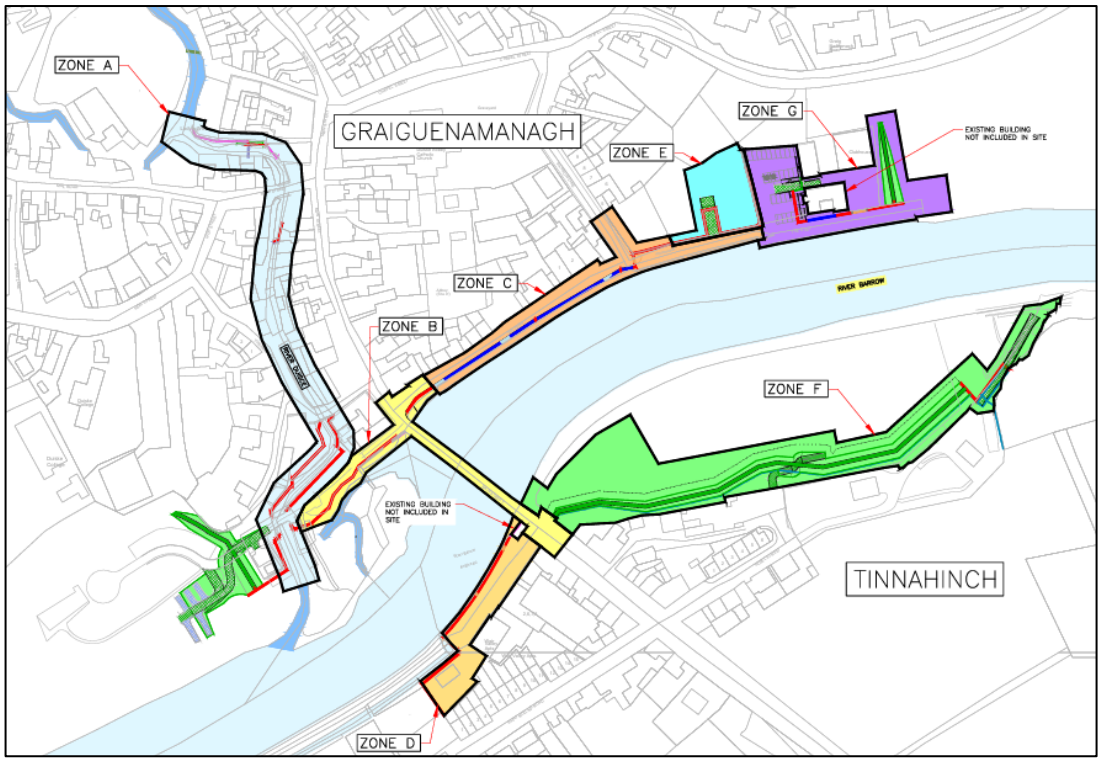


Figure 9-7 Character Areas overall layout

GRAIGUENAMANAGH–TINNAHINCH FRS – CONSERVATION STRATEGY		
AREA TITLE	CHARACTER AREA LOCATION	KEY STRATEGIES
A	RIVER DUISKE CHARACTER AREA	FLOOD RELIEF WORKS TO PROTECT BUILDINGS ARE CARRIED OUT WITHIN AN HISTORIC URBAN RIVERSIDE LANDSCAPE WITH MINIMUM INTERVENTION & FLOOD WALLS ARE CLAD IN RUBBLE LIMESTONE MASONRY INTEGRATING WITH THE CHARACTER OF THE HISTORIC LANDSCAPE
B	GRAIGUENAMANAGH BRIDGE CHARACTER AREA	NO WORKS ARE REQUIRED TO THE BRIDGE BUT ADJOINING WORKS ARE CARRIED OUT TO RETAIN THE SIGNIFICANCE OF THE BRIDGE
C	GRAIGUENAMANAGH QUAY PUBLIC REALM AREA	AN INTERVENTION APPROACH TO THE QUAY WALLS GLAZED PANELS & PUBLIC REALM IS PROPOSED, LED BY THE LANDSCAPE ARCHITECT
D	TINNAHINCH QUAY PUBLIC REALM AREA	THE HISTORIC QUAY WALL & RIVER ACCESS ARE MAINTAINED IN THEIR ORIGINAL STATE WITH NEW WALLS DESIGNED TO BE MUTE WITHIN AN HISTORIC NATIVE LANDSCAPE
E	GLAMPING SITE CHARACTER AREA	EXISTING DWARF WALLS, GATES ARE TO BE CONSERVED & NEW FLOOD WALLS IN RANDOM RUBBLE REFLECT THE HISTORIC CHARACTER
F	TINNAHINCH LANDSCAPE WEST AREA	NO IMPACT IS EXPECTED IN BUILT HERITAGE
G	BOATCLUB CHARACTER AREA	FLOOD WALLS IN THIS AREA IN RANDOM RUBBLE MASONRY, MAINTAINING SIGNIFICANCE OF THE BOAT CLUB

Figure 9-8 Conservation Key Strategies

Underwater Archaeology (ADCO 2022) Appendix 9-10

9.4.67 The archaeological and cultural heritage narrative of Graiguenamanagh–Tinnahinch is well known, and significant remains survive from the later medieval period when the Cistercian Abbey of Duiske (RMP KK029-018001, National Monument 620, RPS C124) founded by William Marshall in 1204–12 became the centrepiece for the emerging town. The monumental scale of such remains is continued through to the eighteenth and nineteenth centuries when much of the river front was transformed to meet the changing needs ushered in by the canal system associated with the Barrow Navigation. Warehouses and residences were also developed along the river front. A number of the upstanding remains along the banks of the Duiske River and the River Barrow are protected structures. Previous archaeological work has for the most part been associated with property development projects within the town. There has been some attention paid to the river areas, but no in-water work has been carried out to date.

9.4.68 The 2021 underwater archaeological survey completed by ADCO has presented the opportunity for a comprehensive survey along the lower length of the Duiske River as it passes through the west side of Graiguenamanagh, as well as an extensive survey within the River Barrow from a point upstream of the town to a point downstream of Graiguenamanagh weir. The mill race that runs alongside Tinnahinch Castle was also inspected.

9.4.69 Full access to the river channels and associated river banks was possible and no constraints were encountered. The survey comprised a non-disturbance underwater

inspection and metal-detection of the river beds and was supported by drone coverage along the river lengths and measured survey where the opportunity presented itself.

9.4.70 The Duiske River is a narrow channel with a clear gravel bed. It follows a circuitous route along the west side of Graiguenamanagh town, with the properties along Main Street, High Street and the Turf Market backing onto it. Significant drops in elevation occur within the channel as it falls down the slope to the Barrow, and such drops are facilitated by a series of weirs constructed across it. The bed of the Duiske River may be regarded as an area of archaeological potential because of its ability to retain material of cultural heritage significance. The riverbed, however, has been impacted upon with the construction of a sewer system, assumed to have been installed in the 1950s or 1960s, into the channel bed as part of a sewerage scheme. .

9.4.71 The Clapper Bridge (RMP KK029-018008) crosses the Duiske River, and detailed record was taken of this stone feature. Detailed record was also taken of a former blacksmith's forge (ADCO 05) that is located on the west bank at Turf Market.

9.4.72 The River Barrow has a wide channel as it passes through Graiguenamanagh and Tinnahinch. The bed of the River Barrow may be regarded as an area of archaeological potential because of its ability to retain material of cultural heritage significance. Such potential, however, is reduced where the bed comprises exposed bedrock but is increased where sediment has built up as areas of entrapment.

9.4.73 The north bank above the bridge was developed as a quay c. 1900 and survives as a length of stone retaining wall that is furnished with sets of stone steps leading into the river channel (NIAH 12318002), as well as a series of mooring bollards.

9.4.74 The standing Graiguenamanagh Bridge dates from the late eighteenth century (NIAH 12318004, 10302404, RPS C125) and replaces a pre-existing structure/s.

9.4.75 Inspection of the now-overgrown former docks area (formerly recorded as NIAH12318047) at the confluence of the Duiske and the Barrow was carried out.

9.4.76 Graiguenamanagh weir (ADCO 15) and Lock No. 20 (NIAH 10302406) were inspected.

9.4.77 Inspection of the possible location of a former bridge site (RMP KK029-042, CW024-029) downstream of the weir was conducted. The bridge record relates to the interpretation of a series of timbers as bridge remains that were found during excavations required to construct Tinnahinch Lock (NIAH 10302406). Underwater inspection of the river channel revealed exposed bedrock extending across the channel, and it is concluded that such would not have supported footings for a bridge. The timbers exposed when excavating the lock may be better interpreted as the remains of a small quay that would have been associated with Tinnahinch Castle (RMP CW024-026), which is located beside the lock.

9.4.78 The curtilage of Tinnahinch Castle was identified as worthy of recording as part of the castle complex.

9.4.79 Inspection of the mill race (ADCO 18) that runs to the south of Tinnahinch Castle revealed a channel that cuts across significant exposures of bedrock and empties into the Barrow

under a well-executed stone-arched culvert (ADCO 19). Both features are most likely associated with the former Barrow Starch Works factory.

9.4.80 A number of other features were identified in both the Duiske and the Barrow, including a timber alignment (ADCO 16) that is probably associated with historic revetment of the riverbank on the Kilkenny side, while the Duiske and the Barrow within the overall project area more generally are regarded as areas of archaeological potential (ADCO 22 and ADCO 23 respectively).

Archaeological Baseline Report for the Upstream Storage Area (CDHC 2023) Appendix 9-15

9.4.81 As part of the suite of works conducted for this report, aerial imagery review, LiDAR assessment and field inspection did not reveal any upstanding or obvious signs of subsurface archaeological features within the upstream storage area.



Figure 9-9 Aerial Premium image, www.osi.ie showing the field inspection numbers

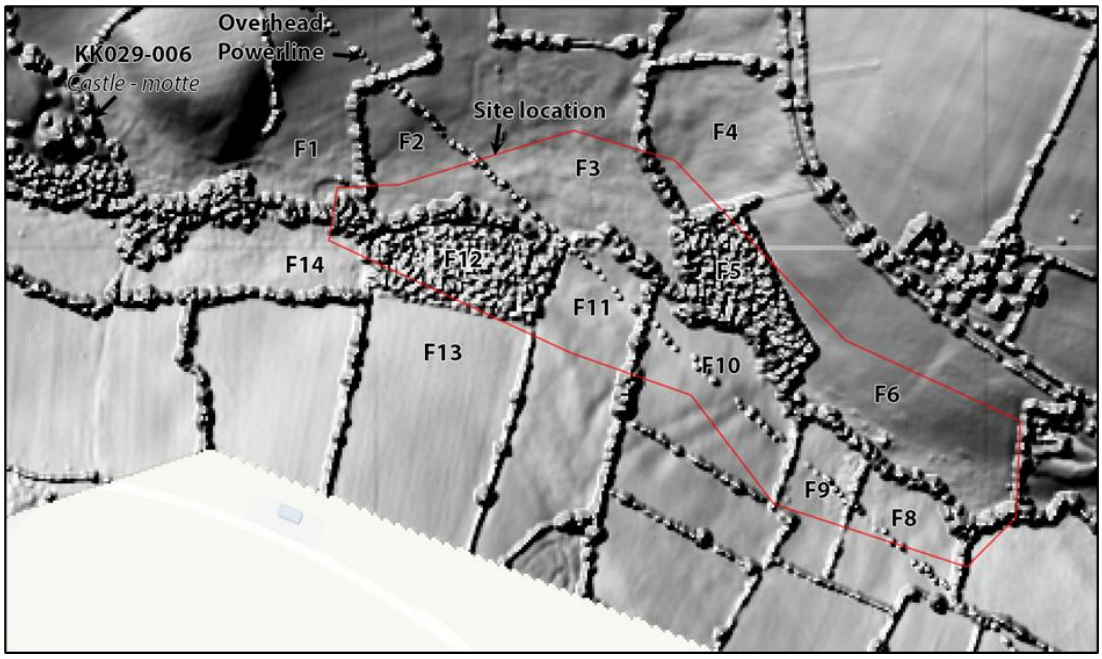


Figure 9-10 LiDAR hillshade model (GSI 2023)

Underwater archaeological survey of the Duiske River for the proposed upstream storage area (ADCO 2024) Appendix 9-11

9.4.82 Full access to the river channel and associated river banks was possible and no constraints were encountered. The survey comprised a non-disturbance waded inspection and metal-detection of the river bed, and was supported by GNSS RTK survey to record river channel and river bank profiles and sections (Licence References 24D149, 24R0195). A hand-held metal detector was employed to assess the potential for the river bed to retain metal features.

9.4.83 The Duiske River is a narrow channel with a clear gravel bed. It follows a circuitous route within the inspection area, with low vegetation overhanging much of the channel. The river channel retains a clear gravel bed with some siltation. The main flow meanders through the channel, with the gravel exposed by the main flow, and the siltation being areas of entrapment away from the main flow. The riverbanks on both sides are simple clay formations leading to a narrow flat floodplain, with rising ground to both the north and south.

9.4.84 No features of archaeological interest were observed in the channel, on the riverbanks or within the floodplain at the inspection location.

Geophysical Survey (TerraDat 2024) Appendix 9-9

9.4.85 The study area was divided into five individual survey areas, and high-resolution geophysical surveying took place of all accessible parts to identify features that may be of archaeological significance.

9.4.86 Due to above-ground structures and (apparent) made ground, no sites or features were identified in Graiguenamanagh Town at Areas A, B, or D that can be interpreted as archaeological in origin.

9.4.87 At the upstream storage area, the surveys at Area E likely reveal a relatively well-preserved post-medieval field system to the north of the river, with less distinct land divisions to the south. Several pit-like anomalies (a pit like anomaly measuring 6m x 3m and a cluster of four smaller monopolar anomalies) south of the river may represent archaeological features. These areas did not present as an obvious or definite archaeological site, that could be clearly demarcated but as linears or spreads of probable/ possible archaeology, that relate to land divisions and field boundaries, a trackway (as shown on the 1st edition OS) and pits.



Figure 9-11 Geophysical Site Locations (A-E)



Figure 9-12 Area E Archaeological Interpretation (TerraDat 2024, figure 19)

Archaeological Monitoring of the Ground Investigations (GI) (ACSU 2023) Appendix 9-13

9.4.88 Archaeological monitoring of GI investigations was undertaken by ACSU in 2023 under licence (Licence Ref. 21E0256 and 21R0098 and 22E0433 ext and 23R0355) and consent (C00149: E005333 and R000553). According to the report, 19th century features were identified, and no archaeological features or deposits were exposed and no finds were recovered.

9.4.89 Monitoring was carried out during the excavation of three Inspection Pits (IP3-5), four Boreholes (BH10-13) and six Slot Trenches (ST8-12) were excavated under C00149, E005333, R000553.

9.4.90 Monitoring was also carried out during the excavation of 14 Inspection Pits (IP17-29 & 31) excavated under 22E0433ext & 23R0355 and of 14 Test Pits (TP1-4, 8-13, 15-16 & 19-20), 21 Slit Trenches (ST1-19, 22-23), 5 Inspection Pits (IP 1-2, 9, 30 & 32) and 21 Boreholes (BH 1-7, 15-18, 21, 23 & 25-32) which were excavated under licence number 21E0256 & 21R0098.

9.4.91 The monitoring report detailing the results is included in Appendix 9-13.

9.4.92 Archaeological testing took place under excavation licence No. E005772, R000749, Ministerial Consent C001049. Testing was carried out along the quayside in Graiguenamanagh, along the north bank of the River Barrow, within the zone of archaeological potential surrounding Duiske Abbey (KK029-018001) which is a National Monument (Ref. no. 620).

9.4.93 The archaeological testing followed a desktop study, with the aim of informing the design process and establishing a better understanding of the subsurface stratigraphy across the area. Spoil and in-situ deposits of potential archaeological interest were scanned using a metal detector for the purpose of finds retrieval (Licence Ref. R749). No metal finds were recovered.

9.4.94 Archaeological remains or deposits of archaeological potential were identified in each of the five test trenches opened (Trenches A-E).

9.4.95 In both Trenches A and B, a dark organic layer containing charcoal was identified, in both cases at 1.1m beneath the tarmac road surface. Sondages excavated indicated a depth of between 0.12m – 0.35m and no dateable finds were evident in this layer, but it is interpreted as being of archaeological potential.

9.4.96 In Trench B a stone drain was present at 0.4m below the tarmac road surface at the NE end of the trench and comprised two courses of side stones and large flat capstones. This drain is probably post medieval in date and appears to be of the same orientation as remnants of the 18th/19th Century saltworks identified by O'Meara (2006 in Trench 5).

9.4.97 In both Trenches C and D remnants of a wall was present, oriented NE-SW in line with the current quay wall, located c.5m away, and it could represent an earlier quay wall. In both trenches the wall had been truncated on its SE side, leaving only the NW face intact and it was identified between 0.65m and 0.85m below the tarmac road surface. The mortared wall measured a maximum of 0.43m wide and 0.3m in surviving height.

9.4.98 In Trench E, a wall oriented NNW-SSE was uncovered at a depth of 0.5m beneath the tarmac road surface and appears to be aligned with the transept wall of the Abbey. The alignment of the wall may indicate an association with the Abbey, but its location does not appear to suggest a precinct wall. Only the east face of the wall, which is mortared, and a rubble core were present in the trench, indicating a width of at least 0.9m and a sondage indicated a surviving height of 0.55m. A metalled surface was also identified in the NW end of the trench at 0.47m below the tarmac surface.

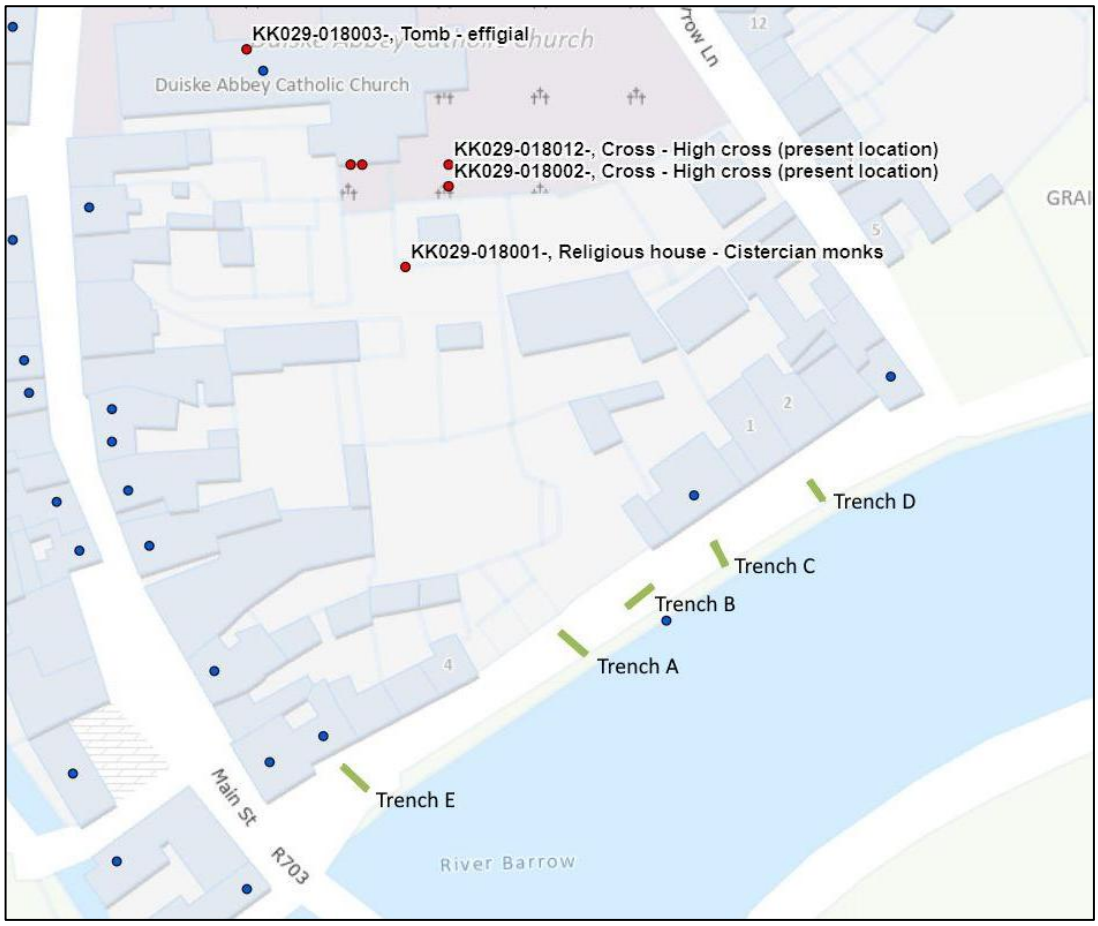


Figure 9-13 Trench layout shown on Modern OS mapping (MapGenie)

Folklore and History (intangible heritage and historic character)

9.4.99 Duiske Abbey commands a focal point at the centre of Graiguenamanagh. The narrow and winding medieval streets of the town centre, their interconnection with the Abbey, and the relationship with the River Barrow, and the Duiske River gives Graiguenamanagh its unique visual and aesthetic character.

9.4.100 The river Barrow, with its historic quays, mill buildings, mill races, bridges, canal, canal lock and weirs are a rich and highly significant cultural, historical industrial and social amenity of Graiguenamanagh- Tinnahinch.

Townland names

9.4.101 Townland names are a valuable source of information, not only on the topography, land ownership and land use within the landscape, but also on its history, archaeological monuments and folklore. While most place names were anglicised or translated relatively accurately, some were corrupted virtually beyond recognition. By the time the Ordnance Survey collected place names in the area in the 1830s, both the native Irish and introduced English forms would have been simultaneously in use in the area. The majority of the townland names in the area are Irish in origin, but Anglo-Norman and English influence is also evident from the use of later English names.

9.4.102 In addition to the townland names set out in Table 9-7 below for the upstream storage area and the Graiguenamanagh-Tinnahinch area, the name of the River Duiske is important to the area, being the feature after which Duiske Abbey is named. This name is derived from *Dubh Uisce*, or Black or Dark Water. Information on the townland names discussed below was sourced from www.logainm.ie.

Table 9-6: Townland Names

Townland	Parish	Barony	Meaning
Coolroe	Graiguenamanagh	Gowran	*An Chúil Rua* – 'The Red Corner'.
Oldgrange	Graiguenamanagh	Gowran	Referred to by this name from at least 1574. Associated with the church and graveyard (RMP KK029-005001/002).
Priestsvalley	Graiguenamanagh	Gowran	Possibly a reference to the use of the River Duiske for milling associated with Duiske Abbey.
Tinnapark	Graiguenamanagh	Gowran	*Tigh na Páirce* – 'House of the Park'.
Graiguenamanagh	Graiguenamanagh	Gowran	*Gráig na Manach* – 'Grange of the Monks'. Associated with Duiske Abbey.
Tinnahinch	Siant Mullin's	Saint Mullin's Lower	*Tigh na hInse* – 'The house of the inch, strath or holm' (river meadow or island).
Ballynakill	Graiguenamanagh	Gowran	*Baile na Coille* – 'The town of the wood'.
Bohermore	Graiguenamanagh	Gowran	*An Bóthar Mór* – 'The big road, in an angle formed by the roads from Graigue to Goresbridge.
Newtown	Graiguenamanagh	Gowran	*An Baile Nua* – 'New town'.
Brandondale	Graiguenamanagh	Gowran	*Gleanntán Bhréanail* – a fancy name associated with a former demesne owned by Mr Burtchael.
Coolfarnamanagh	Graiguenamanagh	Gowran	*Cúil Fhearann na Manach* – previously referred to Monk's Land in 1607 and 1703. 'The corner of the Monk's land'.

Historic Cartographic Review

Down Survey 1656-58

9.4.103 The Down Survey map of County Kilkenny depicts the town of Graiguenamanagh (labelled 'Graige') on the north bank of the River Barrow, accessed by a bridge and with a short segment of the River Duiske shown (www.downsurvey.tcd.ie). The townlands of Oldgrange and Coolroe are labelled west of the medieval town, but no features are depicted in this area.

9.4.104 The map of the Barony of Gowran depicts the townlands of Oldgrange and Coolroe and it is apparent that the modern townlands of Tinnapark and Priestsvalley were at that time part of the townlands of 'Graige' (Graiguenamanagh) and 'Moning' (Moneen). There are no features depicted in the area of the proposed upstream storage area apart from the townland boundaries which followed the course of the River Duiske.

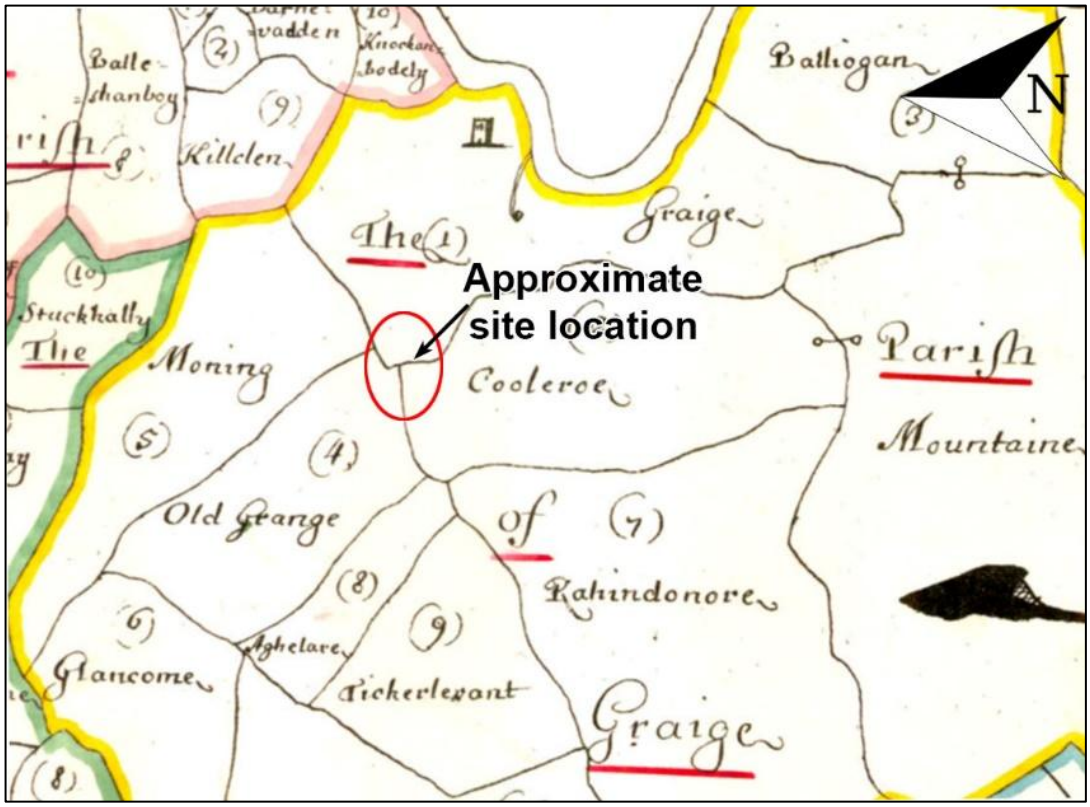


Figure 9-14 Down Survey of the Barony of Gowran (www.downsurvey.tcd.ie)

First edition 6-inch Ordnance Survey, c 1842

9.4.105 The town of Graiguenamanagh is shown on the north bank of the River Barrow. During the 19th century it is depicted as a densely settled area with the ruined Duiske Abbey at its centre. Industry in the form of mills including the former monastic mills, the Turf Market and a salthouse are annotated along the Duiske (Douske) River to the west of the town. A linear quay, fronts onto the River Barrow adjacent to the bridge that connects to Tinnahinch in County Carlow. A dry dock is shown to the west of the bridge at the confluence of the River Barrow and the Duiske River.

9.4.106 At this time Tinnahinch was still largely undeveloped and farmland, with a few sites associated with the canal and previous historic structures visible such as Tinnahinch Castle (CW024-026-) adjacent to the newly built canal lock and lock house and St Michael's Church (CW024-027001-) and associated holy well (CW024-028-).

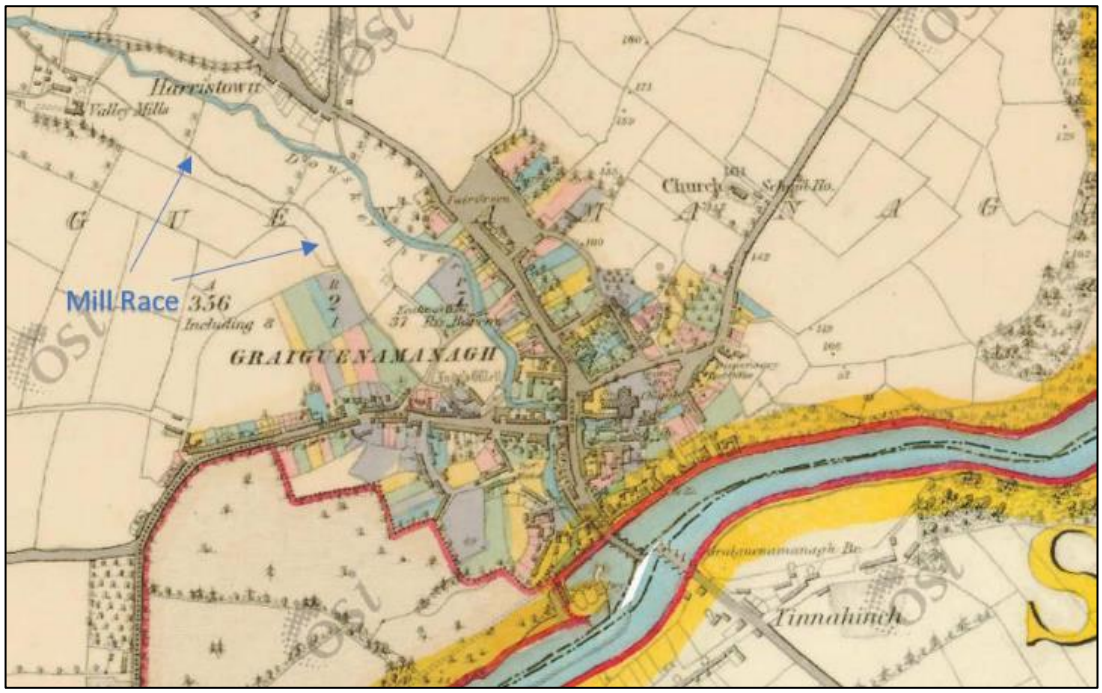


Figure 9-15 First Edition 6-inch Ordnance Survey, 1842

9.4.107 The upstream storage area comprises agricultural fields, with some areas of rough vegetation possibly representing the final vestiges of Duiske Wood. A path is depicted which extends into the site boundary from an unnamed dwelling to the northeast.

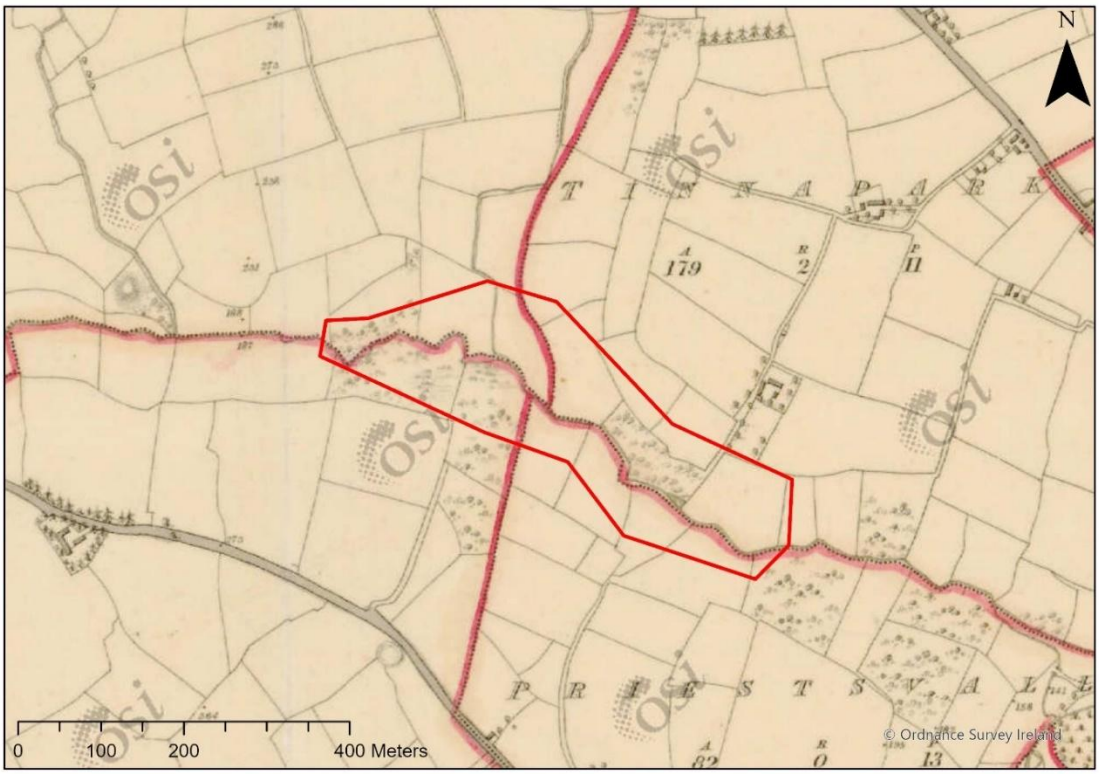


Figure 9-16 First Edition 6-inch Ordnance Survey, 1842

Revised Edition 25-inch Ordnance Survey, 1899-1905

9.4.108 The revised Edition 25-inch map shows the impact of the golden age of river transport on Graiguenamanagh and provides even greater details as to the changing townscape. Between 1840 and 1900, many of the existing houses and buildings in Graiguenamanagh were renovated and repurposed for use as pubs or shops to service the foot passengers and rivermen. In addition to this, there is a marked increase in the building density within the town and an expansion of roadside development increasing the overall size of the town. These changes led to a shift in the town layout and boundaries, the decrease in woodland at the Graiguenamanagh Wood, and the demolition of several buildings within Graiguenamanagh town.

9.4.109 Duiske Abbey and its associated structures, such as the graveyard, the abbey wall, and the site of the church, are shown in greater detail on this map.

9.4.110 The dry dock has been further developed along with the newly constructed weir and canal to the west of Graiguenamanagh Bridge. This activity in the river is located opposite the Barrow Starch Works, located in a now expanded settlement of Tinnahinch located on the southern banks of the River Barrow.

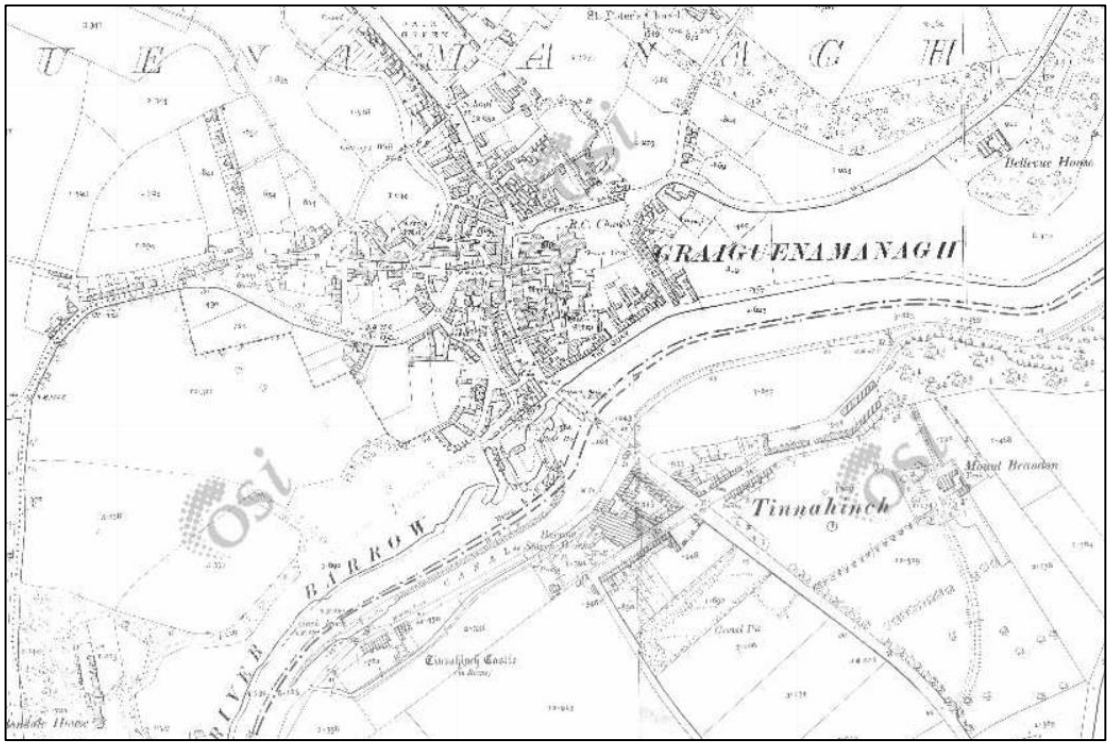


Figure 9-17 Revised edition 25-inch Ordnance Survey, 1900-1902

9.4.111 The 25-inch map of the upstream storage area was published in 1902 and it does not show any significant changes apart from the construction of the R703 road to the north of the site.

9.5 Sensitive Receptors

9.5.1 The works have been designed against the backdrop of a heritage town and the retention of this historic sense of place was central to the design process.

9.5.2 A glossary of impacts as defined by the EPA is provided in Appendix 9-3. The assessment has been carried out according to guidelines relating to archaeological and architectural heritage assessment, and in the context of similar large-scale flood relief and infrastructural projects.

9.5.3 The assessment of effects are described on a geographical basis (as in the main text) and includes a brief description of the proposed interventions and how these will impact on the heritage assets namely – archaeology (terrestrial and underwater), architectural heritage and cultural heritage.

9.5.4 The proposed works have been divided into 10 Works Areas or Character Areas (Table 4-1 in Chapter 4 'Description of the Proposed Scheme and Construction Methodology') and are discussed below on that basis.

9.5.5 The FRS does not envisage riverbed dredging or works within the River Barrow so it is not anticipated there will be significant in-channel impacts to the River Barrow.

Area 1 – Upstream storage Area – Duiske River Valley Area

9.5.6 Nothing of an archaeological nature was detected through the documentary and cartographic evidence and during the field inspection conducted for the study of the upstream storage area.

9.5.7 The results of the geophysical survey at (Area E) appear to suggest the presence of a well-preserved post-medieval field system on the north side of the river, with some isolated pits that may represent archaeological features on the south side of the river. A significant archaeological presence was not detected by the geophysical survey within Area E. As such impacts are unlikely to be significant and it is suggested that the anomalies that were detected or any potential for below ground archaeological features can be dealt with using standard archaeological mitigation such as archaeological test excavation and discussion with the Archaeological Underwater Unit and Planning and Licensing Unit from the Department of Housing, Local Government and Heritage. These anomalies do not present a risk to the project.

9.5.8 The upstream storage area will construct a headwall across the river that extends across the floodplain. The headwall is to retain water for managed release downstream and is a flood protective measure. During the underwater archaeological survey and metal detection survey no features of archaeological interest were observed in the channel, on the riverbanks or within the floodplain at the inspection location. Therefore, no significant in channel impacts are anticipated. The works will require ground disturbance and in-channel disturbance and while there are no obvious archaeological features recorded within the works area, the potential remains for as-yet unrecorded features to be exposed that currently lie buried and concealed from view.

Area 2 – Well Lane to High Street Bridge – River Duiske Character Area

9.5.9 This area extends from Well Lane to High Street Bridge and includes the construction of a debris trap at Well Lane.

9.5.10 Flood proofing existing walls and structures (CH01 and CH02) that align a grassy, mettled walkway, locally known as a 'Mass Path' on the northern bank of the River Duiske will take place. It is proposed that the structures will be protected through the application of a waterproof render. The rear of the structure known as the Globe (RPS C133) will also be applied with this waterproof render and an alteration will take place of a modern window open insertion (raising of a sill level).

9.5.11 A modern pedestrian footbridge will be retained (if possible) but slightly modified as it will be raised on the northern side where steps will be introduced along the 'mass path' to ensure adequate protection during a flood event.

9.5.12 A low-level flood defence wall (0.5m) will replace an existing stub wall and this will require demolition of c.10m of the existing wall and the removal of the planted area that forms the top of this wall. Ornamental planting is proposed as a public realm initiative to replace the removed planting and enhance the area.

9.5.13 Existing plaster will be removed from existing walls to be improved. The wall improvement will entail casing or applying a waterproof casing to the existing walls to the rear of Doyle's (CH01 and CH02). This will be circa 0.5m high and may extend up to 100mm from the existing wall. It will run from upstream of clapper bridge to the existing pedestrian footbridge. A similar approach will be taken to improving the wall at The Globe, where the wall will be improved to a height of circa 1.2m, including raising the window sills by 250mm. Between these sections there will be a low-level flood wall, some 0.5m high that will replace the existing stub wall. This will be faced in stone to replicate the existing wall (Photomontage PM10, Appendix 4-3). The application of this plaster will require a trench to be dug at the base of these walls so the structures can be successfully tanked.

9.5.14 Area 2 includes the Clapper Bridge, a recorded monument which has been subject to survey and research as part of the project. There are no works proposed at this location. Works will take place upstream and downstream of this feature, and it is proposed that an in-water wade inspection will take place to establish if missing displaced stone lintels can be identified for reuniting with the bridge structure.

9.5.15 The debris trap will entail placing auger or driven piles into the bed of the river to trap and catch any heavy debris flowing down the Duiske River. This will serve to protect the clapper bridge from future damage and ensure blockages do not impact the scheme further downstream where multiple structures exist. This trap will be maintained from Well Lane in future.

Area 3- Turf Market (High Street Lower) – River Duiske Character Area

9.5.16 Limited and localised works are proposed along this section of the River Duiske. The proposed flood defence wall is to be located in a restricted working environment, which will require instream works. The wall will be circa 1.8m above bed level and 0.7m above existing ground level along the path. The works shall be facilitated by mini piles. Two

outbuildings accessed by a walkway afforded by a modern pedestrian bridge overlook this area. The proposed works are outlined on Drawing No. W3451-AYE-DWG-W-1419 and W3451-AYE-DWG-W-1420. Photomontage PM09 included under Appendix 4-3 illustrates the flood defence and public realm proposals planned in Area 3.

9.5.17 This area has been subject to a wade survey by ADCO (Appendix 9-10), assessed in terms of conservation engineering solutions by Southgate Associates (Appendix 9-12) and the walls and buildings have been subject to a rectified imagery survey (Appendix 9-16 Philip and Associates).

9.5.18 Site works will consist of the demolition down to below bed level of the existing walkway to the afore mentioned structures and the existing pedestrian access bridge being modified.

Area 4 – Turf Market to the Hub – River Duiske Character Area

9.5.19 The proposed works are located in an area with non-designated stone walls (Appendix 9-8, CH05), stone buildings (Appendix 9-8, C138 (Step House, a protected structure), CH06, CH07, CH08, CH09) and a bridge with supporting stone walls (CH10). Collectively these structures provide an industrial heritage backdrop and an historic character that supports Graiguenamanagh ACA. Special consideration was given to the proposed hard defence walling (Southgate 2025) to this area as part of the designed-in mitigation measures.

9.5.20 This area involves the construction of flood defence walls on both banks of the River Duiske. These will be constructed by using mini piling to minimise the disturbance on the neighbouring historic structures.

9.5.21 Typically on the east and south bank the walls vary from circa 1.2-1.5m above ground level, whilst on the west and north bank, facing The Dock, the walls are a typically 1.1m above ground level.

9.5.22 On the west and north bank there will be a mini pile wall driven outside the existing walls in order to retain them. If any damage occurs due to vibration impacts, the walls will be repaired by specialist stone masons.

9.5.23 On the east and south bank, a mini pile solution has been sought in proximity to the adjoining dwelling, a protected structures (RPS C139) in order to minimise the disturbance and avoid excavation at this location.

9.5.24 On the north bank immediately upstream of The Hub Bridge, leading to Peg Washingtons Lane, a bored pile solution will also be implemented to reduce excavation next to the historic building and to provide cut-off for seepage. Both walls will be faced with natural stone on the landward side of the walls. A reinforced concrete finish will be provided on the riverside.

9.5.25 The existing stone wall along the river side of the ongoing development under Kilkenny County Council planning no. 2460122 will be retained.

9.5.26 A storm drain is to be located near Peg Washington's Lane (Drawing No. W3451-AYE-DWG-W-1417) and will require localised excavation. This drain will traverse the front yard of a

dwelling and stone boundary wall before entering The Hub grounds for discharge to the River Duiske upstream of the bridge (CH10). The drain will pass immediately to the western gable end of CH07 (a stone warehouse/store). The outfall will impact the supporting wing wall of the bridge (CH10) and the construction will entail the removal of the upstream section of the wall permanently. It is an objective to attempt to retain the remaining wall, but if it needs to be removed due to safety consideration, it will be reinstated under conservation engineering supervision.

9.5.27 The proposed flood defence works are outlined on Drawing No. W3451-AYE-DWG-W-1417 and W3451-AYE-DWG-W-1418. Photomontage PM05 included under Appendix 4-3 illustrate the flood defence and public realm proposals planned in Area 4. This area has been subject to a wade survey by ADCO (Appendix 9-10), assessed in terms of conservation engineering solutions by Southgate Associates (Appendix 9-12) and the walls and buildings have been subject to a rectified imagery survey (Appendix 9-16 Philip and Associates).

Area 5 – Boat Club (Barrow Way-Boat Club) – Boat Club Character Area

9.5.28 Works include the construction of flood defence walls, an embankment and public realm works to ensure the connectivity of lands to the River Barrow. The proposed works are outlined on Drawing No. W3451-AYE-DWG-W-1410 to W3451-AYE-DWG-W-1413. Photomontage PM01 included under Appendix 4-3 illustrate the flood defence and public realm proposals planned in Area 5.

9.5.29 The area for the proposed embankment (which will be 1.8m high nearest the river) has been subject to SI investigation pits and trenches which were archaeological monitored.

9.5.30 The flood defence wall will be 1.5m high above ground level in front and around the Boat Club. It is well set back from the quay and will include glazing, with the riverside of the wall clad in natural stone.

Area 6 – Graiguenamanagh Quay (Boat Club–Graiguenamanagh Bridge)– Graiguenamanagh Quay Public Realm Zone including Duiske Abbey Precinct Area

9.5.31 The proposed flood defence works are outlined on Drawing No. W3451-AYE-DWG-W-1410 to W3451-AYE-DWG-W-1413. Photomontage PM02 included under Appendix 4-3 illustrate the flood defence and public realm proposals planned in Area 6.

9.5.32 The low stone wall gate and pillars (Appendix 9-8, NIAH 1218003) will be retained and the proposed conservation measure at this location involves the placement of the new defence wall to the north of the existing wall and gate (i.e. behind them) so to retain them.

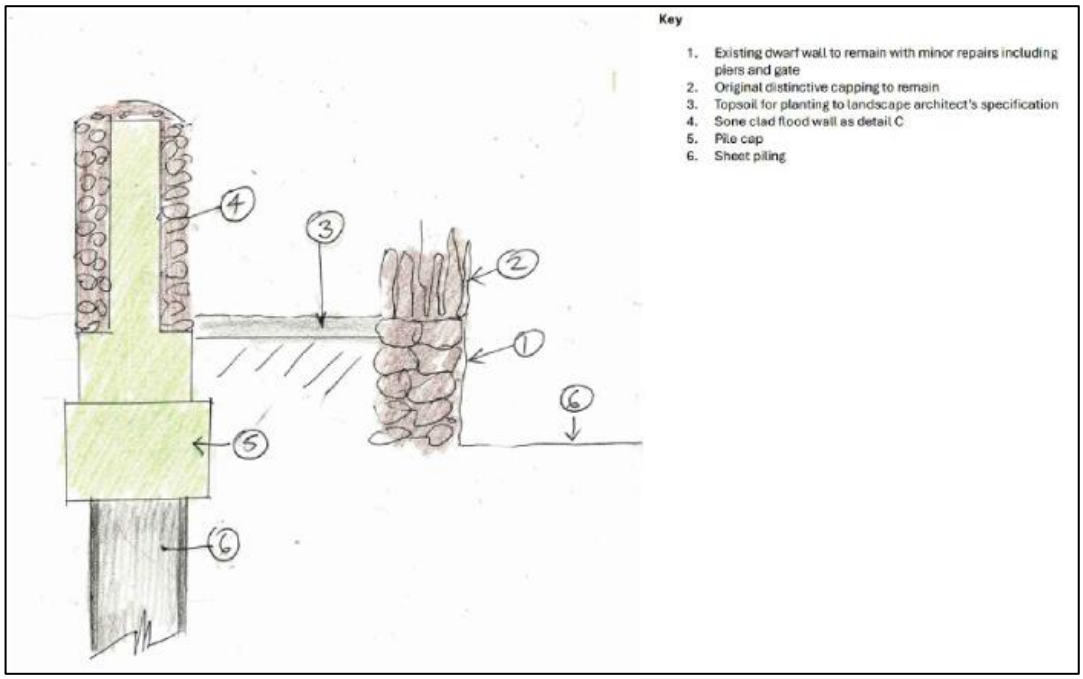


Image 9-1 Proposed conservation works in order to retain the wall, Drawing 1442, Sketch F

9.5.33 The corner of a stone wall will be removed, this corner formed part of a collection of buildings around a central courtyard and is shown on the 1st edition six-inch and later 25-inch edition OS mapping (Appendix 9-8, CH13).

9.5.34 The medieval town of Graiguenamanagh initially developed to the northwest of the abbey and from the time of the Dissolution, it began to slowly encroach on the abbey precinct. The town developed further in the late eighteenth century, influenced by the growing importance of the Barrow River as a trade route. The present quay structure dates to the eighteenth century, and prior to its construction the original riverbank may have been situated nearer to the abbey precinct, probably just to the south of the carpark at Supervalu (Carville 1979). By the early nineteenth century, the site of the monastic buildings was largely occupied by dwellings of the town.

9.5.35 The existing quay wall, flagstones and steps are to be retained. This wall experienced significant rebuild when repair works were completed in 2011 from the riverside. ADCO as part of their reporting carried out a survey of the River Barrow and the quay wall in 2023 (Appendix 9-10).



Image 9-2 View of the quayside and quay wall during repair works (2011)

9.5.36 The proposed walls will be founded on sheet piles driven to at least 6m below ground level. The maximum wall height is circa 1.4m above ground level. The wall consists of at least 1m high glass panels sitting on 900mm of reinforced concrete with natural cut-stone cladding both sides. Three (3no.) sliding flood gates with glass top section are included to encourage connectivity between both sides of the wall.

9.5.37 A 150mm foul rising main from the existing pumping station on the quay to the Hub will be diverted to the dry side of the wall. Works will also take place to improve the surface water drainage, and this will include excavating (and constructing a new storm drain along the entire length of the Quay (on the landward side) of the newly constructed quay wall.

9.5.38 This area has been subjected to Archaeological test excavation under Ministerial Consent (Excavation Licence No. E005772, R000749, Ministerial Consent C001049) to provide greater certainty as to the nature of the below ground remains that lie in proximity to the precinct of Duiske Abbey (a National Monument). A method statement was developed that provided a detailed archaeological assessment of the area and provided information on the historical development of the abbey and the site, a review of historic cartographic sources and an examination of previous archaeological excavations.

9.5.39 The results from the archaeological investigations along the quay are discussed from section 9.4.114-9.4.120 in this chapter and in Appendix 9-15.

9.5.40 Public realm works include the raising of ground level and the building of a low wall to the north of Graiguenamanagh Bridge, a protected structure. The historic bridge will not be subject to any direct works but the setting of the structure has to be considered so any change in the receiving environment will enhance rather than detract from the structure. As such photomontages have been created to show the existing and after situation, photomontages PM04 and PM05 included under Appendix 4-3 illustrate the flood defence and public realm proposals.

9.5.41 Existing lighting poles will be relocated generally in same area, and they are proposed to be located on the wet side of the proposed flood defences (Photomontage PM03). Public realm improvements are described in Appendix 4-2.

Area 7 – The Dock (Graiguenamanagh Bridge to the Hub Bridge) – The Dry Dock

9.5.42 The proposed flood defence works are outlined on Drawing No. W3451-AYE-DWG-W-1414 to W3451-AYE-DWG-W-1416. Photomontage (PM05) included under Appendix 4-3 illustrate the flood defence and public realm proposals planned along the Dock Road in Area 7. Site clearance work will consist of removal of vegetation, demolition of existing walls and chambers. The area of the Dry Dock and along the Duiske River has been subject to assessment by ADCO (Appendix 9-10), assessed in terms of conservation engineering solutions by Southgate Associates (Appendix 9-12) and the buildings have been subject to a rectified imagery survey (Appendix 9-16 Philip and Associates).

9.5.43 Along the Dock Road (CHZ 03) the existing wall attached to the Graiguenamanagh Bridge (a protected structure) (C125) will be retained and the proposed flood defence wall will be built along the southern side of the road where a low stone wall is present (Photomontage PM05). The Dock Road is located within Graiguenamanagh ACA and partly located with the ZON for the historic town (KK029-018). The road is located to the north of the dry dock area (protected structure, RPS D160) and would have afforded access to this and also to Brandondale House.

9.5.44 In order to facilitate stormwater in times of flood, a pumping station is proposed, this will require excavation in the road and surrounding area. A ruined structure (CH11A) and the stone footings of another structure will be removed to facilitate a new outfall from the proposed drainage network. Alternative routes were considered, but could not be advanced due to ecological, safety and technical issues. This ruined structure faces onto a former laneway that led to the Dry Docks and backs onto the River Duiske. It presents today as a roofless, single storey, rubble stone structure.

9.5.45 The dry dock (a protected structure, RPS D160) is located outside the proposed flood relief works. An access will be provided to this feature. The dry dock is of cultural, industrial, social and historical interest and is a reminder as to the significance of Graiguenamanagh as a successful trading, merchant town along the River Barrow.

Area 8 - The Hub

9.5.46 There are no recorded monuments within this area and it was subjected to a geophysical survey. No anomalies of an archaeological nature were revealed as this area was very disturbed from subsurface services etc. Site clearance will include the removal of an existing container, removal of mature trees, removal of topsoil and existing pathways and roads.

9.5.47 Works will involve the construction of a flood defence wall along the bank of the River Duiske (42m long) on sheet piles to a maximum height of 1.6m above ground level. The wall will be clad with natural stone on the landward side and mass concrete on the river side, with a rounded capping. This wall will wrap around the wastewater pumping station. An earthen embankment (62 m long) will tie into the high ground to the north and northeast. Proposals for storm water drainage is proposed along with a small pumping station and a new outfall to the River Duiske.

9.5.48 A wade survey took place of the River Duisk and heritage structure, a bridge (CH10) (refer to section 9.5.26) in this area. A visual and photographic survey took place.

Area 9 - Hotel Street – Tinnahinch Riverbank East Character Area

9.5.49 This area includes the construction of a flood defence embankment and wall along the south-eastern boundary of a greenspace that aligns the River Barrow on the southern bank. The works include an access ramp to maintain access and stormwater drainage and pumping station to serve Tinnahinch.

9.5.50 The embankment will be circa 240m long with a maximum height of 1.25m above ground level. The embankment will have side slopes of 1V:2.5H and will be grass seeded. At the northeastern end a wall, 38m long and circa 1.5m high will be constructed. The wall will be finished in concrete.

9.5.51 A pumping station and outfall will be constructed to discharge to the River Barrow immediately upstream of Graiguenamanagh Bridge.

9.5.52 Works will involve the removal topsoil and vegetation along with some mature trees along the area proposed for the embankment out outfall.

9.5.53 An archaeological geophysical survey was proposed for this area to assess the below ground greenfield potential, but access could not be gained to carry out the survey. A visual and photographic survey took place.

Area 10 – Tinnahinch Quay Character Area

9.5.54 Raised defences are proposed on the left bank at Tinnahinch Quay from Graiguenamanagh Bridge to Tinnahinch Carpark at the mill channel. In addition to this drainage systems and a pumping station are proposed along with an automated sluice gate installation at Tinnahinch mill head race. The defence consists of a flood wall and hinged flood gates along the quays to maintain access. Local changes to the stormwater network are also proposed.

9.5.55 The proposed flood defence wall will consist of a new reinforced concrete wall some 310m long. The majority of the wall will be circa 0.8m high, but it will be up to 1.2m high at Tinnahinch carpark.

9.5.56 There are a number of hinged flood gates to be constructed in the existing openings in the existing wall to maintain access to the quay. The walls will be modified locally to facilitate installation of the gates.

Site Clearance and Compound Areas

9.5.57 The following areas are being considered for site compounds and associated activities consisting of offices, welfare and storage of plant and materials, they are further discussed under sections 9.6.59 to 9.6.64.

Table 9-7 Compound Area

Area Description (Compound No.)	Work Area/Compound Details	Offices	Welfare	Plant & Materials
Main Compound (A)	Main location for offices onsite. All ER and Contractor staff co-located.	Yes	Yes	-
Storage Area (B)	A large compound within the lands to be purchased to facilitate storage of materials such as bulk material for embankment construction and reinforcement for structural concrete works. Access from R703.	No	Yes	Yes
Well Lane to High Street Bridge (C)	Use current vacant site at High Street as mini-compound to provide access and storage of materials for works at Clapper Bridge. Avoid need to cross Clapper Bridge. Working space at Well Lane to facilitate access upstream of Clapper Bridge.	No	Yes	Yes
Boat Club (D)	Greenfield site (currently used for summertime camping) between the boat club and a small parcel of land east of the boat club	No	Yes	Yes
Hotel Street (E)	Compound within the greenfield within to allow storage of bulk material for embankment construction and reinforcement for structural concrete works at Tinnahinch. Access from R703.	No	No	Yes

9.6 Potential Impacts and Effects

The 'do nothing' Scenario

9.6.1 In a Do-Nothing Scenario, flooding will continue to occur throughout the upstream storage area, Graiguenamanagh Town and Tinnahinch Village, resulting in the degradation of the built heritage environment including to the RMP, RPS and NIAH sites. If subsurface archaeological remains exist within the flood relief design extents, these would remain unaffected by the Proposed Scheme.

Construction Phase

9.6.2 The scheme has been designed to reduce any direct impact to the recorded monuments and protected structures within the receiving historic environment for Graiguenamanagh.

It has been designed to have a **significant, positive and permanent** impact on the setting and understanding of the historic fabric of Graiguenamanagh through flood prevention, improved access, upgrading of public realm works.

9.6.3 The design of the scheme has been developed in collaboration with the Public Realm and conservation engineering proposals so as to ensure the new infrastructure maintains views to important heritage elements, such as the quay side and Graiguenamanagh Bridge and that none of the infrastructure components clutters or detract from the character of the historic town.

9.6.4 The works will form a modern solution to flooding at Graiguenamanagh and will help protect dwellings and structures located at the quay and along the Duiske River and throughout the town of Graiguenamanagh and at the quay side of Tinnahinch. The scheme is designed to be reflective of the past industrial and riverine heritage while functional from a flood relief perspective and re-invents the public amenity value of the river edge for the town.

9.6.5 Graiguenamanagh' s location on the River Barrow has greatly influenced it socio-economic development and is an important element in the sense of identify and culture within the town. Cultural heritage assets that contribute to the riverine charm of the town have been identified and assessed (Appendix 9-8).

9.6.6 The overall effect on the existing and standing built heritage environment will be positive, as potential negative construction phase impacts are mitigated by design and by the positive effect of preventing / reducing flooding which would cause degradation of the built heritage. The overall effect of the proposed FRS will be a reduction in flood extents, which will have a **positive** effect on cultural heritage receptors. The only exception to this is the Dry Dock (a protected structure, D160) that will be isolated on the river side of the flood relief works and as a result will not be protected by the development of the flood relief scheme, as other features of a cultural heritage within the town will be.

Area 1 – Upstream Area – Duiske River Valley Area

9.6.7 An archaeological baseline report has been produced for this area (CHZ 09) (CDHC 2023) and is summarised in section 9.4.103 and appended to this chapter (Appendix 9-15). This greenfield area has been investigated through geophysical survey and limited test excavation in the form of trial pits TP-15, TP-16, TP-19 and TP-20 and boreholes BH-30 and 32. The subsoil consisted of an orange-grey coarse clay and stone and no archaeological features, finds or deposits were exposed.

9.6.8 No recorded archaeological, architectural or cultural heritage site will be impacted by the proposed development. Geophysical survey (detection device licence No. 24R0041) did not identify sites of a definite specific archaeological morphology. The Terradat report (2024) revealed a possible post medieval field system north of the river, with less distinct land divisions to the south. Several isolated pit-like anomalies of possible archaeological origin were identified south of the river. If currently unidentified subsurface archaeological remains exist within the development design extents, these would likely be impacted during construction. If currently unidentified subsurface archaeological remains exist

within the development design extents, these would likely be impacted during construction.

9.6.9 The significance of the receiving greenfield area (CHZ 09) is low and the magnitude of impact is low resulting in a **slight, negative** impact.

9.6.10 The Duiske River within the upstream storage area has been subjected to a visual inspection and an underwater archaeological impact assessment (licence 24D149, 24R0195). The survey took the form of a wade inspection and metal detection of the riverbed and recorded the river bank profiles and sections. At this location the river is a narrow channel with a clear gavel bed and along its banks overhung with vegetation. No features of an archaeological interest were observed in the channel, on the riverbanks or within the floodplain at the time of inspection (ADCO 2024) (Appendix 9-11).

9.6.11 The proposed project and the predicted changes to flooding upstream will not impact any recorded or designated cultural heritage site (Drawing 1423), and it was consequently not necessary to expand the study area to include areas of redirected floodwater.

9.6.12 The significance of the riverine environment (CHZ 01) is low, and the magnitude of impact is low resulting in a **slight, negative** impact.

Area 2 – Well Lane to High Street Bridge – River Duiske Character Area

9.6.13 In terms of designated features, there are two recorded monuments, the clapper bridge (KK029-018008) and Lady's Well (KK029-018007), the Globe (a protected structure, C133) and High Street Bridge, (a protected structure, C647, NIAH 1231832) are both features of architectural heritage interest. Non designated assets include the River Duiske (CHZ02), stone walls (CH01), a stone building (CH02) and a river walkway (CH03). Collectively these heritage features form a riverine character area enclosed by high stone walls of an industrial heritage nature. The riverside walkway, referred to locally as a 'mass path' leads to the Clapper Bridge that in turn formerly provided access to the Lady's Well on the far bank of the river. The conservation strategy in this area is one of minimum intervention and for the proposed flood walls to be clad in rubble limestone masonry integrating the new interventions with the existing character of this historic landscape. The walls of the existing buildings to the north of the river will be tanked using a flood proof render. While alterations will take place, they have been designed to be minimally intrusive, to retain the sense of place and protect the historic fabric of the surrounding buildings. Potential impacts along the River Duiske are discussed from north to south.

9.6.14 The debris trap (CHZ02) is located on a narrow stretch of river north of the Clapper Bridge and Lady's Well and south of Keating's Well and ford. The eastern bank consists of modern concrete walling and railings while an earthen vegetated bank forms the western bank. At the time of inspection, the water was at ankle level with a clear view to the gravel bed, nothing of an archaeological significance was revealed. This section of the River Duiske has been subject to an archaeological wade survey, metal detection and impact assessment (ADCO 2021). The archaeological potential of this intervention is deemed to be low, and the magnitude of impact is low resulting is a **slight, negative and direct** impact.

9.6.15 The impact on the historic walls (CH01 and CH02) will be non-structural and connected with performance in terms of flood risk. The Southgate survey (2022) has recommended a flood proof render to be applied to the foundations and lower elevations of the wall effectively partly tanking the structure. The stone wall is of low significance and the magnitude of impact low and as a result of mitigation measures this will result in a **direct, positive, slight and long-term** impact.

9.6.16 The river walk (CH03) is a local asset that provides access to the Clapper Bridge. It has a low significance, the works proposed, i.e. raising the ground level locally, via steps at a pedestrian bridge and the excavation of a trench for tanking/ flood proofing of the adjacent walls (CH01 and CH02) are medium in magnitude. This will result in a **direct, negative, slight and short-term** impact.

9.6.17 There are no specific flood works located at the Clapper Bridge (KK029-018008), however there are flood relief works upstream and downstream of this location and tanking works of a wall (CH01) on the northeast bank adjacent to the structure. The proposal of a debris trap upstream from the Clapper Bridge (KK029-018008) means that it will act as a screening mechanism and remove any obstruction before it reaches the bridge thereby helping to maintain and protect the structure from further deterioration.

9.6.18 For the purposes of this project the bridge was surveyed, laser scanned (see rectified images, Appendix 9-8) and a measured record of the site undertaken by ADCO in 2021. A conservation strategy has been proposed that involves archaeological assessment of the fabric of the fallen stone lintels (Appendix 9-8) and recovery of stone from the river. As part of the works, the significance of the Clapper Bridge is high, and the magnitude of impact is low resulting in an **indirect, moderate, negative and short-term (temporary**) impact.

9.6.19 There are no specific flood works located at the holy well known as Lady's Well (KK029-018007) and there is no impact from proposed flood works as there are no proposed infrastructure works in the vicinity of the well.

9.6.20 At the Globe (Protected Structure C133) works will focus on reducing the size of a window ope to a modern addition at the rear of the building (river side) so a flood proof render can be applied to the foundations and lower elevation of the building. This action will protect against flooding in the future. The significance of the impacted area of the building is low being of late 20th century construction, and the magnitude of the impact is low resulting in a slight negative impact. Overall and in the long term, if the building can be flood proofed this will lead to a positive, moderate impact that will contribute to securing the integrity of the structure.

9.6.21 At High Street Bridge (a protected structure, C647), no flood works will take place in the vicinity of this bridge and therefore no direct impact is anticipated. As works will take place upstream and downstream of this heritage asset and in the wider setting of the bridge, vibration monitoring is recommended. Minor works to repair the upstream spandrel walls to protect the structure will assist in the long-term protection of the structure and it is recommended that this is carried out via an agreed method statement with the authorities. The significance of the structure is medium, and the magnitude of the impact is low resulting in a **direct, slight to moderate positive and long-term** impact. The

application of flood relief works in the wider area will be beneficial in the long run, protecting this structure from further flood events and possible damage.

Area 3- Turf Market (High Street Lower) – River Duiske Character Area

9.6.22 Limited in river works are proposed along this section of the River Duiske. The street frontage and protected structures along Main Street (C654 and C134) will not be impacted by the Proposed Scheme. Separate rubble stone structures built on the former rear plots of the protected structures align the River Duiske. The impact will occur in the river channel and the treatment of the existing river wall. The river channel has been subject to an in-river inspection, and a laser scan survey has taken place so there is a full and accurate record and a rectified survey of the structures and boundary types that align the River Duiske.

9.6.23 The channel has been previously disturbed as there is an existing sewer line immediately to the west of where the proposed mini-piles for the bored pile wall will be placed. The existing railing and pedestrian concrete bridge will be removed. A new bored pile flood defence wall will be built and will be designed to be stone clad on both sides (Drawing 1442, Sketch C). The concrete walkway (0.5m in width) will be replaced.

9.6.24 Works will take place in the river and given the level of previous disturbance, the importance of the receiving environment is determined to be low, and the magnitude of impact is low resulting in a **direct, slight, negative** impact during construction to the river channel.



Figure 9-18 Rectified image of the structures and walls that align the River Duiske (Philips & Associates 2024)

Area 4 – Turf Market to the Hub – River Duiske Character Area

9.6.25 Works will take place in the river at basement level of the dwelling known as ‘Step House’ (C138, Protected Structure) which is located on Market House Lane. There will be no impact to the dwelling, but mini pile walling will be excavated in the river channel adjacent to the concrete plinth and steel supports that provide the foundations for the modern overhang structure that adjoins the dwelling. The raised wall defence has been devised to the engineer’s specifications and designed to the conservation engineer’s specification (Drawing 1442, Sketch C). A connection to the proposed storm drainage in the rear yard will prevent flooding in the basement and rear yard (engineering drawing 1433). The

protected structure is of high significance, positively contributing to the historic character of the area, the magnitude of impact is indirect and low to negligible resulting in an **indirect, slight, negative** impact during construction. In the long term, the building will be protected from a flood event resulting in a **slight, positive** impact once mitigation measures have been applied.

9.6.26 As a precautionary approach and even though no work and no direct impact is anticipated in the environs of the Market House, vibration monitoring of the protected structure will take place. The significance of the Market House (Protected Structure, C137) is high due to its architectural composition, place within the streetscape of Graiguenamanagh and from a social aspect and the magnitude of impact is negligible resulting in a **not significant and indirect** impact.

9.6.27 Stone walling (CH05) and historic stone buildings (CH06 and CH07) along the northern bank of the River Duiske will be retained with a reinforced pile driven concrete wall placed in front of the existing walls along the riverbank. This wall will be designed and use reclaimed river stone facing, recessed mortar with 5-7mm grit and pinning stones to the conservation engineer's specification (Drawing 1442, Sketch D, and Drawing 1418).

9.6.28 These stone walls and structures are not designated assets but add greatly to the attractive built heritage and riverine environment of Graiguenamanagh and contribute to the historic sense of place. As such the significance of the walls and buildings that align the lower River Duiske is medium and the magnitude of impact is medium given the proximity of the work to the historic walls. The significance of **this indirect impact is negative, permanent and moderate**.

9.6.29 In the long term, the flood defence works will stop future flood events that negatively affect the buildings that align the river and will have a positive effect on the historic built heritage.

9.6.30 Peg Washington's Lane (CH08) is located adjacent to the northern bank of the River Duiske and affords access to the water in between the existing buildings. As a raised wall defence is now proposed to a height of 1.1m above ground level (Drawing 1418), there is now an indirect impact to the lane as there will be restricted access to the river. The cultural heritage asset is of medium importance while the magnitude of impact is indirect and low, resulting in a **slight, indirect and negative** impact.

9.6.31 The laneway to the north of CH07 will be excavated as part of the storm drainage proposal for the scheme. This excavation will extend into the front yard of a gated property at the end of the lane and will traverse with the property's enclosing stone wall to connect to the pump station (No. 3) in the Hub area (CH09). There is the potential to reveal below ground archaeological remains and historic structures. As such, given the potential for subsurface archaeological features to be identified and based on current information, the sensitivity of the area is low and the magnitude of the impact is low, resulting in a **direct, negative and slight impact**.

9.6.32 Works will take place upstream and downstream in proximity to the footbridge (CH10). The bridge affords access to the Hub. An outfall from a storm drain will impact the supporting wing wall of the bridge. The construction will entail the removal of the

upstream section of the wall permanently. It is an objective to attempt to retain the remaining wall, but if it needs to be removed due to safety considerations, it will be reinstated under conservation engineering supervision.

9.6.33 As the wall is of local interest and part of the character of the riverscape, it is of a low/ medium significance, the magnitude of impact of its partial removal is a medium impact resulting in a **direct, negative and moderate impact** due to the loss of character and integrity at the bridge site.



Plate 9-1 View of bridge and support stone side wall (CH10)

Area 5 – Boat Club (Barrow Way-Boat Club) – Boat Club Character Area

9.6.34 There are no recorded monuments within this area.

9.6.35 The field proposed for an earthen embankment and a compound (CH04) has been subject to archaeological investigation and the below ground archaeological potential is determined to be low. The significance of the receptor is low, and the magnitude of the impact is low resulting in a **slight** impact.

9.6.36 The gateway and walling to the above-mentioned field is to be retained, a modern wall that forms stone seating (CH12) fronting onto the quay and located at right angles to the gateway will be replaced by a proposed flood defence wall (Drawing 1424 and 1411). Outfall pipes are proposed to traverse the quay. The area is of low in archaeological potential and the significance of the cultural heritage receptors are determined to be low. The magnitude of the impact is considered to be low, resulting in a **not significant** impact.

Area 6 – Graiguenamanagh Quay (Boat Club–Graiguenamanagh Bridge)– Graiguenamanagh Quay Public Realm Zone including Duiske Abbey Precinct Area

9.6.37 This is a landmark area in the centre of Graiguenamanagh, the quay is of importance for the associations with the industrial legacy of the town having been the point where raw and processed materials were shipped to and from warehouses by boats navigating the

River Barrow. Duiske Abbey forms a picturesque backdrop to the quay, enhancing its historic character. Even today, the abbey stands as a dominant visual presence in the existing townscape.

9.6.38 Items of a cultural heritage interest are described from an east to west direction.

9.6.39 There will be no direct impact to the existing gate, piers and low stone walls (NIAH 1218003) and they will remain in place with the new flood wall to be placed to the north of them (Drawing 1442, Sketch F). There is an indirect impact due to the proximity of the proposed works and with the wall behind the gate, the gate will become a decorative feature and non-functional. The cultural heritage asset is medium in importance, and the magnitude of impact is low resulting in an **indirect, slight and negative** impact.

9.6.40 A random rubble stone wall (CH13) of a former building facing onto Graiguenamanagh quay will be removed by the line of the proposed flood defence walling. Testing (Test pit IP-09b) has shown that the foundation of the mortared stone wall extended to a depth of 0.78m. The section of wall to be removed is considered to have a low significance and the magnitude of impact is low resulting in a **slight negative** impact.

9.6.41 A number of buildings that face onto Graiguenamanagh Quay are designated for their heritage and architectural value and form an attractive quayside of houses and a former warehouse that acts as a reminder of the industrial legacy of Graiguenamanagh throughout the nineteenth and early twentieth centuries. These buildings are the waterside guesthouses (C149), a house (C635), a shop (C140) and a house (NIAH 1218005). The works will lead to an **indirect and temporary, negligible and negative** impact during construction as works will take place in proximity to these buildings. However, once the flood relief scheme is built the overall impact is a **direct, positive, and permanent** impact as these structures will be protected against future flood damage.

9.6.42 There is significant potential that subsurface remains associated with the Duiske Abbey could be revealed as a result of the proposed works. The flood relief defences have been designed to maintain the existing quay wall in place. However, there will be excavations taking place along the quay road to accommodate storm drainage and sheet piling associated with the new flood defence walling. As demonstrated by archaeological testing, under Ministerial Consent (E005772, R000749 and C001049) features such as organic deposits and walls were revealed (sections 9.5.106-9.5.116) in five test trenches (A-E). In Trenches A and B, a dark organic layer containing charcoal was identified, in both cases at 1.1m beneath the tarmac road surface. Sondages excavated indicated a depth of between 0.12m – 0.35m and no dateable finds were evident in this layer, but it is interpreted as being of archaeological potential.

9.6.43 In trenches C and D remnants of a wall was present, oriented NE-SW in line with the current quay wall located c.5m away, it could represent an earlier quay wall. In both trenches the wall had been truncated on its SE side, leaving only the NW face intact and it was identified between 0.65m and 0.85m below the tarmac road surface. The mortared wall measured a maximum of 0.43m wide and 0.3m in surviving height.

9.6.44 In Trench E, a wall oriented NNW-SSE was uncovered at a depth of 0.5m beneath the tarmac road surface and appears to be aligned with the transept wall of the Abbey. The

alignment of the wall may indicate an association with the Abbey, but its location does not appear to suggest a precinct wall. Only the east face of the wall, which is mortared, and a rubble core were present in the trench, indicating a width of at least 0.9m and a sondage indicated a surviving height of 0.55m. A metalled surface was also identified in the NW end of the trench at 0.47m below the tarmac surface.

9.6.45 Graiguenamanagh Quay (D152, a protected structure, Appendix 9-8) is a landmark site at the centre of Graiguenamanagh. The flood defence works have been designed in order to preserve the quay wall in place. There is a high archaeological potential to reveal buried archaeological features along the quay given the proximity of Duiske Abbey, a national monument and there is also a potential to reveal below ground associated features such as a precinct wall. The magnitude of the impact is considered to be potentially high, given the level of excavation, resulting in a direct, **significant and permanent** impact.



Image 9-3 Trench layout shown on aerial imagery (Mapgenie 2013-2018)

9.6.46 At Graiguenamanagh Bridge (C125, Appendix 9-8), the returning wall that extends along the quay to the ESB substation shall be retained in-situ. A low wall will be placed in front of the existing stone wall, to the north of it and the ground level shall be built up. There is no direct impact to the bridge. However, the approach and setting to the bridge shall be altered by the walling and upgrade of public realm works. Photomontages PM04 and PM05 capture the visual alterations of the area, at the quay and along Dock Road. There is an indirect impact to the setting of the bridge on the northern quay, public realm works are taking place to enhance the approach and provide a holistic designed solution to the receiving hard surface environment, providing a **moderate positive** impact. Modern

sculptures at the bridge will be removed, securely stored and reinstated in a location agreed with the local authorities.

Area 7 – The Dock (Graiguenamanagh Bridge to the Hub Bridge) – The Dry Dock

9.6.47 There is potential to reveal below ground archaeological features during the excavation of for the pump station works. The Dock Road is located within Graiguenamanagh ACA and partly located with the ZON for the historic town as shown on the Historic Environment Viewer (HEV). The area is considered to have a medium archaeological potential. The magnitude of the impact is considered to be potentially medium, given the level of excavation, resulting in a **moderate negative** impact.

9.6.48 The Dry Docks at Graiguenamanagh are a protected structure and present as an area of silted up remains where the sidewall are still visible (D160, Appendix 9-8) and derelict structures. It is a substantial structure that is intimately connected with the 18th century engineering works within the River Barrow. The docks were where vessels could be built and repaired. The Dry Docks are located on the riverside of the flood defence walls and will leave the remains undefended from future flood events. As an item of 18th century engineering, the significance of the receptor is high.

9.6.49 Due to its location on the river's edge, the Dry Docks area is periodically inundated with water. Preventing this flooding, while also incorporating a flood relief solution, presents a challenge for this riverside structure. As part of the Proposed Scheme, access to the area will be maintained; however, the magnitude of flooding will remain unchanged. The flood relief measures will neither assist, enhance, nor ameliorate the current flooding situation in this area. Consequently, the magnitude of impact is considered neutral or negligible. Overall, the significance of the impact is predicted to be **indirect, negative, and imperceptible—not significant** in terms of any change to the existing condition. The area will remain unprotected by the proposed works and will continue to flood as it has in the past.

9.6.50 The proposed works will require the demolition of a vernacular, disused and ruined structure, known locally as Fenlon's House (CH11A). As a derelict and disused built heritage feature, the significance of the structure is low and the magnitude of impact is high due to its proposed removal, resulting in a **direct, negative and moderate/significant** impact on the remaining structure,

9.6.51 On the Dock Road, the walling adjacent to Graiguenamanagh Bridge will be retained in situ. Photomontages PM05 capture the visual alterations due to the public realm enhancement measures of the area, at the quay and along Dock Road.

Area 8 - The Hub

9.6.52 The entrance gate, ashlar pillars and walling will be removed. The significance of the cultural heritage receptor is low. The magnitude of the impact is medium, resulting in a **direct, negative, and slight-moderate** impact.

9.6.53 Works taking place in the Hub area are shown on drawing 1414. The area is now used as an activities hub and is located upland on the northern bank of the River Barrow. The area has been subject to geophysical survey and no below ground anomalies were revealed.

The area has been previously disturbed to put in place the utilities and infrastructure for the caravan park. The archaeological potential of the land is low, and the magnitude of impact is low resulting in an overall **direct, not significant/ slight** impact.

9.6.54 Where the Duiske flows into the Barrow, the banks are formed of clay and there has been some level of disturbance with the insertion of gabion baskets to hold the banks in place. Where the proposed flood gate is proposed, the banks and River Duiske has experienced previous disturbance. This section of the River Duiske has been subject to an archaeological wade survey, metal detection and impact assessment (ADCO 2021). At this location, where the flood gate is proposed, the river has a low potential due to previous disturbance and the magnitude of impact is low resulting in a **direct, negative and slight,** impact.

Area 9 - Hotel Street – Tinnahinch Riverbank East Character Area

9.6.55 The green field (CHZ06) (Appendix 9-8) that fronts onto the River Barrow at Tinnahinch will facilitate, as part of the flood defences, an earthen embankment, storm drainage infrastructure and walling and a compound (E) to store the bulk materials.

9.6.56 This area is of archaeological potential as it is shown to be undisturbed from the first edition 6-ich OS onwards. Archaeological geophysical survey (identified as Area C in the Terradat report, 2024) was proposed as part of the EIAR process, but access could not be gained.

9.6.57 The area is considered to have a medium archaeological potential. The magnitude of the impact potentially medium to high, given the level of excavation, resulting in a **moderate** impact.

9.6.58 Modern memorials commemorating locals Eddie Power and Mechie Fitzgerald (CHZ06) are located to the west of the field. If the memorials cannot be avoided and protected in situ by fencing, they will have to be removed and stored securely and reinstated once the work has been completed.

9.6.59 The tow path (CH14, Appendix 9-8) on the southern bank of the River Barrow may be subject to a temporary impact during the FRS works. The impact will be confined to one specific area where an outfall is proposed as part of the storm drainage works. The area is considered to have a low-medium archaeological potential being adjacent to a river. The magnitude of the impact is slight, given the localised nature of the works, resulting in a **direct, negative and slight** impact.

Area 10 – Tinnahinch Quay Public Realm Character Area

9.6.60 Tinnahinch Quay (CH17, Appendix 9-8) is considered to have a low to medium archaeological potential. The magnitude of the impact is considered to be potentially medium, given the level of excavation, resulting in a **direct, negative and slight - moderate** impact.

9.6.61 This is no direct impact to the mill race (CH15, Appendix 9-8). At the eastern end of the mill race it is proposed to increase the defences around it by building a new flood defence wall. As an item of cultural heritage interest, the mill race of medium-low significance and the

magnitude of impact is considered to be negligible giving rise to a **not significant** impact. As works will be occurring in proximity to this historic structure it is proposed that vibration monitoring will take place.

Compound and Site Clearance Works

9.6.62 Compound (Sites A-E) and Site clearance works includes the following:

- Establishment of site access
- Establishment of compounds
- Demolition of existing structures
- Clearance of brush, scrub and trees identified for felling.

9.6.63 Compound A, (Appendix 9-8, CHZ09) is located at the upstream storage area, the significance of the receiving greenfield area is low, and the magnitude of impact is low resulting in a **slight, negative and direct** impact.

9.6.64 Compound B, (Appendix 9-8, CHZ07) is located within the grounds of Tirlán Farmlife on a hardcore surface. The site already has a suitable surface and will not require any excavation works, therefore there is no potential to reveal buried archaeological remains.

9.6.65 Compound C, (Appendix 9-8, C651) is located at Well Lane on Mill Road in a brown field site that was cleared (but is now overgrown with vegetation) sometime between 2013-2018. The surrounding walls of the former protected warehouse survive in various states of repair. The significance of the receiving brownfield area is low, and the magnitude of impact is medium resulting in a **slight/medium, negative and direct** impact.

9.6.66 Compound D, (Appendix 9-8, CHZ04 and CHZ05) is located at the Boat Club Character Area in two separate fields (greenfield areas) on either side of the existing Boat Club along Graiguenamanagh Quay. The fields have been subject to archaeological investigation (geophysical survey and monitoring of SI works) and the below ground archaeological potential is determined to be low. The significance of the receptor is low, and the magnitude of the impact is low resulting in a **slight, negative and direct** impact.

9.6.67 Compound E (Appendix 9-8, CH06) is located within the greenfield area to the south of the River Barrow to store bulk material for the embankment construction and reinforcement for structural concrete works at Tinnahinch. The area is considered to have a medium archaeological potential. The magnitude of the impact is potentially medium to high, given the level of excavation, resulting in a **moderate, negative and direct** impact.

Operation and Maintenance Phase

9.6.68 KCC will be responsible for the maintenance of the scheme within their boundaries. Likewise, CCC will be responsible for the maintenance of the scheme within their boundaries. An assessment of impacts is provided in Appendix 9-8 and Table 9-10 (Section 9-13) details pre and post mitigation impacts.

9.7 Mitigation Measures

9.7.1 The proposed construction period is an estimated 36 to 42 months. The construction period has been estimated to allow for poor weather over the winter months, mobilisation between sites, seasonal ecological restrictions and archaeological resolution. Advance archaeological works will take place prior to the construction stage of the project. The estimated period for individual locations is presented in Table 4-17.

Construction Phase

CH_1: Due to the complex nature of the work packages proposed for this scheme, it is proposed that an **OPW Project Archaeologist (PA)** will be made available to provide oversight of all archaeological, architectural and cultural heritage commitments.

CH_2: A competent archaeologist experienced in riverine and terrestrial archaeology will be appointed directly by the client to advise the project team on archaeological and cultural heritage matters during construction; to acquire any consents required to conduct the work, and to supervise and direct the archaeological measures associated with the scheme, coordinate the archaeological element of individual work packages and to ensure that all work is carried out to the required standard (i.e. a scheme wide Project Archaeologist). The appointment of the experienced riverine/underwater archaeologist will be separate to the appointment of a project archaeologist by the Office of Public Works or other project sponsor to oversee those parties' interests in the scheme.

CH_3: As recommended by the National Built Heritage Service (NBHS), **a project conservation engineer will be retained** where appropriate during the preparation of the tender/ works package, construction and reinstatement stages of the FRS. The conservation engineer will ensure that the specifications and methodologies outlined in Drawings 1441 and 1442 are carried out in full and that the work is to an appropriate standard. Methodologies are to be agreed with the NBHS in advance of works.

CH_4a: Recording of upstanding walls and bridge side walls to be replaced and reinstated as part of the proposed FRS will be recorded in advance of construction. This will include a written and photographic record and scaled drawings and will serve to provide a record of the past. The record will note the capping stones, the coursing of the original masonry, where it exists or is preserved. Random rubble masonry will require the retention of all pinning stones so that the rhythm and texture of the original may be replicated and where it is built to courses, the same attention to coursing is essential. The dismantling will be carried out by hand. When construction of the flood walls are complete, the boundary walls will be rebuilt to match the original wall construction. Where a boundary wall will be removed and will not be rebuilt such as CH13 on Graiguenamanagh Quay the stone will be salvaged and reused within the scheme.

CH_4b: Recording of buildings and areas – CH11A Removal of vegetation and full recording of structure by scaled drawing, laser scan and written record will ensure that there is a record for posterity. Mitigation measures to include a written and photographic record and scaled drawings (plan and elevation) of the structure and an internal record, will serve to provide a record of the past.

CH _5: Vibration monitoring will take place on neighbouring structures and walling of a heritage and historic interest to limit accelerations to 3mm/s of any pile driven works. Buildings and structures where vibration monitoring will take place are detailed in Appendix 9-8 and Table 9-9 (including CH04, CH05, CH06, CH07, CH08, CH10, CH15, CH17, KK029-018008, C125, C149, C140, C635, C17, C18, C648, D152, C647, C654 rear of and C134 rear of). See also Chapter 15 'Noise and Vibration'.

CH_6: The safe storage and reuse of historic material, specifically stone (salvaged stone) will take place throughout the project as directed by the conservation engineer and where detailed in Table 9-9 and in agreement with the statutory authorities. For further information see also Appendix 9-8.

CH_7: Archaeological Testing was not suitable for some areas of the scheme due to restricted access to private lands, restricted spaces, existing walls, roads and services. Archaeological test excavation is proposed to take place in the following locations:

- Area 7 - Dock Road to assess the below ground potential of the proposed storm drainage infrastructure and pumping station.
- Area 9 – Assess the greenfield environment of Hotel Street/ Tinnahinch Landscape East Zone and the archaeological potential of the lands where a raised embankment and subsurface drainage and pumping station is proposed.
- Area 1 – Upstream storage area, even though the impact is slight, test excavation of the proposed works (Drawing 1421) has the potential to identify small and isolated features of an archaeological nature (if they exist), gather more information about the stratigraphy and soil and to inform the design and construction tender specifications.
- Area 6 – Further assessment of the Graiguenamanagh Quay Public Realm Zone (Duiske Abbey Precinct Area) in the form of wider box trenches in order to reach deeper levels to ascertain if features associated with a precinct wall and abbey or earlier quay side features exist. This work is to be carried out under Ministerial Consent (see CH_8: Archaeological excavation).

Testing is to take place in advance of construction and site enabling works. The results will inform the construction stage tender packages and will allow for the appropriate timing of the archaeological resolution once agreed with the National Monuments Service (NMS).

Mitigation of the impact of development on the archaeological resource can take the form of 'preservation by record' (full hand excavation); and 'preservation in situ by design' (excluded from development and avoided through design measures) or a combination of both.

Where archaeological features revealed by the test-trenching, are directly impacted by the proposed works and cannot be avoided (preserved in-situ), they will be preserved by record by means of archaeological excavation, recording and publication of results.

CH_8: Archaeological excavation ensures that the removal of any archaeological soils, features, finds and deposits is systematically and accurately recorded, drawn and

photographed, providing a paper and digital archive and adding to the archaeological knowledge of a specified area (i.e., preservation by record). As archaeological excavation involves the removal of the archaeological soils, features, finds and deposits, following this mitigation measure there is no further impact on the archaeological heritage. It is proposed that archaeological excavation along Graiguenamanagh Quay will take place as an advance contract to further understand and record the organic deposits and walls that were revealed from archaeological testing along the road where excavation works will take place for the development of the flood defence works.

Prior to construction, further archaeological investigation will be undertaken at the quayside through an advance archaeological contract. This will involve the excavation of features previously identified during testing, where they are likely to be affected by the proposed development. Subject to agreement with the National Monuments Service (NMS), the excavation will follow a wider box trenching layout to facilitate access to deeper levels and enable more comprehensive archaeological inspection and recording. This approach is intended to prevent delays during the construction phase by ensuring that any archaeological features encountered can be addressed in a considered and timely manner.

The targeted areas for further investigation include extensions to Trenches A–E along the alignment of the proposed works, including the sheet piling. The proposed box trenches, to be agreed with the NMS, will typically measure approximately 5 metres southeast–northwest by 2–3 metres northwest–southeast. Additionally, a trench of similar dimensions will be opened outside the entrance to the supermarket car park, where previous archaeological testing could not be carried out.

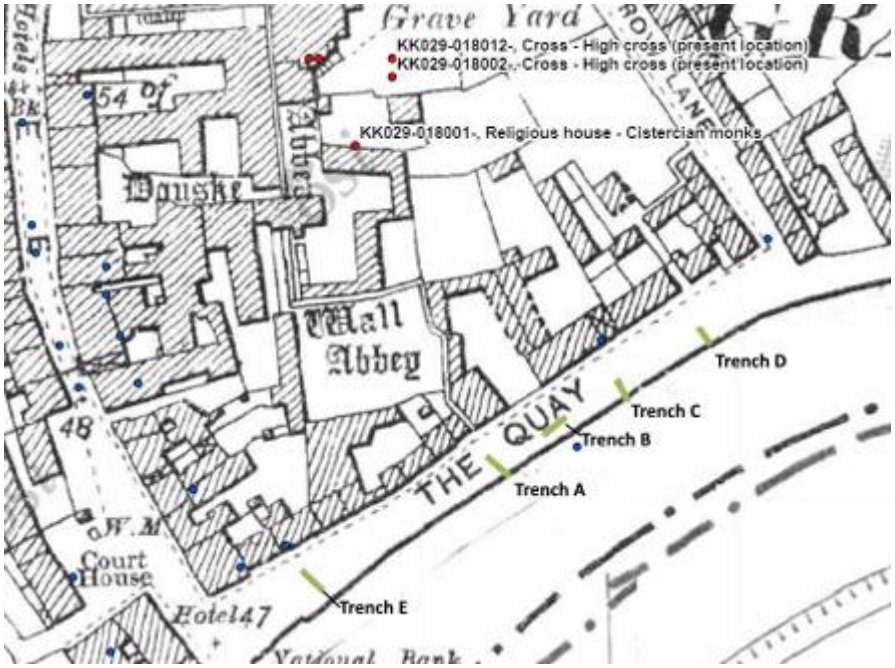


Figure 19 Previous trench layout shown on 25-inch OS mapping

CH_9: Archaeological monitoring. The construction phase will involve earthmoving activities including excavations for the construction of flood walls and provision of

construction compounds and storm drainage, pumping stations and alterations and upgrades to utility services. All earthmoving activities within Area 1 – Area 10 and site clearance works and compound areas will be subject to archaeological monitoring under licence from the NMS of the DHLGH. Archaeological monitoring will ensure the full recognition of, and the proper excavation and recording of, all archaeological soils, features, finds and deposits which may be disturbed below the ground surface. Work will also take place instream along the River Duiske and these works will be archaeologically monitored.

The licensed archaeologist will have provision to inspect all excavation to the formation level for the proposed works and to temporarily halt the excavation work, if and as necessary. They will be given provision to ensure the temporary protection of any features of archaeological importance identified.

CH _10: Archaeological Metal Detection will take place in conjunction with other forms of archaeological investigation in order to identify and recover metallic artefacts. This will take place where archaeological monitoring of the works are taking place under licence to the National Monuments Service and the National Museum of Ireland.

CH _11: Archaeological Wade Survey A visual archaeological instream inspection of the Duiske River will take place in advance of construction works and during vegetation clearance works. This is designed to assess the dynamic riverine environment and its potential, recover stray finds or items of a cultural heritage interest and identify and recover stone lintels (if they are present) that have become displaced, upstream or downstream of the Clapper Bridge.

CH_12: Modern Memorials, Statues and street furniture such as the statue of the monk at Graiguenamanagh Bridge (C125), at Graiguenamanagh Quay 9D152, the bollards and lighting and memorials at Tinnahinch (CH16 and CHZ06) will be removed to a secure location during the enabling and construction works and will be reinstated as required to an agreed location once the works have ceased if they cannot be adequately protected in situ during the course of the works.

CH_13: Consultation and notification. In the event of the discovery of archaeological finds or remains, the OPW PA, NMS and the National Museum of Ireland (NMI) will be notified immediately. If features are revealed, the immediate area will be investigated, allowing no further development to take place until the site is fully identified, recorded and excavated the satisfaction of the statutory authorities.

The provision (time and funding) will be made for the full recording and, if necessary, excavation of the archaeological material in compliance with any measures that the DHLGH and the relevant local authority deem appropriate. This possibility will be accounted for in the Project programme and budget and will be undertaken at the earliest phases of the development to allow the archaeologists sufficient time to record/excavate as required.

CH_14: The flood relief scheme will make provision to allow for, and to **fund**, the necessary heritage works including but not limited to architectural heritage recording,

archaeological monitoring, inspection and excavation works that will be needed on-site during and prior to construction, either directly or indirectly via the appointed contractor.

CH_15: Agreement of Method Statements. All method statements for archaeological works will be reviewed by the OPW PA and approved and amended as necessary before being submitted to the NMS for approval as set out in section 4.2 of the archaeology and Flood Relief Schemes Guidelines.

CH_16: As stated in CH_9, all phases of the development **including site clearance and enabling works**, for example, the preparation of site compound areas, the removal and clearance of scrub and the demolition of existing structures will be appropriately monitored, supervised and assessed where necessary by a competent archaeologist and /or conservation engineer.

CH_17: Archaeological Resolution Contract. As demonstrated in this chapter, there are significant archaeological and cultural heritage assets within the footprint of the works. In order to reduce risk post planning, some of the archaeological mitigations/resolution proposed in the mitigation recommendations of this chapter may be advanced before a main works contract, or as an early part of a main works contract before the flood defence works are commenced. This may include additional geophysical surveys and archaeological excavations/testing. This will ensure a timely resolution of any newly revealed archaeological features and that this work is carried out to the requirements of the National Monuments Service and the Local Authorities.

Follow up archaeological, architectural heritage and cultural heritage inspections (terrestrial and/or underwater) to assess that there are no residual impacts due to the operation of the FRS works.

CH_18: Preservation in situ. This is a primary objective of the archaeological heritage assessment component of FRS projects (NMS 2023). This approach was adhered to with this scheme and where possible and preservation by design have been availed of in order to maintain the historic character and individual archaeological, architectural and cultural heritage elements that contribute to this significant heritage town. Mitigations include: avoiding locations or designs containing or effecting archaeological heritage features, minimising impacts on such features and remedying any changes in context or fabric that may occur.

Operation and Maintenance Phase

CH_19: KCC will be responsible for the maintenance of the scheme in full. As a result of the scheme being developed and in operation, it must be ensured that archaeological monuments, protected structures and features of cultural heritage importance are maintained or enhanced as described in the post mitigation impacts (Table 9-10) (Section 9-13).

9.8 Monitoring

9.8.1 The scheme will be audited for compliance, and a post construction review will be undertaken to ensure that all is as predicted and committed to in relation to the level of impact on the receiving archaeological, architectural and cultural heritage environment.

9.9 Residual Impacts and Effects

Construction Phase

9.9.1 A residual effect is determined to be the degree of change to the cultural heritage environment that will occur after the proposed mitigation measures have taken effect. amended in the case of the derelict vernacular cottage (CH11A, Fenlon's), its removal will be mitigated through a detailed record and survey. However, the structure will ultimately be removed as a result of the scheme, resulting in a permanent change to the receiving environment, even after mitigation has been implemented.

9.9.2 Following mitigation, it is anticipated that there will be no further residual effects to individual heritage features located within Graiguenamanagh-Tinnahinch as a result of FRS measures. Potential impacts to archaeological heritage sites will be mitigated by archaeological investigation including, testing and monitoring, and will include, if necessary, preservation in-situ by design or full archaeological excavation (preservation by record) and architectural features will be recorded and addressed by conservation measures. The overall predicted residual impact to heritage sites will be minimal during the construction stage. However unforeseen residual impacts may occur during the operational and maintenance phase, and these are discussed above.

9.9.3 The potential impact to the setting of the ACA of Graiguenamanagh is determined to be Not Significant, as this was mitigated by a designed approach to the works that minimised interaction with the upstanding heritage features and protected their presentation through conservation solutions. The public realm works further address the individual character areas to provide a cohesiveness and an enhancement of the heritage assets within the townscape and along the River Duiske and at the quayside. Furthermore, the result of the proposed FRS will be in providing protection from a flood event, protecting the ACA, its individual elements (designated and non-designated) and its character from flood related impacts to built heritage and setting. The overall residual impact to the ACA is therefore predicted to be a slight positive significance of effect.

9.9.1 No other significant residual impacts were identified as a result of the Construction Phase of the Proposed Scheme.

Operation and Maintenance Phase

9.9.2 As proposed in section 9.7.25, a follow up inspection, once the scheme is operational and the main works have been completed, will assess the effectiveness of certain mitigation measures. Operational monitoring will also provide a mechanism of assessing any newly identified sites and features that have been revealed as a result of the work and preserved in situ. This will ensure that no unforeseen residual impacts are occurring during the operational stage of the scheme. Follow up monitoring, will also assess that there are no

unforeseen effects to the receiving archaeological, architectural and cultural heritage environment as a result of the Proposed Scheme, such as hydrological impacts or scouring that could lead to a degradation of heritage features.

9.10 Interactions with other Environmental Effects

9.10.1 Interactions with Landscape and Visual (Chapter 11) comprise the potential for impacts to setting and visual amenity of cultural heritage receptors. Consultation between both disciplines has taken place with regard to potential impacts of the built heritage of G-T. Photomontages (PM01-PM13) demonstrate the level of change to the receiving historic environment and views and how public realm proposal seek to address this. Conservation measures such as the careful choice of material to be used to reflect the existing built heritage environment or introduce a new tone, the use of stone clad walling and flood proofing buildings with traditional materials and mortar to assist in their protection and preservation all seek to preserve and enhance the historic townscape and riverscape of the town.

9.10.2 The above in turn results in an interaction with Population and Human Health, specifically with regards to tourism and general amenity. G-T are recognised for their nationally and internationally renowned include the Duiske Abbey, Tinnahinch Castle and St. Michael's Well, and as a result are popular towns to visit. See further in Chapter 6 'Population and Human Health'.

9.10.3 Noise and vibration of the scheme has been taken into account and vibration monitors will be fitted to heritage buildings where necessary to ensure their stability (Table 9-10 and Appendix 9-8). See further in Chapter 15 'Noise and Vibration'.

9.10.4 Archaeological test trenching and excavation form an important part of pre-construction mitigation, in order to identify any archaeological finds/features. Test-trenching and excavation presents potential for silt-laden run-off to enter the watercourses, particularly during events of rainfall and/or flood. Dewatering of trenches and/or excavations gives further cause for in-river sedimentation, whereby direct pumping from sumps into the river may result in sedimented dewater effluent, if not appropriately monitored. This interaction is discussed further in Chapter 8 'Hydrology – Surface Water, as well as Chapter 10 'Biodiversity'.

9.10.5 A further interaction exists with regards to Climate (Chapter 14) under the 'do nothing' scenario, whereby continued and worsening flooding will cause further damage to those assets in the long-term. From the operation phase perspective however, the successful implementation of the Proposed Scheme has significant positive impacts for cultural heritage assets by providing protection against flooding.

9.10.6 All archaeological mitigation will adhere to all relevant mitigation measures set out in the EIAR in particular with regard those measures set out for biodiversity, landscape and water quality. In addition, the archaeological mitigation will respect relevant Irish Environmental Legislation and guidelines such as:

- Water Framework Directive (WFD) (2000/60/EC) – requires protection of water bodies from pollution and hydromorphological change.

- European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011) – enforces buffer zones near designated habitats (Natura 2000).
- Arterial Drainage Acts (if working near OPW-managed channels).
- Planning and Development Act 2000 (as amended) – includes environmental protection provisions.
- Local Authority Development Plans – often set specific setback distances for rivers.

9.10.7 The archaeologist will work in consultation with the project ecologist in sensitive habitat areas. The archaeologist will also be aware of disturbing soils that can lead to fine sediments washing into the river.

9.11 Cumulative Impacts

9.11.1 The projects whose duration of permission overlaps with the likely construction period of the proposed development (i.e., 2026 onwards) are included in developments listed in Chapter16 'Interactions and Cumulative Effects' of this EIAR have been reviewed for potential cumulative impacts.

9.11.2 No cumulative impacts to cultural heritage have been identified in the Proposed Scheme.

9.12 Limitations in Preparing the Chapter

9.12.1 Access to some private lands could not be achieved to carry out archaeological investigations. It is proposed that these investigations will be conducted post planning and in advance of the main works contract or as an early part of the main works contract before the flood defences are constructed. No other limitations were noted during the compilation of this chapter.

9.13 Summary

Table 9-8: Summary of Impacts and Mitigation Measures: Cultural Heritage

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Construction Phase Impacts						
Upstream storage area –	Area 1 - CHZ01 – River Duiske	Low	Low	Slight, direct and negative	• Archaeological monitoring by a licenced archaeologist	No Impact
Upstream storage area - Main Compound A	Area 1 - CHZ09- Greenfield potential	Low	Low	Slight, direct and negative	• Archaeological test excavation • Archaeological monitoring by a licenced archaeologist	No Impact
Debris Trap –	Area 2 - CHZ02 – River Duiske riverine potential	Low	Low	Slight, direct and negative	• Archaeological monitoring by a licenced archaeologist	No Impact
Flood proofing	Area 2 - CH01 – Riverside wall	Low	Low	Slight, positive	• Detailed recording of the boundary wall is recommended. • All works to the carried out to a specified and approved method statement. • Building works to be supervised and recorded by a conservation engineer or a suitably qualified and experience professional subject to agreement with the statutory authorities • Limited excavation adjacent to the wall will be required to protect the foundations of the structures. Archaeological monitoring of this work will take place.	Slight, positive, permanent impact

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Flood proofing	Area 2 - CH02 – Stone Building	Low	Low	Slight, positive	• Detailed recording of the boundary wall is recommended. • All works to the carried out to a specified and approved method statement. • Building works to be supervised and recorded by a conservation engineer or a suitably qualified and experience professional subject to agreement with the statutory authorities. • Limited excavation adjacent to the wall will be required to protect the foundations of the structures. Archaeological monitoring of this work will take place by a licenced archaeologist.	Slight, positive, permanent impact
Raising the ground level locally and flood proofing of adjacent buildings (CH01, CH02)	Area 2 - CH03 – Riverside walk	Low	medium	Direct, Slight, Negative and Short Term	• Archaeological monitoring will take place throughout all earthmoving and in water river works. • Reinstatement of existing walk to original form.	No impact

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
No infrastructure works in vicinity of the well. Tanking of CH01.	Area 2 - KK029-018008 – Clapper Bridge	High	Low	Indirect, Moderate, Negative and Short Term	• Identified to the contractors (enabling and main works) as a recorded monument. • During the course of the works, temporary protection measures will be placed around the bridge including signage. • Vibration monitoring is recommended as works will take place up and down stream in the Duiske River. • A visual archaeological instream inspection to recover displaced stone lintels.	Moderate, positive, long term/ permanent impact
No infrastructure works in vicinity of the well	Area 2 - KK029-018007 – Holy Well	Medium	No impact	No impact	• Identified to the contractors (enabling and main works) as a recorded monument. • All proposed landscaping works in the wider setting of the monument to be approved by the Project Archaeologist and the statutory authorities.	Slight, positive and long term/ permanent impact
Flood proofing works to a protected structure	Area 2 - C133 – The Globe (Protected Structure) Work will be carried out to a modern extension to the rear of the structure	Low	Low	Direct, Slight and Negative	• All works to the carried out to a specified and approved method statement. • As the fabric to the removed is not historic in nature no further oversight is required by a conservation engineer. • Archaeological monitoring by a licenced archaeologist.	Moderate, positive, permanent impact

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
No flood relief works	Area 2 - C647 – High Street Bridge (Protected Structure)	Medium	No impact	No impact	• Vibration monitoring is recommended as works will take place up and down stream in the Duiske River. • Localised pointing in lime mortar on the upstream spandrel wall will assist in the long-term protection of the bridge. • All repair works to be carried out via an agreed method statement with the authorities.	Slight/ Moderate, positive, long- term impact
Raised defences	Area 3 - C654, C134 (Protected Structures) and rubble stone outhouses.	Low	Low	Slight, indirect, negative	• Archaeological monitoring by a licenced archaeologist • Flood defence wall to be designed to the specifications of the conservation architect. • Vibration monitoring on neighbouring structures to limit accelerations to 3mm/s	Slight, positive
Raised defences	Area 3 - C648 Protected Structure	Medium	Negligible	Not Significant, indirect	• Vibration monitoring on neighbouring structures to limit accelerations to 3mm/s	No impact
Raised defences	Area 4 – CH04 Bridge The structure is in proximity to piling works in the river further downstream	Low	Low	Slight, indirect, negative	• Vibration monitoring on neighbouring structures to limit accelerations to 3mm/s	No impact

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Raised wall defences	Area 4 - C138 – Protected Structure, Step House	High	Low/ Negligible	Slight, indirect, negative	• Archaeological monitoring by a licenced archaeologist • Flood defence wall to be designed to the specifications of the conservation architect. • Vibration monitoring on neighbouring structures to limit accelerations to 3mm/s	Slight, positive
To the north of the proposed FRS works	C137 The Market House This is located to the north of Area 4 Turf market to the Hub	High	Very Low/ Negligible	Not Significant	• Vibration monitors will be placed on this structure to limit accelerations to 3mm/s	No impact

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Raised wall defences	Area 4 Stone walls (CH05) and former stone stores/ warehouses (CH06 and CH07)	Medium	Medium	Moderate, indirect, negative	• Archaeological monitoring by a licenced archaeologist • Flood defence wall designed to the specifications of the conservation architect. • Vibration monitoring on neighbouring structures to limit accelerations to 3mm/s • Any repairs required to existing stone walls as a result of the proposed works will be undertaken by experienced stone masons. • In advance of the works, all vegetation is be cleared from the existing stone walls and the walls are be recorded by laser scan digital survey and appropriately annotated by a conservation engineer or experienced professional. A digital and written record is to take place, so the existing built environment is fully recorded.	Slight, positive

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Raised wall defences	Area 4 - CH08 – Peg Washington's Lane	Medium	Low	Slight, indirect, negative	• Vibration monitoring will take place of the structures (CH06 and CH07) adjacent to the laneway to ensure that if there is any movement recorded as a result of the works, amelioration procedures can be put in place to protect the masonry structures. • Archaeological monitoring by a licenced archaeologist • Flood defence wall designed to the specifications of the conservation engineer.	Slight, negative
Storm Drains	Area 4 - CH09 – gated private property and stone wall	Low	Low	Slight, direct and negative	• A full architectural heritage survey (scaled drawing and written description) will take place of the section of stone wall in advance of its removal. • The wall will be reinstated to the requirements of a conservation engineer with the assistance of stone masons. • All excavation works associated with the storm drainage will be archaeologically monitored.	Slight, direct and negative

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Raised wall defences	Area 4 - CH10 Bridge and supporting stone wall	Low/ Medium	Medium	Direct, negative and moderate	• The stone wall will be subject to a full photographic and descriptive survey. Its removal, safe storage of the stone blocks for reuse and reinstatement where possible will take place under the supervision of a conservation engineer. • Vibration monitors will be put in place to ensure that there is no damage as a result of sheet-piling in the vicinity of the structure. • Where works are taking place, archaeological monitoring and recording will take place within the river channel.	The wall will be removed as a result of the scheme.
Proposed Flood Gate	Area 4 and Area 8-CHZ02 – Duiske River	Low	Low	Slight, direct and negative	• Archaeological monitoring by a licenced archaeologist.	No impact
Embankment and compound	Area 5 – CH04 – greenfield potential	Low	Low	Slight, direct and negative	• Archaeological monitoring by a licenced archaeologist.	No impact
Raised flood defences and outfall pipes	Area 5 – CH12	Low	Low	Slight, direct and negative	• Archaeological monitoring to take place in the green field environment and any excavation works required for the quay road. The removal of the stone wall and seating will be recorded by a description and photographic record. Area to be archaeologically monitored.	No impact

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Flood defence wall	Area 6 – NIAH 1218003 – gates/ railings/ walls	Medium	Low	Slight, indirect and negative	• A full architectural heritage survey (scaled drawing, written description and photographic record) will take place of the stone wall and gate. • New defence walling to the conservation engineers' specification. • Vibration monitors will be put in place to ensure that there is no damage • All excavation works will be archaeologically monitored.	Retained and Slight, indirect and negative
Flood defence wall	Area 6 – CH13 – Wall of a former building	Low	Low	Slight, direct and negative	• A full architectural heritage survey (scaled drawing, photographic record and written description) will take place of the stone wall. • All excavation works will be archaeologically monitored.	This will be recorded and removed.

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Flood defence wall, storm drainage, lighting, utility changes and public realm works	Area 6 Graiguenamanagh Quay (D152)	High	High	Significant, direct and permanent	• The quay wall and environment are to be retained and a designed solution where the flood defence wall is set back from the water's edge is preferred. • Vibration monitors will be put in place to ensure that there is no damage damage to the structural integrity of the protected quay. • Archaeological Monitoring of SI works and testing under Ministerial Consent has taken place. Organic deposits and walls have been revealed in Trenches A-E. • Prior to construction, advance archaeological excavation will take place where these features will be affected by the proposed development. • Archaeological monitoring will take place along the quay and on Main Street where there will be opening up/ excavation works.	Providing a further understanding of the below ground archaeology of the quay and possible association with Duiske Abbey. Public realm proposals to provide a cohesiveness and enhance the historic structures along the quay
Flood defence wall, storm drainage, lighting, utility changes and public realm works	Area 6 Graiguenamanagh Quay – properties - (C149, C635, C140/ NIAH 1218005)	High	Low	Negative, Indirect, negligible and temporary	• Vibration monitors will be put in place to ensure that there is no damage to the structural integrity of the dwellings, properties and retail outlets that align the quay road. • Archaeological monitoring will take place along the quay and on Main Street where there will be opening up/ excavation works.	Protection against flooding will be positive, direct and permanent

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Flood Defence Walling, public realm works and utility relocation	Area 6 and Area 7 Graiguenamanagh Bridge (C125)	High	Medium	Indirect, moderate positive	• A full architectural heritage survey (scaled drawing, photographic record and written description) will take place of the approach stone wall. • Vibration monitors will be put in place on the bridge to ensure that there is no damage due to works in proximity to the structure. • All excavation works in the vicinity of the bridge will be archaeologically monitored. • Modern sculptures will be removed, securely stored and reinstated in a location agreed with the local authorities.	Public realm proposals to enhance the setting of the historic bridge
Flood defence wall and storm drainage	Area 7 – The Dock The Dry Dock (D160)	High	Neutral or negligible	Indirect negative and imperceptible-not significant	• This area lies outside the proposed flood relief works. • Ultimately the physical site and this important aspect of the Barrow Navigation and the ingenuity of 18th century engineering will probably be lost over time as it remains unprotected by the proposed works.	No change in impact level

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Flood defence wall and storm drainage	Area 7 – The Dock Vernacular structures including Fenlon's dwelling (CH11A)	Low	High	Moderate/ Significant	• A scaled drawing survey, photographic and descriptive record is proposed of the structure and its surrounds prior to any work taking place in this area. • Archaeological monitoring to take place of any excavation works required for the Dock Road. • The removal of the structure to be archaeologically monitored.	The structure will be removed as a result of the scheme.
Storm drainage	Area 8 – The Hub Entrance gate, ashlar pillars and walling (CH11)	Low	Medium	Slight-Moderate, direct and negative	• It is proposed to record this modern entrance features and rebuild it at an appropriate location.	The entrance feature will be reinstated slight, direct and negative
Embankment, walling, and public realm upgrades,	Area 8 – CHZ08 The Hub. Green field potential	Low	Low	Not significant/ slight, direct and negative	• Archaeological Monitoring during the construction programme. • Archaeological monitoring will take place to works adjacent and within the River Duiske.	No further impact
Flood Gate –	Area 2 - CHZ02 – River Duiske riverine potential	Low	Low	Slight, direct and negative	• Archaeological monitoring by a licenced archaeologist	No further Impact
Outfall as part of the storm drainage	Area 9 – Hotel Street-Tinnahinch Riverbank East	Low-medium	Low	Slight, direct and negative	• All earthmoving and excavation works will be archaeologically monitored.	No further impact

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Flood Defence Wall/Drainage/ Public Realm Works	Area 10 – CH17 (ADCO 17) Tinnahinch Quay	Low-medium	Medium	Slight-Moderate, direct and negative	• New defence walling will be to the conservation engineers' specification. • Vibration monitors will be put in place to ensure that there is no damage to adjacent structures such as Graiguenamanagh Bridge and the former boathouse • All excavation works will be	Slight and Positive
Flood Defence Wall	Area 10 – CH15 (ADCO 18) Tinnahinch Quay - Mill Race	Low-medium	Negligible	Not significant and indirect	• New defence walling will be to the conservation engineers' specification. • Vibration monitors will be put in place to ensure that there is no damage All excavation works will be archaeologically monitored.	No further impact
Compound/ Earthen embankment/ walling	CHZ 06 Compound E (Area 9) – Hotel Street-Tinnahinch Riverbank East	Medium	Medium-High	Moderate, direct and negative	• Archaeological geophysical survey and test excavation when the lands become available in advance of construction. • Archaeological monitoring during the construction programme. • Memorials to be removed, securely stored and reinstated.	No further impact
Compound	CHZ 04 and CHZ05 Compound D (Area 5) – Boat Club Area proposed for welfare and plant and Material storage	Low	Low	Slight, direct and negative	• All excavation works will be archaeologically monitored. • Access to the field will be through an existing modern entrance so there will be no impact to the low stone wall that fronts onto the quay (see drawing 1424) (NIAH 1218003)	No impact

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Compound	C651 Compound C Well Lane at Mill Road proposed for welfare and plant and Material storage	Low	Medium	Slight-Moderate direct and negative	• A full architectural heritage survey (scaled drawing, photographic record and written description) will take place of the surrounding stone walls. • All topsoil stripping works will be archaeologically monitored.	No impact

9.14 References

ADCO 2022. Underwater Archaeological Impact Assessment (UAIA) (Licence 21D0047 and 21R0082) for the River Duiske and River Barrow. Unpublished report.

ADCO 2024. Underwater Archaeological Impact Assessment (UAIA) (Licence 24D0149, 24R0195) Upstream Storage Area. Unpublished report.

ACSU 2024 Archaeological Monitoring of Geotechnical Site Investigations (Licence 21E0256). Unpublished report.

Archdall, M. 1786. Monasticon Hibernicum: or, an history of the abbies, priories, and other religious houses in Ireland. Dublin. Luke White.

Bolger, T. 2002. Archaeological Assessment: Quay Street, Graiguenamanagh, Co. Kilkenny (Licence 02E0214). Unpublished report submitted to the DoEHLG.

Bradley, J. & Manning, C. 1980. "Excavations at Duiske Abbey, Graiguenamanagh, Co. Kilkenny", Proceedings of the Royal Irish Academy, 81C, pp 397-426.

Brooks E.St. J. (ed.) 1950. Knights' fees in Counties Wexford, Carlow and Kilkenny (13th-15th century). Dublin. Stationery Office.

Butler, C. M. and Bernard, J. H. 1918. The charters of the Cistercian Abbey of Duiske in the County of Kilkenny. Proceedings of the Royal Irish Academy 35 C, 1-188.

Carrigan, Rev. W. 1905. (Reprint 1981) The history and antiquities of the diocese of Ossory, 4 vols. Kilkenny. Roberts Books and Wellbrook Press.

Carrigan, Rev. W. 1905. Vol. I, 31, Vol. II, 258.

Carville, G., 1979. Norman Splendour Duiske Abbey Graiguenamanagh. Belfast: Blackstaff Press

CDHC 2023. Archaeological Baseline Report Graiguenamanagh-Tinnahinch Flood Relief Scheme, Upstream Storage Area. Unpublished report.

CDHC 2024. Archaeological Testing Report – Pre-planning Graiguenamanagh Quay, Co Kilkenny, Excavation Licence No. E005772, R000749, Ministerial Consent C001049. Unpublished report.

Cleary, R. 2003. Graiguenamanagh: historic town. In I. Bennett (ed.), Excavations 2001: summary accounts of archaeological excavations in Ireland, 207, No. 691. Bray. Wordwell.

Curtis, E. (ed.) 1932. Calendar of Ormond Deeds 1172-1350 A.D. Vol. 1. Dublin. The Stationery Office.

Curtis, E. (ed.) 1937. Calendar of Ormond Deeds 1509-1547 A.D. Vol. 4. Dublin. The Stationery Office.

Dolan, A. 1994. "The large medieval churches of the dioceses of Leighlin, Ferns and Ossory: a study of adaptation and change", in Irish Architectural and Decorative Studies: The Journal of the Irish Georgian Society, Vol 2.

Farrelly, J., O'Reilly, B., and Loughran, A. 1993. Urban archaeological survey - county Kilkenny (2 vols.). Unpublished report commissioned by the Office of Public Works, Dublin.

Grose, F. 1791. The Antiquities of Ireland – Volume 1, London

Gwynn, A. and Hadcock, R.N. 1970. (Reprint 1988) Medieval religious houses of Ireland. Dublin. Irish Academic Press.

Hayden, A. 1990. Excavations bulletin 1990:075 Duiske Abbey, Graiguenamanagh, Co. Kilkenny.

Joyce, J. (2000) Graiguenamanagh-A Town and its people: An Historical and Social Account of Tinnahinch, Graigue Publications.

Leask, H.G. 1960 (Reprint 1967 and 1990) Irish churches and monastic buildings, vol. II. Gothic architecture to A.D. 1400. Dundalk. Dundalgan Press.

Mills, J. (ed.) 1914 Calendar of the justiciary rolls, or proceedings in the court of the justiciar of Ireland preserved in the Public Record Office of Ireland. Edward I, part 2, 1305-7. Dublin. HMSO.

NMS (2023) Archaeology and Flood Relief Schemes: Guidelines. Government of Ireland.

O'Leary, P. 1892 Notes on the Cistercian Abbey of Graignamanagh. Journal of the Royal Society of Antiquaries of Ireland 22, 237-47.

O'Leary, P. 1892 Tinnehinch Castle. Miscellanea. Journal of the Royal Society of Antiquaries of Ireland 22, 203-4.

O'Leary, P.W. and J. 1924 Graiguenamanagh Abbey. Privately published.

O'Meara, B. 2006. Excavations bulletin: 2006:1035. Graiguenamanagh, Quay Street, Co. Kilkenny.

O'Meara B. & O' Frazer W. (2006) Archaeological Impact Assessment, Main Street Graiguenamanagh Co Kilkenny Ministerial Consent Ref. C041, Planning Ref. 04/2003.

Stalley, R. 1987. The Cistercian Monasteries of Ireland: An account of the history, art and architecture of the white monks in Ireland from 1142 to 1540. London and New Haven, CT: Yale University Press.

Swayne, S. 1988 Duiske Abbey, Graignamanagh. Graignamanagh. Self-published.

Southgate Associates 2022 Preliminary Building and Conservation Strategy Report. Draft unpublished report.

Southgate Associates January 2025. Conservation Strategy Report. Unpublished report.

TerraDat 2024 Geophysical Survey Report (Licence 24R0041) Areas A-E. Unpublished Report.

Wood, H. and Langman, A. (revised by Griffith, M) 1956 Calendar of the justiciary rolls, or proceedings in the court of the justiciar of Ireland preserved in the Public Record Office of Ireland. I to VII years of Edward II. Dublin. Public Record Office.

10 Biodiversity

10.1 Scope of the Assessment

10.1.1 This chapter describes the likely significant direct and indirect effects of the Proposed Scheme on biodiversity, including flora (plants), fauna (animals) and habitats in both the terrestrial and aquatic environment. The chapter should be read in conjunction with Chapter 8 'Hydrology – Surface Water' and Chapter 12 'Land, Soils, Geology and Hydrogeology' due to the interdependencies of these disciplines.

10.1.2 The following aspects have been considered relevant to the biodiversity assessment:

- Design:
    - The design considered biodiversity sensitivities. Several biodiversity enhancement measures will be incorporated into the project design. These measures aim to maintain and enhance biodiversity in the area through the creation of habitat and wildlife corridors for several different species. The detail of these measures is provided in Section 10.10.
- Construction:
    - Construction activities occurring near to and on the banks of the River Barrow and River Duiske have the potential to impact on aquatic ecology through sedimentation and/or accidental released of contaminated materials.
    - Construction activities and the site compounds have the potential to impact on terrestrial biodiversity. Specifically, some of the working areas will require tree removal and vegetation clearance to accommodate construction activities.
    - Construction activities and the site compounds have the potential to impact on terrestrial biodiversity through physical disturbances, noise and vibration.
    - Construction activities will be undertaken in the vicinity of invasive plant species.
- Operation and Maintenance:
    - Maintenance activities in the river have the potential to impact on aquatic biodiversity, specifically the occasional clearing of vegetation along the riverbanks.

10.2 Statutory and Policy Context

Legislation

10.2.1 The main legislation which provides for biodiversity and nature conservation in Ireland are the European Communities (Birds and Natural Habitats) Regulations 2011 (as amended), SI No.477 of 2011 as amended, ("the Habitats Regulations" or "the Habitats Regulations 2011 to 2021" and the Wildlife Acts 1976 (as amended) (which includes inter alia the Wildlife Act 1976, the Wildlife (Amendment) Act 2000, the Wildlife (Amendment) Act 2010, the Wildlife (Amendment) Act 2012, the Wildlife (Amendment) Act 2023, the Heritage Act 2018, including Part 3 thereof, the Planning, Heritage and Broadcasting (Amendment) Act 2021, including Chapter 3 thereof).

10.2.2 Other important pieces of EU and national legislation pertaining to the ecological environment include:

- Wildlife Act 1976, as amended.
- Flora (Protection) Order, S.I. No. 356 of 2022.
- Heritage Council (2011) Best Practice Guidance for Habitat Survey and Mapping.
- Fossitt (2000) A Guide to Habitats in Ireland.
- Transport Infrastructure Ireland (incorporating the National Roads Authority, Revision 1, December 2010). Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Road Schemes.
- National Parks and Wildlife Service, Department of Environment Heritage and Local Government (2006) Bat Mitigation Guidelines for Ireland.
- DEHLG (2009) Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities (Revised 2010).
- EC (2018) Managing Natura 2000 sites. The provisions of Article 6 of the Habitats Directive 92/43/EEC Commission Notice (2018).
- EC (2001) Managing Natura 2000 Sites: The provisions of Article 6 of the Habitats Directive 92/43/EEC.
- EC (2002) Assessment of plans and projects significantly affecting Natura 2000 sites.
- EU (2013) Guidelines on Climate Change and Natura 2000: Dealing with the impact of climate change on the management of the Natura 2000 Network of areas of high biodiversity value.
- Inland Fisheries Ireland (2016) Guidelines on Protection of Fisheries during Construction Works in and adjacent to Waters

Policy

10.2.3 This section summaries policy relevant to this Chapter, including national policy documents and policies and objectives in the relevant county development plans.

10.2.4 **Ireland's National Biodiversity Action Plan (2023-2030)** (NPWS, 2023) in accordance with the Convention on Biological Diversity, is a framework for the conservation and protection of Ireland's biodiversity, with an overall objective to secure the conservation, including, where possible, the enhancement and sustainable use of biological diversity in Ireland and to contribute to collective efforts for conservation of biodiversity globally. Action 1.1.3 of the National Biodiversity Action Plan aspires that "*all Public Authorities and private sector bodies move towards no net loss of biodiversity through strategies, planning, mitigation measures, appropriate offsetting and/or investment in Blue-Green infrastructure*". This is particularly relevant to developments. The plan is underpinned by The Wildlife (Amendment) Act 2023 which supports nature conservation.

10.2.5 **OPW Biodiversity Strategy 2022-2026** (OPW, 2022) outlines OPW's intention for conservation, promoting and enhancing biodiversity across its operations, including the development of flood relief schemes. The OPW biodiversity action strategy objectives include planning for nature and working with water and wildlife. The OPW's strategy is built on five pillars, which guide its actions:

- **Planning for Nature:** Mainstreaming biodiversity into planning and decision-making processes for government buildings, land management, and flood risk management.
- **Natural Leaders:** Strengthening internal governance, including the formation of a Biodiversity Working Group, and providing staff training to foster expertise and cross-functional collaboration.
- **Working with Water & Wildlife:** Integrating biodiversity enhancement into flood risk management by installing features like bat boxes and spawning gravels, and developing environmental guidance for river maintenance.
- **Diversity by Design:** Incorporating biodiversity-friendly designs into new buildings and structures, creating artificial habitats to support wildlife, and implementing biodiversity management plans for OPW sites.
- **Natural Knowledge:** Conducting biodiversity audits of properties, sharing research on invasive species at the National Botanic Gardens, and supporting the National Seed Bank.

10.2.6 **All-Ireland Pollinator Plan (2021 – 2025)** (NBDC, 2021) seeks to halt the decline in pollinators through a range of objectives. Objective 2 of this plan sets the objective of "*Making public land pollinator friendly*". This plan was adopted by Kilkenny County Council in 2021 (Kilkenny County Council, 2021) and Carlow County Council in 2022 (Carlow County Council, 2022). This plan is supplemented by the guidance document, Pollinator Friendly Management of Transport Corridors (NBDC, 2019) and Councils: Actions to Help Pollinators (NBDC, 2016).

10.2.7 **Kilkenny City and County Development Plan (2021-2027)** sets out the development strategy (policies and objectives) for the sustainable future growth of Kilkenny City and County (Kilkenny County Council, 2021). This plan outlines commitments to undertake actions such as:

- The Council will in as far as is practicable and affordable manage and restore semi-natural habitats and their native plants on Council land.
- The Council will promote the planting of native tree and shrub species, by committing to using native species (of local provenance wherever possible) in its landscaping work and on County Council property and maximise the opportunity to enhance biodiversity within the City & County during the life time of the plan.

10.2.8 **Carlow County Development Plan (2022-2028)** sets out the development strategy (policies and objectives) for the sustainable future growth of Carlow County (Carlow County Council, 2022). This plan includes to following policy:

- Encourage and support the incorporation of elements of green infrastructure and biodiversity into all new developments in urban areas, including the design of buildings and their surroundings (e.g. tree planting, green spaces and verges, planters, green roofs, living walls, bird boxes, bat roost sites etc.), and that contributes to and links with the wider green infrastructure network, in particular where similar features exist on adjoining sites.

10.3 Assessment Methodology

Assessment of Impacts

Guidance

10.3.1 The process of identifying, quantifying and evaluating potential impacts of the proposed development on habitats, species and ecosystems was undertaken in accordance with Transport Infrastructure Ireland's (TII) Guidelines for Assessment of Ecological Impacts of National Road Schemes (2009). CIEEM's Guidelines for Ecological Impact Assessment in the UK and Ireland were also considered in the completion of this chapter (CIEEM, 2024).

10.3.2 In addition, reference to the following recognised guidance defined the scope and evaluation process:

- EPA (2022) Guidelines on information to be contained in the Environmental Impact Assessment Report.
- Collins (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd Edition).
- Institution of Lighting Professionals (2020) Guidance notes for the reduction of obtrusive light. Guidance Note 01/20;
- Marnell, F. Kelleher, C & Mullen, E. (2022). Bat Mitigation Guidelines for Ireland v2. Irish Wildlife Manuals, No. 134;

- NBDC (2019) Pollinator-friendly management of: Transport Corridors. All-Ireland Pollinator Plan, Guidelines 9. National Biodiversity Data Centre Series No. 20;
- NBDC (2021) All Ireland Pollinator Plan 2021-2025;
- TII (2006a) Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes.
- TII (2006b) Guidelines for the Treatment of Bats during the Construction of National Road Schemes.
- TII (2006c) Guidelines for the protection and preservation of trees, hedgerows and scrub prior to, during and post Construction of National Road Schemes.
- TII (2008a) Environmental Impact Assessment of National Road Schemes – A Practical Guide (Revision 1).
- TII (2008b) Ecological Survey Techniques for Protected Flora and Fauna during the Planning of National Road Schemes.
- TII (2008c) Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes.
- TII (2008d) Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes.
- TII (2020a) The Management of Invasive Alien Plant Species on National Roads – Standard.
- TII (2020b) The Management of Invasive Alien Plant Species on National Roads – Technical Guidance.

Establishing the Zone of Influence

10.3.3 The key factors to be considered when establishing the Zone of Influence for a proposed project are:

- The nature, scale, and location of the proposed development.
- The sensitivities of the ecological receptors in the receiving environment.
- The potential for cumulative or in-combination impacts.

10.3.4 For example, in the case of a proposed development connected to a river, it may be necessary to extend the Zone of Influence a significant distance upstream and/or downstream to capture all potential impacts on water-dependent ecological receptors.

10.3.5 On the basis of the above key factors, the Zone of Influence for the GTFRS has been defined as the entire area within 10 km of the Proposed Scheme. This is considered to be the maximum extent over which ecological impacts may occur directly, indirectly or in

combination with other plans or projects. The Zone of Influence is presented in Figure 10-1 showing the European sites in this boundary.

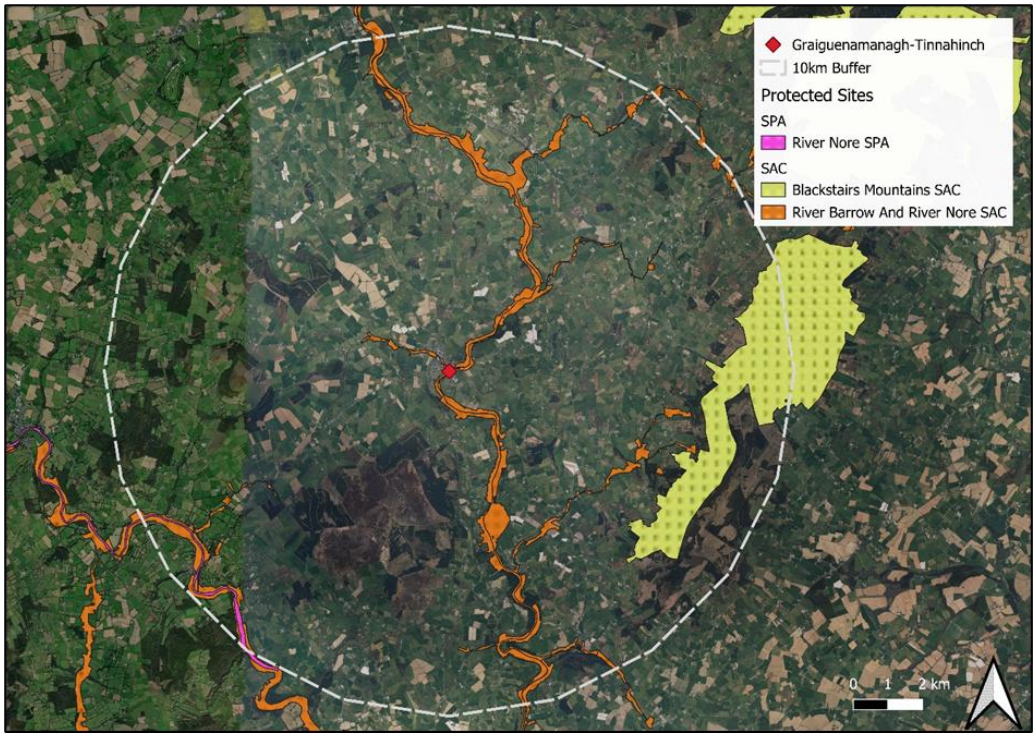


Figure 10-1: Natura 2000 Sites within 10 km of the Proposed Scheme Area

Establishing the Study Area

10.3.6 The extent of the study area is defined by the ecological features likely to occur within an effects distance from the proposed development. The desk study area covered the entire Zone of Influence, as described in the preceding section. For the field study, however, it was not practical to carry out surveys over such a large area. Therefore, the field study area was limited to the area subject to direct impacts or immediate effects, i.e., within a 100 m distance either side of the River Duiske and River Barrow. This study area varied depending on the ecological receptor and is outlined in the individual sections below.

Approach

10.3.7 In accordance with TII, Guidelines for Assessment of Ecological Impacts of National Road Schemes (NRA, 2009), an impact assessment has been undertaken of Key Ecological Receptors within the Zone of Influence of the proposed development. While these guidelines were specifically designed for national road schemes, their guidance on how to assess ecological impacts is comprehensive and applicable to a wide range of different types of projects. According to these guidelines, the Zone of Influence is the "effect area" over which change resulting from the proposed development is likely to occur.

10.3.8 The Key Ecological Receptors are defined as features of sufficient value as to be material in the decision-making process for which potential impacts from the proposed development are likely. In the context of the proposed development, a Key Ecological

Receptor is defined as any feature valued as being of one of the following levels of importance:

- International Importance (i.e., RAMSAR Site, Natura 2000 Site).
- National Importance (i.e., Natural Heritage Areas).
- County Importance (i.e., Area of Special Amenity)
- Local Importance (Higher Value) (i.e., Local populations of priority species)

10.3.9 Features of Local Importance (Lower Value) and features of no ecological value and are not considered to be Key Ecological Receptors.

10.3.10 The evaluation of Key Ecological Receptors and the terminology used to determine ecological value adheres to aforementioned guidance (NRA, 2009). The definitions of impacts follow the definitions in the EPA's 2022 Guidelines, as included in Chapter 1 'Introduction'.

Desk-based Assessment

10.3.11 Initially, a desk study was undertaken to review all available published data describing the ecological conditions within the greater area of the proposed development. The desk study cross-referenced this published data with publicly available maps and aerial orthophotography from Ordnance Survey Ireland (OSi), National Parks & Wildlife Service (NPWS) and Environmental Protection Agency (EPA) to identify Key Ecological Receptors. The baseline information obtained from the desk study was the first stage in defining the Zone of Influence of the proposed development. Determining baseline ecological conditions allows an accurate prediction of the likely impacts of the proposed development on Key Ecological Receptors and an assignment of ecological significance to them.

10.3.12 The desk study included review of the following sources of information:

- River Barrow and River Nore SAC – Site Synopsis (NPWS, 2016)
- River Barrow and River Nore SAC – Conservation Objectives (NPWS, 2011)
- River Barrow and River Nore SAC - Conservation Objectives Supporting Document - Woodland Habitats (NPWS, 2011)
- Article 17 Reports and GIS spatial data (NPWS, 2019)
- Assessment of the distribution and abundance of Kingfisher *Alcedo atthis* and other riparian birds on six SAC river systems in Ireland (Cummins, Fisher, Gaj McKeever, McNaghten, & Crowe, 2010)
- National Biodiversity Data Centre (NBDC) – 1km- and 2km-square species reports (accessed online on 08/02/2025)
- Ecology Surveys 2020-2024, W3451-AYE-ENV-R007 (Ayesa, 2025)

- Bat Survey Report – W3451-ENV-R001 (ByrneLooby, 2020)
- Bat Survey Report (Veon, 2025)
- Environmental Constraints Study Report – W3451-BL-ENV-R001 (ByrneLooby, 2021)
- Ecological Report on the River Barrow at Graiguenamanagh, Co. Kilkenny (Aquafact International Services Ltd. , 2020)
- Electrofishing Survey of the Duiske River, Graiguenamanagh, Co. Kilkenny (Aquafact International Services Ltd. , 2021)
- Graiguenamanagh Q Values Survey (Aquafact International Services Ltd, 2021)
- Graiguenamanagh-Tinnahinch Flood Relief Scheme white-clawed crayfish (*Austropotamobius pallipes*) survey (Triturus, 2021)
- Graiguenamanagh-Tinnahinch Flood Relief Scheme freshwater pearl mussel (*Margaritifera margaritifera*) survey (Triturus, 2021)

Site Visits / Surveys

10.3.13 A series of specialist ecological surveys was completed for the scheme between the period 2020 – 2024, as outlined in the table below. Section 10.4 details the results of the desktop studies and the walkover and specialist surveys undertaken in preparation for this EIAR. The individual subsections for results are also outlined in the table below. The individual reports are contained in the appendices. It is important to note that the 2020/2021 surveys were undertaken within the scheme area as identified in the CFRAM studies. As the scheme developed, and the scheme area changed, the survey areas differed. This detail is provided in the following sections.

Table 10-1: Ecological Surveys Completed for the Proposed Scheme

Survey Name	Subsection for results	Survey Date	Surveyor(s)
Specialist survey for Bats	10.4.24	14-16/09/2020 & 10-14/06/2024	Ayesa (formerly ByrneLooby). Steven Tooher (BSc., MSc, QCIEEM), Senior Ecologist, 5+ years. Joe Butler ((BSc., MSc, QCIEEM) Senior Ecologist, 5+ years. Meadhbh Stack ((BSc., MSc, QCIEEM) Senior Ecologist, 1+ years.
Habitats and species walkover	10.4.10	June 2020 & 28/29 March, 2024	
Specialist survey for wintering birds	10.4.33	16-18/02/2021 & 19/12/2023 – 23/02/2024	
Specialist survey for Breeding birds	10.4.33	02/04/2021 & 09/09/2023 – 27/06/2024	
Specialist surveys for mammals, including otter, badger, pine martin, red squirrel	10.4.40	16-18/02/2021 & 28-29/03/2024	
Specialist survey for herpetofauna	10.4.51	16-18/02/2021	
Specialist survey for flora	10.4.15	16-18/02/2021 & 26-27/06/2024	

Specialist survey for trees	10.4.17	Spring 2021 23-25/05/2023, Nov/Dec 2023	Veon Ecology
Specialist survey for alien invasive flora species	10.4.86	16-18/02/2021 & 26-27/06/2024	Aquafact Brendan O'Connor (BSc, PhD, CMIEEM), 20+ years.
Specialist survey for water quality/Q values/invertebrates	10.4.67	08/02/2021, 09/08/2023 & 26-27/06/2024	Triturus Env Services. Ross Macklin (BSc, PhD, MCIEEM), Principal Ecologist & Fisheries Scientist, 16+ years. Aquafact Brendan O'Connor (BSc, PhD, CMIEEM), 20+ years. APEM Ireland Michael Dobson (BSc, PhD, MCIEEM), 35+ years.
Specialist electrofishing survey	10.4.53	10/02/2021	
Specialist Survey for White-Clawed Crayfish (eDNA sampling and testing)	10.4.77	29/04/2021 & 09/08/2023	
Specialist Survey for Freshwater Pearl Mussel (eDNA sampling and testing)	10.4.70	30/04/2021	
Specialist survey for fish habitat.	10.4.53	09/08/2023	

10.3.14 The reports associated with the above listed specialist surveys can be found in the appendices:

- Habitat and Species Baseline Report CFRAM Scheme Area – Appendix 10-1
- Habitat and Species Baseline Report Upstream Storage Area 2024 – Appendix 10-2
- Bat Survey Report CFRAM Scheme Area 2020 – Appendix 10-3
- Bat Survey Report Upstream Storage Area 2023 – Appendix 10-4
- Bat Survey Report Top-up Report 2023 – Appendix 10-5
- Electrofishing Report 2021 – Appendix 10-6
- Q-Value Survey Report 2021 – Appendix 10-7
- White-Clawed Crayfish Report 2021 – Appendix 10-8
- Freshwater Pearl Mussel Report 2021 – Appendix 10-9
- Aquatic Ecology Survey Report 2023 – Appendix 10-10
- Tree Survey Report 2024 – Appendix 10-11
- Ecology Surveys 2020-2024 (including results of specialist bird and mammal surveys 2024) – Appendix 10-12

- Field Survey Methodologies
- Specific methodologies for the various field surveys are outlined in the following sections, and all were conducted adhering to the following guidelines:
- Guidelines for Ecological Survey Techniques for Protected Flora and Fauna during the Planning of National Road Schemes (NRA, 2008a)
- Best Practice Guidance for Habitat Survey and Mapping (Smith, , O'Donoghue, O'Hora, & Delaney, 2011)
- A Guide to Habitats in Ireland (Fossit, 2000)
- Interpretation Manual of European Union Habitats (EC, 2013).
- Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes (NRA, 2008b)
- Threat Response Plan: Otter (2009-2011) (NPWS, 2009).
- Bat Surveys for Professional Ecologists: Good Practice Guidelines (Collins, J. (ed.) 2016).
- CBS Manual Guidelines for Countryside Bird Survey participants (Birdwatch Ireland, 2012)
- Bird Atlas 2007-11 (BTO, 2011)

Habitats

10.3.15 A habitat survey is a standardised method of recording habitat types and characteristic vegetation, as set out in the 'Best Practice Guidance for Habitat Survey and Mapping' (Smith, , O'Donoghue, O'Hora, & Delaney, 2011). A habitat survey is a method of gathering information about the ecology of a site. Habitats were classified in accordance with the system outlined by Julie Fossitt (Fossitt, 2000).

10.3.16 The site was also assessed for the presence of habitats designated by Annex I of the EU Habitats Directive. The determination of the presence or absence of Annex I habitats was carried out in consultation with the habitat descriptions provided in the most recent Article 17 Reports (NPWS, 2019). The Interpretation Manual of European Union Habitats (EC, 2013) was also consulted. In addition, the spatial GIS data for the Article 17 Reports were examined to determine the distribution of these habitats (as known to the NPWS) within the study area.

10.3.17 This habitat survey method was extended in accordance with the Guidelines for Ecological Impact Assessment in the UK and Ireland (CIEEM, 2024) through the additional recording of specific features indicating the presence, or likely presence, of protected species or other species of nature conservation significance.

10.3.18 Whilst not a full botanical or protected species survey, the extended method of survey enables suitably trained and experienced ecologists to obtain an understanding of the ecology of a site such that it is possible either:

- to confirm the conservation significance of the site and assess the potential for impacts on habitats/species likely to represent a material consideration in planning terms; or
- to establish the scope and extent of any additional specialist ecological surveys that will be required before such confirmation can be made.

Trees

Arboriculture Survey (2023/2024)

10.3.19 Arborists with Veon Ltd assessed trees associated with the proposed works in the town area and the upstream storage area between the 23rd and 25th of May 2023, the 19th of December 2023 and the 15th of November 2024. Trees were visually assessed from ground level. The Arboriculture data presented in the Tree Survey has been recorded in line with BS 5837:2012. The tree survey was conducted by collecting and assessing the following information on all significant trees located on site and proximal to the site.

- Tree number
- Tree species both common and scientific
- Dimensions (height, trunk diameter, crown spread, crown clearence, Root protection area)
- Age class
- Physiological condition
- Structural condition
- Preliminary recommendations
- Estimated remaining contributiuon with their present environment
- Retention category grade
- Ecological Significance

10.3.20 A Tree Constraints and Removal/Retention Plan is mapped and included in the Tree Survey Report in Appendix 10-11.

10.3.21 The tree retention category has been assessed and categorised according to their quality and value within the existing context (BS 5837:2012), and not in conjunction with any proposed development plans. In making this assessment, particular consideration was given to Arboricultural Value, including health, structural form, life expectancy, species and its physical contribution to or effects on other features located on site.

10.3.22 The classification process begins by determining whether the tree falls within the (U) category (unretainable), if not, then the process will continue by assuming that all trees are considered according to the criteria for inclusion in the high value category (A). Trees that do not meet these strict criteria will then be considered for inclusion in the moderate value category (B), and failing this, they will be allocated a low value category (C).

Birds

Wintering and Breeding Bird Surveys (2021)

10.3.23 Both wintering and breeding bird surveys involved line transects along the routes shown in Table 10-2 and Figure 10-2. Surveys were carried out early in the morning, approximately 30 minutes after sunrise. Where possible, surveying was avoided during heavy rain, strong winds or poor visibility (e.g., fog). Each transect line was walked by the ecologist, and all avian species observed (visually or aurally) were recorded. Binoculars were used to scan the surrounding landscape during the transect. Direct sightings were recorded in line with the guidance contained in the Countryside Bird Survey (CBS) Manual (Birdwatch Ireland, 2012), which recommends sightings to be grouped into the following distance bands (perpendicular to and either side of the transect line):

- Within 25 m
- Between 25m and 100 m
- Greater than 100 m
- Birds in flight at any distance

10.3.24 Some crossover is possible during these surveys, and this was noted if it occurred. The ecologist made a judgement call as to whether to include a record that may have been recorded in a separate transect.

10.3.25 Features of the landscape that were deemed significant for birds (e.g., potential breeding habitats, Kingfisher perches, existing nests etc.) were recorded.

Table 10-2: Bird Transect Routes

ID	Start Coordinates (ITM)	End Coordinates (ITM)
A	671190, 642583	670808, 642885
B	670692, 643082	670895, 643529
C	671174, 643780	671491, 643881
D	670854, 643568	670862, 643676
E	670799, 643860	670676, 643993
F	670501, 644128	670312, 644230

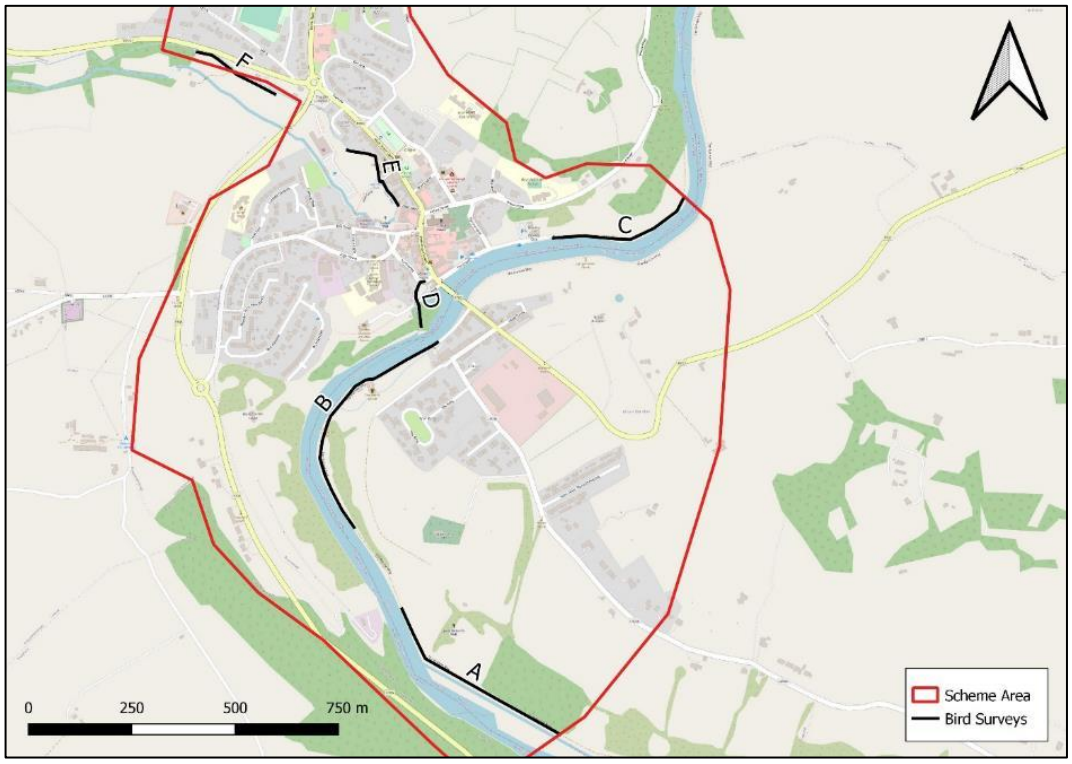


Figure 10-2: Bird Transect Routes

Breeding Bird Survey (2024)

10.3.26 The breeding bird survey methodology was designed and undertaken in accordance with guidance described in:

- Countryside Bird Survey: Status and Trends of Common and Widespread Breeding Birds 1998-2016 (Lewis et al., 2019b)
- Breeding Bird Survey: Methodology and Survey Design (BTO, 2023)
- I-WeBS Counter Manual: Guidelines for Irish Wetland Bird Survey Counters
- Bird Census Techniques (Bibby, et al., 2000)
- 'Field Guide to the Birds of Britain and Europe' by John Gooders (Larousse) - identification
- I-WeBS best practice guidelines of standard techniques for traditional ground surveying are the recommended methods by Bird Watch Ireland

10.3.27 The ecologists modified the survey methodology carried out in Summer 2024, as opposed to the methodology used in 2021. Instead, eight stationary vantage points were identified adjacent to and within the site from which to carry out the point counts/surveys, whilst continuing to record birds between the vantage points. Five points were located within Graiguenamanagh Town (Figure 10-4) and the remaining three points were located at the Upstream Storage site (Figure 10-3).

10.3.28 Three surveys of the site were carried out, beginning at approx. 9 am on 28-29/03/2024, 22-23/05/2024, and 26-27/06/2024. Counts began in the early morning, so that they coincide with maximum bird activity, but avoid concentrated song activity at dawn (BTO, 2023).

10.3.29 Weather conditions within the project site were recorded at the time of survey. Activities that occur at the site that are or have the potential to cause disturbance to waterbirds were also recorded, regardless of whether they cause a noticeable disturbance to birds at the time of observation, or not.

10.3.30 The ecologists stayed at each stationary location for 30 minutes continuously scanning the surrounding areas using a pair of binoculars (Celestron 71008 SkyMaster 25 x 70 Binoculars), and all bird species observed were recorded. Information regarding the species of bird, number of birds (of the same species) and the birds' behaviour were similarly noted. The Countryside Bird Survey (CBS) Manual (Birdwatch Ireland, 2012) recommends sightings to be grouped into distance bands (perpendicular to and either side of the transect line), however this was deemed unnecessary on this occasion as no distance sampling analysis will be undertaken. The primary purpose of this survey is to identify which species utilize the site and the surrounding areas, not to provide accurate counts for population trends as in the CBS.

10.3.31 Aural recordings were also obtained using the app BirdNET (Kahl, Wood, Eibl, & Klinck, 2021). BirdNET's in-app machine learning was used to determine species, according to Kahl et al. (2021) BirdNET has a mean average precision of 0.791 for single-species recordings. Despite the high level of confidence, the ecologist compared aural records obtained in the field to existing records to add a higher level of certainty to species identification.

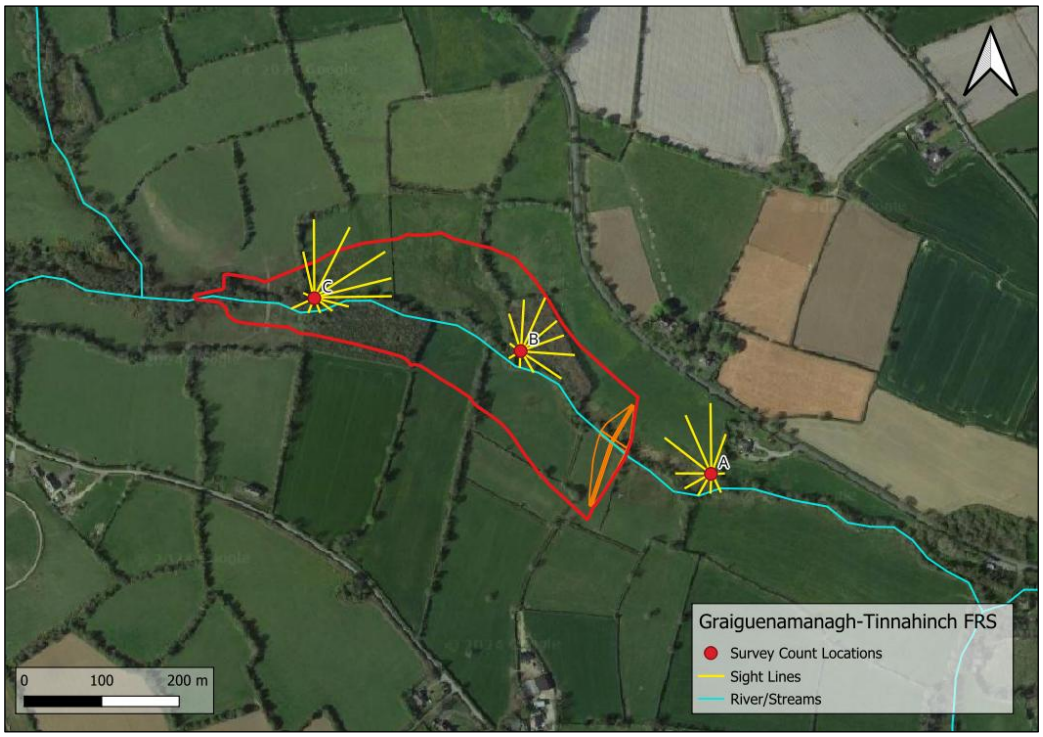


Figure 10-3: Breeding and Wintering Bird Survey Count Locations– Upstream Storage Area

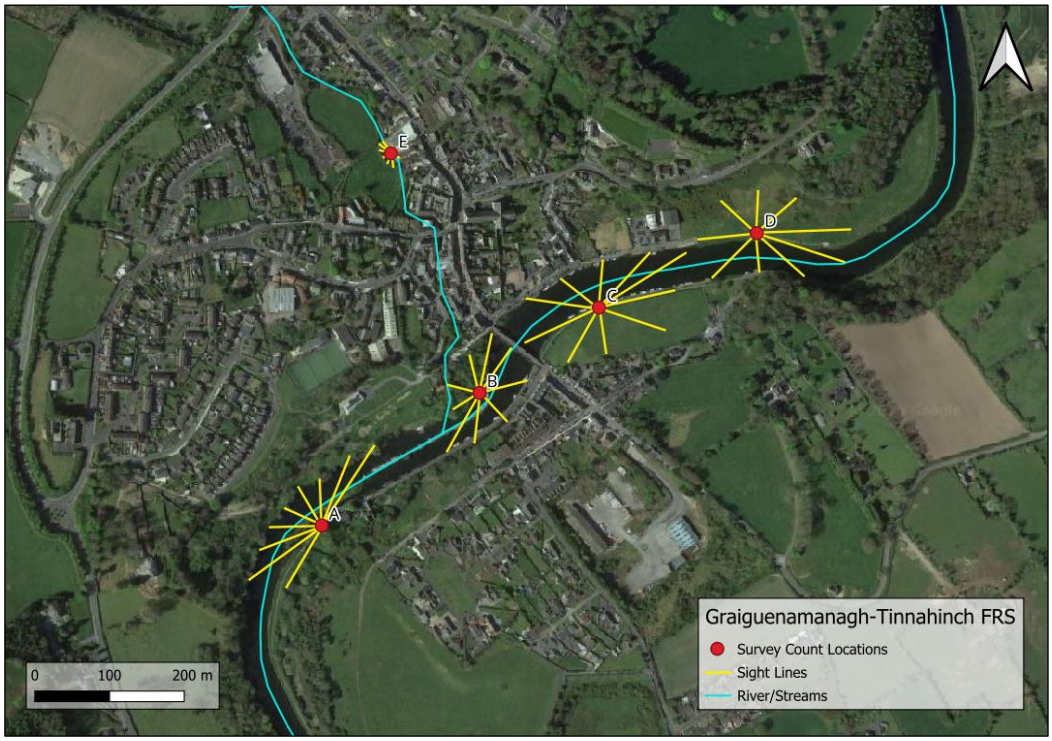


Figure 10-4: Breeding and Wintering Bird Survey Count Locations– Graiguenamanagh Town

Wintering Bird Survey (2023/2024)

10.3.32 The wintering bird survey methodology was designed and undertaken in accordance with guidance described in:

- Low tide waterbird surveys: survey methods and guidance notes (Lewis and Tierney, 2014)
- I-WeBS Counter Manual: Guidelines for Irish Wetland Bird Survey Counters
- Bird Census Techniques (Bibby, et al., 2000)
- 'Field Guide to the Birds of Britain and Europe' by John Gooders (Larousse) – identification
- I-WeBS best practice guidelines of standard techniques for traditional ground surveying are the recommended methods by Bird Watch Ireland.

10.3.33 The ecologists utilised the same eight stationary vantage points as for the breeding bird surveys and shown in Figure 10-3 and Figure 10-4.

10.3.34 Three surveys of the site were carried out, beginning at approx. 9 am on 19-20/12/23, 16-17/01/24, and 22-23/02/24. Counts began in the early morning, so that they coincide with maximum bird activity, but avoid concentrated song activity at dawn (BTO, 2023).

10.3.35 Weather conditions within the project site were recorded at the time of survey. Activities that occur at the site that are or have the potential to cause disturbance to waterbirds were

also recorded, regardless of whether they cause a noticeable disturbance to birds at the time of observation, or not.

10.3.36 The same methodology was employed for these surveys as for the breeding bird surveys outlined in 10.3.30 and 10.3.31.

Bats

Bat Survey (2020)

10.3.37 This survey was undertaken in accordance with the following European Directives, national legislation and guidance:

- Bat Conservation Trust (2015). Bat Surveys for Professional Ecologists – Good Practice Guidelines (3rd edition).
- Council Directive (92/43/EEC) of 21 May 1992 on the conservation of natural habitats and of wild flora and fauna.
- Kelleher, C. & Marnell, F. (2006) Bat Mitigation Guidelines for Ireland. Irish Wildlife Manuals, No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
- National Roads Authority (2005). Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes. National Roads Authority, Dublin.
- Wildlife Acts 1976 to 2018.

10.3.38 The survey area focused on the areas shown in Figure 10-5 where works are proposed to be implemented.

10.3.39 An initial survey of the site was carried out during daylight hours on 14th of September 2020 to gain an overview of the site with regard to its potential use by bats. Sites deemed to be suitable for roosting bats were noted and recorded on a handheld GPS device (Garmin GPSMAP 64S). Notes were taken on the habitats and general appearance of the environment along the entire survey route. Potential roost sites were revisited at dawn and dusk on the following two nights/mornings to establish whether they were being used as roosts by bats. Bat activity was monitored using a heterodyne bat detector (Magenta Bat5), with which it was possible to identify species based on their echolocation frequency.

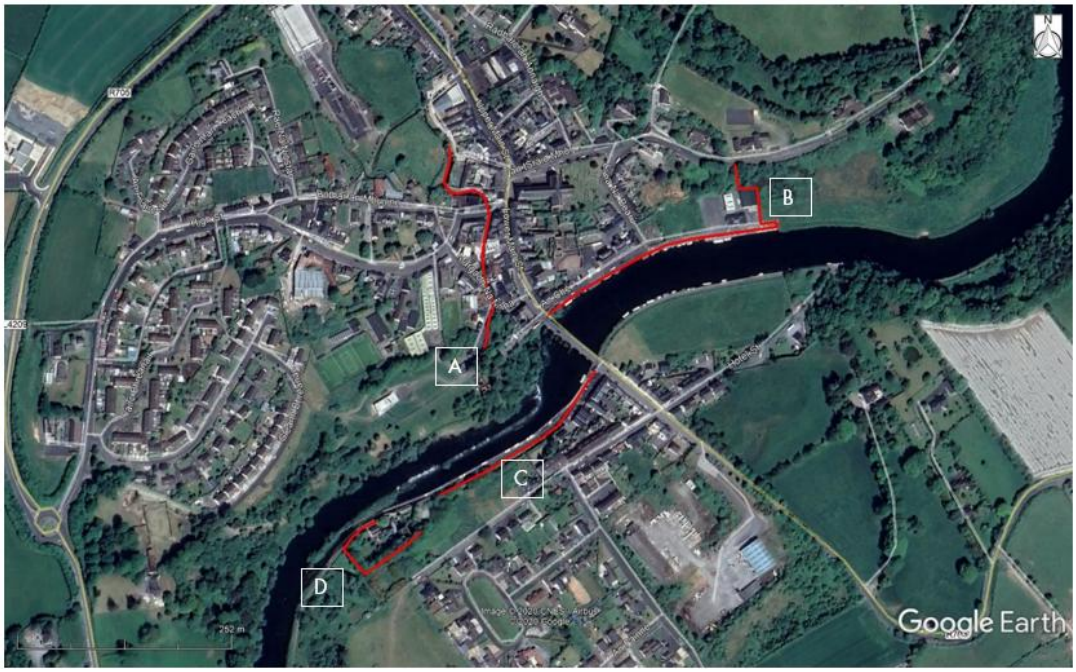


Figure 10-5: Bat Survey Routes (2021)

Upstream Storage Area Bat Surveys (2023/2024)

10.3.40 Initially, a desktop assessment of aerial photographs along the route of the proposed flood relief scheme was undertaken to identify existing habitats, buildings and structures which may be favourable for bat use within the potential works locations.

10.3.41 The following activities/surveys were carried out:

- Daytime walkover survey of the site and immediate area.
- Daytime inspection of the relevant building(s)/structure(s) directly.
- Active acoustic surveys in the study area during night hours.
- Review of historical bat surveys conducted within the vicinity of the site.
- Desktop study of the National Biodiversity Data Centre (NBDC) Bat Suitability Index.

10.3.42 The survey site was assessed during daytime walkover surveys, in relation to potential bat foraging habitat and potential bat commuting routes. Bat habitats and commuting routes identified are considered in relation to the wider landscape to determine landscape connectivity for local bat populations through the examination of aerial photographs. All areas were surveyed on foot, mainly along hard-surfaced roads, grassland, built land and along the river corridor.

Preliminary Roost Assessment:

10.3.43 A preliminary roost assessment (PRA) was carried out during daylight hours (exterior and interior) to identify any evidence of roosting bats, current or historic. Potential roosting features (PRFs) were recorded at these buildings/structures during daytime visual

inspections. A bat activity survey was carried out to confirm the presence or absence of roosting bats at these buildings/structures. Surveys followed guidelines outlined in Collins (2016).

10.3.44 The relevant buildings, structures and trees within the survey area were investigated during daylight hours to record any signs of current and/or historic bat presence, such as droppings, brown staining from urine, feeding remains and surfaces smoothed around entrance holes. Kelleher & Marnell (2006) provide guidance on assessing the potential for structures to support roosting bats. Structures were assessed as per the guidance as increased or decreased potential to function as a bat roost.

10.3.45 The following equipment was used during the PRA and activity surveys:

- Wildlife Acoustics Echometer Touch 2 Bat Detector (Android).
- High-powered Maglite© hand torch and LED head torch.
- Endoscope (Explorer Premium) Wireless inspection camera.
- Activity Surveys

10.3.46 Activity surveys were carried out on site on the following dates in 2023, August 2nd, August 15th, August 16th, September 1st, September 5th, September 7th, September 12th and September 22nd. These surveys involved dusk emergence surveys and transect surveys.

10.3.47 Dusk surveys were started from 10 minutes before sunset to at least 100 minutes post sunset (extended survey period times occurred in relation to walking transects).

10.3.48 Conducting an Emergence Bat survey allows surveyors to identify:

- Whether bats are present in a structure, the species, and number involved.
- Entrance and exit points for the roost.
- Any actions needed to be taken to ensure legal compliance.
- The type of roost, i.e.:
    - Day roosts: individual bats, or small groups of males, are using the area for shelter during daylight hours.
    - Feeding roosts: whereby bats, particularly Brown Long-Eared and Horseshoe species feed during the night.
    - Night roost: where bats rest or shelter between feeding sessions.
    - Hibernation roost: where bats hibernate over the winter periods.
    - Transitional or occasional roost: where bats gather at a temporary site before and after hibernation.

- Mating site: Males and females gather in late summer to early winter.
- Maternity roost: where babies are born and raised until they're independent.
- Satellite roost: where breeding females roost close to the main nursery colony in the breeding season.
- Swarming site: where bats gather in large numbers from late summer to autumn.

10.3.49 As a standard approach, all emerging or re-entering bats observed at a structure are recorded along with their flight path, their species, and the time of flight. Vegetation, habitat, and relevant environmental factors are also detailed, where applicable and appropriate.

10.3.50 Walking transects involve the surveyor(s) walking the survey area, noting the time, location and bat species encountered. The Wildlife Acoustics Echo Meter Touch 2 (Android) recordings are mapped using QGIS with the produces WAV files. The validation of bat records is completed by the principal bat surveyor prior to mapping.

Tree Potential Bat Roost (PBRs) Inspection:

10.3.51 Trees that may provide a roosting space for bats are classified using the Bat Tree Habitat Key (BTHK, 2023)1 and the classification system used is from Collins (2016). The Potential Roost Features (PRFs) listed in this guide are used to determine the PBR value of trees.

10.3.52 It can be challenging to ascertain the presence or absence of roosts in trees, even if no bats are detected, consideration also needs to be given to the transient nature of some bats roosting in trees. If a tree is deemed to be a roost site, then further surveying involving dusk and dawn surveys of the actual trees may be recommended to determine what bat species are present etc. Graiguenamanagh Town Area (Original Scheme Area).

Bat Surveys (2023/2024)

10.3.53 The study area that formed the basis of the bat surveys includes the river Barrow and River Duiske. Additional areas of Graiguenamanagh town were also surveyed within the original CFRAM Scheme area (see Figure 10-6).

10.3.54 Initially, a desktop assessment of aerial photographs along the route of the proposed flood relief scheme was undertaken to identify existing habitats, buildings and structures which may be favourable for bat use within the potential works locations.

10.3.55 The surveys deemed suitable for a particular project is determined on a case-by-case basis. The surveys undertaken for this survey areas are the same as those outlined in 10.3.41 to 10.3.51.

10.3.56 Activity surveys were carried out on site on the following dates in 2023, August 2nd, August 15th, August 16th, September 1st, September 5th, September 7th, September 12th and September 22nd. These surveys involved dusk emergence surveys and transect surveys.

Mammals (non-volant)

Mammal Survey (non-volant) (2021)

10.3.57 A survey was completed by Ayesa (formerly ByrneLooby) ecologists in the original CFRAM Scheme area in 2021. A map of this area can be seen in Figure 10-6.

10.3.58 The survey included particularly otter (*lutra lutra*), but also red squirrels (*Sciurus vulgaris*), badgers (*meles meles*), pine martens (*martes martes*) and other mammals.

10.3.59 In practice, the approach to this type of survey is one whereby certain features of interest are searched for and recorded as part of the habitat survey site walkover. The ecologists would take note of the following evidence:

- Direct sightings of mammals (live or dead)
- Burrows, setts, dens, dreys, holts and otter couches
- Prints
- Prey/food remains
- Faeces

10.3.60 Target notes were also taken, providing supplementary information on ecological features which were significant to specific construction proposals, or features that were too small to map.

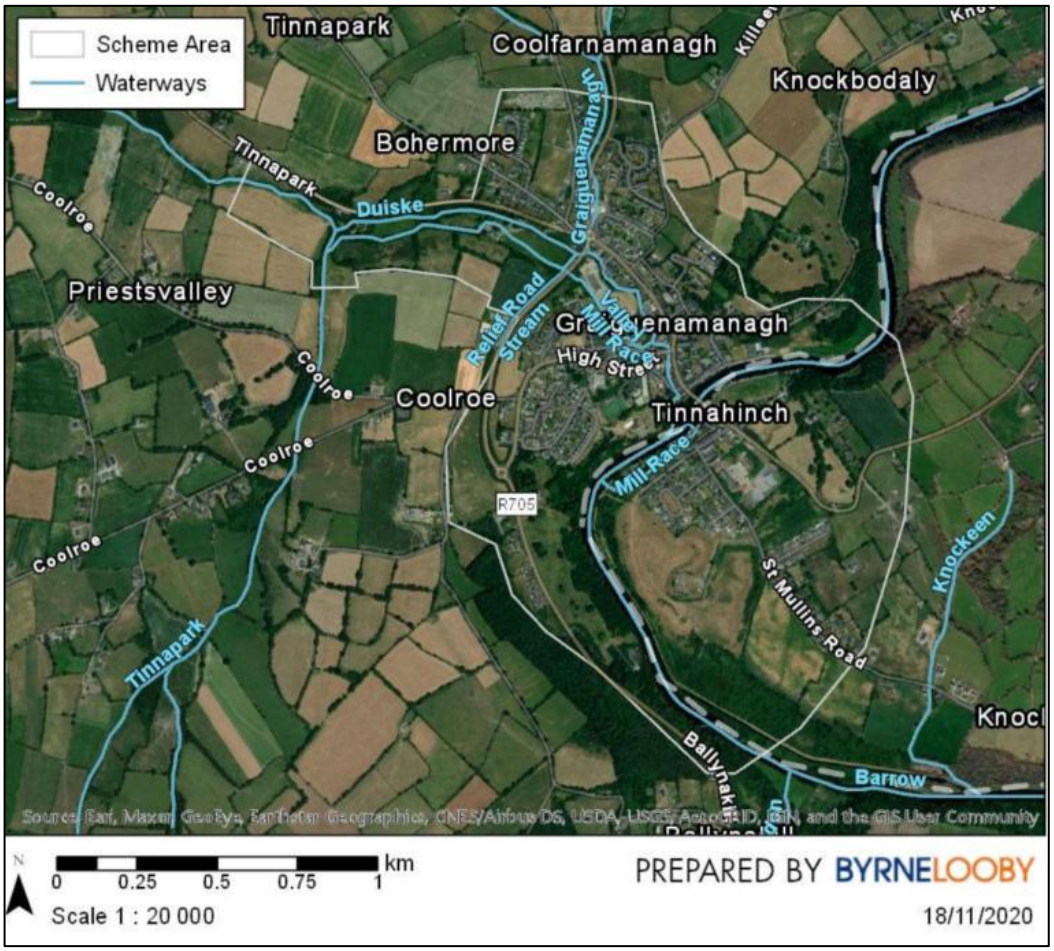


Figure 10-6: Original CFRAM Scheme Area surveyed for the Presence of Mammals in 2021

10.3.61 The following guidance documents were consulted when carrying out these surveys:

- Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes (NRA, 2008)
- Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes (NRA, 2005)
- A Guide to Identifying Evidence of Pine Martens in Wales (Vincent Wildlife Trust, 2017)
- Practical Techniques for Surveying and Monitoring Squirrels (Gurnell et al., 2009, for the Forestry Commission)

Mammal Survey (non-volant) Upstream Storage Area (2023/2024)

10.3.62 The mammal surveys were undertaken in accordance with the guidelines as listed above in Section 10.3.61:

10.3.63 Site visits were carried out by Ayesa ecologists between 9th - 11th of August 2023, 27th - 29th March 2024 to conduct specialist mammal surveys. Mammals were surveyed through the detection of field signs, mammal footprint tunnels, and by direct observations. The

mammal footprint tunnels were subsequently collected on the 11th of August 2023 and 29th March 2024, and data stored for analysis. These field surveys were carried out using the methodology outlined below.

10.3.64 Target notes were also taken, providing supplementary information on ecological features which were significant to specific construction proposals, or features that were too small to map.

10.3.65 Figure 10-7 below, provides an overview of the area extent that was surveyed for tracks and signs of mammals.

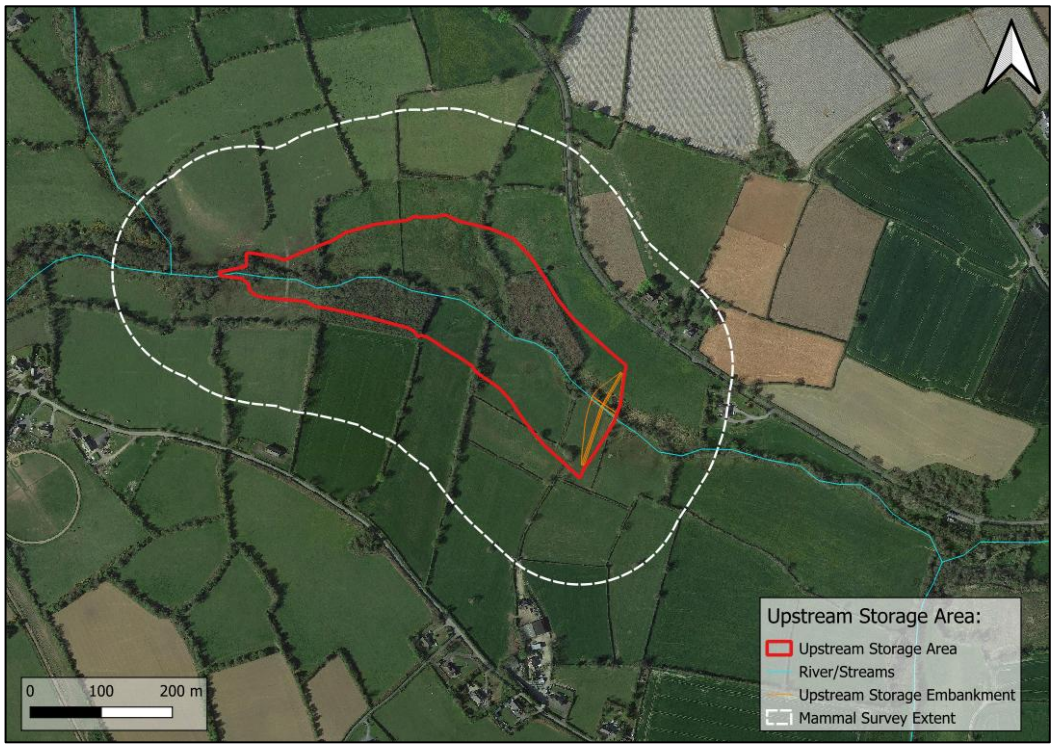


Figure 10-7: Mammal Survey Extent – Upstream Storage Area

10.3.66 The ecologist noted features of interest during the field survey. Any features of interest were photographed, and their GPS location were recorded. Features of interest for this project were non-volant mammals, particularly otters, deer, badgers, pine martens, red squirrels, hedgehogs, Irish stoat, Irish mountain hare and pygmy shrews.

10.3.67 The ecologist searched and took note of the following evidence (if observed):

- Direct sightings of mammals (live or dead)
- Burrows, setts, dens, dreys, day nests, holts, and otter couches
- Prints, hair traces
- Prey/food remains
- Faeces

- Scratching posts at the base of tree trunks
- Snuffle holes (small scrapes where badgers have searched for insects, earthworms, and plant tubers)
- Trails, paths, runs.

10.3.68 For badgers, pine marten, Irish stoat, red squirrel, hedgehog, and Irish hare the search area comprised all land within the Site boundary and surrounding agricultural grasslands and along both sides of the River Duiske, 600m stretch along the banks, where possible.

10.3.69 For otter, the search comprised all land within the Site boundary, surrounding agricultural grasslands and along both sides of the River Duiske, 600m stretch along the banks, where possible.

10.3.70 The mammal footprint tunnel provides a non-invasive and effective presence/absence survey method for small mammals, particularly hedgehogs, otter and other elusive/nocturnal mammals. Figure 10-8 shows the design of these tunnels and Figure 10-9 shows them in the field in Graiguenamanagh.

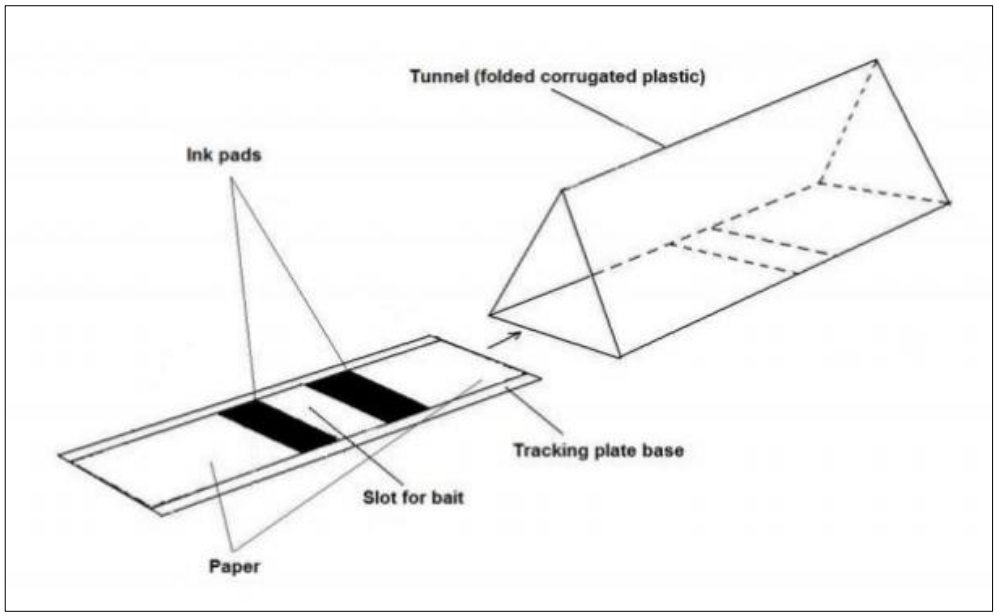


Figure 10-8: Design of the tracking tunnels and sliding baiting tray



Figure 10-9: Mammal Footprint Tunnels - setup and results three days later

10.3.71 Figure 10-10 shows the locations of the mammal footprint tunnels. Several tunnels were installed on the righthand side of the riverbank over a stretch of over 600 metres, this accounts for areas of the river located upstream and downstream within the Proposed Scheme area. These tunnels' locations can give a good representation of otter activity in the area by recording areas close to the River Duiske, which the otter depends upon for feeding and travel. Other mammals such as mink (which are semi-aquatic) may also use this stretch of the river for feeding.

10.3.72 The tunnels were installed during daylight hours on 9th of August 2023 and were collected on the morning of 11th August 2023. Therefore, the prints recorded from the tunnels are representing two full nights of mammal activity (most mammal activity (foraging etc.) occurs during the night).

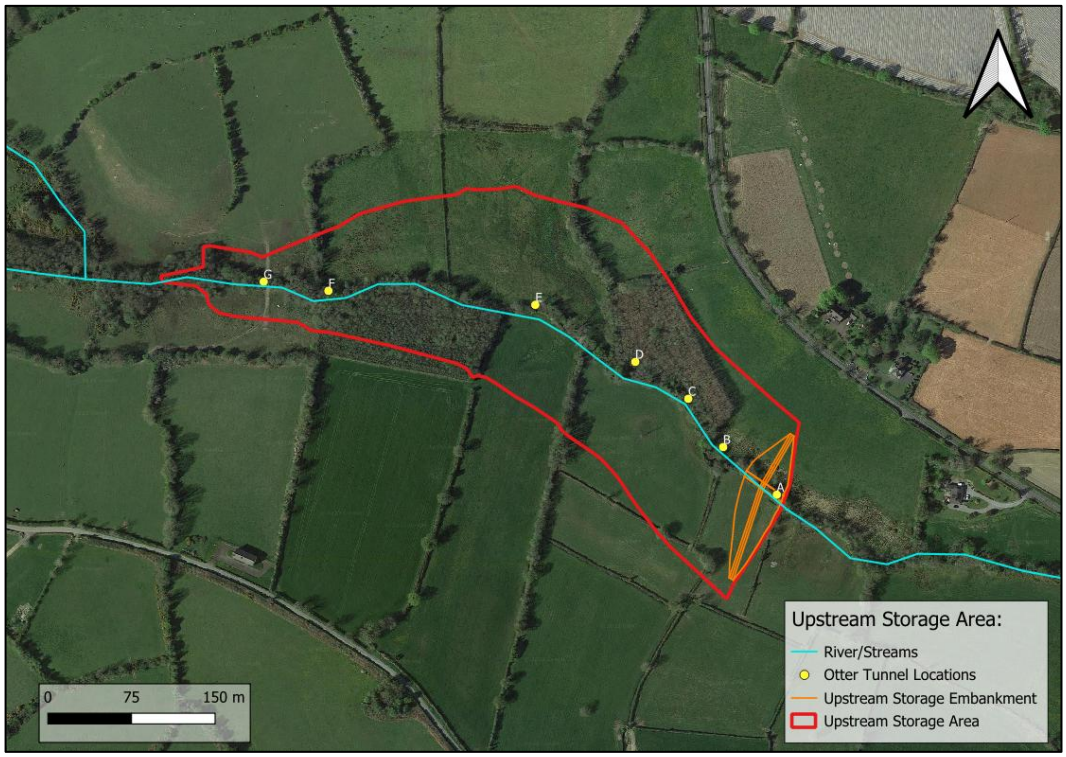


Figure 10-10. Location of Mammal Footprint Tunnels

Mammal Survey (non-volant) Original Scheme Area – Urban Section (2024)

10.3.73 A site visit was carried out by Ayesa ecologists to conduct specialist mammal surveys in March 2024. The purposes of this survey was to revise and update the information gathered within the original CFRAM Scheme area in 2021. Mammals were surveyed through the detection of field signs and direct observations throughout the original CFRAM scheme area (urban section) around the town of Graiguenamanagh (see Figure 10-5). These mammal surveys were refined to reflect changes in design. These surveys were undertaken following the same methodology as outlined in 10.3.66 to 10.3.74.

10.3.74 The following limitations are recognised:

- Nocturnal and/or rare and cryptic mammals such as otter, badger, Irish stoat (though not strictly nocturnal, much of their hunting occurs at night), hedgehog, and pine marten (largely nocturnal) cannot be enumerated by direct observations. True representation of species presence/absence and abundance cannot be achieved as a result of this limitation.

- Ecological survey timing and seasonal constraints providing limited or preliminary data –many protected faunal species are also seasonally constrained with survey timing; potential limitations included periods of hibernation, seasons of low activity (certain species only emerging in certain seasons), and outside the breeding season (high activity).

- Areas that were inaccessible during the mammal surveys, e.g., certain portions of the banks along the River Duiske. Therefore, species may have been present on-

site but were missed as the site walkover was difficult to access for assessment/evaluation.

- As mammals are highly mobile species, covering large ranges for hunting/foraging, evidence/live sightings of the species such as the deer, badger, pine marten, otter, etc. may have been missed.
- The data limitations of the biological records mean that they may not be relied upon as a present-day/updated representation of presence/absence and/or distribution of species. The records can provide indications of the likely presence/absence of species within the Site and the surrounds. However, it should be noted the absence of records for protected species does not equate to evidence of their absence from the area. In addition, variability can occur in the accuracy of online records, and their point counts/observations are often georeferenced to the nearest 1km grid square.

10.3.75 Despite the above-mentioned limitations, a robust understanding of the site's ecology from the mammal survey was obtained.

Herpetofauna

Herpetofauna Original Survey (2021)

10.3.76 The approach to this type of survey is one whereby certain features of interest are searched for and recorded as part of the habitat survey site walkover. Any features of interest were photographed, and their GPS location recorded. The ecologists would take note of the following evidence:

- Spawn
- Potential spawning habitat

10.3.77 The original survey was undertaken with the CFRAM Study Area extent in mind, within the towns of Graiguenamanagh-Tinnahinch (G-T) on 16th of February 2021.

Herpetofauna Survey Upstream Storage Area (2023/2024)

10.3.78 A herpetofauna survey was undertaken by Ayesa's internal ecology team in March 2024. This survey followed the same methodology as above.

10.3.79 This survey relied on the field on the identification of amphibian populations at their breeding sites. Reliably detecting amphibian populations in terrestrial habitats away from their breeding sites or at other times of year requires a substantial amount of survey effort (and is simply not possible during the hibernation period) and therefore should be avoided wherever possible. Key cards were used onsite to help identify any amphibians and/or their associated spawn during the survey.

Herpetofauna Survey Graiguenamanagh/Tinnahinch Original Scheme Area (2023/2024)

10.3.80 A survey was not recommended within the towns of G-T as no suitable habitat was noted. This recommendation is detailed further in the report contained under Appendix 10-12.

10.3.81 However, given historical observations made in 2021, this EIAR will assume presence of spring-spawning herpetofauna within the project area, and will include appropriate pre-construction mitigation as a matter of course.

Aquatic Macroinvertebrates

Q Value / Invertebrate Survey (2021)

10.3.82 A project-specific Biological River Quality Classification System (or Q Value) Survey and kick sampling (macroinvertebrates) was undertaken in February 2021 by Aquafact (Aquafact International Services Ltd, 2021).

10.3.83 Five kick samples were taken, see Figure 10-11. The two-minute kick and one minute stone wash sampling method was employed to collect samples of macroinvertebrates for analysis. This involved placing a standard hand net of pore size 500µm in the river, facing upstream and disturbing the riverbed in front of the net mouth. The ecologist then moved in a diagonal direction upstream to ensure that different micro-habitats were included in the sample. The kick method dislodges macroinvertebrates from the substrates and submerged plant material. This was continued for approximately two minutes and followed by one minute of stone washing.

10.3.84 The resulting sample was transferred from the net to a plastic bucket, then placed into a white sorting tray allowing for the bankside assessment to take place. The freshwater invertebrates were then assigned to the suitable indicator group. The derived species list was then used to assign a Biotic Index value (Q-Value) to the sampled streams.

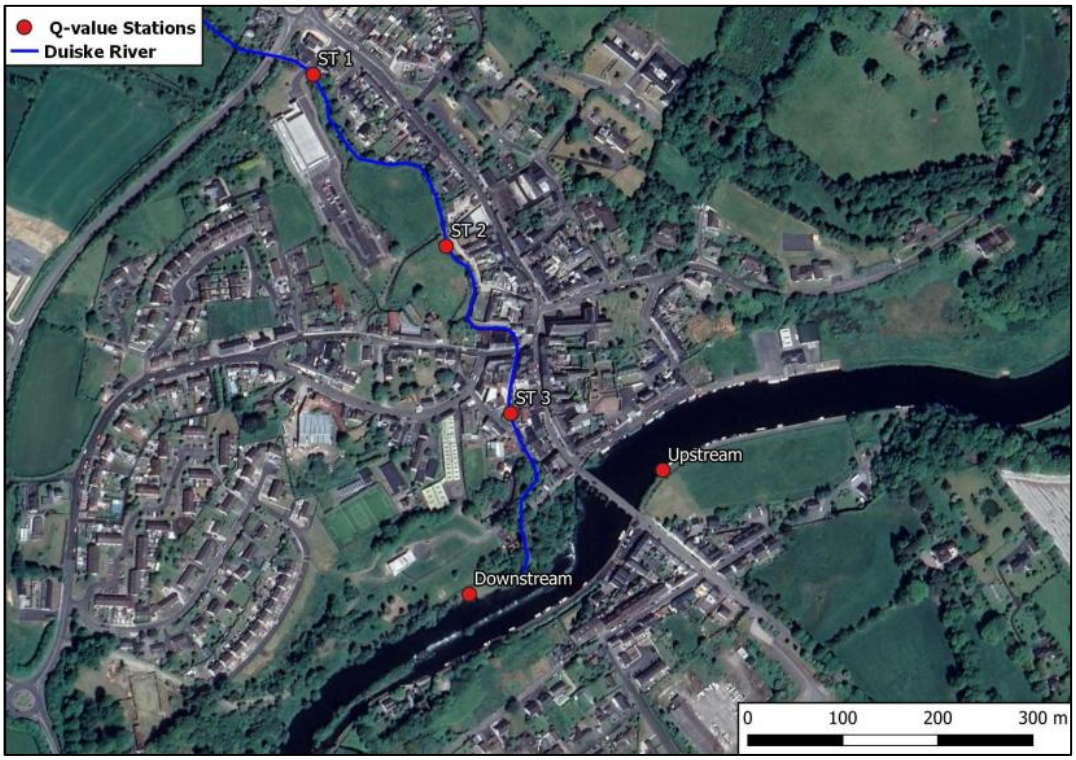


Figure 10-11: Q-Value Site Locations Graiguenamanagh

Q Value / Invertebrate Survey (2023)

10.3.85 A further Q Value Survey and kick sampling (macroinvertebrates) was completed ally by APEM in August 2023 according to the standard methodology used by the EPA (Toner et al., 2005). A two-minute macroinvertebrate kick sample was conducted at each site using a standard, 1 mm mesh size, long-handled net, principally from the faster flowing riffle habitats, but glides, margins and pools were included according to their proportional presence. A further one-minute hand search was carried out to locate macroinvertebrates that attached themselves to solid structures, such as the underside of the cobbles. Each sample was preserved on site with >90% Isopropanol solution and returned to the laboratory for further analysis. Specimens were identified, under a binocular microscope, to family level in the laboratory using the standard range of identification keys published by the Freshwater Biological Association, AIDGAP and others, and their relative abundance was recorded.

10.3.86 An EPA Q-value classification was assigned to each site. The Q-values were assigned based on the presence and relative abundance of sensitive groups and the consideration of additional qualifying criteria, as described by Toner et al. (2005).

Q Value/Invertebrate Survey (2024)

10.3.87 A Q-value survey was undertaken by Ayesa's internal ecology team in June 2024. The intention was to 'top up' the original CFRAM level surveys outlined above.

10.3.88 Five kick samples were taken, see Figure 10-12. This followed the same methodology as outlined in 10.3.85.

10.3.89 Due to the depth of the River Barrow in the "Upstream" location where Aquafact performed a kick sample in 2021, it was not possible to use this station for the top-up survey. This section of river was also in flood and could not be sampled for health and safety reasons.

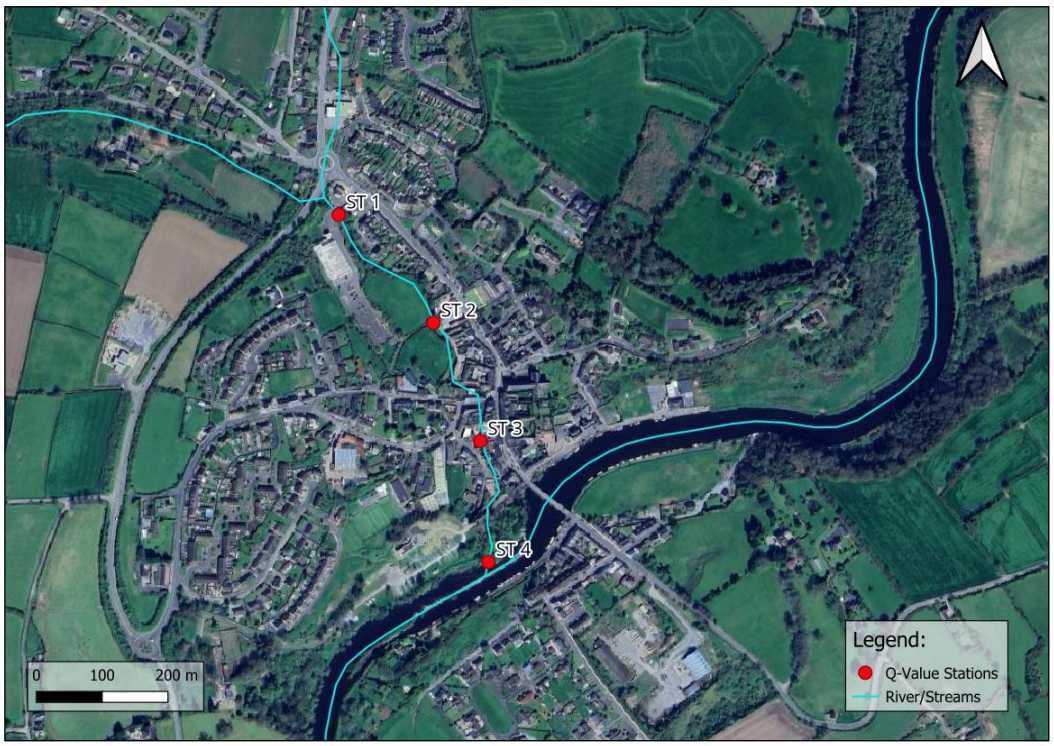


Figure 10-12: Graiguenamanagh Q-Value Station Locations

Fish Species

Electrofishing Survey (2021)

10.3.90 Electrofishing was carried out on 10th February 2021 at the locations indicated in Figure 10-13 using battery powered backpack electrofishing equipment (Smith-Root Lr-24) which was deployed at 240v / 40Hz / 18% duty cycle pulse DC settings. At each station electrofishing was carried out over an elapsed time period totalling 10 minutes (600 seconds). Actual fishing time during this period was provided by a 'fishing on' timer mechanism on the LR-24.

10.3.91 For salmonid species and European eel, electro-fishing was carried out in an upstream direction for a 10-minute CPUE, an increasingly common standard approach for wadable streams (Matson, Delanty, Shephard, Coghlan, & Kelly, 2018). Electrofishing for lamprey ammocoetes was conducted as per Harvey & Cowx (Harvey & Cowx, 2003) by targeting areas of sand/silt, where encountered by using a low frequency (20-30Hz). This was used in combination with the burst of pulses direct current setting to optimize lamprey ammocoete capture without physical damage. This was carried out after completion of the 10-minute CPUE salmonid and eel electrofishing.



Figure 10-13: Electrofishing Survey Sites

Upstream Storage Area Fish Habitat Survey (2023/2024)

10.3.92 An electrofishing survey was not required for this area, however, APEM carried out a fish habitat survey.

10.3.93 Presence of fish species within the area to be affected was determined from pre-existing data and designations. Habitat walkover surveys were conducted in order to identify suitable habitat for the key fish species and their associated important life stages. Electrofishing was not conducted. This decision is explained below regarding minimising disturbance to any SAC QI populations. Existing datasets, which have the advantage of being collected at multiple times, show what has previously been recorded at the sites and habitat walkover surveys then identify suitable habitat for the key species and life stages of importance.

10.3.94 Baseline fisheries data was obtained from previous electrofishing surveys conducted upstream and downstream of the proposed works area on the Duiske River. These surveys were conducted by Inland Fisheries Ireland (IFI) for the Water Framework Directive fish ecological status 2008-2021 project. The newly published dataset river layer shows river fish status and fish distribution from surveys carried out from 2008 to 2021, as well as the species recorded and the dates the surveys were conducted. Aquafact Ltd also conducted electrofishing surveys on the Duiske River in 2021 ca. 1.4 km downstream of the proposed works area.

10.3.95 IFI were contacted regarding the need for electrofishing in the area and have stated that we can assume all fish QIs of the River Barrow and River Nore SAC are present within the

works area. This confirmed our original decision and recommendation to the client, not to undertake electrofishing and so minimise disturbance to any SAC QI populations.

10.3.96 Walkover habitat surveys were conducted on 09 August 2023. Weather conditions were dry with 6/8 okta cloud cover, Beaufort 0 wind3, air temperature 19°C. The river flow at this time was considered low and, therefore, allowed for good visibility during habitat surveys. Each survey mapped habitats suitable for salmonids and lamprey.

10.3.97 The methodology applied to the habitat survey follows that of Hendry & Cragg-Hine (1997). This field mapping technique involves hand drawing features, onto a high-resolution map (OS 1 km tiles), at a scale of 1:10,000 using a field tablet. The riverbank was walked, noting habitat features in the river channel and drawing these directly onto the map, with the boundaries of the different habitat classifications being drawn to represent their actual position within the river, and with annotations as required. Prominent features, such as log jams, macrophyte beds, weirs and bridges, were noted and their locations confirmed using handheld GPS unit. This approach allows exact representation of areas of individual habitat types encountered and, in doing so, a mosaic of the different habitat types can be drawn along the whole section of the river.

Invasives

10.3.98 Invasive species surveys have been ongoing since 2021 with annual treatment also being undertaken. The following methodology is employed for the annual surveys: A GIS based survey focused on the areas proposed for flood relief measures within the scheme area to capture geospatial data of problematic invasive plant species.

10.3.99 Any specimens of species listed in the Third Schedule of the Birds and Natural Habitats Regulations (2011) were recorded. Upon encountering any specimens, the following information was gathered:

- Species.
- Area coverage (approximate); and
- GPS coordinates.

10.3.100 Treatment is being undertaken as detailed in the Invasive Species Management Plan contained within the Construction Environmental Management Plan (CEMP, Appendix 4-4). The areas surveyed and then treated are outlined in Figure 10-14.

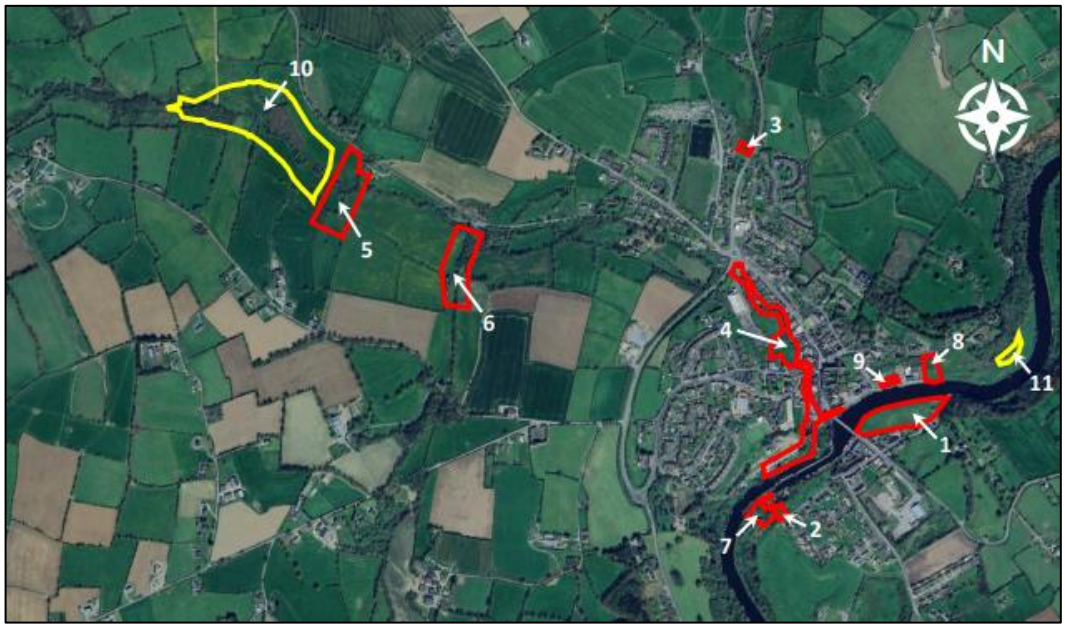


Figure 10-14: IAPS locations and where treatment was carried out (areas numbered 1 to 10) and additional area only surveyed (not treated) to the east of Area 8 now identified as Area 11.

White Clawed Crayfish

White Clawed Crayfish Survey (2021)

10.3.101 Triturus Environmental Ltd. was contracted by Ayesa (formerly ByrneLooby) to undertake a baseline white-clawed crayfish (WCC) (*Austropotamobius pallipes*) survey of the watercourses in the footprint of the Proposed Scheme.

10.3.102 WCC surveys were undertaken at a total of n=14 survey sites under an NPWS open licence (no. C145/2021), as prescribed by Sections 9, 23 and 34 of the Wildlife Act (1976-2018), to capture and release crayfish to their site of capture, under condition No. 6 of the licence.

10.3.103 Twelve 51 x 20cm, 19mm mesh polypropylene Trappy crayfish traps (ballasted with extra rock to prevent excessive movement) were positioned in the vicinity of n=5 proposed instream works areas on the Duiske River and River Barrow. Traps were fished in pairs and were placed in suitable marginal areas overnight and retrieved the following morning. Traps were disinfected with Virkon between sites to minimise transfer of pathogens. All traps were baited with 100g of cat food to attract crayfish to the traps.

10.3.104 To expand survey area coverage, hand-searching of instream refugia (including sweep netting) was undertaken at a total of n=9 sites on the Duiske River and mill race channel, Graiguenamanagh River and the River Barrow. Surveys followed the methodology of Reynolds et al. (2010) and Peay (2003). A minimum of n=25 potential refugia (boulders, macrophyte beds, large woody debris, tree root systems etc.) were searched at each site. Additionally, instream snorkelling facilitated hand-searching of deeper areas of river channel (where applicable). An appraisal of white-clawed crayfish habitat at each site and in the wider survey area was also carried out based on physical channel attributes. Furthermore, an appraisal of crayfish distribution and habitat was completed whilst

undertaking SCUBA dive surveys for the accompanying freshwater pearl mussel survey (Triturus, 2021) of the River Barrow within the survey area.

10.3.105 Further to traditional survey methods, it was important to undertake a riparian walkover survey to examine any spraint from mustelids (i.e. otters & mink) which may contain crayfish remains. Given that mustelids hunt large areas of river, they can detect cryptic prey present at low densities, which are often not easily attainable via conventional survey methodologies. Whilst not quantitative, riparian walkover/spraint surveys are useful for clarifying the presence of absence of crayfish at a particular site.

10.3.106 To further validate the site surveys and to detect potentially cryptically low populations of white clawed crayfish within the study area, n=3 water samples from sites on the Duiske River and River Barrow were analysed for Austropotamobius pallipes environmental DNA (eDNA) in April 2021. Sampling points were strategically chosen on the Duiske River (upstream of Tinnapark River confluence and downstream of Turfmarket Weir) and River Barrow (Lower Tinnahinch Weir) to maximise habitat coverage and eDNA detection within the wider survey area.

10.3.107 In accordance with best practice, composite (500ml) water samples were collected from each sampling point, maximising the geographic spread within each site (20 x 25ml samples at each site) and thus increasing the chance of detecting the target species' DNA. Each composite sample was filtered on site using a sterile proprietary eDNA sampling kit. Fixed samples were sent to the laboratory for analysis on the same day as collection. A total of n=12 qPCR replicates were analysed for each site. Given the high sensitivity of eDNA analysis, a single positive qPCR replicate is considered as proof of the species' presence (termed qPCR No Threshold, or qPCR NT). Whilst an eDNA approach is not currently quantitative, the detection of the target species' DNA indicates the presence of the species at or upstream of the sampling point.

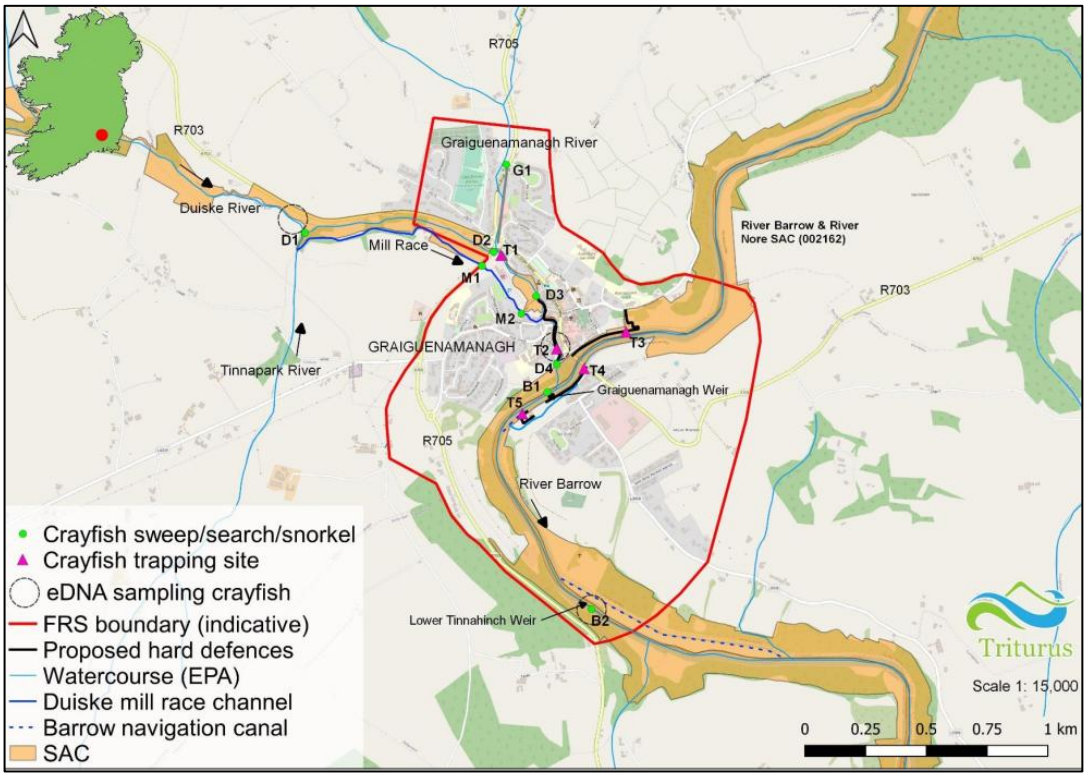


Figure 10-15: Overview of the white-clawed crayfish survey sites Graiguenamanagh

White Clawed Crayfish Survey Upstream Storage Area (2023)

10.3.108 APEM carried out white clawed crayfish surveys for the upstream storage area in 2023 on behalf of Ayesa.

10.3.109 Prior to conducting field surveys for white-clawed crayfish, a check for previous records in the catchment was carried out. Licences for WCC surveys were secured from National Parks and Wildlife Service (NPWS) prior to commencement of the survey (Licence No. C225/2023). Two surveys were conducted on 09 August 2023 to determine the presence/absence of WCC on the Duiske River upstream of, and at, the area of works and according to the standard methodology used by Peay (2003) and Gammell et al. (2021). On arrival, channel conditions were assessed, and a 100 m stretch of suitable river was chosen for survey within the 500m survey stretch. Hand-searching of 50 potential refuges within 5 patches was carried out at each chosen 100 m stretch. Potential refuges were defined as any suitable substrata (e.g., boulder, cobble, woody debris) that would be resistant to high flows and capable of providing cover for WCC. Refuges were searched facing upstream to minimise the disturbance of softer substrata. Where possible, refuges were replaced after searching. Habitat features for each patch were also recorded.

10.3.110 In addition to hand-searching, a string of four trappy funnel baited crayfish traps were laid out on 09 August 2023 and left overnight these within an area of suitable habitat that included abundant refuges and vegetation. Traps were spaced approximately 4 m apart and laid parallel to the riverbank in approximately 0.5 m of water. Each end of the rope was secured to the bank in order to prevent the baited traps from being moved. Each trap

was baited with approximately 40 g of raw fish (mackerel). Traps were left overnight and checked early the following morning on 10 August 2023.

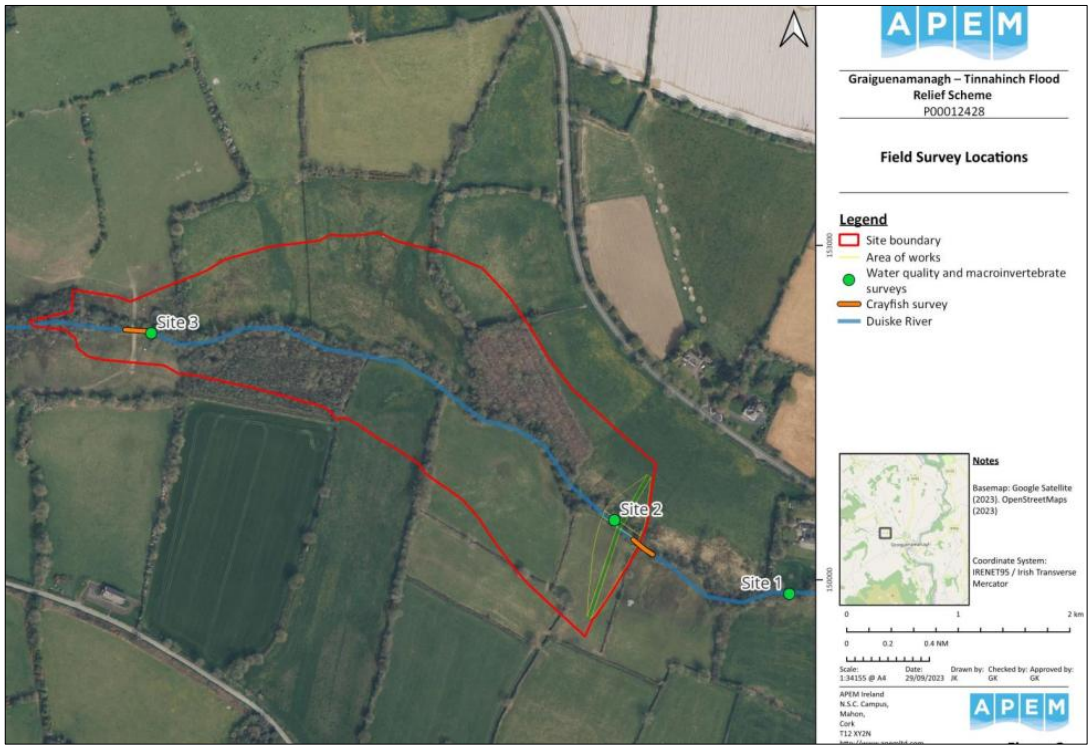


Figure 10-16: Crayfish Survey sites in upstream storage area

Freshwater Pearl Mussel

Freshwater Pearl Mussel Survey (2021)

10.3.111 Triturus Environmental Ltd. was contracted by Ayesa (formerly ByrneLooby) to undertake a baseline freshwater pearl mussel (*Margaritifera margaritifera*) survey of the watercourses in the footprint of the Proposed Scheme located near Graiguenamanagh, Co. Carlow.

10.3.112 The pearl mussel surveys were carried out on Thursday 29th and Friday 30th April 2021 in bright weather, with good underwater visibility and under base flow conditions. This helped to maximise visibility of pearl mussel against dark substrata and also helped increase chances of detection when mussels are filtering in brighter conditions. The visual pearl mussel survey (stage 1 and stage 2) was carried out under Section 23 & 34 of the Wildlife Acts 1976 to 2018 (licence number C136/2021) issued by the National Parks and Wildlife Service (NPWS) on the 12th of April 2021. The survey methodology used was in accordance with the Stage 1 and 2 guidelines given by the NPWS in the Irish Wildlife Manual No. 12 (Anon, 2004) (guidelines currently being updated but unpublished at the time of survey). The surveys were also cognisant of the latest European-wide guidance for freshwater pearl mussel survey methodology (e.g. Boon et al., 2019).

10.3.113 Stage 1 presence-absence surveys were undertaken in n=5 discreet survey sections along a total of c.4km of channel on the Duiske River, Graiguenamanagh River and River Barrow. Surveys incorporated a combination of bathyscope surveying, snorkelling and SCUBA

diving techniques, dependant on local water depths and flow regimes. To maximise detection rates and efficiency, two operators worked in tandem, with one surveyor in-stream and one bank manager to collate data. As per best practice, surveys within each survey section began downstream and worked upstream at each site to avoid silt and debris blocking the view of pearl mussels and to avoid damage to pearl mussels by trampling (i.e. because of better visibility). Notes were also taken on the aquatic habitat conditions and suitability for freshwater pearl mussels at each site, based on the criteria of Moorkens & Killeen (2020), and Skinner et al. (2003).

10.3.114 To further validate the site surveys and to detect potentially cryptically low populations of freshwater pearl mussel within the study area, water samples from sites on the Duiske River and River Barrow were analysed for *Margaritifera margaritifera* environmental DNA (eDNA) in April 2021. The Turfmarket Weir (Duiske) and Tinnahinch Weir (Barrow) sampling points were strategically chosen to maximise habitat coverage within the study area.

10.3.115 In accordance with best practice, eDNA sampling for freshwater pearl mussel was carried out as per the Crayfish eDNA.

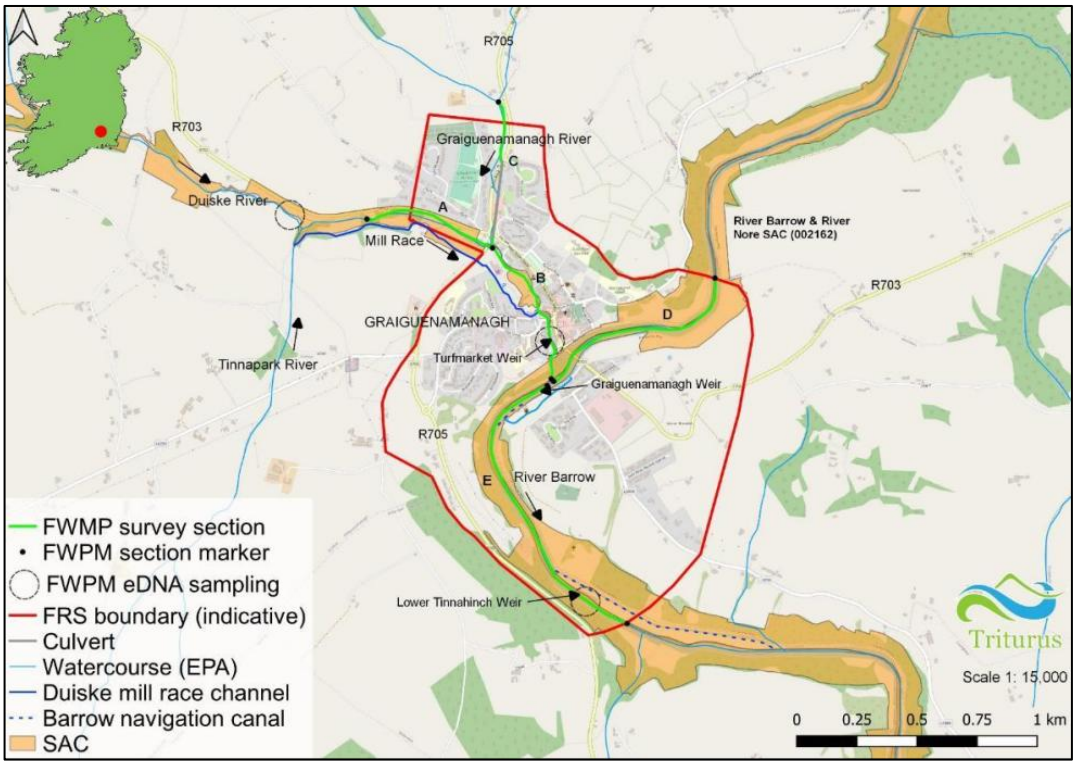


Figure 10-17: Freshwater pearl mussel survey sections, April 2021

Consultation

10.3.116 Determining the ecological issues to be addressed for the assessment was informed by early engagement with relevant stakeholders. During this scoping process, selected consultees were provided the opportunity to input into the proposed development through preliminary discussions on Key Ecological Receptors that could potentially be affected; strategies to avoid negative impacts; and, where possible, compensation or enhancement measures. This chapter has been prepared with consideration of the

outcomes of this consultation, which is detailed further in Chapter 5 - Consultation and Stakeholder Engagement.

10.3.117 Specific to this Chapter, communications were received from the following:

- National Parks and Wildlife Service (NPWS)
- Inland Fisheries Ireland (IFI)
- Office of Public Works (OPW)

10.3.118 Where communications have been received that advise the inclusion of specific third parties in consultation these requests have been actioned. Further, consultation relevant to soils/geology/hydrogeology and surface water (see Chapters 12 and 8 respectively) has also been considered in the preparation of this Chapter, due to the interdependencies of these parameters with biodiversity concerns.

10.4 Baseline Environment

10.4.1 The following sections provide a summary of the baseline environment. This information has been gained from the numerous baseline and specialist surveys undertaken as part of GTFRS, as outlined in Table 10-1. These reports are included under Appendix 10-1 to Appendix 10-12 of this EIAR.

Protected Sites and Species

Natura 2000 sites

10.4.2 Natura 2000 is an ecological network composed of internationally important sites designated under the Birds Directive (Special Protection Areas (SPA)) and the Habitats Directive (Sites of Community Importance (SCI), and Special Areas of Conservation (SAC)). Within 10 km of the river section (Figure 10-1 and Table 10-3) there is 1 Special Protection Areas (SPA) and 2 Special Areas of Conservation (SAC).

Table 10-3: Natura 2000 Sites within 10 km of the Proposed Scheme Area

Type	Site Code	Site Name	County	Distance from Scheme Area
SAC	002162	River Barrow and River Nore SAC	Co. Carlow, Kildare, Kilkenny, Laois, Offaly, Tipperary, Waterford and Wexford	0.0 km
SAC	000770	Blackstairs Mountains SAC	Co. Carlow and Wexford	7.32 km
SPA	004233	River Nore SPA	Co. Kilkenny and Laois	8.78 km

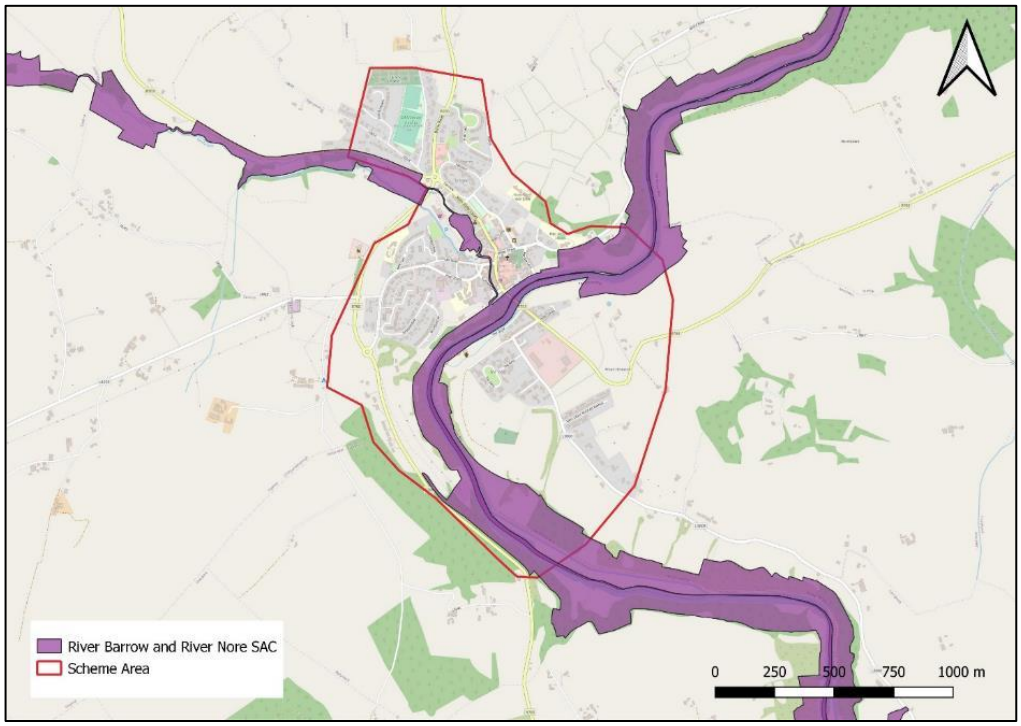


Figure 10-18: River Barrow and River Nore SAC in Relation to the Proposed Scheme

River Barrow and River Nore SAC

10.4.3 The great majority of the River Barrow lies within the River Barrow and River Nore SAC (site code 002162) (see Figure 10-18). This SAC is of high conservation value for the following Qualifying Interest (QI) habitats and plant and animal species (*denotes a priority habitat): The Qualifying Interests (QIs) for the River Barrow and River Nore SAC are:

10.4.4 Habitats:

- 1130 Estuaries
- 1140 Mudflats and sandflats not covered by seawater at low tide
- 1170 Reefs
- 1310 Salicornia and other annuals colonising mud and sand
- 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
- 1410 Mediterranean salt meadows (*Juncetalia maritimi*)
- 3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation
- 4030 European dry heaths
- 6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels

- 7220 Petrifying springs with tufa formation (*Cratoneurion*)*
- 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)*

10.4.5 Species:

- 1029 Freshwater Pearl Mussel (*Margaritifera margaritifera*)
- 1016 Desmoulin's Whorl Snail (*Vertigo moulinsiana*)
- 1355 Otter (*Lutra lutra*)
- 1092 White-clawed Crayfish (*Austropotamobius pallipes*)
- 1106 Salmon (*Salmo salar*)
- 1103 Twaite Shad (*Alosa fallax fallax*)
- 1421 Killarney Fern (*Trichomanes speciosum*)
- 1990 Nore Pearl Mussel (*Margaritifera durrovensis*)
- 1095 Sea Lamprey (*Petromyzon marinus*)
- 1096 Brook Lamprey (*Lampetra planeri*)
- 1099 River Lamprey (*Lampetra fluviatilis*)

River Nore SPA

10.4.6 There is distant upstream connectivity only, with the SPA being located ~ 30 km (hydrological distance) from the nearest Proposed Scheme works. Kingfisher, an Annex II species under EU Habitats Directive, is the sole designated SCI for the River Nore SPA. This species is known to travel large distances to forage. Additionally, the River Duiske and River Barrow provide excellent commuting corridors for Kingfisher.

Blackstairs Mountains SAC

10.4.7 There is distant upstream connectivity only, with the SAC being located ~ 15 km (hydrological distance) from the nearest Proposed Scheme works. QIs designated for this site include terrestrial habitats only. The distant connectivity between the SAC and the Proposed Scheme works provides sufficient buffer to any significant effects.

Nationally Protected Sites

10.4.8 There are no Natural Heritage Areas (NHA) within 10 km of the site, however, there are 6 proposed Natural Heritage Areas (pNHA) listed below (Figure 10-19 and Table 10-4).

10.4.9 Site details and conservation objectives are not listed for these sites on the NPWS website.

Table 10-4: Proposed Natural Heritage Areas within 10 km of the Study Area

Site Code	Site Name	Distance from Scheme Area
000830	Clohastia	c. 3 km
000770	Blackstairs Mountains	c. 6km
000837	Inistioge	c. 8 km
0008444	Murphy's of the River	c. 10 km
000812	Pollmounty River Valley	c. 10 km
000698	Barrow River Estuary	c. 10 km



Figure 10-19: Proposed Natural Heritage Areas within 10 km of the Study Section

Terrestrial and Aquatic Habitats

Terrestrial Habitats

Specialist Field Survey (2021)

10.4.10 Ayesa (formerly ByrneLooby) ecologists undertook a habitat survey of the original Graiguenamanagh/Tinnahinch CFRAM scheme area in 2021. This detail was confirmed by various walkovers in the subsequent surveys within the scheme area.

10.4.11 Habitats recorded in the study area are listed in Table 10-5 below, listed in the order that they appear in 'A Guide to Habitats in Ireland' (Fossitt, 2000) rather than in order of abundance. Descriptions of the above habitats are provided in Chapter 4 of the Habitats and Species Report for the GTFRS (Appendix 10-1 of this EIAR). The habitat mapping is presented in the figures overleaf (also included in Appendix B of the previously mentioned, with breakdown views of those sections indicated).

Table 10-5: Habitats recorded within the CFRAM scheme area

Habitat Name	Habitat Code (as per Fossitt, 2000)
Eroding/Depositing Rivers	FW1/FW2
Canals	FW3
Reed and Large Sedge Swamp	FS1
Improved Agricultural Grassland	GA1
Amenity Grassland	GA2
Dry Meadows and Grassy Verges	GS2
Wet Grassland	GS4
Oak-birch-holly Woodland	WN1
Riparian Woodland	WN5
Wet Willow-alder-ash Woodland	WN6
Mixed Broadleaved Woodland	WD1
Scattered Trees and Parkland	WD5
Scrub	WS1
Ornamental/Non-native Scrub	WS3
Hedgerows/Treelines	WL1/WL2
Spoil and Bare Ground / Recolonising Bare Ground	ED2/ED3
Arable Crops	BC1
Stone Walls and Other Stonework	BL1
Earth Banks	BL2
Buildings and Artificial Surfaces	BL3

Upstream Storage Area Field Survey (2023)

10.4.12 Ayesa (formerly ByrneLooby) ecologists undertook a habitats and species walkover survey in January 2023 in the area encompassing the proposed upstream storage for the GTFRS.

10.4.13 The following habitat types (as per Fossitt, 2000) have been noted within 100m of the planned flood defences:

Table 10-6: Habitats recorded within the Study Area

Habitat Name	Habitat Code (as per Fossitt, 2000)
Eroding/Upland Rivers	FW1
Scrub	WS1
Stone walls and other stonework	BL1
Recolonising Bare Ground	ED3
(Mixed) Broadleaved Woodland	WD1
Wet Pedunculate Oak-Ash Woodland	GA2
Dry Meadows and Grassy Verges	GS2
Wet Grassland	GS4
Hedgerows	WL1
Riparian Woodland	WN5
Improved Agricultural Grassland	GA1
Treelines	WL2

Aquatic Habitats

10.4.14 Floating river vegetation in the Barrow includes water-starworts (*Callitriche* spp.), Canadian Pondweed (*Elodea canadensis*), water-milfoils (*Myriophyllum* spp.), the

pondweed (*Potamogeton x nitens*), Broad-leaved Pondweed (*P. natans*), Fennel Pondweed (*P. pectinatus*), Perfoliated Pondweed (*P. perfoliatus*) and Crowfoot (*Ranunculus* spp) and Club rush (*Scirpus* sp.). Garden escapes included Laurel, Buddleia and Lawson's cypress.

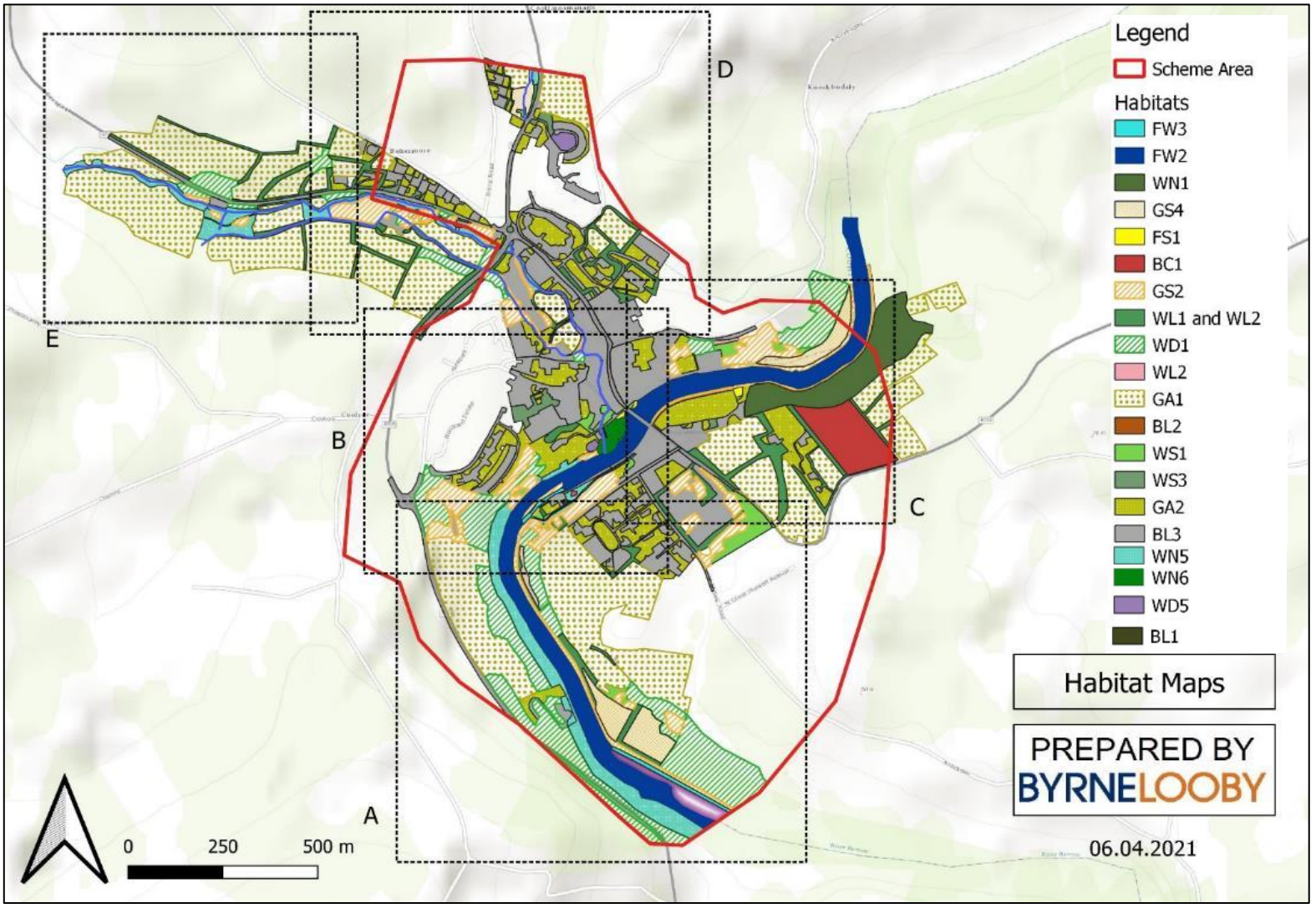


Figure 10-20: Habitat Mapping Graiguenamanagh Original CFRAM Scheme Area (ByrneLooby, 2021)



Figure 10-21: Habitat Mapping Upstream Storage Area (ByrneLooby, 2023)

Flora

Original Flora Survey (2021) and Top up Flora Survey (2024)

10.4.15 No botanical species protected under the Flora (Protection) Order 2015, listed in Annex II or IV of the EU Habitats Directive (92/43/EEC), or listed as species of conservation concern in Ireland were recorded for the study site. All species recorded during the botanical survey are considered common for similar habitats in the general area.

10.4.16 Flora recorded on the walkover survey is listed below:

Table 10-7: Plant Species present in Survey Area

Common Name	Scientific Name
TREES	
Sycamore	*Acer pseudoplatanus*
Horse chestnut	*Aesculus hippocastanum*
Alder	*Alnus glutinosa*
Silver birch	*Betula pendula*
Downy birch	*Betula pubescens*
Lime	*Tilia cordata*
Birch species	*Betula sp.*
Cypress species	*Chamaecyparis sp.*
Hawthorn	*Crataegus monogyna*
Beech	*Fagus sylvatica*
Ash	*Fraxinus excelsior*
Blackthorn	*Prunus spinosa*
Sessile oak	*Quercus petraea*
Pedunculate oak	*Quercus robur*
Oak species	*Quercus sp.*
Rowan	*Sorbus aucuparia*
Willow species	*Salix sp.*
Grey willow	*Salix cinerea*
Crack willow	*Salix fragilis*
Bay Willow	*Salix pentandra*
Yew	*Taxus baccata*
Irish Yew	*Taxus baccata* 'fastigiata'
Hazel	*Corylus avellana*
Eastern Hornbeam	*Ostrya virginiana*
Italian Alder	*Alnus cordata*
Scots Pine	*Pinus sylvestris*
SHRUBS	
Butterfly bush	*Buddleja davidii*
Holly	*Ilex aquifolium*
Cherry Laurel	*Prunus laurocerasus*
Bramble	*Rubus fruticosus agg.*
Gorse	*Ulex europaeus*
Rose species	*Rosa* spp.
Box	*Buxus sempervirens*
CLIMBERS	
Hedge Bindweed	*Calystegia sepium*
Old man's beard	*Clematis vitalba*
Ivy	*Hedera helix*
Honeysuckle	*Lonicera periclymenum*

Common Name	Scientific Name
Virginia Creeper	*Parthenocissus quinquefolia*
GRASSES	
Common bent	*Agrostis capillaris*
Cock's-foot	*Dactylis glomerata*
Yorkshire fog	*Holcus lanatus*
Perennial rye grass	*Lolium perenne*
Common reed	*Phragmites australis*
Annual meadow grass	*Poa annua*
RUSHES	
Soft rush	*Juncus effusus*
Great wood	
AQUATIC PLANTS	
Crowfoot species	*Ranunculus* sp.
HERBS	
Ground elder	*Aegopodium podagraria*
Wild cabbage	*Brassica oleracea*
Wild turnip	*Brassica rapa*
Navelwort	*Umbilicus rupestris*
Ivy-leaved toadflax	*Cymbalaria muralis*
Wild angelica	*Angelica sylvestris*
Cow parsley	*Anthriscus sylvestris*
Lords-and-ladies	*Arum maculatum*
Daisy	*Bellis perennis*
Wavy bitter-cress	*Cardamine flexuosa*
Hairy bitter-cress	*Cardamine hirsuta*
Common mouse-ear	*Cerastium fontanum*
Rosebay willowherb	*Chamerion angustifolium*
Opposite-leaved golden-srages	*Chrysosplenium oppositifolium*
Creeping thistle	*Cirsium arvense*
Marsh thistle	*Cirsium paluste*
Foxglove	*Digitalis purpurea*
Great willowherb	*Epilobium hirsutum*
Broad-leaved willowherb	*Epilobium montanum*
Square-stalked willowherb	*Epilobium tetragonum*
Japanese knotweed	*Fallopia japonica*
Meadowsweet	*Filipendula ulmaria*
Cleavers	*Galium aparine*
Dove's foot crane's bill	*Geranium molle*
Herb-robert	*Geranium robertianum*
Wood avens	*Geum urbanum*
Giant rhubarb	*Gunnera tinctoria*
Hogweed	*Heracleum sphondylium*
Bluebell	*Hyacinthoides non-scripta*
Himalayan balsam	*Impatiens glandulifera*
Yellow iris	*Iris pseudacorus*
Red dead-nettle	*Lamium purpureum*
Great woodrush	*Luzula sylvatica*
Water forget-me-not	*Myosotis scorpioides*
Forget-me-not species	*Myosotis* spp.
Hemlock water-dropwort	*Oenanthe crocata*
Ribwort plantain	*Plantago lanceolata*
Silverweed	*Potentilla anserina*
Creeping cinquefoil	*Potentilla reptans*

Common Name	Scientific Name
Primrose	*Primula vulgaris*
Selfheal	*Prunella vulgaris*
Winter heliotrope	*Petasites pyrenaicus*
Meadow buttercup	*Ranunculus acris*
Lesser celandine	*Ranunculus ficaria*
Creeping buttercup	*Ranunculus repens*
Common sorrel	*Rumex acetosa*
Curled dock	*Rumex crispus*
Broad-leaved dock	*Rumex obtusifolius*
Water figwort	*Scrophularia auricularia*
Common ragwort	*Senecio jacobaea*
Groundsel	*Senecio vulgaris*
Smooth sow-thistle	*Sonchus oleraceus*
Russian comfrey	*Symphytum x uplandicum*
Dandelion	*Taraxacum officinalis agg.*
White clover	*Trifolium repens*
Navelwort	*Umbilicus rupestris*
Common nettle	*Urtica dioica*
Brooklime	*Veronica beccabunga*
Germander speedwell	*Veronica chamaedrys*
Wood speedwell	*Veronica montana*
Common vetch	*Vicia sativa*
Bush vetch	*Vicia sepium*
Dog violet	*Viola riviniana*
Bearberry cotoneaster	*Cotoneaster dammeri*
Large leaf spindle	*Euonymus europaeus*
Scarlet pimpernel	*Anagallis arvensis*
Rugosa rose	*Rosa rugosa*
Common forget - me - not	*Myosotis scorpioides*
Mallow Common	*Malva sylvestris*
Field horsetail	*Equisetum arvense*
Snowberry	*Symphoricarpos albus*
Fushia	*Fuchsia magellanica*
Honeysuckle	*Lonicera periclymenum*
Pineapple weed	*Matricaria discoidea*
Aquatic Plants	
Water Crowfoot	*Ranunculus aquatilis*
FERNS & ALLIES	
Maidenhair spleenwort	*Asplenium trichomanes*
Scaly male fern	*Dryopteris affinis*
Southern polypody	*Polypodium cambricum*
Polypody	*Polypodium vulgare*
Bracken	*Pteridium aquilinum*
Water horsetail	*Equisetum fluviatile*
MOSSES *	
Brachythecium species	
Grimmia pulvinata	
Tortula muralis	

Trees

Arboriculture Survey (2023)

Area 1:

10.4.17 Area 1 is where the upstream storage area is proposed, north-west of the towns. It is the largest of the areas and it consists of agricultural grass fields that slope down to form a valley with the River Duiske which meanders through its centre. Mature hedgerows comprised of species such as hawthorn *(Crataegus monogyna),* blackthorn *(Prunus spinosa),* elder *(Sambucus nigra),* goat willow *(Salix caprea),* holly *(Ilex aquifolium)* and spindle *(Euonymus europaeus)* make up the boundaries between these fields, and mature trees including ash *(Fraxinus excelsior),* oak *(Quercus robur),* horse chestnut *(Aesculus hippocastanum),* sycamore *(Acer pseudoplatanus)* and alder *(Alnus glutinosa)* make up the upper canopies of these hedgerows. All the ash trees display symptoms of ash dieback – causal agent *Hymenoscyphus fraxineus*. The oak trees in this area hold the highest merit, the majority of which have been given Category A grades. There are also two semi-mature forestry plantations in this area comprised of ash *(Fraxinus excelsior),* oak *(Quercus robur),* beech *(Fagus sylvatica)* and alder *(Alnus glutinosa).* Figure 10-22 below shows trees for retention (highlighted in green) and trees to be removed (highlighted in red).



Figure 10-22: Map of trees surveyed in Area 1

Area 2:

10.4.18 Area 2 is a grass field bounded by walls and fences, with a single mature hawthorn (*Crataegus monogyna*) and sycamore (*Acer pseudoplatanus*) towards the back (north) of the field.

Area 3:

10.4.19 Area 3 is the trees along the planned defences at the beginning of the River Duiske, east of the Hub. There are two mature oak trees *(Quercus robur*), a group of mature Lawson cypress' *(Chamaecyparis lawsoniana),* and a mature large leaved lime *(Tilia platyphyllos)* all close the bridge. There is also group of early mature trees between the river and the recreation area, species present include alder *(Alnus glutinosa)*, beech *(Fagus sylvatica)*, white willow *(Salix alba)*, wild cherry *(Prunus avium)* and hazel *(Corylus avellana).*

Area 4:

10.4.20 Area 4 is the trees adjacent to the planned embankment and raised ground behind Tinnahinch Quay. This area is mainly a private garden, with four, self-set trees - a semi mature and early mature ash *(Fraxinus excelsior),* a semi mature sycamore *(Acer pseudoplatanus)* and a mature goat willow *(Salix caprea).* There is also a mixed species, mature woodland on the higher ground to the west of this area, separated by a retaining wall, the trees that make up the outer canopy formation of this woodland, and overhang Area 4, include ash *(Fraxinus excelsior),* western red cedar *(Thuja pilcata)* and larch *(Larix decidua).*

Area 5:

10.4.21 Area 5 is the trees along the planned raised defence wall adjacent to Tinnahinch Castle and the quay. Significant trees in this area include a mature horse chestnut *(Aesculus hippocastanum*) and a mature sycamore *(Acer pseudoplatanus),* both located on the adjoining property side of the wall that runs parallel to the public walkway and river. Outside of this, in the overgrown scrub area to the south of the river, there is a mature white willow *(Salix alba)* and a group of semi mature alder *(Alnus glutinosa)* and white willows *(Salix alba)*. To the east of this area, but still along the quay, there is a group of three, mature, moderate quality, Category B, Lawson cypress (*Chamaecyparis lawsoniana*) trees and a mature, moderate quality, Category B, birch (*Betula pendula*) growing in a small grass area adjoining residences.

10.4.22 Figure 10-23 below shows trees for retention (highlighted in green) and trees to be removed (highlighted in red).

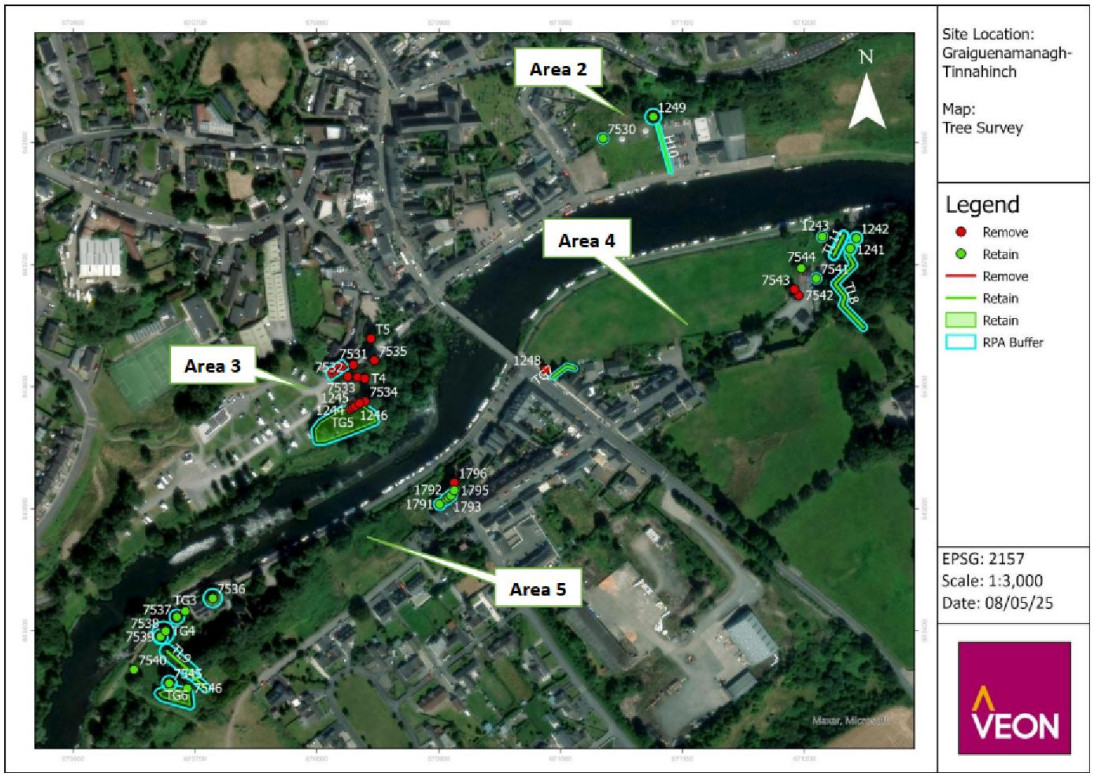


Figure 10-23: Map of trees surveyed in Areas 2-5

10.4.23 In total, 64 Trees were individually tagged, and 6 Trees, 8 Tree Groups, 15 Hedges, 2 Woodland Blocks and 13 Tree Lines were numbered numerically.

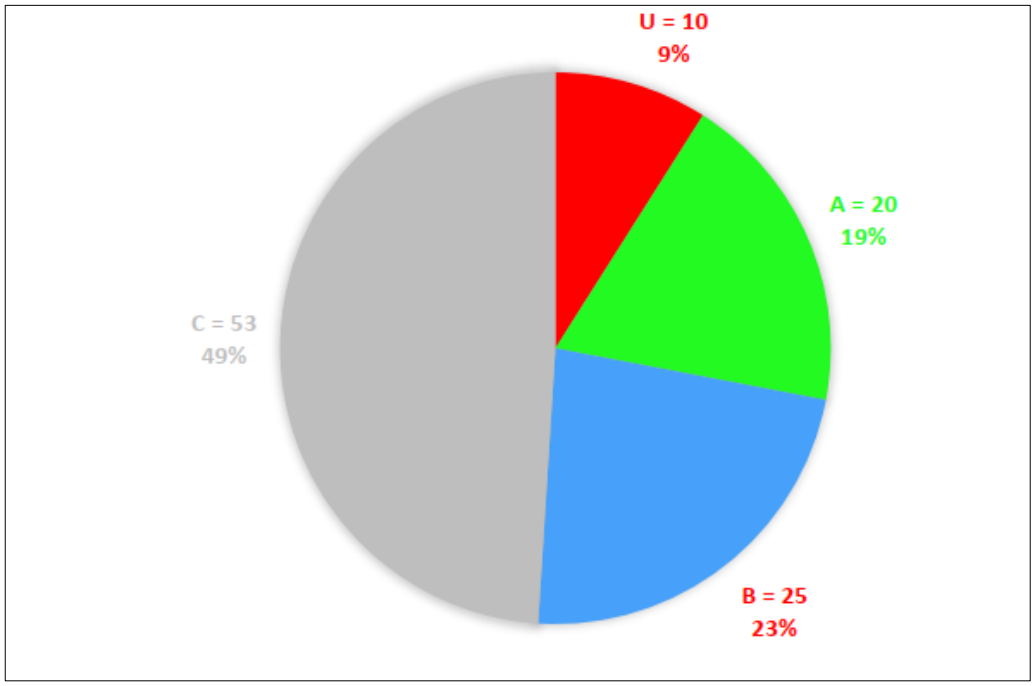


Figure 10-24: Category grade distribution of the surveyed trees

Bats

Desktop Study

10.4.24 The NBDC has compiled data on the suitability of areas as habitats for bats. The data suggests that the site and its surroundings generally have a moderate-to-high habitat suitability for bat usage. The area is deemed most suitable for brown long-eared bats and common pipistrelles. The surrounding landscape is reasonably diverse, comprising a mixture of agricultural grassland, silviculture and urban land-uses, which are punctuated by a network of criss-crossing treelines/hedgerows and a river system. The diverse landscape, as well as the presence of ecological corridors (in the form of hedgerows/treelines and rivers) are what drives the high habitat suitability index for bats in this area.

10.4.25 Records of bat observations compiled by Bat Conservation Ireland have reported five species of bat in G-T at four separate locations, three in Graiguenamanagh and one in Tinnahinch.

Specialist Field Survey (2020)

10.4.26 A summary of the results of the 2020 bat survey are presented below. The full detail is outlined in Appendix 10-3. Figure 10-25 shows the location of the potential bat roosts outlined below.

- PR1: No bats observed in, emerging from, or returning to this structure. Fly-bys of foraging Soprano Pipistrelles and Daubenton's Bat.
- PR2: This potential roost was noted in a building on Peg Washington's Lane. There was sufficient evidence to suggest that bat species (Soprano Pipistrelles) were roosting here. During the dusk survey, soprano pipistrelles appeared to be circling inside the building (frequent pulses were recorded on detector, suggesting bats were flying past the window). During the dawn survey the following morning, a number of Soprano Pipistrelles (clearest at ~55 kHz, erratic flight patterns) were observed circling before disappearing from view towards the northern end of the building. The exact point of exit/entry was not observed. Fly-bys of foraging Soprano Pipistrelle.
- PR3: No bats observed in, emerging from or returning to this structure. Fly-bys of foraging Common Pipistrelle.
- PR4: No bats observed in, emerging from or returning to this structure. Fly-bys of foraging Soprano Pipistrelles.
- PR5: No bats observed in, emerging from or returning to this structure. Fly-bys of foraging Soprano Pipistrelles and Daubenton's Bat.
- PR6: No bats observed in, emerging from or returning to this structure. Fly-bys of foraging Soprano Pipistrelles.

- PR7 & 8: These two sites are close enough so that they can be observed simultaneously from the same vantage point. No bats observed in, emerging from or returning to those structures.

- PR9: There was sufficient evidence to suggest that bat species (Soprano Pipistrelles) were roosting here. During the dusk survey (observing from inside the castle walls), Soprano Pipistrelles were observed emerging over the top of the northern wall. Some descended into the castle and circled for a short time before leaving. The dawn survey yielded a similar pattern, with Soprano Pipistrelles circling before disappearing from view over the northern wall. The exact point of exit/entry was not observed.

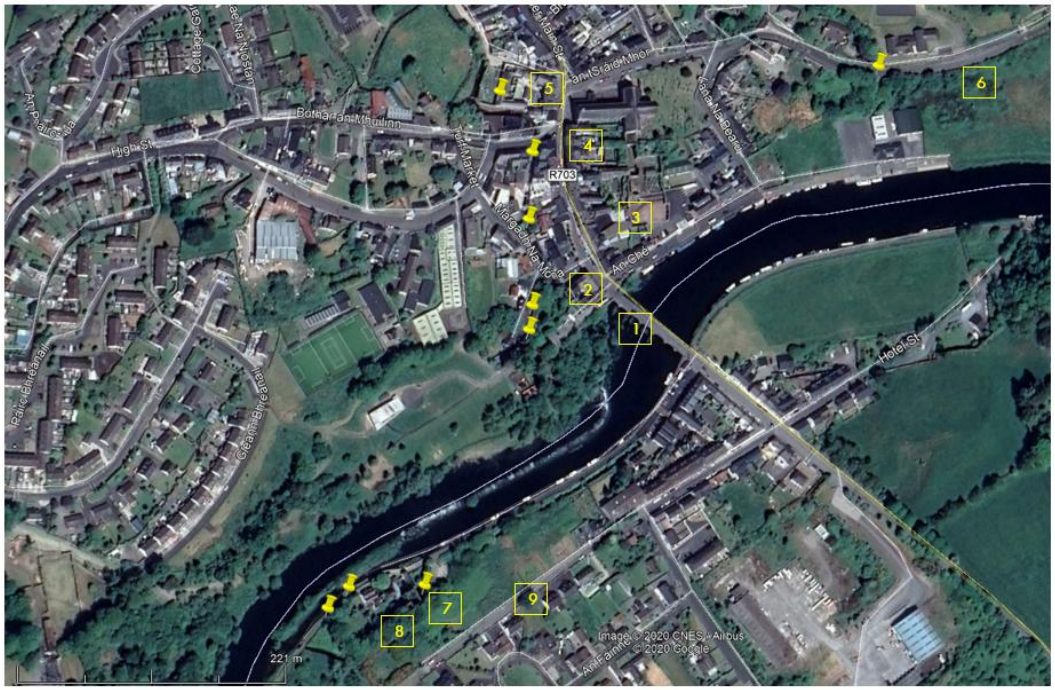


Figure 10-25: Potential bat roosting sites identified (at yellow pinned locations) during site walkover

10.4.27 In summary, G-T is an old town that has retained much of its centuries-old stonework. The presence of the Rivers Barrow and Duiske, as well as numerous patches of scrub, hedgerows, treelines and woodland, cumulatively offer attractive foraging and commuting habitats for several species of bats. These observations are supported by the existing data available online from the National Biodiversity Data Centre and Bat Conservation Ireland. Two of the potential roost sites identified during the daytime survey showed evidence of roosting soprano pipistrelles. Bat activity (in the form of fly-bys) was recorded at all potential roost sites, which indicates that the area as a whole is an important resource for foraging and/or commuting bats. Light pollution is more notable on the northern side of the River Barrow (i.e. PR1-6), which is where the bulk of the town centre is located.

Bat Survey Upstream Storage Area (2023)

10.4.28 Surveys were undertaken using a range of techniques and covered the peak period of bat activity on dates 02/08/2023, 15-16/08/2023, 01/09/2023, 05/09/2023, 07/09/2023, 12/09/2023 and 22/09/2023.

10.4.29 The survey area and its environs offer foraging and commuting habitat for bats. A total of No. 3 bat species have been recorded foraging across the survey area on a regular basis. The habitats of highest value to bats within the survey area were considered to be the mature woodlands, the Duiske and tributaries, hedgerows, treelines, grassland and scrub. The spatial distribution of all species recorded was not uniform: bats were recorded in highest numbers in the vicinity of trees and hedgerows, and lowest in areas of built land with artificial lighting. This is unsurprising, as bats often prefer to feed along linear habitats such as woodland edges or hedgerows. Overall, the survey results demonstrate the value of the study area as a foraging and commuting habitat for bats.

Table 10-8: Bat Survey Results 2023 Overview

Overview of Results:			
Bat Species	**Commuting**	**Foraging**	**Roosts**
Soprano pipistrelle *Pipistrellus pygmaeus*	☑	☑	
Brown long-eared bat *Plecotus auritus*			
Common pipistrelle *Pipistrellus pipistrellus*	☑	☑	
Lesser horseshoe bat *Rhinolophus hipposideros*			
Leisler's bat *Nyctalus leisleri*	☑	☑	
Whiskered bat *Myotis mystacinus*			
Daubenton's bat *Myotis daubentonii*			
Nathusius' pipistrelle *Pipistrellus nathusii*			
Natterer's bat *Myotis nattereri*			

Bat Survey Graiguenamanagh/Tinnahinch Town Area (2024)

10.4.30 Surveys were undertaken using a range of techniques and covered the peak period of bat activity. Surveys were conducted during suitable weather conditions favorable to bats, on 27th May, 23rd June, 18th July and September 4th 2024. The survey area and its environs offer foraging and commuting habitat for bats. A total of No. 4 bat species have been recorded foraging across the survey area on a regular basis. The habitats of highest value to bats within the survey area were considered to be the mature woodlands, the River Barrow and tributaries, hedgerows, treelines, grassland and scrub. The spatial distribution of all species recorded was not uniform: bats were recorded in highest numbers in the vicinity of trees and hedgerows, and lowest in areas of built land with artificial lighting. This is unsurprising, as bats often prefer to feed along linear habitats such as woodland edges or hedgerows. Overall, the survey results demonstrate the value of the works area as a foraging and commuting habitat for bats.

10.4.31 The potential roost (PR2 outlined in Section 10.4.26) at Peg Washington's Lane was further assessed during this survey, as well as other potential roost features previously identified. Pipistrelles sp. were recorded close to their average emergence time near the buildings in the Peg Washington's Lane area. Emergence surveys did not directly observe bats emerging from these buildings. Several buildings within the vicinity have many PRFs. Bats

may occupy these buildings at least occasionally and may roost in different buildings on different days.

Table 10-9: Bat Survey Results 2024 Overview

Overview of Results:			
Bat Species	**Commuting**	**Foraging**	**Roosts**
Soprano pipistrelle *Pipistrellus pygmaeus*	☑	☑	
Brown long-eared bat *Plecotus auritus*			
Common pipistrelle *Pipistrellus pipistrellus*	☑	☑	
Lesser horseshoe bat *Rhinolophus hipposideros*			
Leisler's bat *Nyctalus leisleri*	☑	☑	
Whiskered bat *Myotis mystacinus*			
Daubenton's bat *Myotis daubentonii*	☑	☑	
Nathusius' pipistrelle *Pipistrellus nathusii*			
Natterer's bat *Myotis nattereri*			

Birds

Desktop Study

10.4.32 Records of bird species in the area go as far back as 1991. The full list of species recorded is included in Appendix D of the Habitats and Species Report for the GTFRS (Appendix 10-1 of this EIAR). The survey showed the usual suite of both resident and winter/summer visitor bird species present along the riverbank, including barn swallow, Grey Heron, Sand Martin and Eurasian Jackdaw.

Specialist Field Survey (2021)

10.4.33 A total of 23 bird species were recorded at the site between the wintering survey and breeding survey. Table 10-10 and Table 10-11 list the species in order of abundance for each survey period. Mean species richness was highest in Transect A, and lowest in Transect D (Table 10-12Table 10-11). During the wintering survey, 21 species were recorded; 25 were recorded during the breeding survey Results of the bird surveys are presented in in Appendix E of the Habitats and Species Report for the GTFRS (Appendix 10-1 of this EIAR).

10.4.34 Of the species identified, 8 are protected under the Wildlife Acts, 5 are listed on BOCCI's Amber list, and 3 are listed in Annex II and III of the EU Birds Directive.

10.4.35 The Great Spotted Woodpecker is not designated but had been absent from Ireland for over 100 years until 2005, when it re-appeared in Co. Wicklow. It appears to have been gradually increasing its range since then, although no official records exist for the woodlands around G-T. There is a record from 2015 near Borris, Co. Carlow (~7km upstream). During the surveys, the characteristic drumming of the woodpecker was heard in two locations – in the woodland on the Carlow side of the Barrow opposite the boat club, and in the woodland on the Kilkenny side, northwest of Tinnahinch Castle. However, anecdotal information suggests that this sound is a lesser-known sound made by a "raven". There are several resources online referring to a vocalised "drumming" sound sometimes made by carrion crows (Corvus corone) that is sometimes misinterpreted as the drumming of a woodpecker (British Birds, 1951). There are no existing records of C.

corone. The ecologist could not obtain a sighting of the bird, so it could not be confirmed one way or the other. If Great Spotted Woodpeckers inhabit woodlands a short distance upstream, then it is not unlikely that they have increased their range to include the woodlands around G-T.

10.4.36 Sites deemed suitable for perching Kingfishers were recorded. Suitable perches are generally narrow, stable structures that allow Kingfishers to perch above flowing water while searching for prey. In total, 18 Kingfisher perches were recorded. Further details are included in the Habitats and Species Report for the GTFRS (Appendix 10-1 of this EIAR).

Table 10-10: Species Abundance (Wintering Survey)

Species	Scientific Name	No. of Transects with +ve ID	Designation
Rook	*Corvus frugilegus*	5	N/A
Blackbird	*Turdus merula*	4	N/A
Chaffinch	*Fringilla coelebs*	4	N/A
House Sparrow	*Passer domesticus*	4	Protected Species: Wildlife Acts, Birds of Conservation Concern - Amber List
Blue tit	*Cyanistes caeruleus*	3	N/A
Great tit	*Parus major*	3	N/A
Coal tit	*Periparus ater*	2	N/A
Collared Dove	*Streptopelia decaocto*	2	N/A
Jackdaw	*Corvus monedula*	2	N/A
Magpie	*Pica pica*	2	N/A
Mallard	*Anas platyrhinchos*	2	Protected Species: Wildlife Acts, EU Birds Directive - Annex II, Annex III
Pied wagtail	*Motacilla alba yarrellii*	2	N/A
Wren	*Troglodytes troglodytes*	2	N/A
Buzzard	*Buteo buteo*	1	N/A
Cormorant	*Phalacrocorax carbo*	1	Protected Species: Wildlife Acts, Birds of Conservation Concern - Amber List
Great Spotted Woodpecker	*Dendrocopus major*	1	N/A
Greenfinch	*Carduelis chloris*	1	N/A
Mute swan	*Cygnus olor*	1	Protected Species: Wildlife Acts, Birds of Conservation Concern - Amber List
Robin	*Erythacus rubecula*	1	N/A
Song thrush	*Turdus philomelos*	1	N/A
Woodpigeon	*Columba palumbus*	1	Protected Species: Wildlife Acts, EU Birds Directive - Annex II, Annex III

Table 10-11: Species Abundance (Breeding Survey)

Species	Scientific Name	No. of Transects with +ve ID	Designation
Blackbird	*Turdus merula*	5	N/A
Chaffinch	*Fringilla coelebs*	5	N/A
Great tit	*Parus major*	4	N/A
Rook	*Corvus frugilegus*	4	N/A
Woodpigeon	*Columba palumbus*	4	Protected Species: Wildlife Acts EU Birds Directive - Annex II, Annex III
Blue tit	*Cyanistes caeruleus*	3	N/A
Robin	*Erythacus rubecula*	3	N/A
Song thrush	*Turdus philomelos*	3	N/A
Starling	*Sturnus vulgaris*	3	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Wren	*Troglodytes troglodytes*	3	N/A
Blackcap	*Sylvia atricapilla*	2	N/A
Chiffchaff	*Phylloscopus collybita*	2	N/A
Goldfinch	*Carduelis carduelis*	2	N/A
Great Spotted Woodpecker	*Dendrocopus major*	2	N/A
House Sparrow	*Passer domesticus*	2	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Long-tailed tit	*Aegithalus caudatus*	2	N/A
Magpie	*Pica pica*	2	N/A
Barn Swallow	*Hirundo rustica*	1	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Jackdaw	*Corvus monedula*	1	N/A
Mallard	*Anas platyrhinchos*	1	Protected Species: Wildlife Acts EU Birds Directive - Annex II, Annex III
Pheasant	*Phasianus colchicus*	1	Protected Species: Wildlife Acts EU Birds Directive - Annex II, Annex III
Raven	*Corvus corax*	1	N/A
Treecreeper	*Certhia familiaris*	1	N/A
Whitethroat	*Sylvia communis*	1	N/A
Willow warbler	*Phylloscopus trochilus*	1	N/A

Table 10-12: Species Richness at each Survey Transect

Transect ID	Species Richness		
	Wintering Survey	Breeding Survey	Mean
A	10	10	10
B	6	13	9.5
C	9	10	9.5

D	9	6	7.5
E	6	10	8
F	8	10	9

Wintering and breeding bird surveys 2023/2024

10.4.37 The birds recorded during the wintering bird survey undertaken by the Ayesa ecologists on 19-20/12/2023, 16-17/01/2024 and 22-23/02/2024 are shown in the Ecology Surveys Summary Report in Appendix 10-12. A full list of breeding birds recorded in 2024 are also outlined in Appendix 10-12. These results are listed in tables that refer to each stationary point that bird records were taken from in both the Upstream Storage Area and within the G-T towns.

10.4.38 Table 10-13 lists out the bird species that were recorded during the breeding and wintering surveys in 2023/2024 that carry special protection (Birds of Conservation Concern in Ireland or birds listed in the Annexes of the EU Birds Directive (2009/147/EC) (EC, 2009)).

10.4.39 Photographs of bird species recorded during the survey are shown in Appendix 10-12. These pictures were taken using mobile phone devices; therefore, it was difficult to obtain high quality images of certain species of birds. Several recorded bird species were not captured on camera during the survey. This includes the Kingfisher which moves up and downstream at a fast pace and is difficult to photograph without the use of a high-quality camera.

Table 10-13: Recorded Birds listed for Special Protection – Ayesa, 2023/2024

Birds of Conservation Concern in Ireland (BoCCI)	EU Birds Directive – Annexed Species
Amber Listed:	Annex I:
Common Kingfisher (*Alcedo atthis*)	Common Kingfisher (*Alcedo atthis*)
Common Starling (*Sturnus vulgaris*)	
Great Black-Backed Gull (*Larus marinus*)	
Great Cormorant (*Phalacrocorax carbo*)	Annex II:
Wood Pigeon (Columba palumbus)	Wood Pigeon (*Columba palumbus*)
	Annex III:
	Mallard (*Anas platyrhynchos*)
	Wood Pigeon (*Columba palumbus*)

Mammals (non-volant)

Desktop Study

10.4.40 The study site contains suitable foraging, commuting, breeding and resting habitats for common mammal species in general and similar habitats are also present at a larger scale in the wider landscape. The mammal fauna recorded for the study site are terrestrial species listed of 'Least Concern' in the Irish Red Data Book of Mammals (Marnell et al., 2009). Overall, the proposed site is of local importance for mammal (non-volant) species.

Otter (lutra lutra):

10.4.41 The National Biodiversity Data Centre (NBDC) has numerous records of Otter (Lutra lutra) (National Otter Survey 2012) occurring within the works scheme area and the species has quite extensive areas of both aquatic and terrestrial habitat for foraging and movement through the site. Otter is listed as vulnerable in the Irish Red Data Book and is fully protected in the State by the Wildlife Act. It is also listed in both Annex II and IV of the EU Habitats Directive and in Appendix II of the Berne Convention.

Badger (Meles meles):

10.4.42 The NBDC has records of badger to the east, northeast, north and northwest of Graiguenamanagh. The adjacent parkland may provide some albeit limited foraging opportunities for Badger (e.g. earthworms and other invertebrates, see Byrne et al. 2012). Ongoing/regular human disturbance may deter Badgers from using the site on a regular basis.

Pine Martin (*Martes martes*)

10.4.43 Pine marten has not been recorded as occurring in G-T; however, the NBDC records map this species as occurring within ca 10 km of the town. Lawton et al (2019) note that like the red squirrel, pine marten continues to return to areas in Ireland from where it had previously declined.

10.4.44 The pine marten is protected in Ireland by both national and international legislation. Under the Irish Wildlife Acts it is an offence, except under licence, to capture or kill a pine marten, or to destroy or disturb its resting places. Ongoing/regular human disturbance may deter pine marten from using the site on a regular basis.

Red Squirrel (Sciurus vulgaris)

10.4.45 Red squirrel has been reported in the area of the scheme since at least 1984 (source: NBDC website). More recently, Lawton et al. (2019) carried out an all-Ireland survey of red squirrel (and also, grey squirrel and pine marten discussed elsewhere) and note that records of red squirrel have continued to increase since the previous surveys in 2007 and 2012.

10.4.46 The red squirrel is protected under the Wildlife Act (1976) and Wildlife (Amendment) Acts (2000 and 2010) and the Bern Convention (Appendix III). Ongoing/regular human disturbance may deter red squirrel from using the site on a regular basis. Red squirrel is associated very closely with forests and general tree cover. Marnell et al. (2019) states that they tend lose out to grey squirrel populations in broadleaf and mixed wood habitat, due to competition and the impact of squirrel pox virus, which is carried by the grey squirrel.

Specialist Field Surveys (2021)

10.4.47 Potential evidence of otter activity was noted during the specialist field surveys, including a potential couch, holt and spraint in locations shown upstream on the River Duiske and downstream on the River Barrow (none in the immediate area of the proposed works).

10.4.48 No field signs of pine martin nor red squirrel were observed during the ecological site walkover and ecological surveys. However, faeces of the Eurasian rabbit (Oryctolagus cuniculus) were observed in the field adjoining the Killeen Stream at the northern end of the scheme area.

Upstream Storage Area Mammal Survey (2023)

10.4.49 Evidence of non-volant mammals was observed in several locations throughout the site. Images of mammal evidence is shown in Appendix 10-12. Primarily, there was evidence to suggest the presence of badger, as observed through the presence of scat and footprints. There was no evidence of otter, fox, mink, pine martin or other small carnivorous mammals observed throughout the proposed development site, however. The above-mentioned evidence of mammal activity is mapped in Figure 10-26 below.

Top Up Survey (Original Scheme Area) 2024

10.4.50 Evidence of non-volant mammals was observed in several locations throughout the site. Images of mammal evidence is shown in Appendix 10-12. Primarily, there was evidence to suggest the presence of badger, as observed through the presence of footprints. Fish remains were seen on the bank of the River Barrow close to the town centre. This may be as result of an otter or mink foraging in the area. There was no evidence of fox, pine martin or other small carnivorous mammals observed throughout the proposed development site, however. The above-mentioned evidence of mammal activity is mapped in the figure below.



Figure 10-26: Mammal evidence 2023/2024

Herpetofauna (reptiles and amphibians)

Desktop Study

10.4.51 Ireland has only one native frog species, the Common frog (*Rana temporaria*). It is listed as an internationally important species and is protected under the Habitats Directive (92/43/EEC) and the Irish Wildlife Act (1976, amended 2000). There are records available from the NBDC that indicate to recent sightings of this species in the study area (one sighting in 2013 and two sightings in 2019). There are no records available from the NBDC of smooth newt (*Lissotriton vulgaris*) or natterjack toad (*Epidalea calamita*) in G-T or its surroundings. The smooth newt *(Lissotriton vulgaris)* is the only member of the Urodela (the tailed amphibians) found in Ireland. In Ireland it is an offence to capture, kill or sell a newt, including a newt tadpole, without a licence.

Specialist Field Surveys (2021)

10.4.52 No field signs of the Smooth Newt and Natterjack Toad reptile were observed during the ecological site walkover. Evidence of common frog activity (frogspawn) was noted in two locations, slightly upstream of the proposed works.

Freshwater Fish

Desktop Study

10.4.53 The River Barrow is one of Ireland's best coarse angling river fisheries and is a mixed stock fishery containing salmon, trout, pike and several coarse fish species and has excellent stocks of roach, rudd, bream, skimmers, roach-bream hybrids, rudd-bream hybrids, perch and dace. Tench are also present and although seldom reported, carp may also be found on some stretches. Coarse fishing on the Barrow is easily accessible all along the 68km of towpath or by crossing agricultural lands with the permission of the landowners. Access to fishing on the river can also be obtained through a number of angling clubs that control fishing on some sections of this coarse fishery. The Barrow is a wide river, up to 40m wide in places and is generally quite shallow, with a slow to moderate flow. Average depths range from 1 to 3m (IFI web site).

10.4.54 The ecology of both Rivers Barrow and Duiske in the context of the Water Framework Directive has been discussed in Chapter 8 'Hydrology'. To summarise, the WFD surface water monitoring programme 2016-2021 reported that the ecological status or potential of the portion of the River Barrow (BARROW_230) located in the study area is considered to be 'poor' and the River Duiske (DUISKE_020) was classed as 'Moderate'.

10.4.55 The River Barrow has recently been proposed as a candidate Highly Modified Waterbody (HMWB). In the context of the biodiversity of the river, it means that instead of having an environmental objective of Good Ecological Status (GES), which applies to natural water bodies, an alternative environmental objective of Good Ecological Potential (GEP) applies to these water bodies. GEP is an alternative objective, which takes account of the changes in aquatic ecology caused by the physical modification. This may result in a change in the status of the River Barrow in the future. Currently, the Fish Status or Potential, which is monitored in the context of Ecological Status or Potential of the River Barrow

(BARROW_230) is 'poor', and the Invertebrate Status or Potential is 'moderate'. The fish element is not monitored for the River Duiske (DUISKE_020), but the Invertebrate Status or Potential is 'moderate'.

10.4.56 A desk-based fisheries assessment was undertaken, reviewing largely on a study carried out by Delanty et al. (2017) on fish stocks in the entire catchment of the Barrow (Aquafact International Services Ltd. , 2020).

10.4.57 The River Duiske catchment supports at least four species of fish, namely brown trout (*Salmo trutta*), Atlantic salmon (*Salmo salar*), European eel (*Anguilla anguilla*) and at least one of three species of lamprey. The adjacent River Barrow supports up to twelve species of fish as per the below table from Delanty et al. (2017), as referenced in Aquafact International Services Ltd, 2020.

Table 10-14: Fish species in the River Barrow Catchment (Delanty *et al.*, 2017)

Fish Species	Total Count	No sites present
Dace	1381	32
Roach	754	28
Perch	224	26
Minnow	442	24
Atlantic Salmon (juvenile)	774	20
Atlantic Salmon (adult)	19	7
Pike	58	19
Gudgeon	215	17
Brown Trout (juvenile and adult)	139	16
European Eel	33	15
Stone loach	22	11
Roach x Bream hybrids	14	6
3 spined stickleback	8	1
Flounder	2	1

10.4.58 The non-migratory fish species listed could be expected to inhabit the main River Barrow throughout the year. Migratory adult Atlantic salmon, destined to spawn in the River Duiske catchment, might be expected to enter the River Barrow during the summer months and perhaps remain in the river's deep water until the completion of maturation and the initiation of movement into the River Duiske perhaps during the month of December. The nature of the River Duiske does not suggest that it offers suitable holding habitat for adult salmon over a prolonged period. Juvenile salmon might be expected to leave the River Duiske at the smolt stage, typically during the months of March through May, when river flows are elevated and the water temperature range is 7-13°C. Salmon smolt migrating downstream from areas higher up in the River Barrow catchment might also be expected to pass through Graiguenamanagh during the months March through May when river flows are elevated and the water temperature range is 7-13°C. The River Barrow catchment currently supports an Atlantic salmon population / stock which is estimated to be below its Conservation Limit, based on recent catchment wide electrofishing survey data.

Twait Shad

10.4.59 The Article 17 Spatial Dataset provides an indication of the species' distribution and range. For this species, one record is available, but is in the downstream portions of the River Barrow, >5km from the study area.

Lamprey

10.4.60 Brook, River, and Sea lamprey are listed under Annex II of the European Union Habitats Directive (92/43/EEC), with the River Lamprey also listed on Annex V of the Habitats Directive and are included in schedule 4 of the European Communities (Birds and Natural Habitats) Regulations (S.I. No. 477/2011). They are also listed on Appendix III of the Bern Convention. The Article 17 Spatial Dataset indicates that Sea Lamprey (*Petromyzon marinus*) is not commonly found in the study area, but Brook Lamprey (*Lampetra planeri*) is. For the River Lamprey (*Lampetra fluviatilis*) one record is available but is in the downstream portions of the River Barrow, >5km from the study area.

Atlantic Salmon

10.4.61 The distribution and range of Atlantic salmon (as per Article 17 Reports) spans almost the entire country and includes the study area.

Specialist Field Survey (2021)

10.4.62 Ayesa (formerly ByrneLooby (via their sub-consultants Aquafact International Services Ltd and Triturus Environmental Services)) conducted an electrofishing survey in 2021.



Figure 10-27: Three electrofishing locations on the Duiske River and Graiguenamanagh Stream

10.4.63 Five species were encountered during the survey, namely, Brook lamprey, Atlantic salmon, Brown trout, European Eel and Stone loach. Atlantic salmon were present at the two sites on the Duiske River but were absent at site D1 on the Graiguenamanagh Stream. Brown trout were present at all of the survey locations. Brook lamprey were present at two of the three sites being absent at the most downstream site D3. Eels were present at both sites on the Duiske River but were absent at site D1 on the Graiguenamanagh Stream. A single Stone loach was found on the most downstream survey site D3.

Table 10-15: Result showing the Number and Minimum Density of each Species Captured

Site Number	0+ brown trout		1++ brown trout		0+ salmon		1++ salmon		European eel		Brook lamprey	
	No.	No./m^2	No.	No./m^2	No.	No./m^2	No.	No./m^2	No.	No./m^2	No.	No./m^2
D1	0		3	0.022							3	0.022
D2	11	0.039	9	0.032	8	0.029	7	0.025	3	0.011	35	0.125
D3	8	0.04	3	0.015	14	0.07	7	0.035	2	0.01		

Fish Survey – Upstream Storage Area (2023)

10.4.64 Electrofishing surveys were conducted ca. 550m upstream of the proposed work site on 20 July 2015 and 09 July 2020 and ca. 1.5 km downstream of the proposed work site on 09 July 2020 by IFI, and ca. 1.4 km downstream of the proposed work site by Aquafact Ltd on 10 February 2021. These surveys identified the presence of salmon, brown trout, European eel and lamprey spp. The Duiske River has also been identified as a potentially important nursery ground for Atlantic salmon by Delanty et al. (2017) and for lamprey (King, 2006).

10.4.65 Although no observations of Twaite shad *Alosa fallax* [1103] have been recorded within the Duiske River, as the proposed site is within the River Barrow and River Nore SAC (002162) it needs to also be assumed that this QI fish species is present and should be considered for mitigation. Table 10-16 below identifies the fish species actually recorded both above and below the proposed works area during electrofishing surveys.

Table 10-16: Fish Species recorded by IFI and Aquafact on River Duiske with potential to reside

Fish Species	2015 IFI Survey (Upstream of proposed works)	2020 IFI Survey (Upstream of proposed works)	2020 IFI Survey (Downstream of proposed works)	2021 Aquafact Survey (Downstream of proposed works)
Salmon, *Salmo salar*	X	X	X	X
Brown Trout, *Salmo trutta*	X	X	X	X
European eel, *Anguilla anguilla*		X	X	X
Lamprey species	X			X

Top up Survey (2024)

10.4.66 No notable qualitative changes to any habitats in the study area have been noted and, from secondary review, no significant pollution events occurred in either river since 2021. For this reason, and the availability of recent electrofishing data, additional fish habitat and electrofishing surveys were not considered a requirement.

Other Aquatic Taxa

Aquatic Invertebrate Survey (2021)

10.4.67 Stations 1 to 3 were taken from the Duiske River. Station 1 located to the north of the town recorded a Q-value of 4, which was the highest of any of the stations. Stations 2 and 3 both recorded an intermediate Q3-4. Two stations were sampled in the River Barrow, one upstream of the weir and one downstream. Both locations recorded a Q-value of 3 (Table 10-17). All species recorded where typical of the habitats sampled. Species composition recorded at station 2 and 3 is as expected for a slightly polluted status with only a few sensitive species present and in low numbers.

Table 10-17: Biological sampling results

Location	Q-Value
ST1	Q4
ST2	Q3-4
ST3	Q3-4
Upstream	Q3
Downstream	Q3

Aquatic Invertebrate Survey – Upstream Storage Area (2023)

10.4.68 Each of the sites would be classed as Q3 based on the data gathered, equivalent to Moderate WFD status. Each site was dominated by Group C (tolerant) taxa, with a small number of Group B (less sensitive) taxa. All sites had a similar invertebrate composition, although overall abundance and taxon richness was lower in Site 2 than the other sites. Two Group A (sensitive) taxa were recorded, but only as single individuals and thus, as per the methodology, not included in the Q-value calculation.

Table 10-18: Summary of Q values assigned, and total number of taxa observed at each site

Parameter		Site 1 - Downstream of works area	Site 2 – within area of works	Site 3 - upstream of works area
Q Value Classification		Q3	Q3	Q3
Number of Taxa	Group A (sensitive)	-	*	*
	Group B (less sensitive)	3	1	3
	Group C (tolerant)	11	9	10
	Group D (very tolerant)	-	-	-
	Group E (most tolerant)	-	-	-
	Total+	19	13	21

*Present, but only as single individuals, so not included in the classification
+Other taxa were present and counted in the total number of taxa but either had only one individual and were, therefore, discounted from Q value classification, or were not a taxon considered in the classification system

Aquatic Invertebrate Top Up Survey (2024) in Original Scheme Area

10.4.69 Photographs and examples species recorded at each station are included in Appendix 10-6. Stations 1 to 3 were taken from the Duiske River. Station 1 located to the north of the town recorded a Q-value of 3, which was the lowest of any of the stations. Stations 2 and 3 both recorded an intermediate Q3-4. One station was sampled in the River Barrow, station

4 located downstream of the weir. Station 4 recorded an intermediate Q-value of 4-5 (Table 10-19). All species recorded where typical of the habitats sampled. Species composition recorded at station 2 and 3 is as expected for a slightly polluted status with only a few sensitive species present and in low numbers.

Table 10-19: Biological Sampling Results.

Station	Q-Value
ST 1	Q3
ST 2	Q3-4
ST 3	Q3-4
ST 4	Q4-5

Freshwater Pearl Mussels

Desktop

10.4.70 Freshwater pearl mussels (*Margaritifera margaritifera*) are present in the River Barrow; however, these populations are up stream of Graiguenamanagh. The freshwater pearl mussel is listed as Endangered on the IUCN Red List and is one of the 365 most endangered species in the world. It is protected under the Wildlife Act and Annex II and V of the EU Habitats Directive. Freshwater pearl mussel is listed as a QI for the River Barrow and River Nore SAC (NPWS, 2011).

10.4.71 There are records of freshwater pearl mussels upstream of G-T. Extant populations are only known to occur in three tributaries. These are the Mountain River, Ballymurphy River (Ballyroughan River) (i.e. not the main River Barrow channel) and Aughavaud River ≥4 km upstream (Triturus, 2021). The Mountain River and Ballymurphy River populations are located c. 7km and 5km upstream of Graiguenamanagh, respectively. The freshwater pearl mussel would appear to be extinct in the main channel of the River Barrow (Triturus, 2021).

10.4.72 There were no contemporary or historical records for freshwater pearl mussel available for the Duiske River, Graiguenamanagh River or River Barrow in the vicinity of Graiguenamanagh or Tinnahinch (Triturus, 2021).

Freshwater Pearl Mussel Survey (original Scheme Area) (2021)

10.4.73 Stage 1 freshwater pearl mussel surveys undertaken in the vicinity of Graiguenamanagh in April 2021 failed to identify freshwater pearl mussels (live or dead) through a combination bathyscope, snorkelling and SCUBA dive surveys. However, *Margaritifera margaritifera* eDNA was detected in the River Barrow water sample, collected at Lower Tinnahinch Weir (1 positive qPCR replicate out of 12). Although eDNA via qPCR is not fully quantitative in respect that it can only confirm the presence of a species, the laboratory result supports a low concentration of freshwater pearl mussel DNA within the Barrow channel in the vicinity of Graiguenamanagh. Due to various significant pressures (e.g. eutrophication, siltation), the River Barrow retains no suitability for a recruiting freshwater pearl mussel population, and the species is generally accepted as being extinct within the main Barrow channel (Lucey, 1998; however, see below).

10.4.74 eDNA analysis for FPM in the Duiske River by Triturus in 2021 returned a negative result for FPM eDNA (0 positive of 12 qPCR replicates, respectively). These results were considered as evidence of the species' absence from the Duiske River and its tributaries (i.e. Graiguenamanagh and Tinnapark Rivers) with the nearest being the Mountain and Ballymurphy Rivers located.

10.4.75 The high sensitivity of eDNA analysis likely enabled a detection of these upstream freshwater pearl mussel populations from the Lower Tinnahinch Weir water sample. Although highly variable, downstream transport of eDNA in riverine environments is known to extend to >100km (Pont et al., 2018), with reported detectable distances for freshwater bivalves ranging from as little as 25m to 12km (e.g. Preece et al., 2020; Lor et al., 2020; Stoekle et al., 2015). Although studies are lacking, the greatest reported distance at which freshwater pearl mussel eDNA has been detected from a known downstream population is 1.7km (Wacker et al., 2019a). In light of this, it is unclear whether our analysis detected pearl mussel eDNA from the upstream Mountain River or Ballymurphy River populations. Alternatively, the detected eDNA may have originated from pearl mussel washed into the main Barrow channel from the Mountain River. Fluvial mussel migration from the Mountain River to the main Barrow channel has been noted previously in the River Barrow catchment. Recent NPWS data (2018) indicate low numbers of pearl mussels within the main Barrow channel downstream of the Mountain River and Little Ballyine River confluences, respectively. These are likely individuals originating in the Mountain River. The closest live pearl mussel record for the River Barrow record is located approx. 6.1km upstream of Graiguenamanagh (Ballyine River confluence). It is possible that our analysis detected eDNA emanating from this location or from an overlooked site of fluvially-migrated mussels from a Barrow tributary.

10.4.76 From the above analysis, it has been assumed that FPM are not present in the scheme area.

White-Clawed Crayfish

Desktop

10.4.77 White-clawed Crayfish (*Austropotamobius pallipes*) are known to occur in the River Barrow. However, large numbers of dead crayfish were reported in the stretch of the river from Carlow to Graiguenamanagh in 2017. It has been confirmed using DNA analysis that the cause of death was Crayfish Plague. Subsequent outbreaks have been reported (source: 'Crayfish plague' webpage at biodiversityireland.ie).

10.4.78 The white-clawed crayfish is listed on Annexes II and V to the Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive), which means any site considered to be of significance to the species should be designated as a Special Area of Conservation (SAC).

10.4.79 The white-clawed crayfish has been classified as Globally Threatened by the International Union for Conservation of Nature (IUCN)/World Conservation Monitoring Centre. Ireland and Northern Ireland (NI) are considered to be important areas for the conservation of the species as their geographical isolation and current absence of non-native species and

crayfish plague potentially give any populations wider conservation implications within the UK and Europe.

10.4.80 Lowering of river water quality can contribute to inadequate conditions for White-clawed crayfish.

White Clawed Crayfish Survey in Original CFRAM Scheme Area (2021)

10.4.81 White-clawed crayfish surveys were undertaken on Thursday 29th and Friday 30th April 2021 via trapping (n=5 sites), hand-searching/sweep netting (including snorkelling) (n=9 sites) and the examination of otter spraints for crayfish remains. No white-clawed crayfish were recorded. Furthermore, eDNA analysis of n=3 water samples failed to identify any white-clawed crayfish eDNA within the wider survey area.

10.4.82 The results of the surveys are presented below in terms of the number of crayfish recorded and overall crayfish suitability as well as general observations on the ecology of each survey site. The survey sites are summarised per site below and in more detail in Appendix A of the White-clawed Crayfish Survey 2021 in Appendix 10-8. Scientific names are provided at first mention only.

Table 10-20: Survey Results for the n=14 white-clawed crayfish Survey Sites, 2021

Site	Watercourse	Methodology	Location	Crayfish recorded
D1	Duiske River	Hand-searching/ sweep netting	Tinnapark River confluence	No
D2	Duiske River	Hand-searching/ sweep netting	R705 road bridge	No
D3	Duiske River	Hand-searching/ sweep netting	Well Lane footbridge	No
D4	Duiske River	Hand-searching/ sweep netting	u/s Old Dock Bridge	No
G1	Graiguenamanagh River	Hand-searching/ sweep netting	u/s R705 culvert	No
M1	Mill Race channel	Hand-searching/ sweep netting	R705 road bridge	No
M2	Mill Race channel	Hand-searching/ sweep netting	Well Lane footbridge	No
B1	River Barrow	Hand-searching/ sweep netting	d/s Graiguenamanagh Weir	No
B2	River Barrow	Hand-searching/ sweep netting	Lower Tinnahinch Weir	No
T1	Duiske River	Trapping	Graiguenamanagh/Duiske River confluence	No
T2	Duiske River	Trapping	d/s Turfmarket Weir	No
T3	River Barrow	Trapping	Diving board	No
T4	River Barrow	Trapping	Graiguenamanagh Bridge	No
T5	River Barrow	Trapping	River Barrow (near Tinnahinch Lock Upper)	No

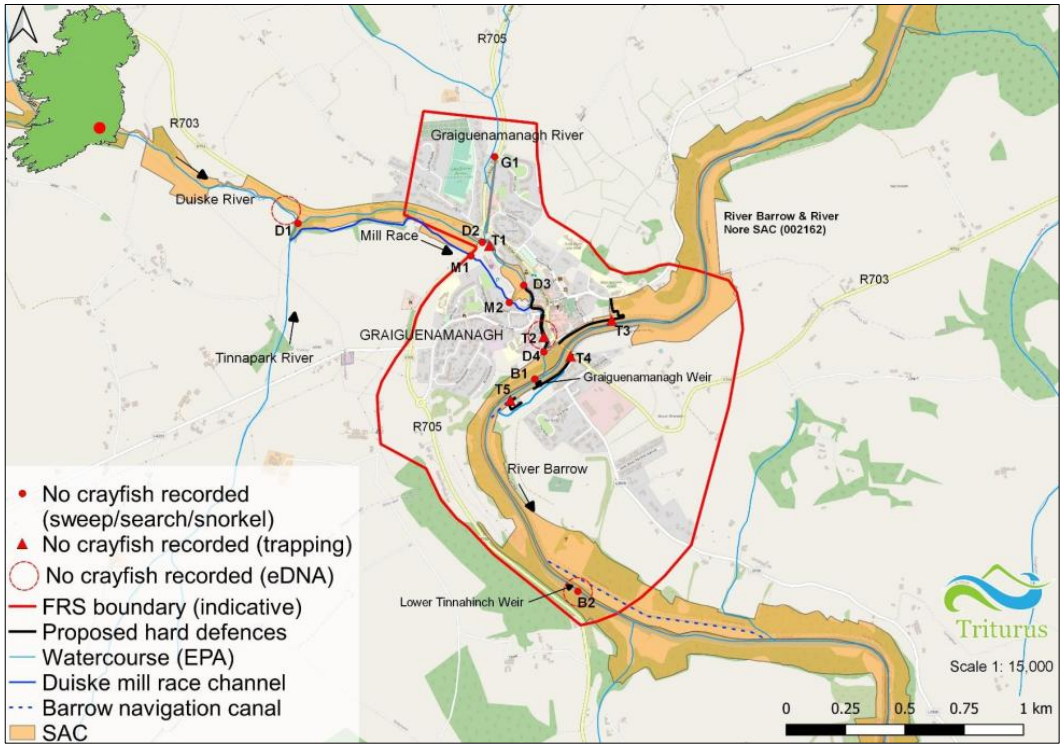


Figure 10-28: Results summary of white - clawed crayfish survey, April 2021

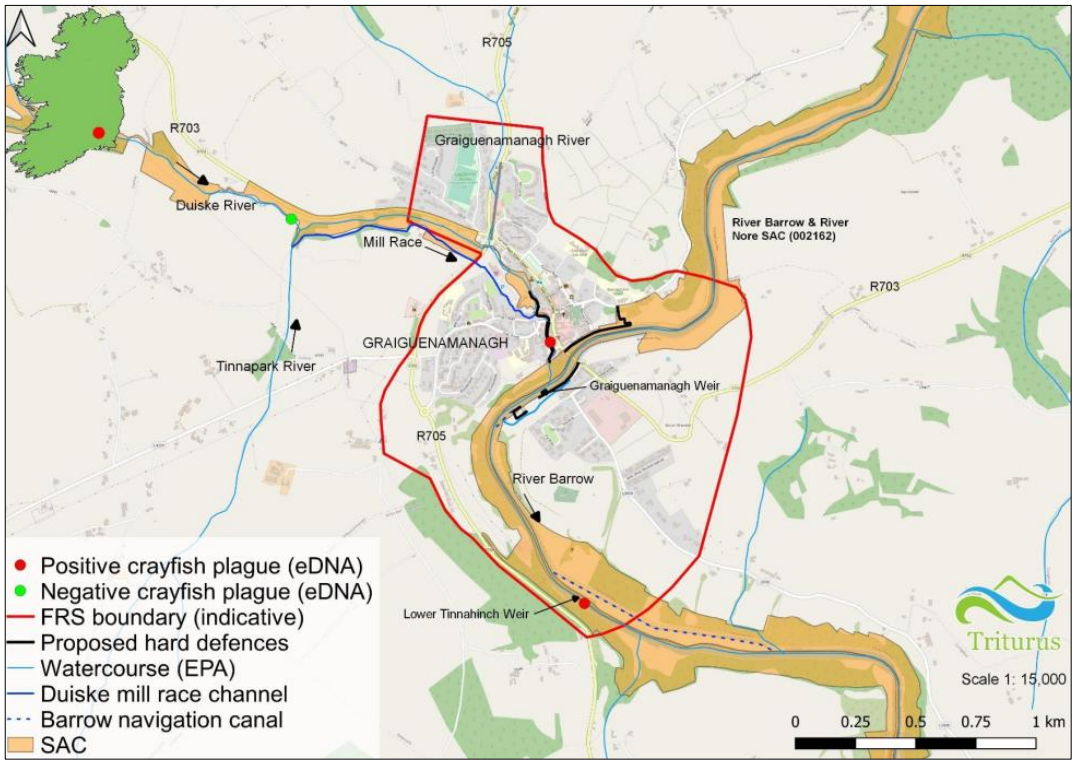


Figure 10-29: Result summary of crayfish plague eDNA sampling, April 2021

White Clawed Crayfish Upstream Storage Area Survey (2023)

10.4.83 WCC have been recorded throughout the Barrow catchment (Department of Culture, Heritage and the Gaeltacht, 2019). Crayfish plague, caused by the water mould

Aphanomyces astaci, is present in the river (Update on Crayfish Plague in Ireland | Fish Health Unit).

10.4.84 No crayfish were found during surveys and the traps laid overnight were empty when retrieved. However extensive areas of suitable habitat were found throughout the site in the form of large cobble and boulders, undercut banks and woody debris within the glide/run sections, as well as along river margins with overhanging vegetation. It is possible, therefore, that crayfish plague is now found within the Duiske River, accounting for the absence of the species in the reaches surveyed.

10.4.85 A survey of this type, based on a single site visit and short river reach, always has the risk of missing presence of the species elsewhere in the area to be affected. However, the complete absence of records, including from the baited traps, which will attract this mobile species, would suggest either genuine absence or the presence of very low numbers existing in small, localised populations. Furthermore, it should be noted that crayfish presence was searched for during the freshwater pearl mussel surveys to back up any evidence found during this survey.

Invasive Species

Flora

10.4.86 Currently, Regulations 49 and 50 of the European Communities (Birds and Natural Habitats) Regulations 2011 make it an offence to: Plant, disperse, allow dispersal or cause the spread of a number of non-native 'invasive species' including Japanese knotweed and Himalayan balsam.

10.4.87 The surveys found that the following invasive species (as listed in the Third Schedule of the Birds and Natural Habitats Regulations 2011 (S.I. No. 477/2011)) are present in the vicinity of the scheme area:

- Himalayan balsam (Impatiens glandulifera)
- Japanese knotweed (Reynoutria japonica)

10.4.88 The distribution of invasive alien plant species is predominantly confined to the main watercourses (Rivers Duiske and Barrow) and the immediate riparian environments bordering them. This predominantly riparian distribution of IAPS can be attributed to the presence of an extant seed bank (for Himalayan Balsam) yet to germinate providing a reduced yet not exhausted source of new growth (albeit to a lesser extent now due to seasonal treatments) and more so the Rivers Barrow and Duiske are known transmission vectors as they are fed a constant stream of viable plant matter (seeds with respect to Himalayan Balsam and stem / root material in the case of Japanese Knotweed) from further upstream. Furthermore, the rivers vary in their route meaning some areas become more prone to infestation (inside of bends or where other obstacles in the river channels slowed the water down for example).

10.4.89 Treatment has been ongoing since 2021. This has resulted in a gradual reduction in the intensity of growth of invasive species. Overall levels of IAPS regrowth have been

substantially reduced across the board and treatment now has evolved into a monitoring and management process designed around preventative approaches to large scale reinfestations. The treatment has had a net positive outcome.

10.4.90 Figure 10-30 outlines the locations of invasive species within the Proposed Scheme area. An Invasive Species Management Plan is contained within the Construction Environmental Management Plan (CEMP) in Appendix 4-4.

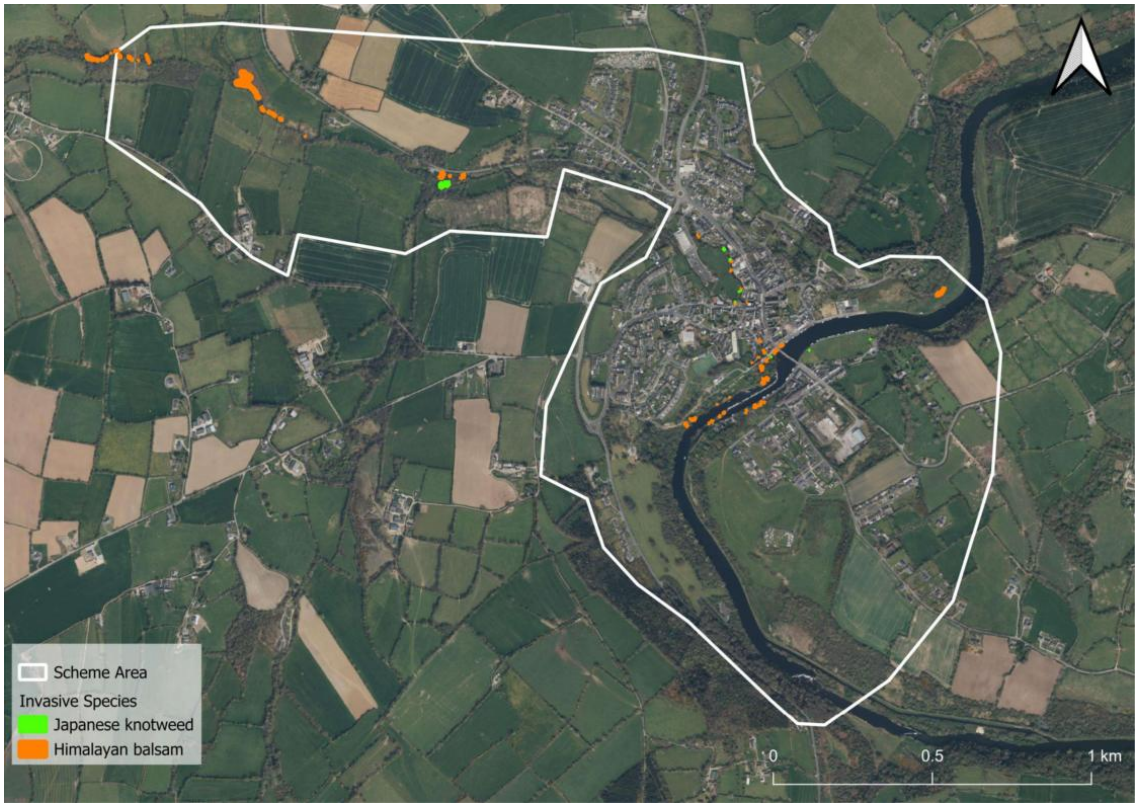


Figure 10-30: Outline map of invasive species in the Proposed Scheme area

Fauna

10.4.91 No fauna invasive species were recorded during the surveys.

10.5 Sensitive Receptors

10.5.1 In line with the methodology outlined in Section 10.3, the evaluation of ecological features (habitats and species) which could be affected by the Proposed Scheme includes:

- Any statutory designated areas, with the exception of Natura 2000 sites, which are situated within 10 km of the Proposed Scheme that have potential ecological connection(s) with the Proposed Scheme area;
- Any surface or groundwater bodies that have hydrological connectivity with the Proposed Scheme area;
- Any habitat type recorded within the Proposed Scheme area; and

- Any species of conservation importance which has been confirmed as occurring within the Proposed Scheme area.

10.5.2 The value of the feature is defined with reference to the geographical context of the scheme i.e. the specific importance of the scheme to each of the habitats or protected species populations identified as being present within it or making use of it. This assessment of value is based on the condition of the site during the survey period, although, where information is available, reference is made to these. The evaluation considers any statutory or non-statutory conservation status, its extent (or population size) within the site compared to the resource elsewhere and whether it has characteristics which either elevate or depress its importance in comparison with a 'typical' example (for example, whether a habitat is particularly species rich, or depleted in species). Common and widespread species or habitats, therefore, only have a level of importance in respect to the biodiversity of their immediate area (taken in this case to be represented by the boundary of the Site).

10.5.3 Some protected species may, under certain circumstances (such as a single example occurring within the Proposed Scheme area, as part of a much larger local population) be considered to only be of importance within the Site itself. Such species, based on legal and planning regulation compliance, are included within the Impact Assessment and, (if necessary) dedicated impact mitigation measures are provided.

Table 10-21: Evaluation of Ecological Receptors from the Proposed Scheme

Ecological Receptor	Importance	Rationale
Designated Sites / Habitats		
River Barrow and River Nore SAC	International Importance	As this site is designated under the European Communities (Birds and Natural Habitats) Regulations 2011, made under European Habitats Directive, it is considered to be of international importance. This feature (SAC) has hydrological connection to the works and is thus carried forward into the design mitigation and impact assessment sections.
River Nore SPA	International Importance	As this site is designated under the European Communities (Birds and Natural Habitats) Regulations 2011, made under European Habitats Directive, it is considered to be of international importance. This feature (SPA) has hydrological connection to the works and is thus carried forward into the design mitigation and impact assessment sections.
Clohastia pNHA	National Importance	Within 10 km of the scheme area and appear to have a hydrological connection. National importance on the basis that these sites are designated as proposed Natural Heritage Areas (pNHA).

Ecological Receptor	Importance	Rationale
Pollmounty River Valley pNHA	National Importance	Within 10 km of the scheme area and appear to have a hydrological connection. National importance on the basis that these sites are designated as proposed Natural Heritage Areas (pNHA).
Barrow Estuary pNHA	National Importance	Within 10 km of the scheme area and appear to have a hydrological connection. National importance on the basis that these sites are designated as proposed Natural Heritage Areas (pNHA).
Linear Habitats	Regional/County Importance	Immature Treelines were recorded in some areas of the proposed works area. These habitats act as ecological corridors connecting many different forms of wildlife from one habitat to another, whilst providing shelter and protection from predators. Hedgerows and treelines are recognised as valuable due to low woodland coverage nationally. Hedgerows and treelines are recognised as important ecological corridors in the Kilkenny City and County Development Plan 2021 – 2027. These habitats are carried forward into the design mitigation and impact assessment sections.
Wooded Areas	Regional/County Importance	Wooded habitats recognised as ecologically valuable due to the low woodland coverage nationally. They provide shelter and commuting habitat for many species (i.e. bats and other mammal species). These habitats are carried forward into the design mitigation and impact assessment sections.
Urban Environment	Local Importance (Lower)	The heavily developed nature of some areas within the scheme area results in its assessment of being of less than local ecological value and is not considered further in this assessment. This includes built up areas consisting entirely of hardstand (concrete, tarmac).
Rivers and Streams	Local Importance Higher (Duiske) and International Importance (River Barrow SAC)	These river systems provide foraging and commuting corridors for mammals such as the otter (Annex IV species). Some areas contain ecologically sensitive aquatic plant species such as water crowfoot which forms part of the Annex I habitat Water courses of plain to

Ecological Receptor	Importance	Rationale
		montane levels, with submerged or floating vegetation of the *Ranunculion fluitantis* and *Callitricho-Batrachion* (low water level during summer) or aquatic mosses (3260). These habitats are carried forward into the design mitigation and impact assessment sections.
Grassland habitats	Local Importance (Higher)	Semi-Natural Grasslands are important reservoirs for biodiversity, supporting a diverse range of plant and animal species. They also perform a wide range of other ecosystem services such as healthy soil, climate regulation, flood attenuation, etc. These habitats are carried forward into the design mitigation and impact assessment sections.
Mammals		
Otter (*Lutra lutra*)	International Importance	Otters are listed on Annex II and Annex IV of the Habitats Directive and also on the Wildlife Acts. Otters are a QI of River Barrow and River Nore SAC, and impacts are considered in the context of this within the Natura Impact Statement prepared for the Proposed Scheme. Site activity may deter terrestrial mammals from the proposed site during daylight hours when activity is at its highest. Otters are largely nocturnal. This species is thus carried forward into the design mitigation and impact sections.
Badger (*Meles meles*)	Regional/County Importance	Badgers and their setts are protected under the provisions of the Wildlife Act, 1976, and the Wildlife Amendment Act, 2000. It is an offence to intentionally kill or injure a protected species or to wilfully interfere with or destroy the breeding site or resting place of a protected wild animal. Evidence of Badger activity was recorded within the Graiguenamanagh town area and the upstream storage area. Site activity may deter terrestrial mammals from the proposed site during daylight hours when activity is at its highest. Badgers and otters are largely nocturnal.

Ecological Receptor	Importance	Rationale
		This species is thus carried forward into the design mitigation and impact sections.
Bats	Regional/County Importance	Bats are known to forage and commute in the area. They use the treelines for these activities. A potential bat roost at Peg Washington's lane is within the proposed works areas. This species is thus carried forward into the design mitigation and impact sections.
Birds		
Overwintering birds	Local (Higher) Importance	Various different bird species of bird were recorded during the wintering bird survey. These bird species are either/or protected under the Wildlife Acts and under the EU Birds Directive- Annex II; Annex III. These birds were not recorded in any significant populations. Wintering bird species are carried forward into the design mitigation and impact assessment sections.
Breeding birds	Local (Higher) Importance	The project area provides some habitats to a range of common bird species and so the valuation of local importance is applied. This includes treelines and scrub habitat which may be suitable for nesting. All bird species are carried forward into the design mitigation and impact assessment sections.
Fish Species		
Lampetra planeri (Brook Lamprey) [1096] *Lampetra fluviatilis* (River Lamprey) [1099] *Alosa fallax fallax* (Twaite Shad) [1103] *Salmo salar* (Salmon) [1106]	International Importance	The fish species listed in this row are annex species and are all QI species of the River Barrow and River Nore SAC which flows through the town of Graiguenamanagh. Fish habitats will be slightly altered over a short period where the flow control structure is placed in the upstream storage area. These species are carried forward into the design mitigation and impact assessment sections.

10.6 Identification of Potential Sources of Impact

10.6.1 This section examines the potential sources of impact that could potentially result in adverse effects on the biodiversity and protected habitats and species that occur within

the Zone of Influence of the Proposed Scheme. These potential sources of impact could arise during both the construction and operational phases but require complete source > pathway > receptor changes for adverse impacts to arise.

Physical Damage

10.6.2 Physical damage includes degradation to, and modification of, protected habitats. It can occur in working areas and along access routes where construction works are undertaken, and it may be temporary or permanent. The construction works have the potential to encroach on several different habitats such as areas of scrub and treelines and well as embankments which could facilitate otter activity. All land within the redline boundary of the proposed works has the potential to be damaged or experience a loss of habitat on a temporary basis during construction, while there will be a permanent loss of habitat/land within the footprint of the Proposed Scheme.

Disturbance (noise/visual)

10.6.3 A number of activities can result in disturbance, including visual and noise. This is more frequently associated with construction activities but could also be associated with some aspects of the operational phase (e.g. structure maintenance, public access). Disturbance can cause sensitive species, such as birds, to deviate from their normal, preferred behaviour, resulting in stress, increased energy expenditure and, in some cases, species mortality.

Changes in Water Quality

10.6.4 A number of activities can impact upon water quality, in particular nutrient status and turbidity levels. For example, inundation of contaminated/nutrient enriched land and sediment mobilisation can all impact on water quality. This can adversely impact on habitats and also species, for example by impacting upon macroinvertebrate communities. As noted in 10.4.55, the WFD River Waterbody Status 2016-2021 for the section of River Barrow flowing through Graiguenamanagh town is ‘poor’ and the section of the River Duiske where works will take place is ‘moderate’.

Pollution

10.6.5 Certain activities, in particular construction works, may lead to the release of pollutants into water, air or the ground. This can impact upon habitats directly and also the species they support.

Invasive Species

10.6.6 Invasive species have legal implications if left untreated. They can spread rapidly over suitable habitat, including riverbanks, wetlands or disused waste land.

10.6.7 Potential direct and indirect impacts are discussed in detail below. Where potentially significant adverse impacts are identified in Section 10.7 below, avoidance and mitigation measures are proposed in Section 10.8 to offset these impacts.

10.7 Description of Potential Impacts

10.7.1 The following sections outline the potential impacts that could be realised as a result of the Proposed Scheme, both during construction and operational phase. These impacts are discussed in Table 10-25.

Effects on Natura 2000 Sites

10.7.2 The proposed development is hydrologically connected to one European site. As likely significant effects could not be excluded at the screening stage, a Natura Impact Statement (NIS) has been prepared. The NIS presents all the predicted effects on these sites and their Qualifying Interests and also provides a detailed analysis and evaluation of these effects in the context of the relevant Conservation Objectives. The NIS also prescribes mitigation measures to address any adverse effects identified. As such, there is some overlap between this chapter of the EIAR and the NIS for the proposed development. However, both the EIAR and NIS for the proposed development are standalone documents which do not rely on each other.

General Impacts on Key Ecological Receptors

1) Habitat Loss

10.7.3 The proposed development will inevitably lead to some habitat loss in order to facilitate the construction of hard defences. Many habitats listed above, including woodland habitats are within the footprint of the proposed works. The habitats directly impacted by the works include aquatic habitats, agricultural land, woodlands and grassland habitats. Table 10-22 below, outlines the locations of where these habitats will be lost within the scheme area. The footprint of works has been minimised where possible to reduce the loss of habitats in this area. However, the majority of defences will be constructed in already built land.

2) Habitat Fragmentation

10.7.4 Any loss of linear woodland (areas of treelines and/or scrub) will result in habitat fragmentation which could lead to the displacement of wildlife from the area and the fracture of an ecological corridor which will inhibit the movement of species through the area and into more natural refuges along the corridor. These treelines are largely concentrated in the upstream storage area and Hotel Street. There are also several trees proposed for removal in the Graiguenamanagh town area. This includes an area where the River Duiske enters the River Barrow adjacent to Graiguenamanagh Motorhome Park, two specimens towards the end of Hotel Street on the Tinnahinch side of the town and a further two specimens just south of Graiguenamanagh Bridge on the Tinnahinch side. The treelines to be removed are indicated in Figure 10-22 and Figure 10-23 detailed in the Tree Survey Report in Appendix 10-11.

10.7.5 In Area 1 (upstream storage area), there is approximately 315 metres of treeline to be removed to make way for the proposed works. In the town area of Graiguenamanagh, there is approximately 21 metres of treeline and 10 individual tree species to be removed in Area 3 (adjacent to campsite), there are 3 trees to be moved from Area 4 (around

parkland), and 1 tree to be removed from Area 5 (located near the quay on Tinnahinch side of the River Barrow). This detail is provided in drawing no. W3451-AYE-DWG-W-1426 in Appendix 4-1 of this EIAR.

10.7.6 The upstream storage area flow control structure has been designed to allow the free flow of fish species.

3) Habitat Degradation

10.7.7 The construction of the proposed development could lead to habitat degradation. The potential impacts include the pollution of the Duiske River and River Barrow, and the conversion of wooded habitat (treelines & scrub in the upstream storage area) to built land. The upstream storage area will account for approximately 472.5m^2 of lost woodland, assuming the treelines and hedgerows to be removed have a depth of approximately 1.5m. The treelines to be removed in the other areas of the Proposed Scheme are as detailed in the preceding sections.

10.7.8 Water quality impacts arising from both the construction and the operation of the proposed development have the potential to affect habitats and species directly and indirectly. Accidental pollution events could result in sediment and pollutants entering the Duiske River and River Barrow. Increased storm water overflow incidences could also result in increased pollutants entering the above-mentioned rivers.

4) Disturbance

10.7.9 Construction of the proposed development will result in temporary noise, vibration, lighting and visual disturbance and will affect species both within and outside the construction footprint. These disturbances can alter feeding and breeding patterns, reduce reproductive success, and force animals to avoid suitable habitats, negatively impacting population health and biodiversity. This disturbance is short-term in nature and is unlikely to result in long-term effects.

5) Direct Mortality

10.7.10 Direct mortality is possible as a result of site clearance, tree felling and vegetation removal. Birds are particularly vulnerable during the nesting season (March-August inclusive) when works could lead to the loss of nests. Bats are vulnerable to tree felling because it can destroy their roosts, food sources, and maternity sites, leading to injuries or death, especially for young bats that cannot fly. Some bats hibernate in trees by finding and using natural cavities, hollows, and cracks in mature trees, especially those with features like woodpecker holes or loose bark.

6) Indirect Mortality

10.7.11 The physiological effects of exposure to, and ingestion of significant concentrations of hydrocarbons on fish has been well-documented; these include delayed maturation, embryo malformation and suppressed gene expression (Holth, Thorsen, Pal, & Ketil, 2010). Many bird species have diets consisting of fish (Cormorant, Kingfisher etc.). Consumption

of contaminated prey can represent a risk of ill-health and could potentially result in mortality. Fish is also the staple diet of the otter.

Construction Phase Impacts

10.7.12 The following table outlines the key ecological receptors and the impacts upon them associated with each of the Works Packages, as outlined in Table 4-18 of Chapter 4 'Description of the Proposed Scheme and Construction Methodology'.

Table 10-22: Construction Impacts by Works Packages

Works Package	Associated Impact
WP1	Works will consist of site set-up and enabling works. This includes site clearance. Tree removal will take place during this time, resulting in habitat loss/fragmentation/degradation, particularly to Linear Habitats, Wooded Areas and Grassland habitats. These impacts will be **permanent, moderate, negative**, but reducing to **permanent, slight, negative** in time as the natural riparian and woodlands species recover. There will also be disturbance to mammal, bat, bird and fish species. These impacts will be **temporary, significant negative** without mitigation. It may also result in direct mortality of bird/bat species, having a **short-term, significant and negative** without the inclusion of mitigation measures. It also has the potential to impact upon the species that use these habitats. There will be associated impacts from the additional site investigations and surveys. These enabling works have the potential to disturb terrestrial mammal, bird, bat and fish species (via potential hydrocarbon/silt run-off) that utilise the habitats surrounding all works areas. These impacts will be **temporary, significant and negative** without mitigation.
WP2	The National Biodiversity Data Centre (NBDC) has numerous records of Otter (*Lutra lutra*) (National Otter Survey 2012) occurring within WP2 area and the species has quite extensive areas of both aquatic and terrestrial habitat for foraging and movement through the site. Badger spraint, fox sprint and mammal trails were recorded during Ayesa mammal surveys in this area. Several Annexed bird species were recorded using treelines, hedgerows and woodland in this area also. This includes house sparrow, mallard and wood pigeon. Linear woodland and hedgerows in this area also forms suitable foraging routes for bats. Works will consist of the construction of the flood defences in Area 1, the upstream storage area. The impacts here will be largely **temporary/short-term significant and negative**, associated with the construction of the storage area. Without mitigation measures, these works have the potential to result in habitat degradation of Linear Habitats and Rivers and Stream, direct mortality of Fish species and indirect mortality for Fish, Otters and Birds. Impacts may come from the following sources: physical damage, pollution and changes in water quality. This is particularly notable with the

Works Package	Associated Impact
	river diversion required to construct the flow control structure. These impacts will be **short-term significant and negative**. There will also be disturbance to terrestrial mammal, bat, bird and fish species that utilise the habitats in the surrounding environs of the upstream storage area. The use of the land in the upstream storage area for site compound B will result in habitat degradation of grassland habitats. These impacts will be **short-term moderate and negative.** This will have further impacts upon River Barrow and River Nore SAC and River Nore SPA. The potential impacts include habitat degradation/loss within the associated river, and direct mortality of fish species and indirect mortality of otter bird species. These impacts would be **temporary/ significant, negative.**
WP3	Works will consist of the construction of the flood defences in Areas 2, 3 and 4 on the River Duiske. The impacts here will be largely **temporary, significant and negative** associated with the construction of the flood defence walls on the River Duiske, with instream works required. The National Biodiversity Data Centre (NBDC) has numerous records of Otter (*Lutra lutra*) (National Otter Survey 2012) occurring within Graiguenamanagh town area and the species has quite extensive areas of both aquatic and terrestrial habitat for foraging and movement through the site. However, it should be noted that resting spots are not plentiful within the WP3 area of the town given its built-up nature. Several Annexed bird species were recorded using treelines, hedgerows and woodland in this area also. This includes house sparrow, mallard and wood pigeon. Common swifts and house martins were recorded in large numbers along this stretch of the River Duiske and appeared to be nesting under the eaves of old buildings in the area. Grey wagtail and dippers are also recorded as within this stretch of the River Duiske watercourse. There are many bridges along this area suitable for bat foraging activity along the River Duiske. These include High Street Bridge and Turf Market Bridge. Old buildings and sheds in this section of the town also provide suitable bat roosting habitat, as identified in Section 10.4.26. No specific roost could be confirmed, but bats likely occupy these buildings at least occasionally and may roost in different buildings on different days. Without mitigation measures, these works the potential to result in habitat degradation of Linear Habitats and Rivers and Stream, direct mortality of Fish species and indirect mortality for Fish, Otters and Birds. There will also be disturbance to terrestrial mammals, bat, bird that utilise the habitats in the surrounding environs. There will also be significant disturbance to fish species, where instream works will take place on the River Duiske. The site compounds at this location will be within the urban environment in already built land so there are no associated impacts expected.

Works Package	Associated Impact
	This will have further impacts upon River Barrow and River Nore SAC and River Nore SPA. The potential impacts include habitat degradation/loss within the associated river, and direct mortality of fish species and indirect mortality of bird species. These impacts would be **temporary/short-term significant, negative.**
WP4A	The National Biodiversity Data Centre (NBDC) has numerous records of Otter (*Lutra lutra*) (National Otter Survey 2012) occurring within Graiguenamanagh town area and the species has quite extensive areas of both aquatic and terrestrial habitat for foraging and movement through the site. Potential otter food remains (half eaten fish) was recorded just east of the boat club during a 2024 mammal survey undertaken by Ayesa. Badger footprints were also recorded near the boat club along the riverbank during the same survey. Barn swallows and house martins were recorded in high numbers along this section of the River Barrow during Ayesa breeding bird surveys. They were recorded collecting mud and other material for nesting along the riverbank by the boat club. They were also recorded in flight between the boat club and Graiguenamanagh Bridge. The great cormorant was also regularly recorded during Ayesa bird surveys flying up and down this section of the River Barrow. Mallards (Annex II, III species) were regularly recorded resting along the riverbank of the Barrow within the Hub area. Kingfisher (Annex I bird species) was recorded near a potential nesting habitat approximately 200 metres west of the Hub area along the River Barrow. Graiguenamanagh Quay doesn't provide an optimal foraging route or roosting/sheltering habitat for bats. It is a paved area, and it doesn't contain any linear foraging routes. However, Graiguenamanagh Bridge at the end of the quay appears to be a suitable location for bat species that forage along the River Barrow. Old buildings and bridges near Peg Washington's Lane and the wooded area adjacent to Graiguenamanagh Bridge may also facilitate bat activity. Works will consist of the construction of the flood defences at Areas 5, 6, 7, 8 on the right bank of the River Barrow, within the townlands of Graiguenamanagh. The impacts here will be largely **brief/temporary, moderate/significant and negative** associated with the construction of the flood defence measures. These works are largely set back from the river within the urban environment. Without mitigation measures, there will be disturbance to terrestrial mammals, bat, bird that utilise the habitats in the surrounding environs, particularly around the Boat Club and The Hub. The use of the land near the Boat Club for site compounds D and E will result in habitat degradation of grassland habitats. There are also potential risks via surface water runoff of sediment/hydrocarbons to the nearby aquatic environment, particularly the River Barrow which forms part of River Barrow and River Nore SAC.

Works Package	Associated Impact
WP4B	This area doesn't appear to have a high suitability for bats. Any bird recordings were recorded from a nearby woodland to the west. These recordings mainly consisted of great tit, chiffchaff, gold crest and long tailed tit. No mammal recordings were seen here during the mammal surveys. However, it is acknowledged that otters and badgers are likely to be within surrounding areas given online records and evidence on the opposite riverbank. Works will consist of the construction of the flood defences at Areas 9 and 10 on the left bank of the River Barrow, within the townlands of Tinnahinch. The impacts here will be largely **brief/temporary, moderate/significant and negative** associated with the construction of the flood defence measures. These works are largely set back from the river within the urban environment. Without mitigation measures, there will be disturbance to terrestrial mammals, bat, bird that utilise the habitats in the surrounding environs, particularly at Hotel Street. The use of the land adjacent to Hotel Street for site compounds F will result in habitat degradation of grassland habitats.

Operation Phase Impacts

10.7.13 The following table outlines the key ecological receptors and the impacts upon them associated with each of the areas, as outlined in Table 4-1 of Chapter 4 'Description of the Proposed Scheme and Construction Methodology'.

Table 10-23: Operational Impacts by Area

Area No.	Description	Impacts
Area 1	Storage Area	The terrestrial habitat at this location will remain largely unchanged, except for the footprint of the embankment and the new access road. This will result in a reduction of wet grassland, and hedgerows. Reduction of hedgerows will decrease habitat connectivity for bird and bat species. These species forage along linear habitats and use them for shelter. Terrestrial mammals such as badgers and foxes also use hedgerows for shelter. Wet grassland which contains taller, denser vegetation is a more optimal foraging area for terrestrial mammal species (particularly smaller mammals i.e. shrews, voles) as opposed to intensively managed grassland which it will be replaced with. As mentioned in Table 10-22, mammal trails were recorded in this area along with badger and fox spraint. The aquatic habitats will be reduced the length of the flow control structure. However, the free flow of water and fish species can be maintained through the hydrobrake. It is not anticipated that the flow control structure will be a significant barrier to otters, which are known to forage along the River Duiske. Although otters are dependent on rivers, they are not

Area No.	Description	Impacts
		confined to them and can traverse across farmland when required. These impacts are **permanent moderate negative** impact on habitat area. There will be **permanent imperceptible negative** impact on the species that use the habitats at this location.
Area 2 and Area 3	Well Lane to Turf Market	There will be **negligible** impacts to terrestrial habitats at this location as the flood defences will be built on urban fabric. The operational impacts to aquatic habitats will be **negligible** in the long-term as the new flood walls will be constructed on the same line as existing built environment.
Area 4	Turfmarket to The Hub (Lower Turfmarket)	There will be **negligible** impacts to terrestrial habitats at this location as the flood defences will be built on urban fabric. The operational impact of the flood defences at this location will result in a change to the existing riverbank, which will have a **permanent moderate negative** impact.
Area 5	Boat Club	Removal of dry meadow habitat may reduce the availability of sheltering and foraging habitat for mammals. Particularly small mammals such as shrew and voles. The removal of dry meadow habitat will also have a negative impact on pollinator diversity in this area. Impacts to mammals and pollinators in this area are considered **permanent slight negative** impact. The terrestrial habitat at this location will remain largely unchanged, except for the footprint of the embankment. This will result in a reduction of dry meadows, which will have a **permanent slight negative** impact. The works in the remaining area will be built upon urban fabric. There will be no operational impact upon aquatic habitats.
Area 6	Graiguenamanagh Quay	There will be **negligible** impacts to terrestrial habitats at this location as the flood defences will be built on urban fabric. The stormwater drainage at this location will outfall to the River Barrow. This will result in stormwater entering the River Duiske sporadically. Stormwater drainage impacts watercourse turbidity, primarily by introducing suspended sediments and pollutants. This runoff, carrying materials from urban surfaces, increases the cloudiness of the water, reducing light penetration and potentially harming aquatic life. This will have an **infrequent, slight negative** impacts.
Area 7	The Dock	The operational impact to terrestrial habitats at this location will be **negligible**. The existing land is largely urban fabric. Whilst there will be some tree removal at this location, there is additional planting proposed as part of the Proposed Scheme. The stormwater drainage at this location will outfall to the River Duiske. This will result in stormwater entering the River Duiske sporadically. Stormwater drainage impacts watercourse turbidity, primarily by introducing suspended sediments and pollutants. This runoff, carrying materials from

Area No.	Description	Impacts
		urban surfaces, increases the cloudiness of the water, reducing light penetration and potentially harming aquatic life. This will have an **infrequent, slight negative** impacts.
Area 8	The Hub	The operational impact to terrestrial habitats at this location will be **negligible**. The habitat here is amenity grassland. The embankment at this location means similar habitat will remain. Whilst there will be some tree removal at this location, there is additional planting proposed as part of the Proposed Scheme. The stormwater drainage at this location will outfall to the River Duiske. This will result in stormwater entering the River Duiske sporadically. Stormwater drainage impacts watercourse turbidity, primarily by introducing suspended sediments and pollutants. This runoff, carrying materials from urban surfaces, increases the cloudiness of the water, reducing light penetration and potentially harming aquatic life. This will have an **infrequent, slight negative** impacts.
Area 9	Hotel Street	The terrestrial habitat at this location will remain largely unchanged, except for the footprint of the wall, embankment and the new maintenance road. This will result in a reduction of amenity grassland. These impacts are **permanent moderate negative** impact. The stormwater drainage at this location will outfall to the River Duiske. This will result in stormwater entering the River Duiske sporadically. Stormwater drainage impacts watercourse turbidity, primarily by introducing suspended sediments and pollutants. This runoff, carrying materials from urban surfaces, increases the cloudiness of the water, reducing light penetration and potentially harming aquatic life. This will have an **infrequent, slight negative** impacts.
Area 10	Tinnahinch Quay	There will be no operational impact upon terrestrial and aquatic habitats at this location as the flood defence walls will be within the existing urban fabric.

Table 10-24: Effects on ecological receptors in the absence of mitigation

Ecological Receptor	Characterisation of Impact	Effect Without Mitigation
Construction Phase Impacts		
River Barrow and River Nore SAC	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of construction within the river Duiske. Species loss – due to disturbance, habitat loss, direct mortality or indirect mortality as result of the construction.	Temporary, negative impact, significant at an international scale

Ecological Receptor	Characterisation of Impact	Effect Without Mitigation
	Reduction in water quality – resulting in habitat degradation, direct mortality or indirect mortality.	
River Nore SPA	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of construction within the river Duiske. Species loss – due to disturbance, habitat loss, direct mortality or indirect mortality as result of the construction. Reduction in water quality – resulting in habitat degradation, direct mortality or indirect mortality.	Temporary, negative impact, significant at an international scale
Linear habitats/ Wooded areas	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of loss of treeline/hedgerow habitat in upstream storage area and several trees in town area. As mentioned in Table 10-23 and 10-24, linear/wooded habitats are to be removed from the parts of the upstream storage area (Area 1). Trees are also proposed for removal in Graiguenamanagh town, particularly within the Dock Area (Area 7) (See table 10-23 and 10-24).	Permanent, negative impact, significant at a regional/ county scale.
Rivers and streams	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of construction within the river Duiske. Species loss – due to disturbance, habitat loss, direct mortality or indirect mortality as result of the construction. Disturbance to faunal species – due to disturbance, habitat loss/disturbance, direct mortality or indirect mortality. Reduction in water quality – resulting in habitat degradation, direct mortality or indirect mortality. River diversion is required to construct the flow control structure in WP2/Area 1 (see Table 10-23 and 10-24). This could result in physical damage, pollution and changes in water quality in the absence of mitigation.	Permanent, negative impact, significant at a local-international scale.
Grassland habitats	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of the spread of invasive species and the reduction in floral diversity from work compound areas.	Permanent, slight negative impact,

Ecological Receptor	Characterisation of Impact	Effect Without Mitigation
	Species loss – due to disturbance, habitat loss, direct mortality or indirect mortality as result of the spread of invasive species and the reduction in floral diversity from work compound areas. Grassland habitats from several works' areas will be required to facilitate works. This includes the upstream storage area (Area 1), which involves the removal of some wet grassland, the boat club (Area 5) which involves the removal of some dry meadow habitat, the Hub (Area 8) involves the removal of some amenity grassland and Hotel Street (Area 9) involves the removal of some amenity grassland (see Table 10-23, 10-24).	significant at a local scale.
Terrestrial mammals (non-volant) (otter/badger)	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of construction (scrub, trees, resting spots for otters). Species loss – due to disturbance, habitat loss, direct mortality or indirect mortality as result of the noise emissions from construction activity and hazardous storage of machinery. Reduction in water quality – resulting in habitat degradation, direct mortality or indirect mortality as a result of surface water contamination. Removal of linear habitat from upstream storage area (Area 1) may reduce sheltering habitat for mammals. Trees are also proposed for removal in Area 7 (See Table 10-23, 10-24).	Permanent, significant negative impact at a local scale.
Bats	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of the scheme resulting in a loss of roosting/foraging habitat with clearance of treelines/hedgerows. Species loss – due to disturbance, habitat loss from the construction noise and light pollution. As mentioned in Table 10-23 and 10-24, linear/wooded habitats are to be removed from the parts of the upstream storage area (Area 1). Trees are also proposed for removal in Graiguenamanagh town, particularly within the Dock Area (Area 7) (See table 10-23 and 10-24).	Permanent and negative, significant at a county scale.
Overwintering / breeding birds	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of the clearance of	Permanent, significant negative

Ecological Receptor	Characterisation of Impact	Effect Without Mitigation
	vegetation during breeding season and potential surface water pollution. Species loss – due to disturbance, habitat loss from noise emissions from construction activity. As mentioned in Table 10-23 and 10-24, linear/wooded habitats are to be removed from the parts of the upstream storage area (Area 1). Trees are also proposed for removal in Graiguenamanagh town, particularly within the Dock Area (Area 7) (See table 10-23 and 10-24).	impact at a local scale.
Freshwater Fish (including brook lamprey, river lamprey, twaite shad and salmon)	Habitat/species loss/disturbance – due to habitat loss, fragmentation or degradation and disturbance as a result of surface water pollution and damage to riverbed/potential spawning locations during instream works. River diversion is required to construct the flow control structure in WP2/Area 1 (see Table 10-23 and 10-24). This could result in physical damage, pollution and changes in water quality in the absence of mitigation.	Permanent, significant negative impact at a local scale
Operation phase Impacts		
Linear habitats/ Wooded areas/ grassland habitats	The planting of native saplings and immature trees will have a last positive impact on the scheme area as they continue to grow. The introduction of pollinator-friendly dry meadows will also result in an enhancement of habitat opportunities for native bees. Once mature they offer habitat and foraging opportunities for a large number of species.	Permanent, positive impact, significant at a local scale.
Freshwater Fish (including brook lamprey, river lamprey, twaite shad and salmon)	The flow control structure in the upstream storage will not restrict the movement of the fish through the river Duiske. However, it does require riverbed reinforcements which will alter the natural riverbed and flow over a short stretch (less than 60m) of the river.	Permanent imperceptible impact at a local scale.
Rivers and streams	Stormwater drainage impacts watercourse turbidity, primarily by introducing suspended sediments and pollutants. This runoff, carrying materials from urban surfaces, increases the cloudiness of the water, reducing light penetration and potentially harming aquatic life.	Infrequent, slight negative impacts at a local scale.

Ecological Receptor	Characterisation of Impact	Effect Without Mitigation
All other ecological receptors	The largest impacts are anticipated in the construction phase. The ecological receptors are anticipated to return to their normal state/habits following the completion of construction.	Neutral effect

10.8 Mitigation Measures

Construction and Pre-Construction Phase

General

Bio_1: All construction will be undertaken in accordance with the CIRIA (2015) Environmental Good Practice on Site (Charles and Edwards 2015);

- Mitigation described in this report will be followed during pre-construction, construction and operation phases;
- A site-specific CEMP will be written by the contractor prior to site works commencing. This CEMP will incorporate the mitigation measures listed here.

Site Compound

Bio_2: The site compounds shall be located within the site boundaries.

- The compounds are sited as far from any water course where possible in order to minimise any potential impacts, leaving an appropriate buffer (typically 3m) of natural bed and banks undisturbed allowing a natural bank-path. Silt fences will be erected to prevent any run-off from the perimeter of the compounds.
- Site compounds site shall be restored to their original state following the construction phase.

Pre-construction Surveys

Bio_3: A pre-construction survey of the scheme will be undertaken by an experienced Ecologist in order to confirm the baseline conditions and refine environmental mitigation as required prior to construction works commencing on the site.

10.8.1 Once planning permission has been secured, pre-construction ecology surveys will be carried out within the Proposed Scheme area well in advance (ideally 3-4 months prior to construction works) in order to ensure that sufficient updated information is available to inform derogation licence applications, as required.

Ecological Clerks of Works

Bio_4: An Ecological Clerk of Works (ECoW) will be employed to monitor the works and to inform the team through Ecological Toolbox Talks during the proposed works and tree felling activities. A species protection plan will be designed by a professional ecologist to ensure that works related to this proposal take into account any protected species, including birds and bats, present on site and the nearby surroundings.

- A minimum of 1 no. ECoW visit will be conducted per week during the course of the construction works at this site during the construction phase. The ECoW shall be present on-site during commencement of works. As such the following points must be adhered to for this scheme:
- An ECoW will be involved as required during the construction period for this scheme, in order to ensure that the required mitigation is implemented.
- The ECoW and the Contractor will walk the Proposed Scheme together prior to work commencing on the site, in order to discuss the ecological constraints, to highlight all required mitigation and to demarcate exclusion zones appropriately.

Specific Mitigation

Measures for the Protection of Surface Water

10.8.2 Temporal impacts due to increased levels of turbidity/sedimentation and accidental spillages cannot be ruled out. Mitigation measures will be required to manage the potential impacts:

Bio_5: To minimise exacerbated adverse effects, the removal of vegetation, soil, existing concrete will not take place during periods of heavy rain. Weather forecasts will be considered during the construction works and works will be minimised when there is forecast for heavy rain.

Bio_6: Earth moving works will be avoided during very wet weather conditions to minimise the occurrence of sediment and/or contaminant mobilisation. during very wet weather conditions to minimise the occurrence of sediment and/or contaminant mobilisation.

Bio_7: Fuels, lubricants and hydraulic fluids for equipment used on the construction site, as well as any solvents and oils, will be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, provided with spill containment.

Bio_8: Fuelling and lubrication of equipment may be conducted on the site but within designated areas and in conjunction with appropriate spill prevention measures (e.g., drip trays, plant nappies, etc).

Bio_9: Oil and fuel stored in bunded areas shall be stores an appropriate distance from any discharge point as to prevent accidental spills entering the aquatic environment.

Bio_10: Refuelling must be carried out using 110% capacity double bunded mobile bowsers. The refuelling bowser must be operated by trained personnel. The bowser must have spill containment equipment which the operators must be fully trained in using.

Bio_11: A fuel spill kit shall be retained on the site for the period of construction.

Bio_12: Any spillage of fuels, lubricants, or hydraulic oils will be immediately contained, and immediate emergency control measures implemented to ensure no ingress into the aquatic environment. The nearby dirty water drain outlet must be blocked with an oil absorbent boom until the fuel/oil spill has been cleaned up and all oil and any contaminated material removed from the area. This contaminated material must be properly disposed of in a licensed facility.

Bio_13: The site Environmental representative must be immediately informed of the oil leak/spill and must assess the cause and the management of the clean-up of the leak or spill. They must inspect nearby drains for the presence of oil and initiate the cleanup if necessary.

Bio_14: The washing of vehicles and/or construction machinery and/or HGVs must occur within designated wash areas (i.e., away from watercourses or areas connected to nearby watercourses).

Bio_15: Moreover, wash down water from exposed aggregate surfaces, cast-in-place concrete and from concrete trucks will be trapped on-site in a dedicated area, to allow sediment to settle out and reach neutral pH before clarified water is allowed to percolate into the ground.

Bio_16: Discharge from site will be discharged to silt bag with overflows directed to land before being discharged to the river.

10.8.3 It is considered that, with the implementation of the proposed mitigation measures outlined above, there will be no significant risk to the nearby watercourses. With appropriate measures in place to address the risks arising from silt/turbidity or accidental spills, potential impacts to nearby watercourses can be avoided entirely.

Noise and Vibration Mitigation Measures

10.8.4 The following mitigation measures will be adopted as standard practice and will be adhered to for the duration of the construction works. These are in line with those outlined in Chapter 15 ‘Noise and Vibration’.

Bio_17: During the works, best practice noise reduction measures described in British Standard 5228-12009+A1:2009, Code of Practice for Noise and Vibration Control on Construction and Open Sites must be incorporated into the Construction and Environmental Management Plan.

Bio_18: For mobile plant items such as cranes, HGV’s, excavators and loaders, maintaining enclosure panels closed during operation can reduce noise levels over normal operation.

Bio_19: Mobile plant will be switched off when not in use and not left idling.

Bio_20: For steady continuous noise, such as that generated by diesel engines, noise reduction must be achieved by fitting a more effective exhaust silencer system.

Bio_21: Acoustic screens are required to be erected in certain locations for the duration of the proposed works. These screens shall be carefully positioned to be as effective as possible. In general, the barrier shall have no gaps or openings in the joins of the barrier material. The barrier material shall have a minimum mass per unit area of 7 kg/m2 and minimum height of 2.4m. This will be informed by the ECoW.

Bio_22: Low decibel machinery must be used for those that will be used continuously such as water pumps to limit any noise emissions from the site in the late evenings and early mornings when mammal (i.e., otter) activity is at a higher level.

Preventing the spread of Invasive Species

10.8.5 Treatment is ongoing for invasive species in the scheme area. The following management protocols regarding alien invasive species will be implemented prior to the commencement of construction works:

Bio_23: Best practice construction measures will be taken to avoid the spread of invasive plant species during the construction phase as they can quickly out-compete native plant species in Ireland. Construction workers onsite must be made aware of the location of invasive species before construction activity commences and consider that Physical removal and treatment of the invasive species will be undertaken only in areas where they invasives cannot be avoided by construction activities.

Bio_24: It is advised that the contractor refers to the following documents, which provide detailed information for the control of invasive species and noxious weeds: Chapter 7 and Appendix 3 of 'The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads' (NRA, 2010) and the Invasive Species Management Plan appended to the CEMP (Appendix 4-4 of this EIAR).

Precautionary Measures for Preventing Disturbance to Terrestrial Mammals

10.8.6 As evidence of otter and badger activity is confirmed to be present in the area, mitigation will be required including:

10.8.7 Surface water protective measures outlined in **Bio_5** to **Bio_16** of the specific mitigation measures will be adhered to for the protection of watercourses used by otters. This will help avoid the contamination of prey that otters feed on as well as maintaining the water quality of the river in which the otters forage.

10.8.8 Noise emission measures outlined in Section **Bio_17** to **Bio_22** of the specific mitigation measures will be adhered to for the protection of mammals including otters. This will help avoid significant negative impacts to surrounding mammal species from potential noise emissions from the site.

Bio_25: Careful storage of machinery by cordoning off of hazardous machinery with temporary fencing at the end of the working day and the restriction of works to daylight

hours (otters and badgers are largely nocturnal) will be implemented by the contractor on site. These mitigation works will necessarily be implemented throughout the entire construction period.

Bio_26: In the event that new holt / couch / evidence of Otter is identified during the construction phase, the guidance within the "Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes" (NRA, 2008) will be followed, accordingly.

Bio_27: Culvert crossing and instream works must be designed such that they do not impede the movement of Otter along watercourse. Instream works will allow enough space for otters to pass through without having to divert onto land and back onto the watercourse downstream. This is not possible for the flow control structure in the upstream storage are, however, all other instream works will allow free passage of otters.

Bio_28: No night lighting/security lights shall be directed towards the river in a way that causes artificial illumination of the river corridor.

Precautionary Measures for the Protection of Bats

10.8.9 Specific measures will be required to protect bats onsite, and these are detailed further below.

Bio_29: Lighting: Where construction lighting is required, light spill will be minimised as much as possible. This can be achieved by the use of directional lighting (i.e. lighting which only shines on the proposed works and not nearby countryside) to prevent overspill. This will be achieved by the design of the luminaire and by using accessories such as hoods, cowls, louvres, and shields to direct the light to the intended area only. Lighting will be minimised in potential foraging and commuting areas, and the times during which the lighting is on will be limited to provide some dark periods. Lights will be positioned to avoid sensitive areas and restricted so that there are dark areas. The timing of lights will be restricted to avoid bat activity (i.e. from dusk until dawn).

Bio_30: Trees to be Retained: Where possible, mature trees and treelines that are located immediately adjacent to planned work areas or are not directly impacted will be avoided and retained intact. Overall impacts on these sites will be reduced through modified design and sensitivity during works. Retained trees will be protected from root damage by machinery by an exclusion zone of at least c. 7 metres or equivalent to canopy height. Such protected trees will be fenced off by adequate temporary fencing prior to other works commencing. This will ensure that bat transport and foraging routes (treelines) remain intact and unharmed from the works.

Bio_31: Removal of Trees: Any mature broadleaved tree(s) scheduled for removal as part of the proposed development plans will be surveyed for bat presence by a suitably experienced specialist immediately prior to felling. If bats are found, an application for a derogation licence will be made to the National Parks and Wildlife Service to allow its legal removal. Such trees will ideally be felled in the period late August to late October, or early November, in order to avoid disturbance of any roosting bats as per National Roads Authority (NRA) guidelines and also to avoid the bird breeding seasons. Tree felling will be completed by mid-November at the latest as bats roosting in trees are vulnerable to

disturbance during their hibernation period (November - April). If trees are to be removed outside of these periods extra care will be taken prior to felling to ensure no protected species are present. Trees with ivy cover, once felled, will be left intact onsite for 24 hours prior to disposal to allow any bats beneath foliage to escape overnight.

Bio_32: Boundary Vegetation: Linear features such as treelines and hedgerows serve as commuting corridors for bats (and other wildlife). The onsite boundary vegetation especially that bordering the Duiske and Barrow Rivers will be retained and/or replaced once construction ends. Native species will be chosen in all landscaping schemes. Planting schemes attempt to link in with existing wildlife corridors (hedgerows and treelines) to provide continuity of wildlife corridors.

Precautionary Measures for the Protection of Freshwater Fish

Standard avoidance of pollution of watercourses

Bio_33: Mitigation to prevent a reduction in water quality and damage to the river channel habitats following the works include improved fencing along the riverbank and riparian zone, along with provision of drinking troughs, in order to prevent the poaching from livestock which was evident at a number of locations along the channel surveyed, in the upstream storage area.

Precautionary Measures for the Protection of Salmonids

Bio_34: No instream works will be carried out between the months of October and June (inclusive) to avoid the most sensitive time for fish species and fish species movements, unless agreed otherwise with IFI in writing.

Bio_35: Although Salmonids were only identified during fish community surveys in the lower reaches of the River Duiske, the ECoW will undertake an assessment of proposed sites for the watercourse diversion and culvert crossing works to determine the suitability of the site as Salmonid spawning habitat. River flow, depth and substrate will be assessed in these areas to determine suitability for salmonid spawning.

Bio_36: The final placement of the inlet for the upstream storage flow control structure instream will be in such a way that the natural flow of water is not significantly altered nor impedes the movement of fish species along the watercourse.

Bio_37: Bankside disturbance will be kept to an absolute minimum to avoid bank slumping and / or significant sediment influxes

Bio_38: The proposed temporary watercourse diversion works will occur along a stretch of lowest gradient (where feasible) to minimise significant alteration in surface water flow and / or sediment run-off / transport.

Bio_39: The proposed temporary watercourse diversion will be lined with an appropriate substrate mix (gravels-sand-cobbles) to reflect the natural substrate composition of the watercourse.

Protection of Watercourse during Instream Works

Bio_40: The stretch of river planned for temporary diversion measures will be investigated for the presence of fish species (e.g., Salmon, Trout, Lamprey, etc) by an appropriately qualified fisheries/aquatic ecologist prior to any diversion works commencing. This will occur:

- Immediately prior to rivers/streams being diverted into a newly constructed river channel, electrofishing will be conducted to capture and transfer fish from the original channel to the new one or upstream/downstream of the affected channel.
- Once the watercourse has been diverted, a manual search of the original watercourse must be made to transfer any remaining fish and / or crustaceans to the new river/stream channel.

Bio_41: For any temporary river diversion works, specific attention must be given to the avoidance of unnecessary vegetation clearance.

Bio_42: Watercourse diversion works and culvert crossing works will take place during periods of low flow.

Bio_43: Minimal excavation works will be undertaken to minimise potential sediment run-off into watercourses where culvert crossing and diversion will occur.

Bio_44: Where feasible, soil excavation will be completed during dry periods.

Bio_45: Where required, silt fences will be used along the banks of watercourses and instream where diversion works will occur to limit the runoff / influx of disturbed sediment. Additionally, silt fences will be used in areas proximal to excavation / diversion works that are susceptible to sediment influx (e.g., drainage lines, natural depressions, tributaries, etc).

Bio_46: Site clearance for river diversion works will only commence and be undertaken when works are required, adopting a planned approach to avoid mass site clearing that will ultimately result in exposed ground for long periods of time.

Bio_47: Any / all protected habitats / species will be identified and zoned as “no-go” areas established and suitably isolated from works using fences, barriers, screens and signage.

Bio_48: Invasive or noxious plants (e.g. Japanese knotweed, Himalayan balsam, etc.) will be removed through appropriate means from the river diversion course before works commence.

Bio_49: The timing of vegetation removal will be carefully considered to avoid particularly sensitive periods of the year (e.g., bird nesting season, high flow periods).

Bio_50: During site clearance operations, appropriate measures must be taken to ensure the stability of the bank, particularly where there is a risk of raised water levels (i.e. seasonal high flows) until the vegetation is re-established or prior to the placement of concrete support infrastructure.

Bio_51: Appropriate flow regulator infrastructure will be placed into the river diversion pathway, either as natural infrastructure (e.g., rock / boulders) or artificial infrastructure (e.g., concrete blocks) to maintain the natural flow of the diverted river, which will also minimise unnecessary sediment removal and flow downstream. This is particularly pertinent to consider during potential periods of higher flow following precipitation events. Alteration in the natural flow regime may result in increased sedimentation of river stretches or erosion of key habitats and / or riverbanks downstream.

Bio_52: All temporary crossing structures used to cross watercourses during construction will be designed in accordance with the Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016) and Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes (NRA, 2005) to maintain fish and macroinvertebrate passage, and to prevent sedimentation and erosion.

Trees (Woodland and Linear features (Treelines/Hedgerows))

Pre-Construction

Bio_53: Vertical barriers/fencing and/or ground protection must protect all trees proximal to the proposed works that are being retained on site. It is essential that these provisions be put in place prior to any development work or soil excavations are carried out. The purpose of protective barriers is to exclude any harmful construction activity that may damage the Root Protection Area (RPA). A root protection area is calculated as using the diameter of the tree trunk at 1.5 meters height x12 (Woodland Trust, 2021). These barriers help protect the main stem of the tree. Tree protection barriers will be fit for the purposes of excluding construction activities and be durable to withstand an impact. The barrier will consist of a vertical and horizontal frame and should be at least 2.3m in height.

Bio_54: To ensure the protection barriers are respected, clear concise signage must be affixed to the barrier in an unrestricted easily viewed location. The signage must specify that no construction activity is to take place within the RPA. This will remain the case until completion of all works unless certain works are deemed acceptable following consultation with an arborist. The signage must also state that no materials of any description are to be stored or the “spilling out” of materials should not occur within the RPA. Site personnel must be made aware of the importance of the protective barrier.

During Construction

Bio_55: Any excavation works carried out within the RPA will be undertaken with extreme care and should be carried out with due diligence, avoiding damage to the protective bark covering larger roots. This may involve excavation by mini-digger and/or hand as deemed appropriate.

Bio_56: Where works occur in very close proximity to trees to retained, trunk protection will also be put in place using hessian sacking and timber strips clad around the tree, in order to mitigate any potential damage that may occur.

Bio_57: Alteration of ground levels within the RPA will only be carried out following a considered assessment of the likely impact on the tree. In general, a ground alteration in

excess of 75mm will be avoided. Changes in ground levels in the vicinity of a tree may alter the existing soil hydrology and necessitate the incorporation of adequate drainage around the tree. New impermeable surfaces will not cover more than 20% of the RPA. An increase in ground level up to a maximum of 1m is tolerable for certain species using specific techniques (beech and oak are not amenable to such a level of disturbance). This involves the construction of a dry well around the tree trunk allowing for future growth and the incorporation of coarse aggregates to provide sufficient drainage and allow for gaseous diffusion in the raised ground.

Post Construction

Bio_58: A number of areas have been identified as suitable for replanting as outlined in Section 10.10 and in Chapter 11 'Landscape and Visual'. These areas are within The Hub, the Dock and Graiguenamanagh Quay. The species assemblage will broadly resemble what currently exists onsite along with other native tree species which will be added to the mix. The planting of trees has many benefits, including from a landscape perspective. However, for biodiversity, they allow the creation of habitats for birds, bats and other species. Further, they contribute to the creation/maintenance of a wildlife corridor.

Precautionary Measures for the Protection of Birds

Bio_59: To limit the potential impact of construction on breeding birds, removal of woody vegetation will be restricted to the non-breeding season (September to February, inclusive). Where the construction programme does not allow this, an ecologist will undertake a breeding bird check immediately prior to vegetation clearance. Where no breeding birds are present, clearance may proceed without requiring a derogation licence from the NPWS. However, given that breeding birds and the nests of all bird species are protected under the Wildlife Acts, a licence would be required from the NPWS to permit the destruction of nest sites. NPWS will be consulted prior to disturbance of breeding birds during the breeding season (1st of March to the 31st of August).

Bio_60: If the contractor intends to carry out clearance works during the bird breeding season, guidance will be sought from the NPWS with regard to compliance with Section 40 (1) and Section 40 (2) (e) of the Wildlife Acts (see below):

> (1) (a) It shall be an offence for a person to cut, grub, burn or otherwise destroy, during the period beginning on the 1st day of March and ending on the 31st day of August in any year, any vegetation growing on any land not then cultivated.
>
> (1) (b) It shall be an offence for a person to cut, grub, burn or otherwise destroy any vegetation growing in any hedge or ditch during the period mentioned in paragraph (a) of this subsection.
>
> (2) Subsection (1) of this section shall not apply in relation to— (e) the clearance of vegetation in the course of road or other construction works or in the development or preparation of sites on which any building or other structure is intended to be provided.

Bio_61: Treelines and areas of scrub offer birds suitable nesting habitat locations. These areas will be protected and remain untouched during construction. The proposed works will be carried out with the aim of avoiding as much damage to this potential bird nesting habitat as possible.

Bio_62: Any trees or scrub in the way of the development layout are to be removed in such a manner not to cause damage to those trees to be retained. Root protection areas will be marked out around the trees to be retained. No machinery will enter these areas.

10.8.10 Surface water protective measures outlined in **Bio_5** to **Bio_16** of the specific mitigation measures will be adhered to for the protection of watercourses used by waterbirds.

10.8.11 Noise emission measures outlined in **Bio_17** to **Bio_22** of the specific mitigation measures will be adhered to for the protection of surrounding waterbirds. This will help avoid significant negative impacts to surrounding bird species from potential noise emissions from the site.

Operation and Maintenance Phase

Bio_63: Mitigation measures for the protection of surface water (**Bio_5** to **Bio_16**) and for the protection of freshwater fish (**Bio_33** to **Bio_53**) will be followed for the clearance of the debris trap and any long-term vegetation maintenance during the operational phase.

10.9 Monitoring

Ecological Clerks of Works

10.9.1 Monitoring will take place during construction by the Ecological Clerk of Works.

10.9.2 Post-construction monitoring will take place to ensure the usage of the Biodiversity Enhancement Measures as outlined in Section 10.10 below.

10.10 Biodiversity Enhancement Measures

10.10.1 These measures will be further developed in the detailed design stage of the Proposed Scheme. Enhancement is improved management of ecological features or provision of new ecological features, resulting in a net benefit to biodiversity, which is unrelated to a negative impact or is 'over and above' that required to mitigate/ compensate for an impact. Enhancement measures should be designed to deliver biodiversity that are specified in relevant policy documents, and evidence should be provided to support the likelihood of delivering the predicted benefit.

10.10.2 These measures aim to maintain and enhance biodiversity in the area through the creation of habitat and wildlife corridors for several different species. Further they support policy objectives outlined in the OPW Biodiversity Action Strategy 2022-2026, the All-Ireland Pollinator Plan 2021-2025, Kilkenny City and County Development Plan and the National Biodiversity Action Plan 2023-2030.

10.10.3 The placement of these enhancement measures is indicated on Drawing No. W3451-AYE-DWG-W-1445.

Creation of Pollinator Friendly Dry Meadows

10.10.4 The proposed works and construction compound areas will inevitably have an impact on flora vegetation throughout G-T.

10.10.5 Further, pollinator meadows will be incorporated into the land at the embankment at Hotel Street in Tinnahinch and the clubhouse in Graiguenamanagh with the meadow placed on the dry side of the embankment. These will be implemented according to the All-Ireland Pollinator plan methodologies and recommended seed mixes. These meadows will be maintained by the local council (Kilkenny County Council). This will maintain/enhance biodiversity in the area. These meadows will be combined with bee scrapes (see below). The below figures provide a visual example of these measures.



Figure 10-31: Wildflower Meadow managed at Pavillion Park, Lisdoonvarna



Figure 10-32: Lees Road Sports Complex managed for pollinators (June 2023)

Bee scrape

10.10.6 Bee scrapes will be created along the rear of new embankments created for the scheme. Alternatively excess topsoil used for embankments could be used to create a smaller pollinator friendly embankment. This embankment will not be planted with vegetation and instead would be left as open ground to allow solitary bees to tunnel and make their home inside the banks. These work most effectively when located near a pollinator friendly meadow.

10.10.7 The best locations for these are proximal to the pollinator friendly meadows:

- Hotel Street embankment
- Clubhouse embankment

10.10.8 The below figures give an indication of how these measures can be implemented in the field.



Figure 10-33: Example of a Bee Scrape



Figure 10-34: Example of a Bee Scrape

Implementing holes, cracks and crevices in the walls of hard flood defences

10.10.9 The creation of holes, cracks and crevices in the walls to be installed can provide roosting habitat for bats as well as potential nesting habitat for martens that nest in burrows along embankments. It can also provide nesting habitat/refuge for the Kingfisher which is known to occur in the area. The most suitable location for these are:

- The new wall to be constructed at the Hotel Street embankment
- The new wall to be constructed on the riverbank at Turfmarket – The Hub on the left bank.

10.10.10 The following artificial nesting structures will be installed:

- Artificial kingfisher and sand martin burrows:
  - This artificial structure is made up of cavity blocks and a series of holes which the sand martins can fly into. It also has a tunnel and nest chamber.
- House martin nesting cup:
  - House Martins build mud nests on the eaves of buildings often in colonies averaging five nests. They will readily use artificial nests, and this may encourage other birds to nest nearby. These nests should be sited underneath the eaves of houses or outbuildings and are supplied as twin boxes to further increase success Dimensions: Height: 16.5cm (6.5ins) Width: 38cm (15.0ins) Depth: 12cm (4.7ins) Nest Diameter: 2 x 15cm (2 x 5.9ins) (Birdwatch Ireland).
  - These nest cups are best suited in the old buildings situated immediately north of Mill Road adjacent to the River Duiske. Some of these buildings appear to be run-down and/or derelict. There are also old sheds in this area. House martin activity was high in this part of Graiguenamanagh town.



Figure 10-35: Example of Sand Martin Burrows



Figure 10-36: Example of House Martin Nesting Cups (Source. Birdwatch Ireland

Installation of bat boxes

10.10.11 Bat boxes can be installed along several locations within the town area. It would be useful to install these bat boxes in areas located near existing bridges where bats are known to forage on insects at night.

10.10.12 There are many old buildings located in the town of Graiguenamanagh suitable for bats. The installation of these bat boxes would further enhance bat diversity in the town area, and they would be likely to be used by the bats. The most suitable locations for these are:

- The underside of Graiguenamanagh bridge
- Retaining wall on the banks of the River Duiske at clapper bridge.
- Turfmarket bridge
- The bridge at The Hub

10.10.13 A mix of the following bat boxes will be installed:

- Crevice bat box:
    - Designed for those bat species which would naturally roost in crevices and internally has either two or three crevices for the bats to roost within. These crevice bat boxes are especially suitable for both Common Pipistrelles and Soprano Pipistrelles. These two species are the most abundant bats in the Ireland (including Graiguenamanagh) and most frequently use bat boxes.
- Chavenage bat box:
    - The Chavenage Bat Box is a single chamber quality nesting box for bats. this natural timber Bat Box will provide a roost for various species, such as the Pipistrelle, Noctule, Leisler's, Natterer's, Daubenton's and Brown Long-eared bats. The Bat Box will fit into any garden, woodland, or house wall site. Made from untreated solid, high quality, durable FSC certified timber which

provides longevity and excellent insulation. The Chavenage bat box has a narrow entrance slot at the base for access. As a result, preventing predation.

- Bat brick:
    - Bat bricks were made by Liz Greenwood from Greenwood's Eco habitats from Ecostyrocrete™ material, which is shredded polystyrene mixed with cement. The shredded polystyrene is sourced from recycled plastic.
    - The bat bricks can be uniquely designed to fit a bridge. Crevices are within the design, which do not extend all the way to the back and therefore expand into a narrow cavity. The bats can move horizontally along the back of the brick. These bricks are screwed onto the ceiling of a bridge with four stainless steel screws and nylon plugs.
- Bat Tube:
    - The tube is designed as a bat summer roost for bricking-into the external walls of buildings and/or walled structures.
    - Bat tubes are longer internal cavities with multiple sections or crevices. These are often made of woodcrete and are available in modular versions which can be connected in the facade allowing for side-by-side or a longer tower format.
    - These boxes come built-in and can be incorporated into newly constructed hard defence structures.



Figure 10-37: Crevice Bat Box (Source: wildlife services.uk)



Figure 10-38: Chavenage Bat Box (Source: wildlifecommunity.co.uk)



Figure 10-39:Example of a Bat Brick Installed under a Bridge



Figure 10-40: Example of a Bat Brick



Figure 10-41: Example of a bat tube

Installation of wagtail nest box

10.10.14 Wagtail nest boxes are ideal nesting boxes for the use of dippers (*Cinclus cinclus*) and grey wagtail (*Motacilla cinerea*), both of which have been recorded in high numbers within the scheme area.

10.10.15 The most suitable locations for these are:

- The underside of Graiguenamanagh bridge
- Turfmarket bridge and the bridge at the Hub

10.10.16 These boxes are designed to create a space for dippers and wagtails to nest when natural cavities beneath bridges are missing.

10.10.17 They are well suited for damp spots near rivers and stream as there is nothing to rot or corrode. The box is angled back to reduce chance of the box being damaged or swept away by a river in spate.



Figure 10-42: Wagtail Nest Box

10.11 Residual Impacts and Effects

10.11.1 With the implementation of the mitigation measures outlined above, residual effects on sensitive ecological receptors are assessed as **not significant** during the construction and operational phase, as outlined in Table 10-25.

10.11.2 There will be **slight negative permanent effects** on aquatic habitats that will be localised to the flow control structure. However, this is representative of less than 60m of a 23km river.

10.11.3 There will also be **infrequent, slight negative effects** as a result of the stormwater drainage outfalls that will be active during the flood events.

10.11.4 The operation of new walls will affect the hydromorphology of the river in the upstream storage area and the confluence of River Duiske, and River Barrow. It is important to note that the reaches of the Duiske, where the new walls are to be constructed is already modified. The hydromorphology will also be impacted by the operation of the upstream storage area during large flooding events only and thus this residual effect is **imperceptible**. Refer also to Chapter 8 'Hydrology – Surface Water'.

10.11.5 The planting of trees allows for a mitigation of the trees to be removed. The number of trees to be planted (38 trees) will be slightly less than the number to be removed (24 individual trees and 7 treelines/hedgerows). This will have a **residual negative** effect on the scheme area that will become a residual **imperceptible** effect as the trees mature. The

new trees to be planted will be a native mix which will further help to maintain biodiversity in the area.

10.11.6 The inclusion of the biodiversity enhancement measures will also have a **residual positive effect**. This includes the planting of species rich meadow grasslands in areas that previously dominated by species poor improved agricultural grassland.

10.11.7 It is considered that, with the implementation of the mitigation measures set out in this Chapter, the construction and operation of the proposed development will not have a significant negative impact on biodiversity within the Zone of Influence.

10.12 Interactions with other Environmental Effects

10.12.1 A full review of the potential interactions with other environmental effects is provided in Chapter 16 'Interactions and Cumulative Effects'.

10.12.2 The most significant interactions for the assessment of biodiversity impacts are those associated with hydrology/surface water (Chapter 8 'Hydrology – Surface Water') as the waterbodies in the scheme area offer valuable habitats for a number of significant and protected species, including QIs of the SAC. Impacts on waterbodies from effects of river diversion, sedimentation/turbidity and accidental contamination will have associated impacts with fish, mammals and vegetation within the rivers.

10.12.3 Other interactions exist between the impacts identified to biodiversity and those identified to Land, Soils, Geology and Hydrogeology (Chapter 12). A potential effect on the hydrology environment includes the excavation of made ground and overburden which could potentially increase the sediment loading to the surface water environment and impact to associated aquatic species. Further, contaminated or imported soil has the potential to run off during the construction phase and have negative impacts on surface water environments. Further, contaminated imported soil has the potential to run off during the construction phase and have negative impacts on surface water environments and associated biodiversity, or cause spread of invasive species.

10.12.4 Interactions also exist with Air Quality impacts (Chapter 13) whereby direct and indirect effects are possible to flora and fauna, including damage to foliage/plants, changes in habitat foraging and ingestion of particulate matter or pollutants by fauna.

10.12.5 Further, the construction of the scheme requires removal of trees which will impact upon flora and fauna and provide interactions with Landscape and Visual concerns (see Chapter 11). A positive interaction exists here too, whereby native tree and plant species are proposed to be planted in the upstream storage area and where public realm works are taking place providing habitat enhancement/linkage opportunities.

10.13 Cumulative Impacts

10.13.1 A full review of the potential cumulative impacts is provided in Chapter 16 'Interactions and Cumulative Effects'.

10.13.2 Cumulative impacts are those which accrue to key biodiversity receptors as a result of incremental changes caused by other existing and proposed plans or projects together with those caused by the proposed development.

10.13.3 Cumulatively, the identified projects in Chapter 16, in combination with the proposed development may create added pressure upon flora and faunal sensitivities present in the study area, however the combined impact is unlikely to be significant given the nature and scale of the identified projects and ability for all impacts to be sufficiently mitigated through best-practise construction techniques.

10.14 Limitations in Preparing the Chapter

10.14.1 The limitations relate solely to the Habitat and Species Baseline walkover undertaken in the upstream storage area. As the extended habitat survey was conducted in February, plant identification was limited in its accuracy. This is because flowers were absent from most flora, foliage was absent from deciduous trees, and any annual plants were completely absent. This has the following implications:

- Grass species identification is very difficult without the flower. Some species have distinguishable leaf characteristics, such as the velvety hairs and purple stripes on Holcus lanatus. Occasionally a dead flower was present on a specimen, which aided identification.

- Deciduous tree identification was possible if the ecologist had access to the twig and bud. This was mostly possible, and identification was made easier if leaf litter was present at the base of the tree. Occasionally the branches of trees were so high as to be completely out of reach – even with binoculars it was sometimes not possible to identify these trees.

10.14.2 There had been substantial rainfall in the days leading up to many of the site surveys. Where applicable, this has been listed in the individual reports. To summarise, this meant that:

- The flow and water levels in watercourses were high, which made any in-stream work difficult. Close access to some areas was impossible for this reason, but observations from a distance were made, and these were kept as accurate as possible. Some trees, for example, had to be surveyed from the opposite bank.

- Features such as scats, prints, otter couches etc. may have been damaged or washed away by rainfall.

10.14.3 Despite the above, it was possible to obtain a robust understanding of the site's ecology from the survey work undertaken. In particular, it was possible to identify sensitive habitats that may be affected by the works. Furthermore, the lack of deciduous foliage was advantageous in terms of searching for mammal burrows (including holts, dens etc.), notable features in trees, and features along the riverbank, all of which would otherwise be obscured by dense foliage later in the year. It is the professional opinion of the ecologists that additional survey of the site would not materially alter the conclusions drawn from the survey work or the mitigation measures outlined herein.

10.14.4 Furthermore, it should be noted that additional survey work was required in the upstream storage area during the drier summer months. This included breeding bird surveys. The ecologists used this survey time to also confirm/deny findings from the February extended habitat survey, as well as recording any additional evidence of mammal activity in the area. The water levels of the river were also lower during the summer months, so it was possible to access areas that had limited accessibility in the February baseline survey.

10.14.5 Other limitations are noted in 10.3.74 regarding mammal (non-volant) surveys.

10.15 Summary

10.15.1 Table 10-25 provides a summary of impacts and mitigation measures required to reduce the impact of the scheme to ecological receptors. The Ecological Receptors are features of sufficient value as to be material in the decision-making process for which potential impacts from the proposed development are likely. They are defined as any feature valued as being of one of the following levels of importance:

- International Importance (i.e., RAMSAR Site, Natura 2000 Site).
- National Importance (i.e., Natural Heritage Areas).
- County Importance (i.e., Area of Special Amenity)
- Local Importance (Higher Value) (i.e., Local populations of priority species)

10.15.2 The evaluation of Key Ecological Receptors and the terminology used to determine ecological value adheres to aforementioned guidance (TII, 2009). The definitions of impacts follow the definitions in the EPA's 2022 Guidelines, as included in Chapter 1 'Introduction'.

Table 10-25: Summary of Impacts and Mitigation Measures: Biodiversity

Ecological Receptor	Characterisation of Impact	Effect Without Mitigation	Mitigation	Residual Impacts – Significance of effects after mitigation
Construction Phase Impacts				
River Barrow and River Nore SAC	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of construction within the river Duiske. Species loss – due to disturbance, habitat loss, direct mortality or indirect mortality as result of the construction. Reduction in water quality – resulting in habitat degradation, direct mortality or indirect mortality.	Temporary, negative impact, significant at an international scale	Mitigation measures are outlined in the Natura Impact Statement included as part of the planning application from the Proposed Scheme. All mitigation measures outlined in Section 10.8 should be followed to reduce impacts to the River Barrow and River Nore SAC.	The Proposed Scheme will not have any long-term recurring significant impacts on water quality within the river Barrow and river Duiske. There also will not be any significant negative impacts on the Qualifying interests for which the SAC is designated. Therefore, there will be no significant adverse impact on the integrity of the River Barrow and Nore SAC. Residual effects are considered **not significant.**
River Nore SPA	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of construction within the river Duiske. Species loss – due to disturbance, habitat loss, direct mortality or indirect mortality as result of the construction. Reduction in water quality – resulting in habitat degradation, direct mortality or indirect mortality.	Temporary, negative impact, significant at an international scale	Mitigation measures are outlined in the Natura Impact Statement included as part of the planning application from the Proposed Scheme. All mitigation measures outlined in Section 10.8 should be followed to reduce impacts to the River Nore SPA.	The Proposed Scheme will not have any long-term recurring significant impacts on water quality within the river Barrow and river Duiske. There also will not be any significant negative impacts on the Qualifying interests for which the SPA is designated. Therefore, there will be no significant adverse impact on the integrity of the River Nore SPA. Residual effects are considered **not significant.**

Ecological Receptor	Characterisation of Impact	Effect Without Mitigation	Mitigation	Residual Impacts – Significance of effects after mitigation
Linear habitats/Wooded areas	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of loss of treeline/hedgerow habitat in upstream storage area and several trees in town area.	Permanent, negative impact, significant at a regional/ county scale.	Tree protective measures will be put in place to protect trees to be retained during construction. Removal of trees will be timed appropriately to reduce impacts on the species that rely upon them for habitats. Planting of native species vegetation will be undertaken compensate for those to be removed.	Planting of new native tree species will maintain biodiversity in the area. Residual effects are considered not significant.
Rivers and streams	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of construction within the river Duiske. Species loss – due to disturbance, habitat loss, direct mortality or indirect mortality as result of the construction. Disturbance to faunal species – due to disturbance, habitat loss/disturbance, direct mortality or indirect mortality. Reduction in water quality – resulting in habitat degradation, direct mortality or indirect mortality.	Permanent, negative impact, significant at a local-international scale.	Mitigation measures to protect surface water, and freshwater fish and to protect watercourse during instream works have been outlined. These include measures to reduce the risk of pollution and invasive species such as the use of silt fences, bunds, fuel spill kits etc.	With the exception of a small stretch in the upstream area (less than 60m), the river Duiske will be reinstated to the same as its current state. Residual effects are considered not significant.

Ecological Receptor	Characterisation of Impact	Effect Without Mitigation	Mitigation	Residual Impacts – Significance of effects after mitigation
Grassland habitats	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of the spread of invasive species and the reduction in floral diversity from work compound areas. Species loss – due to disturbance, habitat loss, direct mortality or indirect mortality as result of the spread of invasive species and the reduction in floral diversity from work compound areas.	Permanent, slight negative impact, significant at a local scale.	Implementation of biosecurity measures during construction, and periodic monitoring for new growth. The reinstatement of site compounds to their original state. Creation of pollinator friendly meadows post construction.	Significant reduction in risk from invasive species. Floral diversity will be maintained or enhanced as a result of the creation of pollinator meadows. Net biodiversity levels will not reduce significantly. Residual effects are considered not significant
Terrestrial mammals (non-volant) (otter/badger)	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of construction (scrub, trees, resting spots for otters). Species loss – due to disturbance, habitat loss, direct mortality or indirect mortality as result of the noise emissions from construction activity and hazardous storage of machinery. Reduction in water quality – resulting in habitat degradation, direct mortality or indirect mortality as a result of surface water contamination.	Permanent, significant negative impact at a local scale.	The full list of mitigation measures are included in the Section 10.8 but those measures include: - Pre-construction mammal survey to be carried out to ensure that protected species have not taken up residence at the site in the interim period. - Noise control measures. - Surface water control measures. - Careful Storage of Machinery.	Terrestrial mammal mitigation measures will ensure mammals will not be significantly impacted on by the works. Residual effects are considered not significant.

Ecological Receptor	Characterisation of Impact	Effect Without Mitigation	Mitigation	Residual Impacts – Significance of effects after mitigation
Bats	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of the scheme resulting in a loss of roosting/foraging habitat with clearance of treelines/hedgerows. Species loss – due to disturbance, habitat loss from the construction noise and light pollution.	Permanent and negative, significant at a county scale.	The full list of mitigation measures are included in the Section 10.8 but those measures include: - Avoidance of tree removal during bat hibernation season. Inspecting trees for the presence of bats before vegetation removal. - Lighting control measures. - Replanting of removed trees to reinstate commuting corridors for bats. - Retention of mature trees that provide suitable roosting potential for bats.	Bat mitigation measures will ensure bats will not be significantly impacted on by the works. Residual effects are considered not significant.
Overwintering / breeding birds	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of the clearance of vegetation during breeding season and potential surface water pollution. Species loss – due to disturbance, habitat loss from noise emissions from construction activity.	Permanent, significant negative impact at a local scale.	The full list of mitigation measures are included in the Section 10.8 but those measures include: - Noise control measures. - Surface water control measures.	Works to take place outside of the breeding season with the implementation of noise control and surface water control measures. Significant effects are avoided entirely.
Freshwater Fish (including brook lamprey, river	Habitat/species loss/disturbance – due to habitat loss, fragmentation or degradation and disturbance as a result of surface water pollution and damage to riverbed/potential	Permanent, significant negative impact at a local scale	The full list of mitigation measures are included in the Section 10.8 but those measures include:	The implementation of the flow control structure will slightly restrict the habitat potential for fish in the upstream storage area where the flow control structure is in place. Freshwater fish mitigation

Ecological Receptor	Characterisation of Impact	Effect Without Mitigation	Mitigation	Residual Impacts – Significance of effects after mitigation
lamprey, twaite shad and salmon)	spawning locations during instream works.		- Standard surface water pollution control measures. - In-stream temporary access platforms will be built where necessary. These shall be lined with terram such that original bed is unaffected and can be reinstated in orderly fashion. - Immediately prior to rivers/streams being diverted into a newly constructed river channel, electrofishing should be conducted to capture and transfer fish from the original channel to the new one. - No instream works will be carried out between the months of October and June (inclusive) to avoid the most sensitive time for fish species and fish species movements.	measures will ensure fish species will not be significantly impacted on by the works. Residual effects are considered not significant.
Operation Phase Impacts				
Linear habitats/Wooded areas/grassland habitats	The planting of native saplings and immature trees will have a last positive impact on the scheme area as they continue to grow. The introduction of pollinator-friendly dry meadows will also result in an enhancement of habitat opportunities for native bees. Once	Permanent, positive impact, significant at a local scale.	N/A	Planting of new native tree species will maintain biodiversity in the area. Residual effects are considered negative but becoming neutral imperceptible as the trees mature, although they will be subject to maintenance such as tree trimming.

Ecological Receptor	Characterisation of Impact	Effect Without Mitigation	Mitigation	Residual Impacts – Significance of effects after mitigation
	mature they offer habitat and foraging opportunities for a large number of species.			
Freshwater Fish (including brook lamprey, river lamprey, twaite shad and salmon)	The flow control structure in the upstream storage will not restrict the movement of the fish through the river Duiske. However, it does require for riverbed reinforcements which will alter the natural riverbed and flow over a short stretch (less than 60m) of the river.	Permanent imperceptible impact at a local scale.	N/A	The alteration of a short stretch (less than 60m of a 23km river) of the riverbed will be permanent to facilitate the upstream storage area. Residual effects are considered imperceptible.
Rivers and streams	Stormwater drainage impacts watercourse turbidity, primarily by introducing suspended sediments and pollutants. This runoff, carrying materials from urban surfaces, increases the cloudiness of the water, reducing light penetration and potentially harming aquatic life.	Infrequent, slight negative impacts at a local scale.	N/A	These infrequent impacts will be temporary, only during times of flood. Residual effects are considered imperceptible.
All other ecological receptors	The largest impacts are anticipated in the construction phase. The ecological receptors are anticipated to return to their normal state/habits following the completion of construction.	Neutral effect	N/A	Residual effects are considered neutral.

10.16 References

Anon. (2004). *Margaritifera margaritifera. Stage 1 and Stage 2 survey guidelines.* NPWS.

Aquafact International Services Ltd. (2021). *Graiguenamanagh Q-Value.*

Aquafact International Services Ltd. . (2020). *Ecological Report on the River Barrow at Graiguenemanagh, Co. Kilkenny.*

Aquafact International Services Ltd. . (2021). *ElectrofishingSurvey of the Duiske River, Graiguenemanagh, Co. Kilkenny .*

Ayesa. (2025). *Graiguenamanagh/Tinnahinch Flood Relief Scheme - Ecology Surveys 2020-2024, .*

Birdwatch Ireland. (2012). *CBS Manual Guidelines for Countryside Bird Survey participants .*

Boon, P. J., Cooksley, S. L., Geist, J., Killeen, I. J., Moorkens, E., & S. I. (2019). *Developing a standard approach for monitoring freshwater pearl mussel (Margaritifera margaritifera) populations in European rivers.* Aquatic Conservation: Marine and Freshwater Ecosystems.

BTO. (2023). *Breeding Bird Survey: Methodology and survey design.*

Byrne, A. W., Sleeman, D. P., O'Keeffe, J., & Davenport, J. (2012). *The ecology of the European badger (Meles meles) in Ireland - a review.* BIOLOGY AND ENVIRONMENT: PROCEEDINGS OF THE ROYAL IRISH ACADEMY, VOL. 112B.

ByrneLooby. (2020). *Graiguenamanagh/Tinnahinch Flood RElief Scheme, Bat Survey Report, W3451-ENV-R001.*

ByrneLooby. (2021). *Environmental Constraints Study Report , W3451-BL-ENV-R001 .*

Carlow County Council. (2022). *Carlow County Development Plan 2022-2028.*

CIEEM. (2024). *Guidelines for Ecological Impact Assessment in the UK and IReland: Terrestrial, Freshwater, Coastal and Marine.*

Colhoun, K., & Cummins, S. (2013). Birds of Conservation Concern in Ireland 2014-2019. *Irish Birds, 9*, 523-544.

Cummins, S., Fisher, J., Gaj McKeever, R., McNaghten, L., & Crowe, O. (2010). *Assessment of the distribution and abundance of Kingfisher Alcedo atthis and other riparian birds on six SAC river systems in Ireland.* Birdwatch Ireland.

EC. (2013). *Interpretation Manual of European Union Habitats .*

Fossit, J. (2000). *A Guide to Habitats in Ireland .*

Fossitt, J. (2000). *A Guide to Habitats in Ireland.* Dublin : The Heritage Council.

Gammell, M., McFarlane, A., Brady, D., O'Brien, J., Mirimin, L., Graham, C., . . . O'Connor, I. (2017). *White-clawed Crayfish Austropotamobius Pallipes Survey in Designated SACs in 2017.* NPWS.

Harvey, J., & Cowx, I. (2003). *Monitoring the River, Sea and Brook Lamprey, Lampetra fluviatilis, L.*

Holth, T. F., Thorsen, A., Pal, A. O., & Ketil, H. (2010). Long-term exposure of Atlantic cod (Gadus morhua) to components of produced water: condition, gonad maturation, and gene expression. *Canadian Journal of Fisheries and Aquatic Sciences*.

Kahl, S., Wood, C. M., Eibl, M., & Klinck, H. (2021). *BirdNET: A deep learning solution for avian diversity monitoring.*

Kilkenny County Council. (2021). *Kilkenny City and County Development Plan 2021 .*

Kilkenny County Council. (2021). *Kilkenny City and County Development Plan 2021-2027.*

Killeen, I., & Moorkens, E. (2020). MApping Juvenile Habitat for the Freshwater Pearl Mussel. *Journal of Conchology*.

Lawton, C., Hanniffy, R., Molloy, V., Guilfoyle, C., Stinson, M., & Reilly, E. (2019). *All-Ireland Squirrel and Pine Marten Survey 2019.* NPWS.

Lor, Y. S. (2020). *Using environmental DNA (eDNA) to detect the endangered Spectaclecase Mussel (Margaritifera monodonta).* Freshwater Science.

Matson, R., Delanty, K., Shephard, S., Coghlan, B., & Kelly, F. (2018). *Moving from multiple pass depletion to single pass timed electrofishing for fish community assessment in wadeable streams.* Fisheries Research.

Moorkens, E. (2008). *NS II Freshwater Pearl Mussel Sub-basin Management Plans: Monitoring of the.* Unpublished Report to the National Parks and Wildlife.

Moorkens, E. (2009a). *NS II Freshwater Pearl Mussel Sub-basin Management Plans: Monitoring of the Freshwater Pearl Mussel in the Mountain River.* Unpublished Report to the National Parks and Wildlife.

Moorkens, E. (2009b). *NS II Freshwater Pearl Mussel Sub-basin Management Plans: Monitoring of the Freshwater Pearl Mussel in the Ballymurphy River.* Unpublished Report to the National Parks and Wildlife.

Moorkens, E. C. (1992). *Status of the Freshwater Pearl Mussels Margaritifera margaritifera and M. m. durrovensis in the Nore, Barrow and Suir River Tributaries, South-East Ireland.* The Irish Naturalists' Journal.

Moorkens, E. C. (2018). *Margaritifera margaritifera (errata version published in 2018). The IUCN Red List of Threatened Species 2018.*

National Biodiversity Data Centre. (2021). *Biodiversity maps*. Retrieved Feburary 2021, from https://www.biodiversityireland.ie/

NBDC. (2016). *Councils: Actions to Help Pollinators .*

NBDC. (2019). *Pollinator-friendly management of Transport Corridors.*

NBDC. (2021). *All-Ireland Pollinator Plan 2021-2025.*

NPWS. (2011, 7 19). *River Barrow and River Nore SAC – Conservation Objectives .* Retrieved 7 27, 2022, from https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002162.pdf

NPWS. (2011, 5). *River Barrow and River Nore SAC - Conservation Objectives Supporting Document - Woodland Habitats, Version 1.* Retrieved 7 27, 2022, from https://www.npws.ie/sites/default/files/publications/pdf/002162_Barrow%20Nore%20SAC%20Woodlands%20Supporting%20Doc_V1.pdf

NPWS. (2016, 2 9). *River Barrow and River Nore SAC – Site Synopsis .* Retrieved 7 2022, from https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY002162.pdf

NPWS. (2019). *Article 17 Reports 2019.* Retrieved from https://www.npws.ie/publications/article-17-reports/article-17-reports-2019

NPWS. (2023). *National Biodiversity Action Plan 2023-2030.*

NRA. (2008a). *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes.*

NRA. (2008b). *Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes.*

NRA. (2009). *Guidelines for Assessment of Ecological Impacts of National Roads Scheme.*

OPW. (2022). *OPW Biodiversity Action Strategy 2022-2026.* Retrieved from https://assets.gov.ie/static/documents/opw-biodiversity-action-strategy-2022-2026.pdf

Peay, S. (2003). *Monitoring the white-clawed crayfish Austropotamobius pallipes. .* Conserving Natura 2000, English Nature.

Pont, D. R. (2018). *Environmental DNA reveals quantitative patterns of fish biodiversity in large rivers despite its downstream transportation.*

Preece, E. P. (2020). *Monitoring for freshwater mussel presence in rivers using environmental DNA.* Environmental DNA.

Reynolds, J., O'Connor, W., O'Keeffe, C., & Lynn, D. (2010). *A technical manual for monitoring white-clawed crayfish Austropotamobius pallipes in Irish lakes.*

Ross, E. (2006). *Initiation of a monitoring program for the freshwater pearl mussel, Margaritifera margaritifera (L.) in the Mountain River (Barrow).* Unpublished report to National Parks and Wildlife Service.

Skinner, A., Young, M., & Hastie, L. (2003). Ecology of the Freshwater Pearl Mussel. *Conserving Natura 2000 Rivers*.

Smith, , G. F., O'Donoghue, P., O'Hora, K., & Delaney, E. (2011). *Best Practice Guidance for Habitat Survey and Mapping.*

Stoeckle, B. C. (2015). *Environmental DNA as a monitoring tool for the endangered freshwater pearl mussel (Margaritifera margaritifera L.): a substitute for classical monitoring approaches?* Aquatic Conservation: Marine and Freshwater Ecosystems.

Triturus. (2021). • *Graiguenamanagh-Tinnahinch Flood Relief Scheme freshwater pearl mussel (Margaritifera margaritifera) survey.*

Triturus. (2021). *Graiguenamanagh-Tinnahinch Flood Relief Scheme white-clawed crayfish (Austropotamobius pallipes) survey.*

Veon. (2025). *Graiguenamanagh Tinnahinch Flood Relief Scheme Bat Survey Report.*

Wacker, S. L. (2019). *Host specificity drives genetic structure in a freshwater mussel.* Scientific reports.

11 Landscape & Visual

11.1 Scope of the Assessment

11.1.1 This chapter examines the potential landscape and visual impacts of the proposed flood defence works at Graiguenamanagh-Tinnahinch (G-T), on the surrounding areas. The landscape and visual impact assessment examines and evaluates the implications of the proposed works in terms of landscape character and visual alterations arising from the proposed flood defence scheme. The assessment also describes outline proposals to mitigate and attempt to achieve a long-term integration of the proposed works with its landscape setting.

11.2 Statutory and Policy Context

Legislation

11.2.1 The structure for assessing the landscape impact of the Proposed Scheme is based upon the following guidelines:

- Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, May 2022)
- Guidelines for Landscape and Visual Impact Assessment (Landscape Institute & I.E.M.A., UK 2013)

11.2.2 The criteria for describing the significance, quality and duration of the effects of the proposed development are outlined in Table 1-2 of Chapter 1 'Introduction'. The graphic in Figure 11-1 shows typical classifications of the significance of effects.

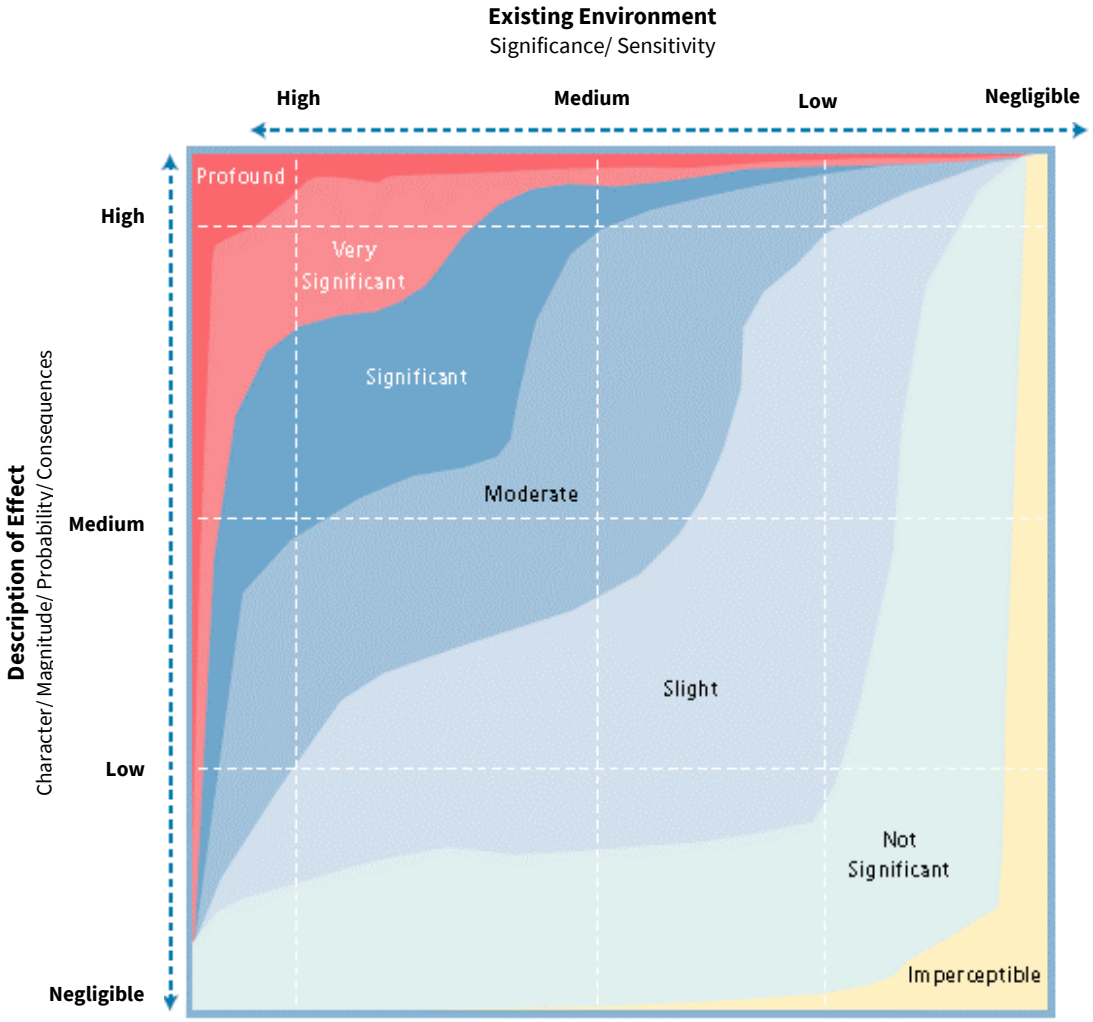


Figure 11-1: Chart Showing Typical Classifications of the Significance of Effects (Guidelines on the information to be contained in Environmental Impact Assessment Reports, EPA, May 2022)

Planning Policy Context

11.2.3 The main texts that were referred to in the compilation of this chapter were:

- Kilkenny City & County Development Plan 2021 - 2027
- Carlow County Development Plan 2022 - 2028
- Graiguenamanagh – Tinnahinch Local Area Plan 2021

11.2.4 There are a variety of land uses zoned within this subject site, as shown below.

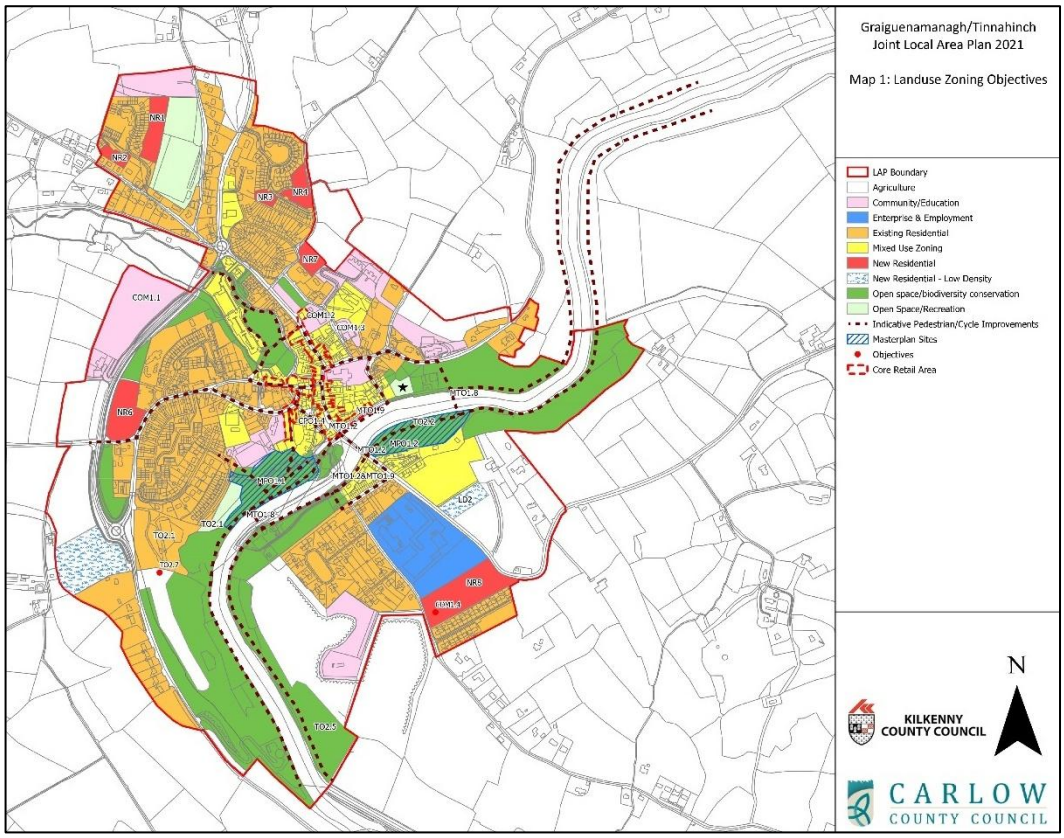


Figure 11-2: Land use Zoning Map (Source: Graiguenamanagh-Tinnahinch Joint LAP 2021-2027

11.3 Assessment Methodology

11.3.1 The assessment contained within this EIAR is undertaken in line with the Guidelines for Landscape and Visual Impact Assessment (Landscape Institute & I.E.M.A., UK 2013).

11.3.2 The assessment was informed by a series of photomontages which were prepared by Chris Shackleton Consulting to represent, as accurately as possible, the physical and visual characteristics of the proposed development from a variety of distances and directions around the site. Priority was given to views from the public domain, such as main roads and to views from potentially sensitive locations such as from scenic routes. For each of the visuals, an existing and a proposed view is presented and where the Proposed Scheme is not visible in the view the elements of the development will be shown as a red outline.

11.4 Baseline Environment

Character & Context

11.4.1 The study area encompasses the settlement of G-T located along the River Barrow, with Graiguenamanagh, west of the river, located within Co. Kilkenny and Tinnahinch, east of the river, located in Co. Carlow. The study area stretches to the south towards Brandon Hill and west along the Duiske River and the R703 towards Thomastown.

11.4.2 Graiguenamanagh Bridge/ George Semple Bridge (R703), comprising of seven arches, over the River Barrow links the two settlements and was originally built in 1767 and the River Duiske tributary enters the Barrow at Graiguenamanagh. The town is located approximately 16km from Thomastown, 33km from Kilkenny City, 40km from Carlow and 41km from Waterford City. While there is evidence that there were settlements at Graiguenamanagh for many millennia earlier, the founding of the Duiske Abbey in 1204 is defining in the town's history and development. The town gradually expanded beyond the abbey and development into a market town which was assisted by the construction of the Grand Canal and the navigation of the River Barrow, which connected the town with Dublin, New Ross and Waterford. Tinnahinch Castle, located along the eastern banks of the River Barrow, was constructed in 1615 by the Duke of Ormonde.



Figure 11-3: Scheme Area (Source: Ayesa, 2025)

Landscape Character

11.4.3 The landscape setting of G-T is strongly influenced by its location within a narrow river valley and the upland areas that surround it. The settlement is located at a bend along the River Barrow, and the relatively steep slopes of the river valley are a significant feature within the Study Area. The wider setting of the study area is of an undulating landscape

due to Brandon Hill to the south, the upland areas at Glencoum to the north and the Blackstairs Mountains to the east.

11.4.4 While all the proposed Work Packages (WPs) within the study area are connected by way of the River Barrow or River Duiske, and for ease of reference the study area can be divided into ten different areas:

- Area 1: Upstream storage area – River Duiske
  - North-west of Graiguenamanagh town
  - Within the River Duiske valley
  - Agricultural fields that slope down to the River Duiske
  - Vegetation cover includes woodland, mature trees, scrub, hedgerows to field boundaries, grassland
  - Scenic routes on higher ground overlooking Duiske and Barrow River valleys

- Area 2: Well Lane to High St. Bridge, Area 3: Turf Market, Area 4: Turf Market to the Hub (Lower Turf Market)– River Duiske
  - Town centre location
  - Views towards Duiske Abbey
  - Narrow river channel with mills and weirs
  - Stone bridges dating from 18th c.
  - Buildings (some dating from 19th c. backing onto river with numerous informal bridges over the River Duiske

- Area 5: Boat Club, Area 6: Graiguenamanagh Quay – River Barrow
  - Town centre location
  - Northern side of the River Barrow
  - Mooring boats along quay
  - Quay walls dating from 18th c.
  - Buildings fronting onto the river e.g. dwellings (some dating from 18th c., guesthouse (converted from a 19th c. salt house), boathouse
  - Remnants of stone structures relating to Duiske Abbey (current SuperValu car park)
  - Two-way vehicular route with informal car parking along river edge & access into two car parks
  - Part of wider walking trails such as the South Leinster Way

- Area 7: The Dock, Area 8: The Hub – River Barrow & River Duiske
  - Remnant structures relating to the former dry dock
  - Community hub building and grounds – facility that provides recreational opportunities (e.g. canoeing) and caravan park; part of walking trails such as the Brandon Hill loop and South Leinster Way

- Area 9: Hotel St – River Barrow
  - South of the River Barrow
  - Large open field with amenity pathway along the River Barrow
  - Part of wider walking trails such as the South Leinster Way and Barrow Way

- Residential buildings fronting onto this field
- Woodland area to eastern end of this field

- Area 10: Tinnahinch Quay – River Barrow
  - Mooring boats along river edge
  - Residential and commercial buildings fronting onto river
  - Road and car parking facing onto the river
  - Part of wider walking trails such as the Barrow Way, and access route to Tinnahinch Castle

Landscape Character Assessments

11.4.5 Landscape Character Assessment (LCA) is a process which describes, maps and classifies landscapes objectively. Defining landscape character enables an understanding to be formed of the inherent value and importance of individual landscape elements and the processes that may alter landscape character in the future.

Co. Kilkenny Landscape Character Assessment

11.4.6 A Landscape Character Assessment report was prepared for County Kilkenny in 2003 and summarised in the Kilkenny City and County Development Plan 2021-2027 (KCDP).

"The Landscape Character Assessment identified four landscape character types, which are subdivided into 14 landscape character areas, with some areas identified as being of special landscape character value and also identified features and areas of high landscape sensitivity." (Source: KCDP 2021-2027).

In relation to landscape character the KCDP 2021-2027 states that the council will: " protect and sustainably manage the landscape character of County Kilkenny, having regard to the findings of the landscape character assessment and the Development Management Requirements as set out in this chapter for the sustainable development of the county and appropriate conservation of its landscape character."

Landscape Character Types

"Landscape Character Types are distinct types of landscape that are relatively homogenous in character and are generic in nature in that they may occur in different localities throughout the county, but share similar combinations of geology, topography, land cover and historical land use. The Landscape Character Assessment divides the county into four landscape character types (LCTs). These are:

- *Upland Areas*
- *Lowland Areas*
- *River Valleys*
- *Transitional Areas"*

(Source: KCDP 2021-2027)

11.4.7 The subject site / scheme area is located within the 'Upland LCT' and the 'River Valley LCT', as shown below.

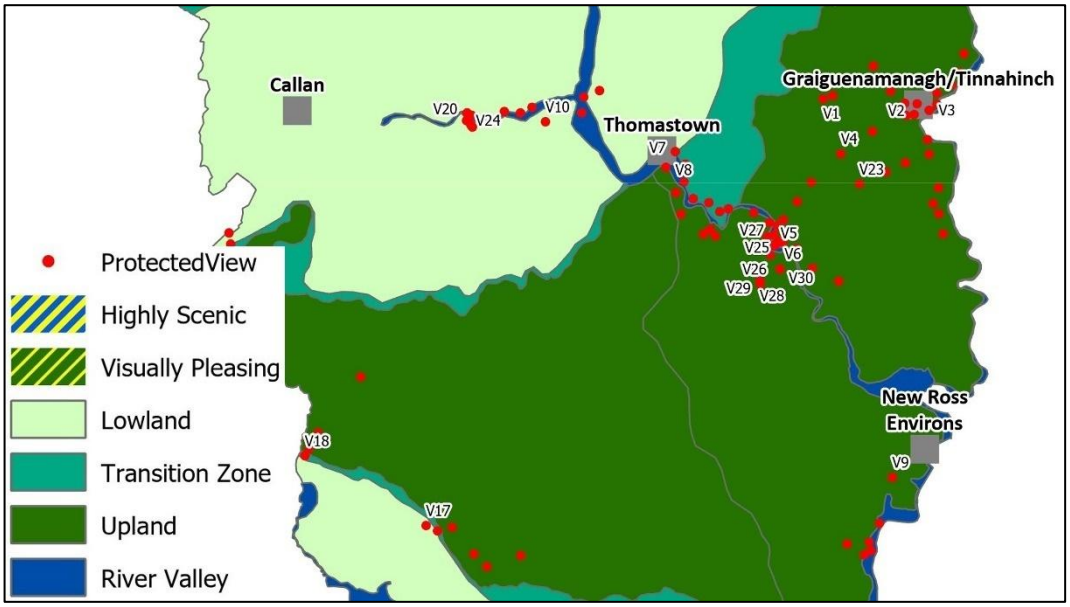


Figure 11-4: Landscape Character Types (Source: KCDP 2021-2027)

Landscape Character Areas (LCAs)

11.4.8 The landscape character assessment identifies Graiguenamanagh as falling within two Landscape Character Areas – 'Brandon Hill Uplands' and the 'Barrow Valley'.

Brandon Hill Uplands – Landscape Character Area:

This character area is a large upland area to the east of the County, whose principal upland areas include the Brandon and Croghan Hills to the east of the County. The hills are in an almost circular shape around the town of Graiguenamanagh. The terrain in this upland area slopes from the River Barrow valley at the east and the River Nore at the west. The primary and secondary ridgelines of the Croghan Hills vary in elevation from 263 to 365m above sea level, and the Brandon Hill primary ridgeline has an elevation of 515m above sea level.

The elevated nature of this physical unit provides a defined skyline and significant and scenic views over the scenic River Barrow and Nore valleys and the towns of Inistioge and Graiguenamanagh. These uplands also form part of the South Leinster Way walking route. Distant views also include those of the Blackstairs Mountains.

The area is perceived as highly scenic and of significant visual amenity value within the County, and a number of scenic drives are identified. Brandon Hill and its environs are perceived as sensitive landscapes, with low and limited development potential, with only tourism development being considered acceptable.

Critical Landscape Factors:

- *Elevated Vistas: The R703 crosses the Croghan Hills from Graiguenamanagh in an east-west direction. As a result of these straight and elevated road level, long-distance vistas of the Barrow and the Nore valleys are available along from the road. The R705 and R700 run along the lower slopes of Brandon Hill with extensive upland and forestry views.*
- *Steep Slopes*
- *Prominent Ridge Lines*
- *Undulating topography*
- *Low Vegetation*
- *Shelter Vegetation*

The Barrow Valley – Landscape Character Area

The Barrow Valley is an extensive river valley flowing in a north-south pattern to the east of the County. Many local villages have become well established along the riverbanks, such as Graiguenamanagh and Goresbridge.

The river valley is identifiable by its floodplain levels and slopes of deciduous trees with a slow progression to pasture lands. Running along the Barrow Drive, the riverbanks are predominately grassland. Large tillage fields with few inner boundaries are particular to this area. Estate landholdings are bounded by stonewalls and gateposts with large parcels of grazing lands within.

The terrain is undulating with extensive views of mountains (Castlecomer, Freagh and Brandon Hills and South Leinster Way) and coniferous plantations (along Brandon Tow Path). Distant views also include the Blackstairs Mountains in Co. Carlow.

The area is perceived as highly scenic as well as special and sensitive in landscape terms, providing significant visual amenity value to the County. Consequently, it is considered to have tourism potential, particularly around Graiguenamanagh.

Critical Landscape Factors:

- *Smooth Terrain*
- *Low Vegetation*
- *Localised River Views: This character unit follows the path of the River Barrow. Due to the low-lying nature of this area, many views of the river valley are available from the local roads and from viewing points located along the hilltops. The main concern for natural linear features such as this is to avoid visual intrusion by development, which will interrupt and reduce the integrity of the river valley.*
- *Undulating topography*
- *Shelter Vegetation*

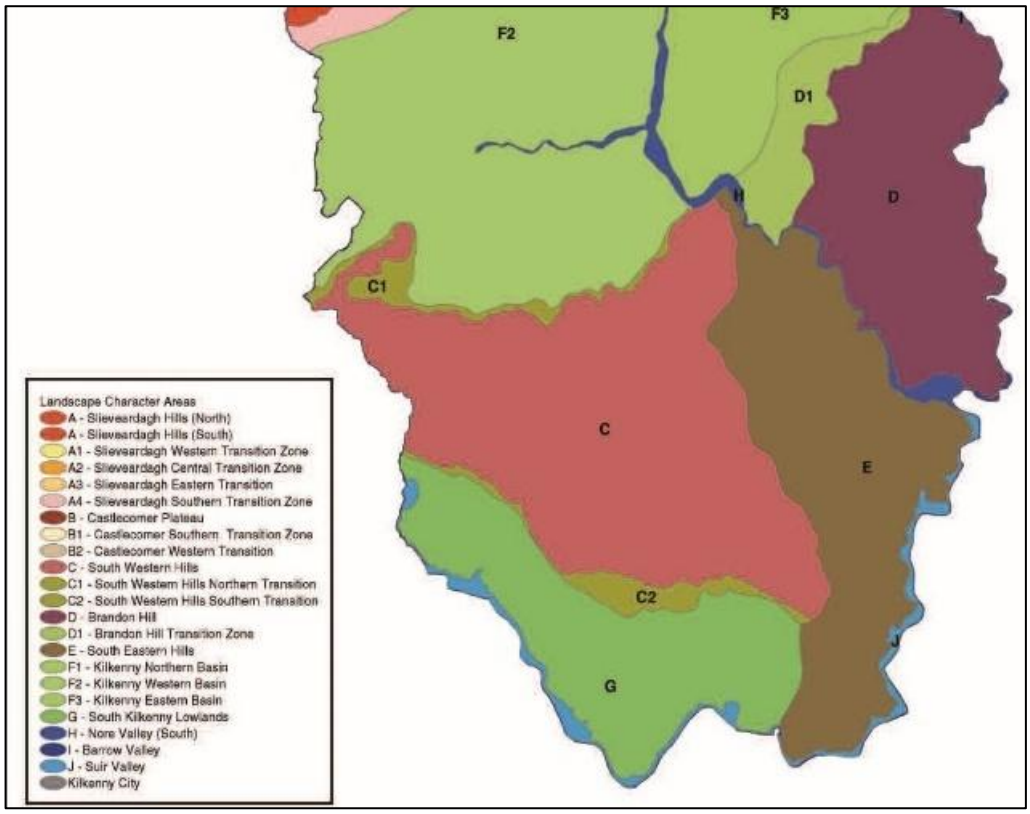


Figure 11-5: Co. Kilkenny - Landscape Character Areas (Source: Landscape Appraisal of Co. Kilkenny, 2003)

Landscape Areas of Highly Scenic and Significant Visual Amenity Value

11.4.9 In relation to these special value landscapes the KCDP 2021-2027 also includes the development management requirement:

"To ensure that development within the Landscape Character Areas of Brandon Hill Uplands and the River Valleys of the Nore, Barrow and Suir, which are highly scenic and visually pleasing, and of significant visual amenity value, are carefully sited and designed and can be successfully assimilated into the landscape."

Landscape Character Sensitivity

11.4.10 The Kilkenny landscape character assessment states that "the sensitivity of the Landscape Character Areas is defined as its overall resilience to sustain its character in the face of change and its ability to recover from loss or damage to its components".

11.4.11 Upland LCTs: "These areas are conspicuous when seen from lowland areas. However, these character units also have areas of 'internal' visual robustness (due to high degree of enclosures) despite 'external' visual vulnerability - due to elevation, ridgelines and steep slopes. Therefore, within the upland areas mixed robustness/vulnerability zones can be found, depending on configuration and topography".

11.4.12 The River Valleys LCTs: "River valley areas represent potentially vulnerable linear landscape features, as they are often highly distinctive in the context of the general

landscape. However, landscape sensitivities are often very localized or site-specific within this unit".

Sensitive Areas

11.4.13 The Kilkenny landscape character assessment identifies both the Upland LCT and the River Valleys LCT as sensitive landscapes and that Graiguenamanagh is particularly sensitive to tourism related development pressures.

"The Barrow River to the east of the County and Brandon Hill on the south-east uplands are most perceived as sensitive, which corresponds to the Barrow River Valley and the Brandon Hill Uplands. The most sensitive areas to development pressures (particularly as a result of tourism) identified were those areas of Inistoige and Graiguenamanagh. Kilkenny City environs were also identified as a sensitive landscape, however not to the degree in which Graiguenamanagh and Inistoige were described.

These areas can be correlated to the sensitivity of landscape features such as the river shores and the skyline defined by mountain tops. These are all conspicuous features of the natural landscape to which the eye is drawn because of strong contrasts of form and colour where there is contact between the land and sky or water. Therefore, they represent sensitive/ vulnerable features on the landscape as any development on or in the vicinity of shores or skylines has the potential to affect the visual integrity of the surrounding environment." (Source: KCDP 2021-2027)

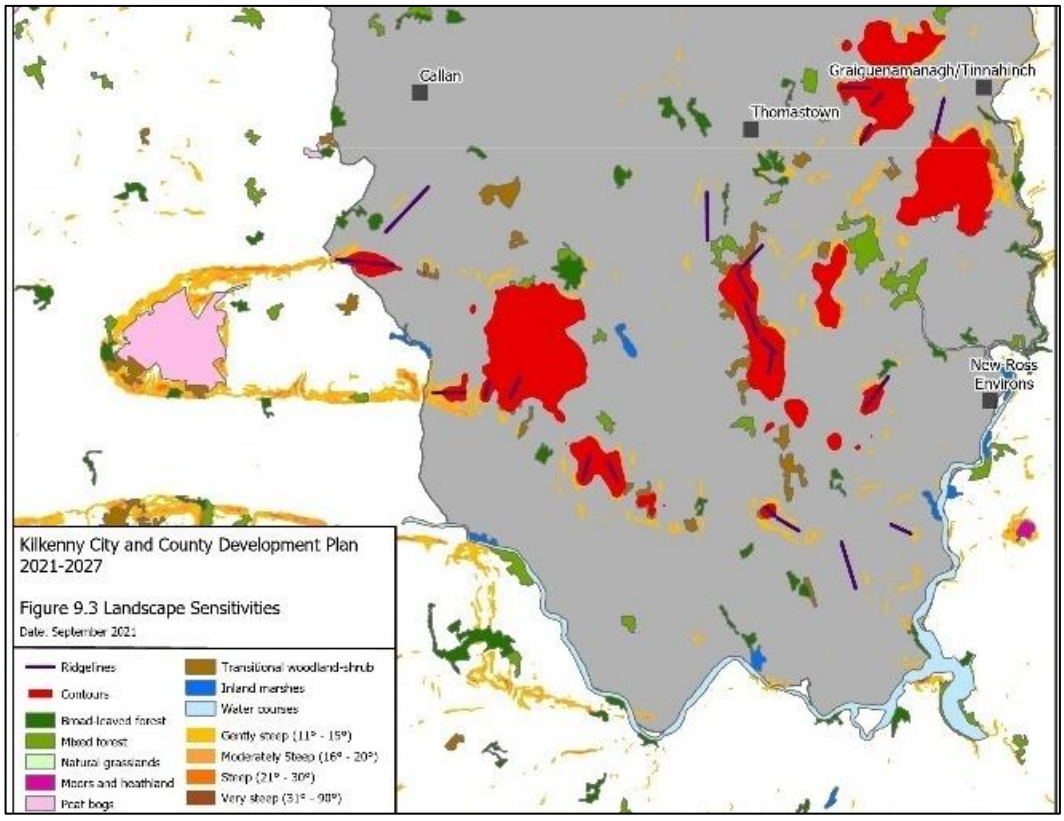


Figure 11-6: Landscape Sensitivities (Source: KCDP 2021-2027)

Table 11-1: Landscape Sensitivity Matrix (Source: Landscape Appraisal of Co. Kilkenny, 2003)

	Name	Sensitive	Sensitive - Normal	Normal	Robust - Normal	Robust
1	Extensive Lowlands					
2	Steep Transition Slopes					
3	Upland Ridges/Peaks					
4	Upland Enclosures					
5	Upland Plateaux					
6	Foothills/Midslopes					
7	Lowland Transitions					
8	Agricultural Lowlands					
9	River Corridors					
9a	Floodplain Slopes					
9b	Floodplains					
9c	Riverbank					
		Most	Landscape Sensitivity			Least
	Uplands					
	Lowlands					

Co. Carlow Landscape Character Assessment:

Co. Carlow Landscape Character Assessment

11.4.14 A Landscape Character Assessment report was summarised in the Carlow County Development Plan 2022-2028 (CCDP).

Landscape Character Areas and Landscape Types

11.4.15 The Landscape Character Assessment for Carlow identified four landscape character areas:

- Blackstairs and Mount Leinster Uplands
- Central Lowlands
- River Slaney/East Rolling Farmland
- Killeshin Hills

11.4.16 These landscape character areas were subject to a more detailed analysis, which identified seven landscape character types:

- Broad River Valley
- Narrow River Valley
- Built Up Areas

- Farmed Lowland
- Farmed Ridges
- Rolling Rough Grazing
- Uplands

11.4.17 The scheme area is located within the 'Central Lowlands Landscape Character Area' and the 'Narrow River Valley Landscape Character Type' (as illustrated on Figure 11-7 and Figure 11-8).

11.4.18 The landscape character assessment identifies the Central Lowlands – Landscape Character Area as:

"The central lowlands landscape character area occupies a substantial portion of the County and includes the County's major settlements. The landscape is primarily rural, with medium to quite large fields defined by well maintained and generally low hedges and occasional to frequent hedgerow trees. Since the 1950s, field enlargement has been taken place to accommodate larger farm machinery and has involved the removal of hedges and trees. A dense network of local roads traverses the area, as well as the M9 and the N80.

The Central lowlands has capacity to absorb most types of development subject to the implementation of appropriate mitigation measures. The area encompasses river valleys and ridges that are, however, more sensitive to development than other locations within the area. These include the Barrow, Slaney and Douglas River Valleys.

The Central Lowlands contain the following Landscape Types: broad and narrow river valleys, farmed lowlands and farmed ridges." (Source: CCDP 2022-2028)

Landscape Sensitivity & Capacity:

"Landscape sensitivity is a way of measuring the ability of the landscape to accommodate change or intervention without suffering unacceptable loss of character or value." (Source: CCDP 2022-2028)

11.4.19 The range of landscape sensitivities are illustrated on Figure 11-9 and shown on Table 11-2.

Table 11-2: Landscape Sensitivity Matrix (Source: Carlow CDP 2022 – 2028)

Landscape Character Types	Sensitivity				
	1	2	3	4	5
	Least	Decreasing	Moderate	Increasing	Most
Built up areas					
Farmed Lowland					
Broad River Valley					
Farmed Ridges					
Narrow River Valley					
Rolling Rough Grazing					
Uplands					

11.4.20 The Carlow Landscape Character Assessment identifies Tinnahinch as being located within:

- Landscape Character Area – Central Lowlands
- Landscape Type – Narrow River Valley

11.4.21 The Tinnahinch landscape has also been classified as Level 5 –the landscape type that is most sensitive to change.

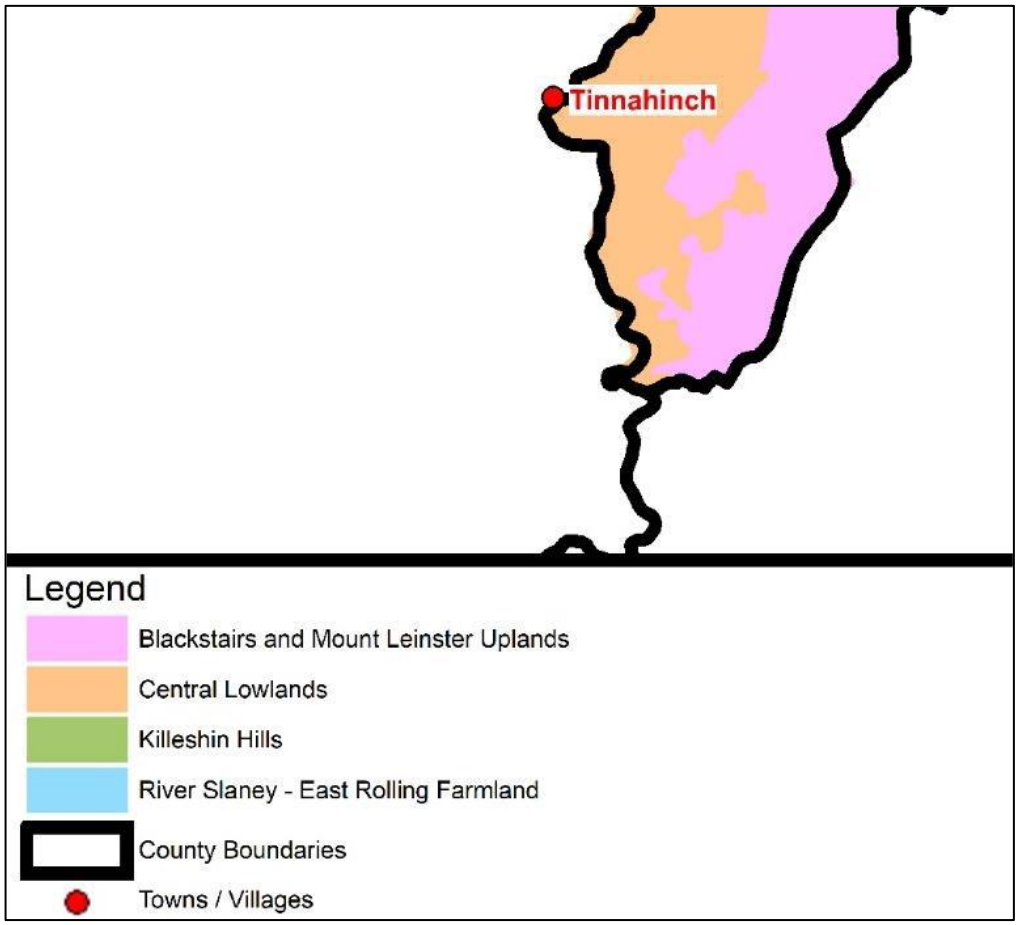


Figure 11-7: Co. Carlow Landscape Character Areas (Source: Carlow CDP 2022 – 2028)

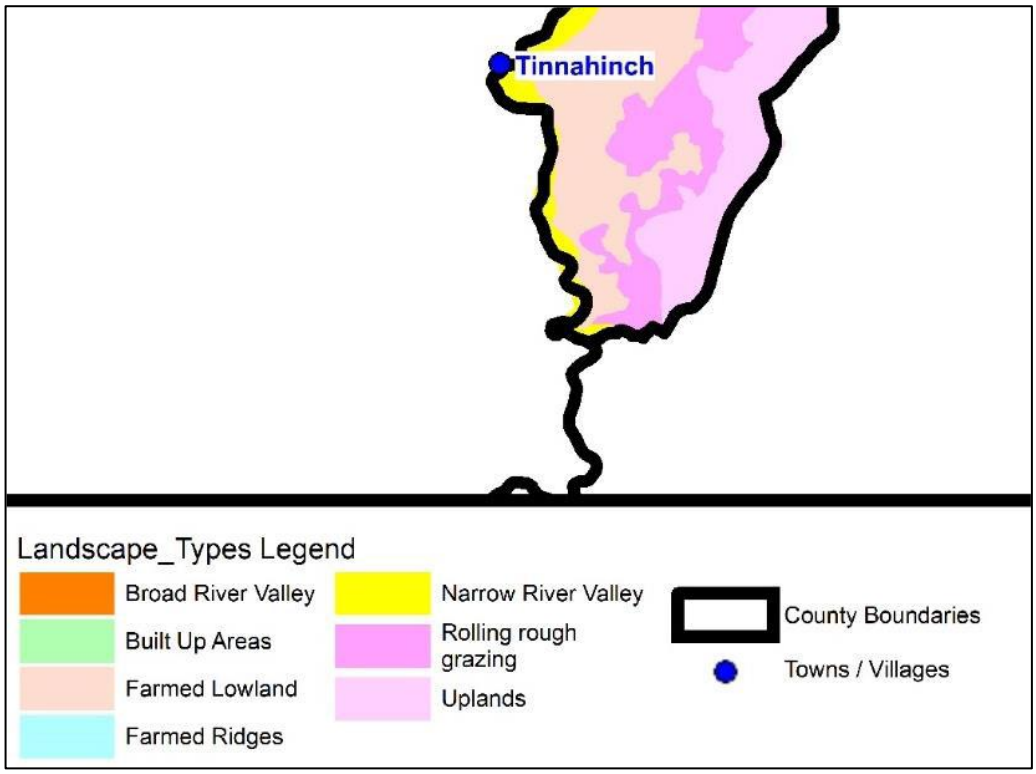


Figure 11-8: Co. Carlow Landscape Character Types (Source: Carlow CDP 2022 – 2028)

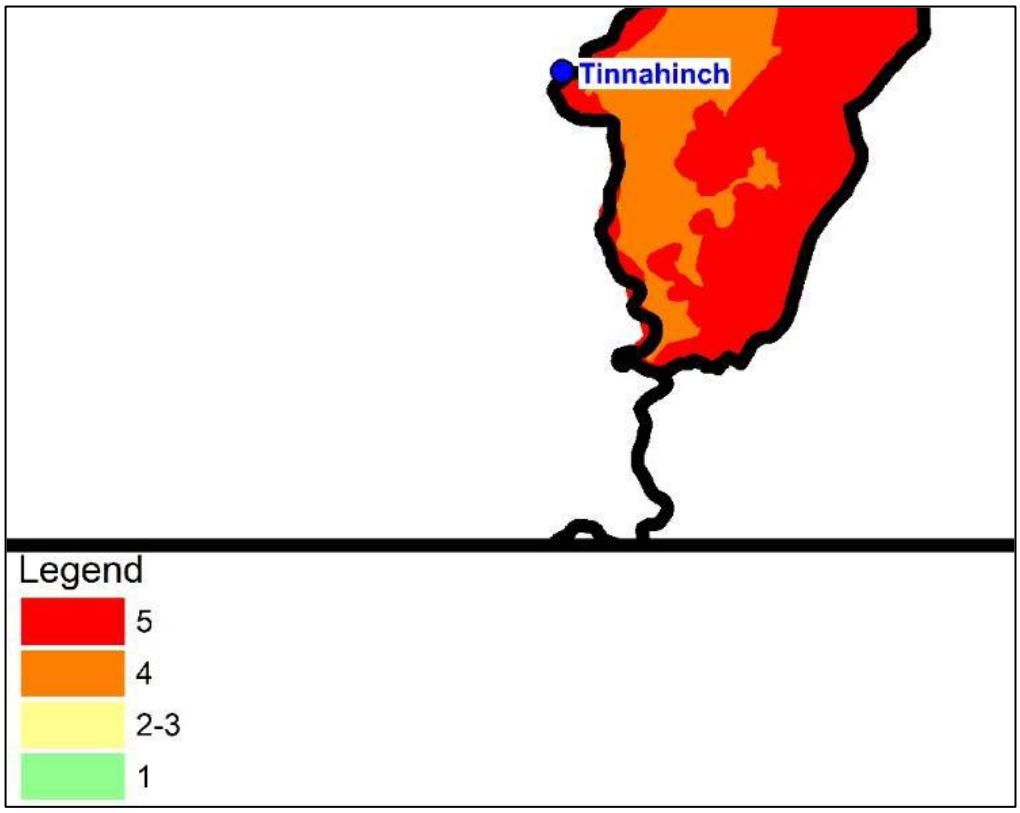


Figure 11-9: Co. Carlow Landscape Sensitivity (Source: Carlow CDP 2022 – 2028)

Protected Structures, Recorded Monuments & Architectural Conservation Areas

11.4.22 Refer to Chapter 9 'Cultural Heritage' for further details in relation to protected structures, recorded monuments and architectural conservation areas:

- Recorded Monuments: Structures that are protected under the National Monuments (Amendment) Act, 1994.
- Protected Structure (RPS): Structures that are considered to be of special architectural, historic, archaeological, artistic, cultural, scientific, social or technical interest. Structures that are on the RPS list are afforded statutory protection.
- National Inventory of Architectural Heritage (NIAH): Inventory of post-1700 architectural heritage of Ireland, carried out to aid in the protection and conservation of the built heritage. NIAH surveys provide the basis for the recommendations of the Minister for Arts, Heritage, Regional, Rural and Gaeltacht Affairs to the planning authorities for the inclusion of particular structures in their Record of Protected Structures (RPS).

Graiguenamanagh

11.4.23 There is one National Monument within Graiguenamanagh, the (Cistercian) Abbey, (Duiske) which is in the ownership of the State (KK029-018001- 620), it is also on the list of National Monuments. The G-T LAP 2021-2027, refers to 12Nr structures listed on the Record of Monuments and Places and 52Nr structures listed on the Record of Protected Structures within Graiguenamanagh, as shown on Figure 11-10 and Figure 11-11 and listed on Table 11-3 and Table 11-4 below.

Table 11-3: Graiguenamanagh - Record of Monuments & Places (Source: G-T LAP 2021-2027)

Nr	Description	RM Ref.	Location
1	Historic town	KK029-018----	Graiguenamanagh
2	Wall monument	KK029-018004-	Graiguenamanagh
3	Cross	KK029-018005-	Graiguenamanagh
4	Religious house -Cistercian monks	KK029-018001-	Graiguenamanagh
5	Cross -High cross (present location)	KK029-018002-	Graiguenamanagh
6	Tomb -effigial	KK029-018003-	Graiguenamanagh
7	Burial	KK029-018006-	Graiguenamanagh
8	Ritual site -holy well	KK029-018007-	Graiguenamanagh
9	Water mill -unclassified	KK029-018009-	Graiguenamanagh
10	Cross -High cross	KK029-018012-	Graiguenamanagh
11	Clapper bridge	KK029-018008-	Graiguenamanagh
12	Bridge	KK029-042----	Graiguenamanagh

Table 11-4: Graiguenamanagh - Record of Protected Structures (Source: G-T LAP 2021-2027)

Nr	Description	NIAH Ref.	RPS Ref.	Location	Town
1	Graiguenamanagh Bridge	12318004	C125	Over the River Barrow	Graiguenamanagh

Nr	Description	NIAH Ref.	RPS Ref.	Location	Town
2	Houses, row of four	N/A	C126	Chapel St. (N)	Graiguenamanagh
3	Cottages, row of four	12318027, 1231051-53	C127	Chapel St. (N)	Graiguenamanagh
4	Duiske Abbey Gates	12318015	C128	Chapel St. (S)	Graiguenamanagh
5	Duiske Abbey Gates	12318015	C129	Chapel St. (E)	Graiguenamanagh
6	'M. Ryan', Public House	12318022	C130	Main St. Upper (W)	Graiguenamanagh
7	E. Prendergast', House	12318023	C131	Main St. Upper (W)	Graiguenamanagh
8	M. Doyle', Public House	12318024	C132	Main St. Upper (W)	Graiguenamanagh
9	Hughes', House	N/A	C133	Main St. Upper (W)	Graiguenamanagh
10	'Hughes', House and shopfront	12318039	C134	Main St. Lower (W)	Graiguenamanagh
11	Parsons', 'Joseph Kissane Ltd.', House	12318042, 12318043	C135	Main St. Lower (W)	Graiguenamanagh
12	'Street Scenes'. House and shop.	N/A	C136	Main St. Lower (W)	Graiguenamanagh
13	Market House	12318044	C137	Market Square	Graiguenamanagh
14	House	12318045	C138	Market House Lane	Graiguenamanagh
15	'The Anchor', Public House	12318046	C139	Main St. Lower (W)	Graiguenamanagh
16	'F.J. Murray', shop	12318008	C140	Main St. Lower (E)	Graiguenamanagh
17	House and shopfront	12318009	C141	Main St. Lower (E)	Graiguenamanagh
18	House and shopfront.	12318010	C142	Main St. Lower (E)	Graiguenamanagh
19	House and shopfront	12318011	C143	Main St. Lower (E)	Graiguenamanagh
20	'Barron's', House and shop	12318012-13	C144	Main St. Lower (E)	Graiguenamanagh
21	Garda Barracks, former	12318014	C145	Main St. Lower (E)	Graiguenamanagh
22	House and shopfront	12318016	C146	Main St. Lower (E)	Graiguenamanagh
23	'Staunton'. House and shopfront	N/A	C147	Main St. (E)	Graiguenamanagh
24	School, former	12318018	C148	Main St. Upper (E)	Graiguenamanagh
25	Warehouse	12318006	C149; D151	The Quay	Graiguenamanagh
26	Brandondale House, Country House	12318049	C150	New Ross Road	Graiguenamanagh
27	Dwelling at the Quay	12318007	C635	The Quay	Graiguenamanagh
28	Corrigaleen Hous	12318017	C637	Main Street, Upper	Graiguenamanagh

Nr	Description	NIAH Ref.	RPS Ref.	Location	Town
29	Dwelling at Upper Main Street	12318019	C638	Main Street, Upper	Graiguenamanagh
30	O'Connell's	12318020	C639	Main Street, Upper	Graiguenamanagh
31	House	12318021	C640	Main Street, Upper	Graiguenamanagh
32	House	12317025	C641	Graiguenamanagh	Graiguenamanagh
33	Fairmount House	12318026	C642	Convent of the Sisters of Mercy	Graiguenamanagh
34	Parochial House	12318028	C643	Chapel Street	Graiguenamanagh
35	Outbuilding	12318029	C644	Chapel Street	Graiguenamanagh
36	House	12318030	C645	Chapel Street	Graiguenamanagh
37	'Blanchfield's'	12318041	C646	Main Street Lower	Graiguenamanagh
38	Bridge	12318032	C647	High Street	Graiguenamanagh
39	'Coffee on High'	12318033	C648	High Street	Graiguenamanagh
40	Abbey Villa (House)	12318034	C649	High Street	Graiguenamanagh
41	T. O'Shea Public House	12318035	C650	High Street	Graiguenamanagh
42	Warehouse	12318036	C651	High Street	Graiguenamanagh
43	Warehouse	12318037	C652	High Street	Graiguenamanagh
44	Cushendale Woollen Mills	12318038	C653	High Street	Graiguenamanagh
45	The Angler's Restaurant	12318040	C654	The Quay	Graiguenamanagh
46	House	12318048	C810	New Ross Road	Graiguenamanagh
47	House	12318054	C811	New Ross Road	Graiguenamanagh
48	House	12318055	C812	New Ross Road	Graiguenamanagh
49	Creamery	12318050	D150	Main Street Upper/Borris Road	Graiguenamanagh
50	Quay	12318002	D152	The Quay	Graiguenamanagh
51	Bridge (Footbridge)	N/A	D153	Over Duiske River	Graiguenamanagh
52	Dry Dock	12318047	D160	Right Bank of the Barrow	Graiguenamanagh

Tinnahinch

11.4.24 The G-T LAP 2021-2027, refers to 4Nr structures listed on the Record of Monuments and Places and 7Nr structures listed on the Record of Protected Structures within Tinnahinch, as shown on Figure 11-10 and Figure 11-11and listed on Table 11-5 and Table 11-6 below.

Table 11-5: Tinnahinch - Record of Monuments & Places (Source: G-T LAP 2021-2027)

Nr	Description	RM Ref.	Location
1	Graveyard	CW024-027002-	Tinnahinch
2	Castle -Tower House	CW024-026----	Tinnahinch
3	Church	CW024-027001-	Tinnahinch
4	Bridge	CW024-029----	Tinnahinch

Table 11-6: Tinnahinch - Record of Monuments & Places (Source: G-T LAP 2021-2027)

Nr	Description	NIAH Ref.	RPS Ref.	Location	Town
1	House	N/A	CW358	Lock Keepers House, Lock No. 21, Barrow Navigation	Tinnahinch
2	Bridge	10302404	CW496	Graiguenamannagh Bridge	Tinnahinch
3	House	10302407	CW497	Canal Agents House, Barrow Navigation	Tinnahinch
4	Canal Lock	10302406	CW498	Lock No. 20, Barrow Navigation	Tinnahinch
5	Canal Lock	10302408	CW499	Lock No. 21, Barrow Navigation	Tinnahinch
6	House	10302403	CW500	Bennett's	Tinnahinch
7	House	10302405	CW501	The Cottage	Tinnahinch

Architectural Conservation Areas & Zone of Archaeological Potential

11.4.25 Due to the long history of settlement and movement within the Graiguenamanagh area, most of the town centre is designated a Zone of Archaeological Potential (ZAP) and much of the study area is also located within a zone designated as an Architectural Conservation Area as shown on

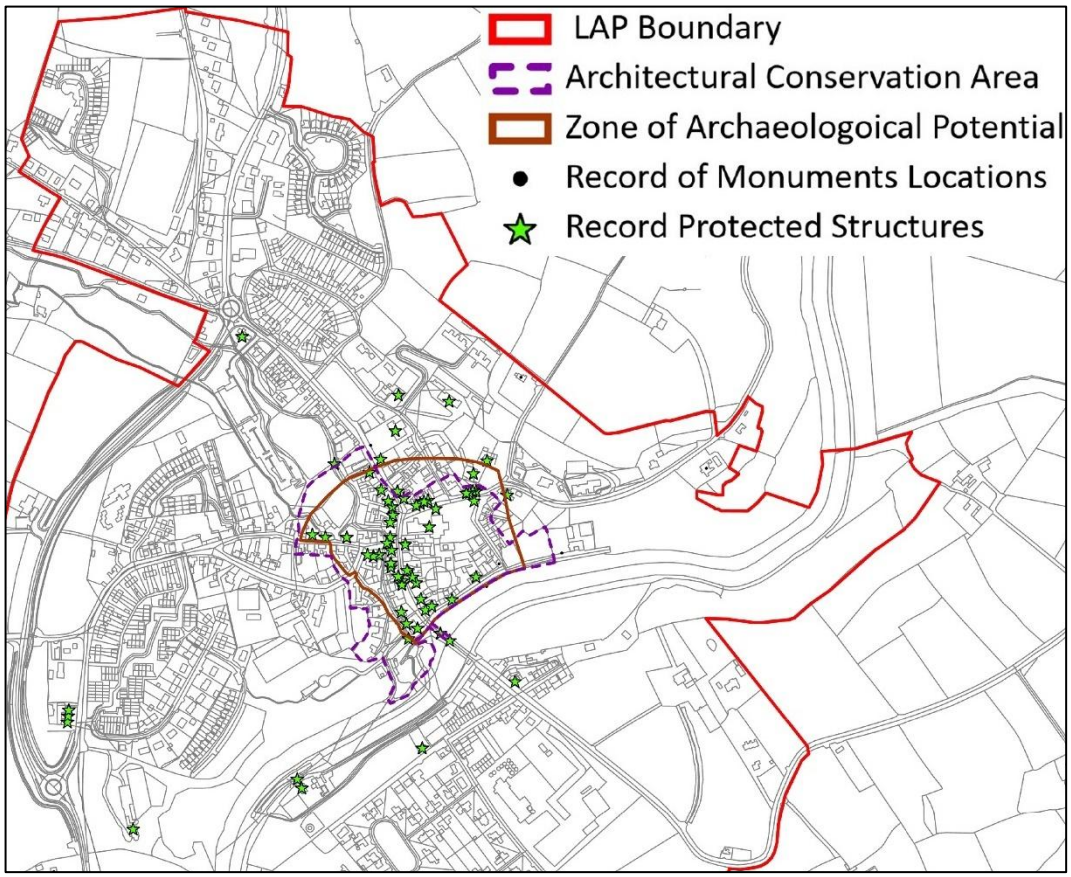


Figure 11-12. The G-T Joint Local Area Plan 2021-2027 contains the following policy and objectives in relation to Architectural Conservation Areas and Zones of Archaeological Potential:

"It is the policy of Kilkenny County Council to preserve the historic character of the designated Architectural Conservation Area and to carefully consider any proposals for development that would affect the special value of these areas.

Objectives:
It is an objective of the Plan:

- *ACAO1.1: To ensure that new development, including infill development, extensions and renovation works within or adjacent to the ACAs preserve and enhance the special character and visual setting of the ACA including views and vistas, streetscapes, building lines, fenestration patterns and architectural features and to seek visual impact assessments where appropriate for such development.*
- *ACAO1.2: To ensure retention of traditional shopfronts that are of special interest, while focusing on repair instead of replacement. Inappropriately detailed signage, such as plastic and internally illuminated signs will be discouraged.*
- *ACAO1.3: To encourage contemporary design where new buildings are introduced in the ACA*
- *ACAO1.4: To support the sensitive restoration and reuse of heritage buildings, to address dereliction and vacancy in the town centre and promote appropriate uses subject to good conservation principles.*

Archaeological Heritage:
It is the policy of Kilkenny and Carlow County Councils to safeguard the archaeological heritage, including underwater archaeological heritage, in the Joint LAP area and avoid negative impacts on sites, monuments, features or objects of significant historical or archaeological interest.

Objectives:

- *ARCO1.1: To protect and preserve all Archaeological objects within the meaning of the National Monuments Acts from inappropriate development that would adversely affect and/or detract from the interpretation and setting of these historic sites.*
- *ARCO1.2: To promote awareness of Graiguenamanagh's Zone of Archaeological Potential and notable archaeological sites within Graiguenamanagh and Tinnahinch and to facilitate access and understanding of key historical assets.*
- *ARCO1.3: To require an Archaeological (including underwater) Impact Assessment of proposals for developments, where appropriate, due to their location, size, or nature that may have implications for the archaeological heritage of the town."*

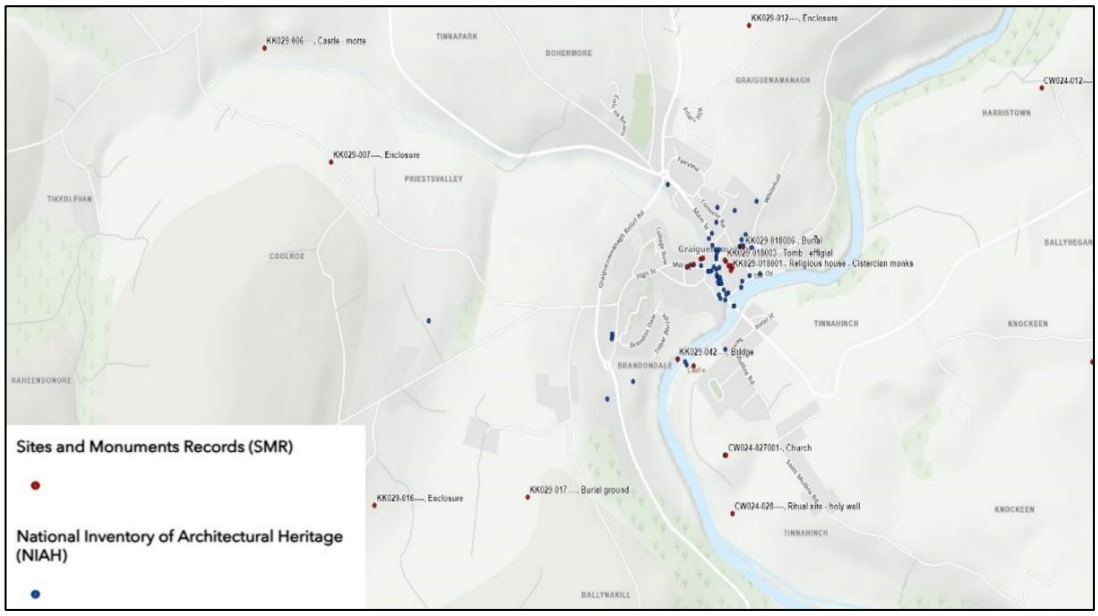


Figure 11-10: Sites & Recorded Monuments, NIAH (Source: NMS, Gov. of Ireland, 2025)

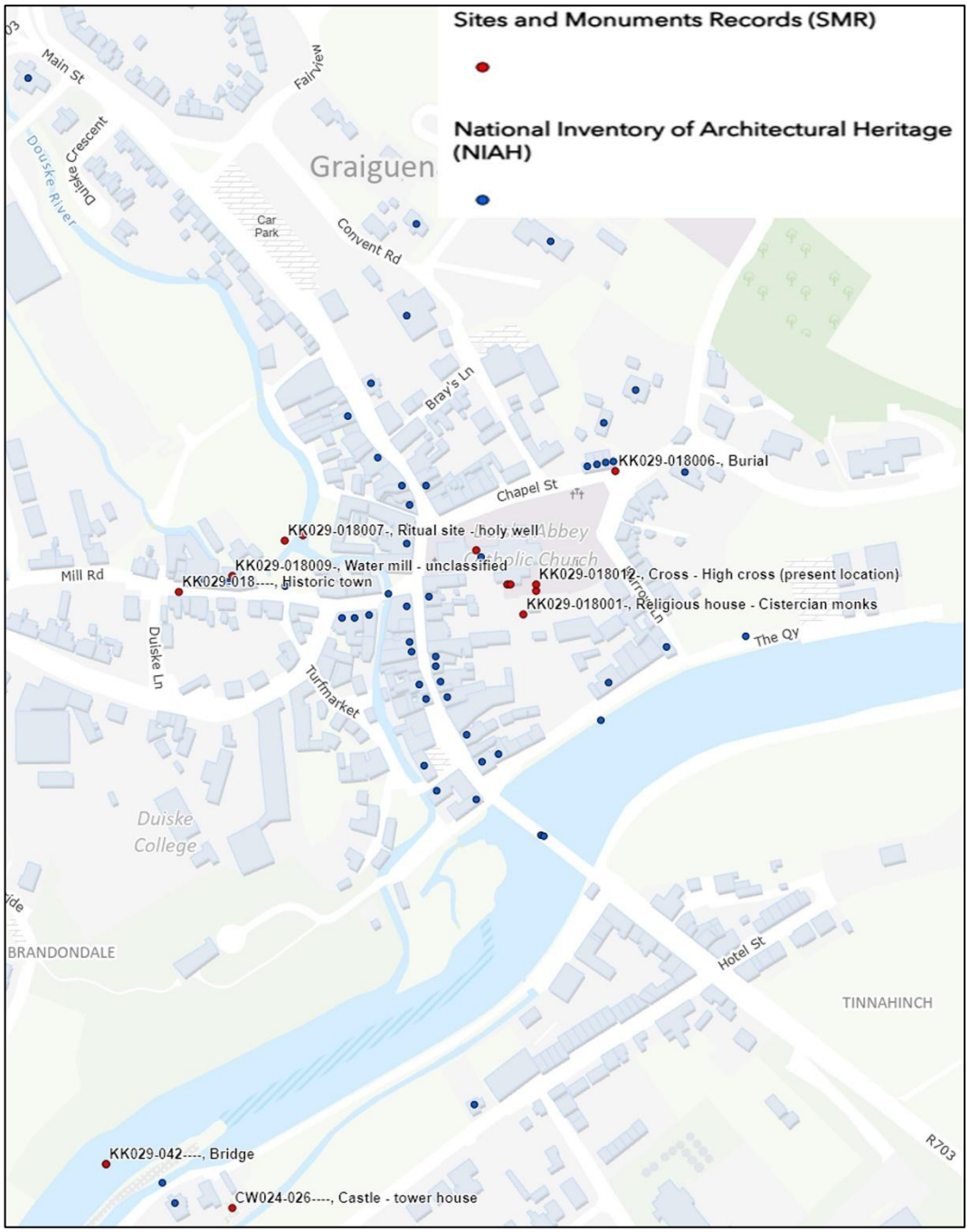


Figure 11-11: Sites & Recorded Monuments, NIAH (Source: NMS, Gov. of Ireland, 2025)

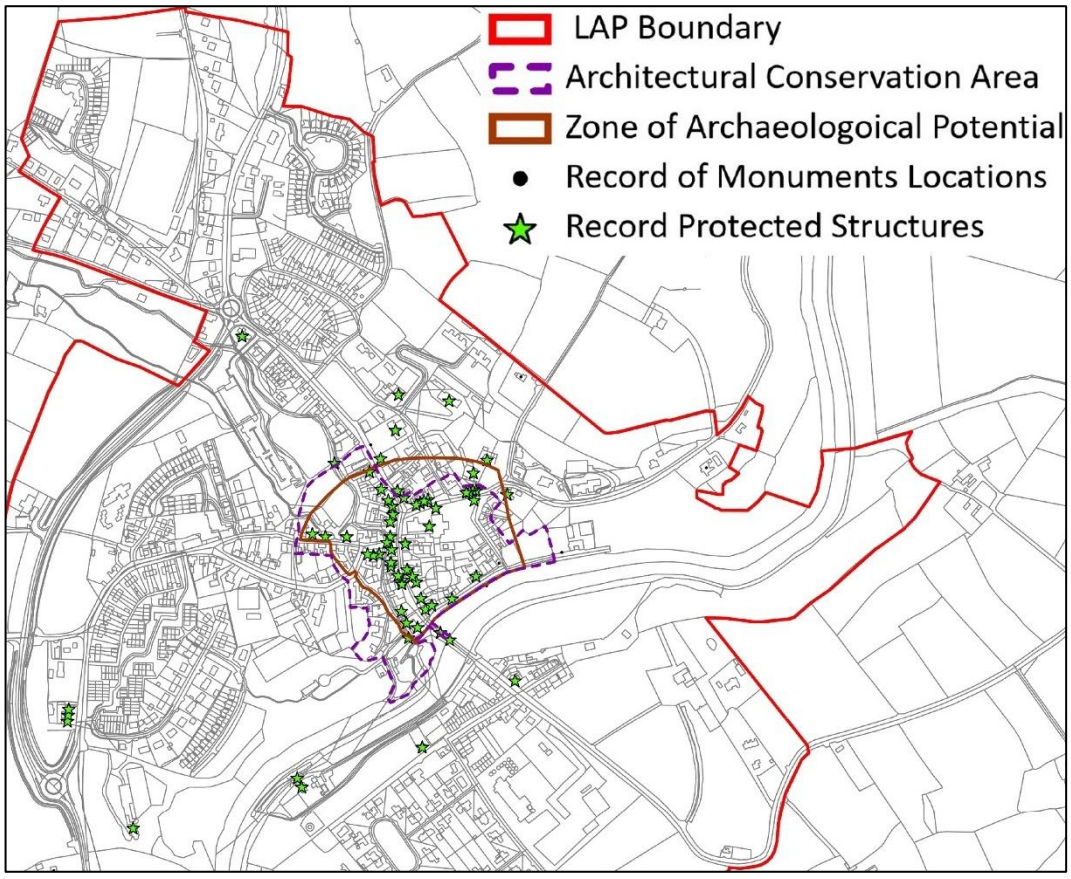


Figure 11-12: Heritage Map (Source: G-T LAP 2021)

Statutory Designations

Special Areas of Conservation (SAC), Special Protection Areas (SPA) and proposed Natural Heritage Areas (pNHA)

11.4.26 Refer to Chapter 10 'Biodiversity' for further detail on these designated sites.

11.4.27 The statutory designation that has the most influence on the study area is the River Barrow and River Nore Special Area of Conservation (SAC Site Code: 002162). This SAC comprises freshwater stretches of the Barrow/Nore River catchments as far upstream as the Slieve Bloom Mountains and includes the tidal elements and estuary as far downstream as Creadun Head in Waterford. The Duiske River which is a tributary to the River Barrow, and its associated mill races that extend through Graiguenamanagh's town centre, is also included in the SAC. In relation to statutory designations the KCDP contains the following requirements:

"To ensure that development proposals, where relevant, improve the ecological coherence of the Natura 2000 network and encourage the retention and management of landscape features that are of major importance for wild fauna and flora as per Article 10 of the Habitats Directive.

To protect and where possible enhance wildlife habitats and landscape features which act as ecological corridors/networks and stepping stones, such as river corridors, hedgerows

and road verges, and to minimise the loss of habitats and features of the wider countryside (such as ponds, wetlands, trees) which are not within designated sites.

To ensure that appropriate mitigation and/or compensation measures to conserve biodiversity, landscape character and green infrastructure networks are required in developments where habitats are at risk or lost as part of a development."

Existing Woodlands, Trees & Hedgerows

11.4.28 The Graiguenamanagh–Tinnahinch Local Area Plan 2021 acknowledges the importance of woodlands, trees and hedgerows to the local area:

"Woodlands and individual trees also make an important contribution to the landscape setting, amenity and natural heritage of Graiguenamanagh and Tinnahinch. The Council also recognise the importance of hedgerows in terms of both ecological and visual amenity and there will be a presumption against their removal during developments."

11.4.29 The G-T Local Area Plan 2021 contains the following objectives that are relevant to woodlands, trees and hedgerows:

Green Infrastructure Objective:
"GIO 1.2: To preserve, protect and augment trees, groups of trees, woodlands and hedgerows within the settlement by increasing, where appropriate, tree canopy coverage and tree planting using locally native species by incorporating them within design proposals and supporting their integration into the existing Green Infrastructure network."

Natural Heritage Objectives:
"NHO1.1: To identify, protect, conserve and enhance wherever possible, wildlife habitats and species of local importance, not otherwise protected by legislation. Such habitats would include woodland, river, grassland areas and field boundaries (hedgerows, stone walls and ditches). Such features form part of a network of habitats and corridors, which allow wildlife to exist and flourish and contribute to compliance with Article 10 of the Habitats Directive.
NHO1.2: Support the protection of biodiversity and ecological connectivity within the plan area including woodlands, trees, hedgerows, roadside verge vegetation, rivers, streams, natural springs, wetlands, stonewalls, fens, geological and geo-morphological systems, other landscape features and associated wildlife, where these form part of the ecological network. Seek to retain and incorporate these natural features into developments, in order to avoid ecological fragmentation and maintain ecological corridors or stepping stones in the context of Article 10 of the Habitats Directive:
a) Seek to retain and incorporate these natural features into developments, in order to avoid ecological fragmentation and maintain ecological corridors and stepping stones.
b) Protect and enhance the water quality and ecology of the River Barrow, in the plan area and their function as ecological corridors, by maintaining the existing banks and channel.
c) Conserve and restore biodiversity through the appropriate planting of native trees, shrubs and hedgerows indigenous to the area and of Irish provenance in public and private areas and in new developments.

d) Seek to prevent inappropriate development along the banks of the river which would negatively impact on the ecological quality and biodiversity of the waters and ecological corridor.
e) Seek to prevent the introduction of imported ash trees/plants or other such species into the plan area in line with the Plant Health Directive and any updated legislation.
f) In order to protect light sensitive species such as crayfish, lighting fixtures should provide only the amount of light necessary for personal safety and should be designed so as to avoid creating glare or emitting light above a horizontal plane.

NHO1.3: To ensure the protection of water quality due to the implementation of this Joint LAP.

NHO1.4: To limit the removal of vegetation and/or alteration of bank characteristics by reserving land along the river bank for ecological corridors and maintain them free from inappropriate development and discourage culverting or realignment. The Planning Authorities shall consult with Inland Fisheries Ireland and other statutory bodies as required by the planning regulations in respect of this and shall have regard to their comments in the making of any planning decision."

11.4.30 There are areas of mature woodland, tree planting and hedgerows within and in close proximity to the study area. While there are no Tree Preservation Orders within the study area, the woodland, trees and hedgerows provide significant visual and residential amenity and biodiversity benefits within this area and the surrounding environment. There are areas of woodland, trees and hedgerows also contained with the River Barrow and River Nore Special Area of Conservation (SAC Site Code: 002162).

11.4.31 An arboriculture survey was carried out on the trees and hedgerows that are in close proximity to the proposed flood defence measures, the proposed upstream storage area and along any access/construction routes that will be required. These are summarised in the Table 11-7 below and are discussed in detail within Chapter 10 - Biodiversity and the Arboricultural Report (Appendix 10-11).

Table 11-7: Category grade table of surveyed trees – A: high quality, B: moderate quality, C: low quality, and U: unsuitable for retention (Source: Arboricultural Report, Veon, 2025)

Category Grade	No. of Trees
Category U 8 Trees 2 Tree Lines	**Tree Nos.** 7519, 1253, 7526, T7, T4, 1241, 1242, 7537 **Tree Line Nos.** 11, 12
Category A 19 Trees 1 Tree Line	**Tree Nos.** 7503, 7504, 7505, 7506, 7508, 7509, 7510, 7515, 1251, 1252, 7524, 7527, T3, 7528, 7529, 7520, T2, 7531, 1243 **Tree Line No. 6**
Category B 21 Trees 1 Tree Line 3 Tree Groups	**Tree Nos.** 7507, 7512, 7513, 7518, 7523, 7521, T1, 1249, 7530, 7532, 7534, 7535, T5, 7543, 7536, 7538, 1791, 1792, 1793, 1794, 1796 **Tree Line No. 9** **Tree Group Nos.** 1, 2, 5

Category C 22 Trees 15 Hedges 2 Woodland Blocks 9 Tree Lines 4 Tree Groups	**Tree Nos.** 7501, 7502, 7511, 7514, 7516, T6, 7525, 7522, 7533, 1244, 1245, 1246, 1247, 7541, 7542, 7544, 1248, 7539, 7540, 7545, 7546, 1795 **Hedge Nos.** 1A, 1B, 1C, 1D, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 **Woodland Block Nos.** 1, 2 **Tree Line Nos.** 1, 2, 3, 4, 5, 7, 8, 10, 13 **Tree Group Nos.** 3, 4, 6, 7517
Total = 70 Trees, 8 Tree Groups, 15 Hedges, 2 Woodland Blocks, 13 Tree Lines	

Views & Prospects

Graiguenamanagh–Tinnahinch Local Area Plan 2021-2027

11.4.32 The G-T Local Area Plan 2021-2027 contains the policy and objectives:

SRV1 Scenic Routes and Views
It is the policy of Kilkenny and Carlow County Councils to ensure that the proposed location, siting and design of buildings and structures and any mitigation measures identified in the Joint LAP, protect the special character of the identified scenic routes and protected views.

Objectives
It is an objective of the Council:
SRVO1.1: To protect the visual amenity and character of scenic routes and views in Graiguenamanagh-Tinnahinch and its hinterland as identified in the Kilkenny and Carlow County Development Plans.

SRVO1.2: To require a Visual Impact Assessment of proposals for development that may impact the special character and visual amenity of scenic routes and views as part of the planning application process. Prohibit development that will block or interfere with a significant view or prospect. Where it is considered that a development may impact on views or prospects, have regard to the significance of any such impact and any appropriate mitigation measures that should be incorporated.
SRVO1.3: Protect the landscape character in the plan area included in the Landscape Character Assessment for County Kilkenny and Carlow. Ensure that new developments are responsive to the high and special sensitivity landscapes within the plan area, visually vulnerable areas, elevated areas or locally important townscape contexts.

Kilkenny City and County Development Plan 2021-2027:

11.4.33 In relation to views and prospects the KCDP 2021-2027 contains the following objective and management requirements:

"The Council will preserve and support the improvement of places or areas from which views or prospects of special amenity value exist.
Development Management Requirements:
To protect the landscape character, quality and local distinctiveness of County Kilkenny, and have regard to the guidance set out in the Landscape Character Assessment.

To ensure that development in the River Valleys will not adversely affect or detract from either protected views (especially from bridges) or distinctive linear sections of river valleys (especially open floodplains) when viewed from settlements.
To maintain the visual integrity of areas of greater sensitivity in the county and ensure that any development in these areas is appropriately sited and designed. Applicants shall demonstrate that the proposed development can be assimilated into the landscape and will not have a disproportionate visual impact on the landscape."

11.4.34 Figure 11-13, Figure 11-14 and Figure 11-15 indicates the protected views and scenic routes within Co. Kilkenny and Table 11-8 below list those that are relevant to the scheme area.

Table 11-8: Protected Views, relevant to the scheme area (Source: Kilkenny County Development Plan 2021-2027)

View Nr	Location	Orientation
V1	Thomastown/Graiguenamanagh Road, R703 from Coppenagh Hill between the junctions with road numbers LP4203 and LT8215-1	East & south over the Barrow Valley
V2	Graiguenamanagh/New Ross Road, R705; and in particular between the junctions with road numbers LP4209 and LS8246	East over the Barrow Valley and in particular the views overlooking St. Mullins
V3	Graiguenamanagh/Ullard Road (LS8221) just north of Graiguenamanagh, between the junctions with road numbers LS8226 and LS8222.	East and south east over the Barrow Valley
V4	Inistioge/Graiguenamanagh Road (LP 4209) between the junctions with road numbers LS8241 and R705.	South east over Brandon Hill
V5	Inistioge/Graiguenamanagh Road (LP4210) overlooking the LS8237 (between its junctions with road numbers LS8238 and the R700).	South west over Inistioge and the Nore Valley

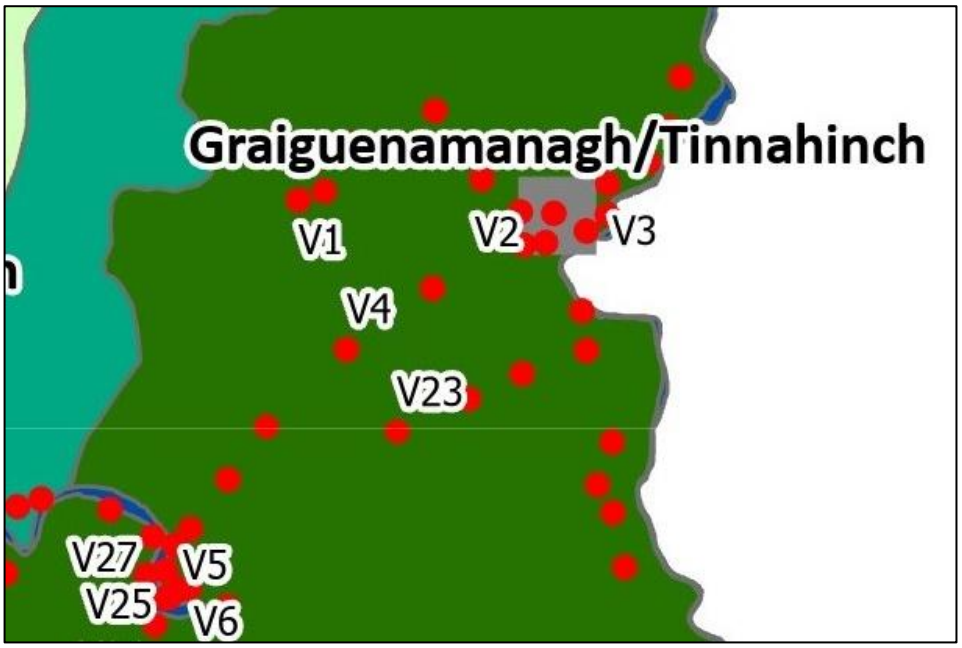


Figure 11-13: Protected Views – extract from LCA (Source: KCDP 2021-2027)

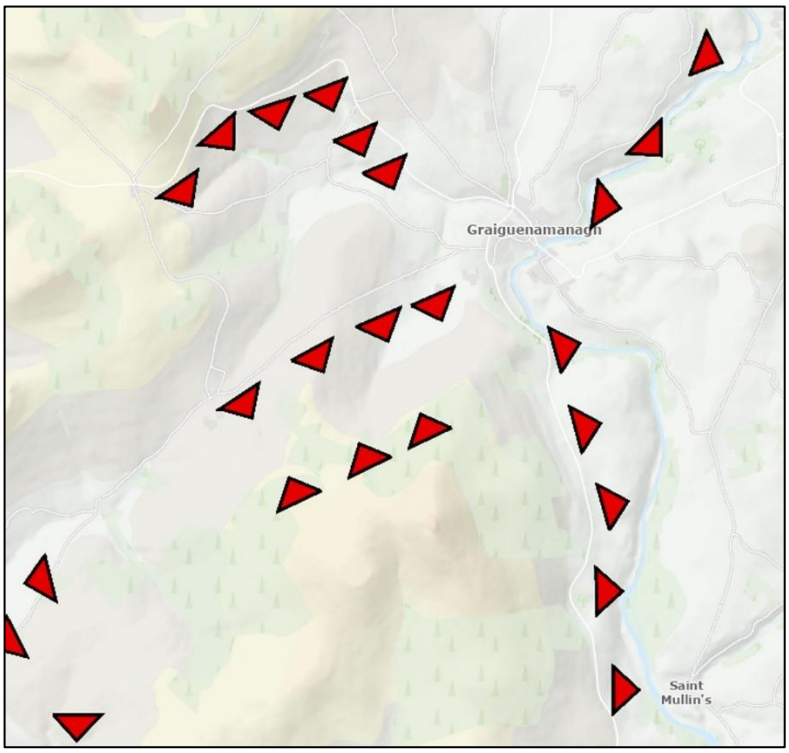


Figure 11-14: Protected Views (Source: KCDP 2021-2027)

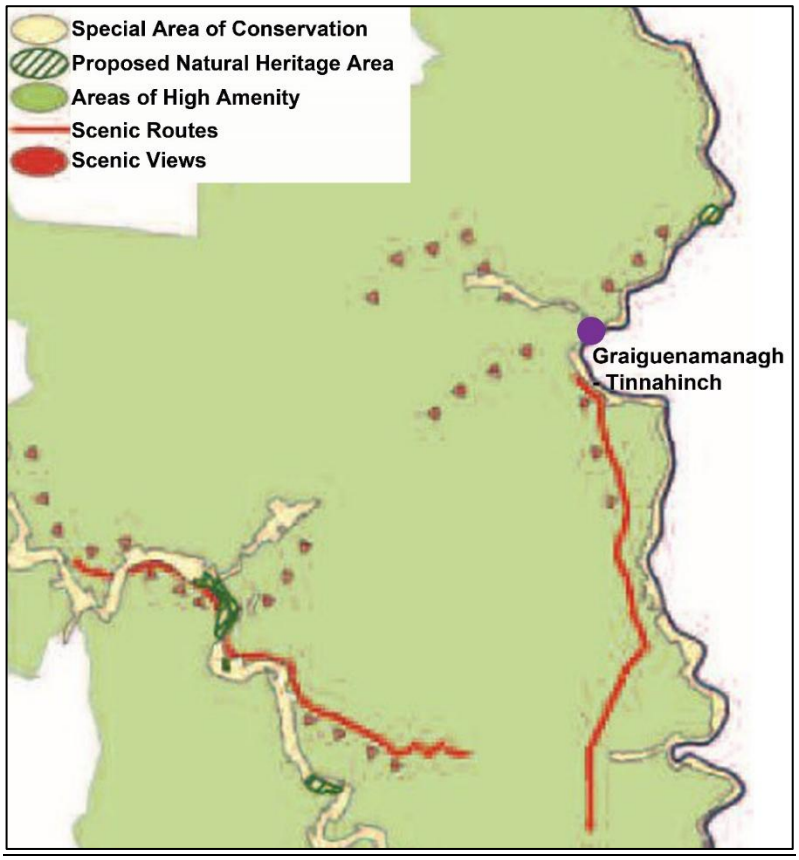


Figure 11-15: Scenic Routes & Scenic Views (Source: Landscape Appraisal of Co. Kilkenny, 2003)

Carlow County Development Plan 2022 – 2028

11.4.35 In relation to views and prospects the CCDP 2022-2028 contains the following objectives:

"Policy LA P11: Protect and preserve the established appearance and aesthetic attributes of views and prospects that contribute to the inherent quality of the County's landscape, including views, prospects and scenic routes, and particularly views to and from mountains, hills, river valleys and river corridors, and views of historical or cultural value (including buildings and townscapes) and views of natural beauty.

Objective LA O1: Ensure that the management and assessment of development throughout the County takes account of the recommendations and assigned Landscape Character Areas, Landscape Types, and Landscape Sensitivity, and the Schedule of Views, Prospects and Scenic Routes."

11.4.36 The Carlow County Development Plan 2022 – 2028 identifies a number of views, prospects and scenic routes (refer to Table 11-9 and **Error! Reference source not found.** and Figure 11-17) Scenic Route 15 and View 47 while they are not located within the study area, they are within the Zone of Theoretical Visibility.

Table 11-9: Views and Scenic Routes in close proximity to study area (Source: Carlow County Development Plan 2022 – 2028)

View Nr	Location	Orientation	Route	Features
45	Cournellan	East	R729	Vista; Panoramic view of Blackstairs Mts.
46	Clashganny Locks		R729	Vista; River Barrow; Marked viewing point
47	Carriglead	East	L3008	Vista; South end of Blackstairs Mts.
Scenic Route Nr	Location		Route	Features
14	Carriglead/Glynn		L7061	Blackstairs Mts.
15	South from Graiguenamanagh		L3008	Barrow Valley and Kilkenny hills to west

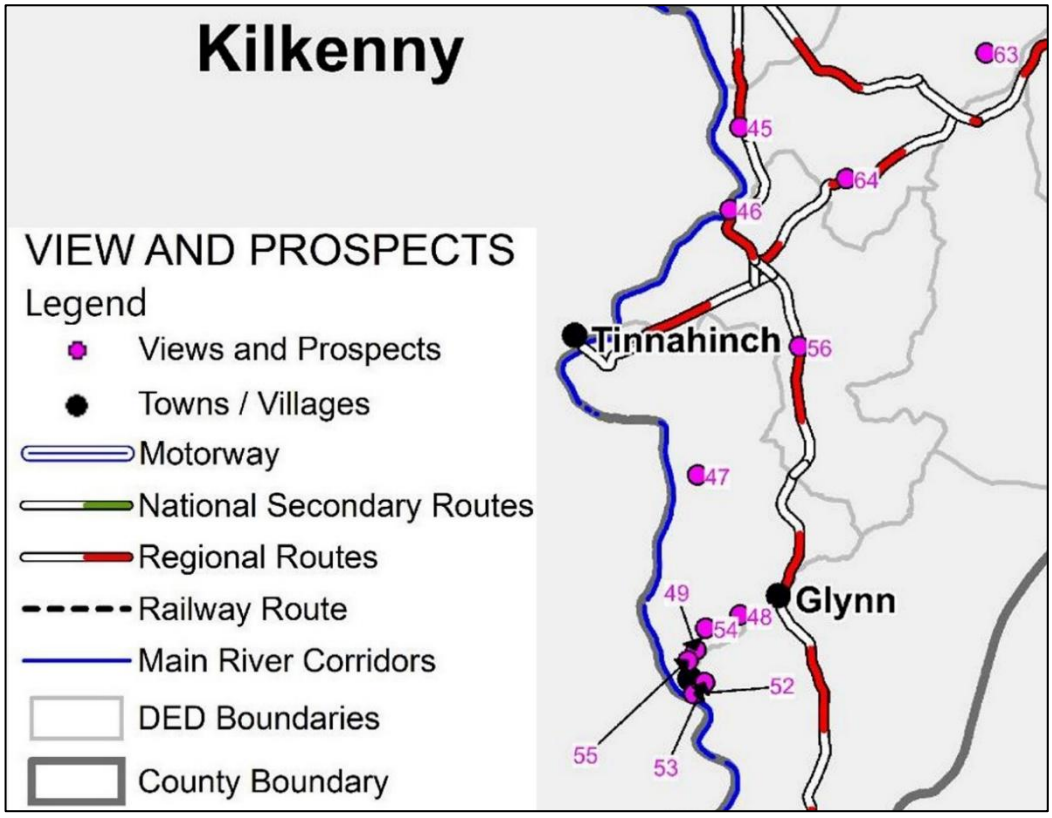


Figure 11-16: Views & Prospects (Source: CCDP 2022-2028)

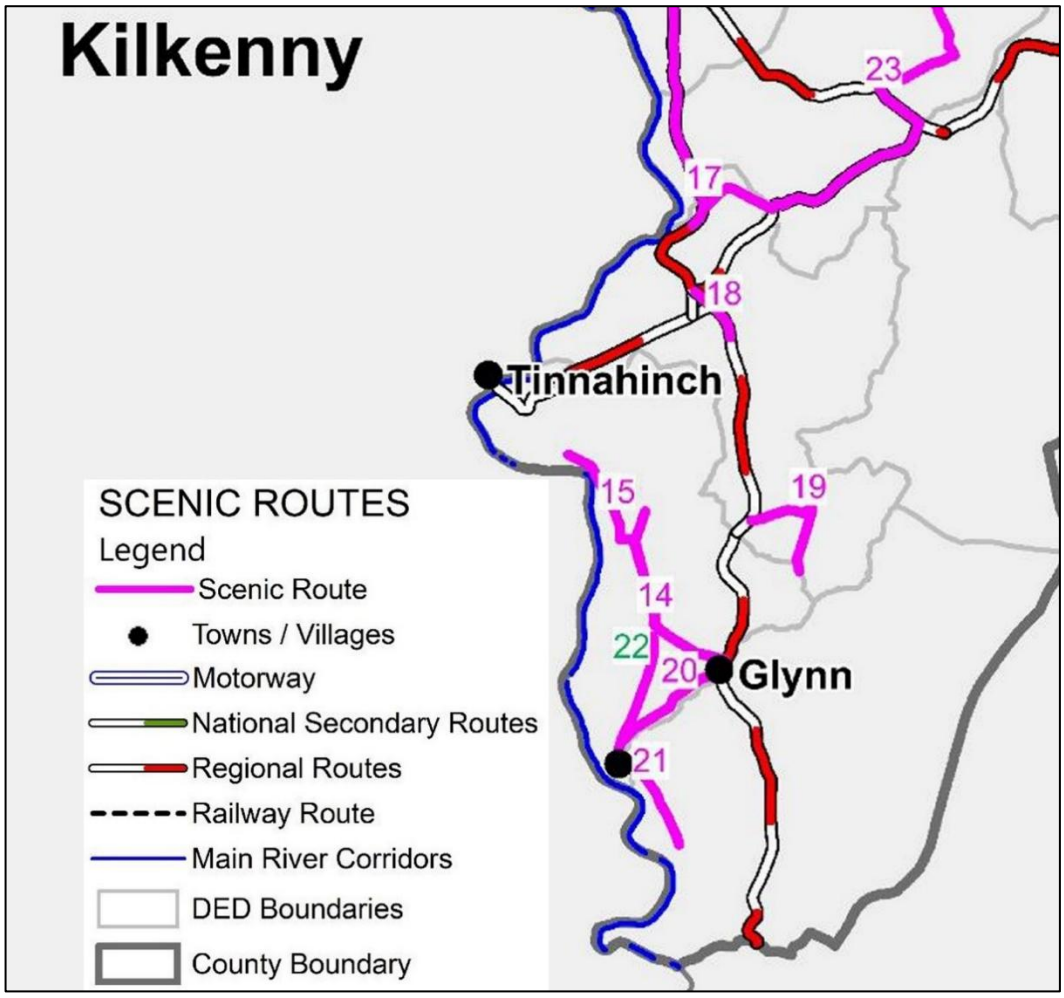


Figure 11-17: Scenic Routes (Source: CCDP 2022-2028)

Visibility into and from the site

11.4.37 Within the town centre, there are generally expansive views of the River Barrow from the open quays and the riverside amenity pathways. Views of the river are limited in certain town centre locations due to buildings constructed in close proximity to the river, particularly along the River Duiske where various buildings back directly onto the river. In the surrounding landscape away from the town centre, there are generally only localised views of the rivers within the study area, due to the visual confinement created by existing topography of the river valley and the existing dense vegetation along the river corridors.

11.4.38 While certain views, prospects and scenic routes are not located within the study area, they are within the Zone of Theoretical Visibility as shown on Figure 11.21. The majority of the views, prospects and scenic routes are located outside of the town centre, with the majority looking away from the site towards the Blackstairs Mountains, Brandon Hill or sections of the River Barrow to the north and south of the scheme area. However, the proposed flood storage area to the west of Graiguenamanagh town centre is within the viewshed of "*V1 -Thomastown/Graiguenamanagh Road, R703 from Coppenagh Hill between the junctions with road numbers LP4203 and LT8215-1, that looks east & south over the Barrow Valley*".

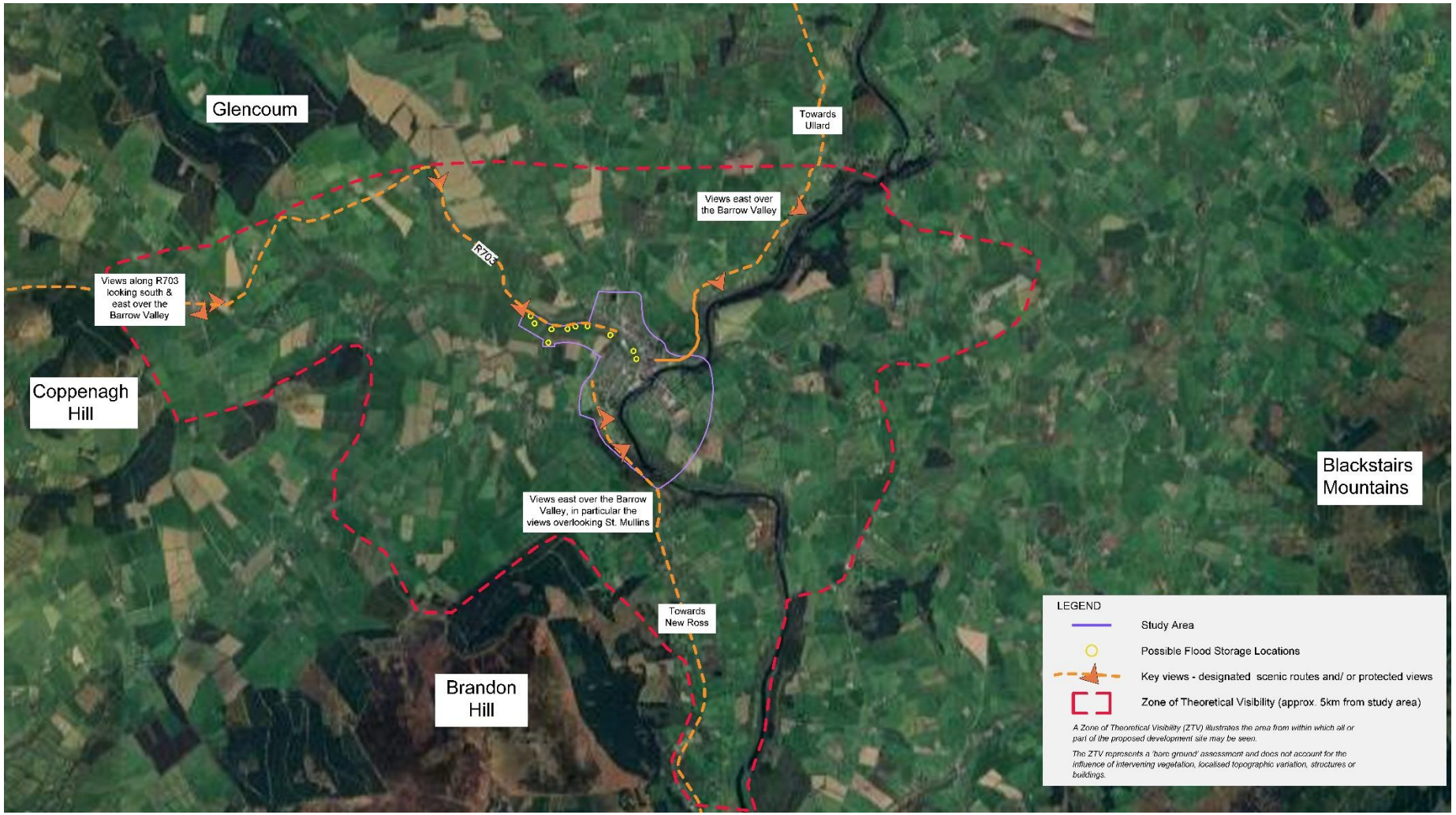


Figure 11-18: Extents of Study Area, Zone of Theoretical Visibility (ZTV) & Scenic Routes and/or Protected Views.
A Zone of Theoretical Visibility (ZTV) illustrates the area from within which all or part of the proposed development site may be seen. The ZTV represents a 'bare ground' assessment and does not account for the influence of intervening vegetation, localised topographic variation, structures or buildings. with important views along public roads indicated

11.5 Sensitive Receptors

11.5.1 The sensitive receptors are outlined in the preceding sections. The LCAs and Protected Views as identified in the KCDP and CCDP are sensitive to changes to the landscape. There are also sensitivities due to the presence of protected cultural heritage features, as well as natural heritage features. The individual Works Areas are also sensitive receptors as detailed in the Section 11.6 below. These are considered for their Landscape Character and their Visual Amenity.

11.6 Potential Impacts and Effects

Do Nothing Scenario

11.6.1 If these particular flood defence proposals works are not undertaken, the landscape character and visual amenity of the scheme area would remain unchanged and would evolve on current trends. During flood events public open spaces, agricultural lands and buildings would continue to flood, resulting in possible damage to structures and vegetation and limited access to public amenity spaces, resulting in **moderate-significant, negative** impacts on the landscape and visual amenity for the temporary duration of the potential flood event

Impact on Landscape Character

Area 1: Upstream storage area – River Duiske

11.6.2 The main changes that may have localised impacts on the landscape character include:

- The flood defence proposals within this area that may have a visible impact on the local landscape includes the raised earthfill structure, the concrete flow control structure and spillway.
- The proposed entrance off the main road, the access route, lighting and associated storage structures will also have an impact on the character of this landscape.
- It is also anticipated that several trees and sections of scrub and hedgerow will need to be removed to facilitate the construction of the flood defence proposals and the proposed access road.
- To assist in the integration of the flood defence proposals, road and associated services into the surrounding landscape, tree, hedge, planting and wildflower meadows have been proposed where feasible.

11.6.3 New tree planting is not always possible where it is determined the trees may compromise the proposed flood defence proposals in the future or at times of flooding.

Construction Phase:

11.6.4 It is anticipated that during the construction phase of the project the impact on the character of the local landscape may be **temporary, moderate-significant and negative** due to:

- to the more open nature of the landscape in this area
- the scale of the proposed flood defence measures
- the loss of vegetation and ground disturbances
- the presence of construction machinery, traffic, cranes, lighting and construction compound.

Operation and Maintenance Phase:

11.6.5 During the operational phase, it is anticipated that the impact on the landscape character will be **slight-moderate and negative** in the short term and will lessen as the existing vegetation continues to mature.

Area 2: Well Lane to High St. Bridge, Area 3: Turf Market, Area 4: Turf Market to the Hub (Lower Turf Market), Area 5: Boat Club, Area 6: Graiguenamanagh Quay, Area 10: Tinnahinch Quay

11.6.6 The flood defence proposals along the River Barrow and River Duiske, within the town centres of Graiguenamanagh and Tinnahinch, are anticipated to only have an impact on the immediate surrounding areas, due to the visual confinement created by:

- Existing topography of the river valley
- Existing dense vegetation along the river corridors, resulting in localised views of the river in places
- Existing built environment - the various buildings within the town, particularly those backing onto the river within the town centre along the River Duiske

11.6.7 In the surrounding landscape, away from the town centre, there are generally only localised views of the River Barrow within the study area, none of which permit views towards the flood defence measures proposed within the town centres. Therefore, it is anticipated that these proposals will not have any impact on the character of the wider landscape, outside of the town centre.

11.6.8 It is anticipated that the following elements will have localised impacts on the townscape:

- Changes to the road layout - changing from a two-way vehicular route to a one-way system (Graiguenamanagh) and reconfiguration of parking and pedestrian route (Tinnahinch).
- Changes to the public realm – segregation of pedestrian routes, surface changes, street furniture, planting. Where appropriate materials and street furniture that are sympathetic to or from the locality and do not detract from existing significant features or historical structures, have been proposed, to assist in creating a cohesive townscape.
- Flood defence embankment north of the boat club and ground raising west of the boat club car park.

- New flood defence walls and gates - where possible glazed panels have been proposed to minimise the visual and physical impact of the proposed walls, to facilitate views to and from the river and to assist in retaining the open character of the quays and maintaining the town's relationship with the river. Also, where possible the siting and extents of the flood defence walls followed the current alignment of existing walls or boundaries, to maintain the character of the area.

Construction Phase:

11.6.9 It is anticipated that during the construction phase of the project, while the impacts may be localised, they may be **temporary, moderate-significant and negative** on the character of the local townscape, due to the presence of construction machinery, traffic, cranes, lighting and construction compounds.

Operation and Maintenance Phase:

11.6.10 During the operational phase, largely due to the flood defence structures being proposed within areas that already contain similar built elements e.g. walls, it is anticipated that the impact on the landscape character will be **permanent, slight and negative.**

Area 7: The Dock & Area 8: The Hub

11.6.11 The main changes that may have localised impacts on the landscape character include:

- The flood defence proposals within this area that may have a visible impact on the local townscape/ landscape includes raised wall heights, flood gates and raised ground levels/ flood defence embankment.
- Several trees will need to be removed to facilitate the construction of some of these flood defence measures.
- Realignment of the maintenance/ emergency access route and pedestrian pathways including a stepped route.
- Proposed tree, hedge and shrub planting and wildflower meadows.

Construction Phase:

11.6.12 It is anticipated that during the construction phase of the project, while the impacts may be localised, they may be **temporary, moderate and negative** on the character of the surrounding landscape, due to the presence of construction machinery, traffic, cranes and lighting.

Operation and Maintenance Phase:

11.6.13 During the operational phase, following the implementation of the mitigation measures it is anticipated that the impact on the landscape character will be **not significant and negative** and will continue to lessen in the long term to imperceptible and neutral, as the proposed planting becomes establish and the existing vegetation continues to mature.

Area 9: Hotel St

11.6.14 The main changes that may have localised impacts on the landscape character include:

- The flood defence proposals within this area that may have a visible impact on the local townscape/ landscape includes the raised embankment (including fencing and maintenance track) and a flood defence wall.
- It is also anticipated that several trees will have to be removed to facilitate the construction of the flood defence proposals.
- These changes will result in a change in the landscape character of this area

Construction Phase:

11.6.15 It is anticipated that during the construction phase of the project, while the impacts may be localised, they may be **temporary, moderate-significant and negative** on the character of the surrounding landscape due to the presence of construction machinery, traffic, cranes, lighting and construction compound.

Operation and Maintenance Phase:

11.6.16 During the operational phase, following the implementation of the mitigation measures it is anticipated that the impact on the landscape character will be **slight and negative** and will continue to lessen in the long term as the existing vegetation continues to mature.

Protected Structures, Recorded Monuments & Architectural Conservation Areas

11.6.17 As comprehensively discussed within Chapter 9 'Cultural Heritage' of this EIAR it is anticipated that proposed works will have an overall **positive** impact on the protected structures, recorded monuments and the ACA, as they will be protected against the impacts of future flooding events.

Statutory Designations

11.6.18 Chapter 10 'Biodiversity' of this document discusses the impacts on the relevant designated sites within or in close proximity of the study area, and it concludes that there will be **no significant and negative impacts** on these sites arising from the proposed works.

Impact on Existing Trees & Hedgerow

11.6.19 The Arboricultural Report (refer to Appendix 10-11) indicates the extents of trees and hedgerows that will need to be removed to facilitate the construction of the flood defence proposals, as summarised in Table 11.11 below. This report also states that the *"overall impact the proposed development will have on the arboricultural assets is considered to be **moderate to high**".*

Table 11-10: Tree removal and their category grade (Source: Arboricultural Report, Ayesa, 2025)

Category Grade	No. of Trees
Category U 4 Trees 1 Tree Line	**Tree Nos.** 1253, 7519, 1797, T4 **Tree Line No.** 12
Category A 3 Trees	**Tree Nos.** 1251, 1252, 7531
Category B 7 Trees 1 Tree Groups	**Tree Nos.** 7518, 7532, 7534, 7535, T5, 7543, 1796 **Tree Group Nos.** 2
Category C 9 Trees 4 Hedges 2 Tree Lines 1 Tree Group	**Tree Nos.** 7516, 7533, 1244, 1245, 1246, 1247, 1248, 7542, T6 **Hedge Nos.** 1C, 1D, 11, 12 **Tree Line Nos.** 4, 5, **Tree Group Nos.** 7517
Total = 23 Trees, 2 Tree Groups, 4 Hedges, 3 Tree Lines	

Impact on Views & Prospects

General Visual Impacts

11.6.20 During the construction phase, the following elements of the proposed development have the potential to cause visual impacts, they will however be short to medium term in duration:

- Temporary construction compounds and construction routes
- Temporary site works – hoarding, lighting, cranes, car parking, storage areas
- Construction traffic – dust and emissions
- Tree and vegetation clearance
- Groundworks – excavations, ground raising
- Laying of foundations (e.g. walls) and site services

11.6.21 During the operational phase the principal elements which are likely to give rise to landscape and visual impact in the long term are:

- Changes to road layout along Graiguenamanagh Quay
- Alterations to ground levels
- Height of proposed or amended walls
- New structures, lighting, boundaries and pathways
- Proposed tree and shrub planting

- Flood storage area – embankments; concrete flow control structure; spillway; access road; lighting

Impact on Scenic Routes & Protected Views

11.6.22 The CCDP 2022–2028 and the KCDP 2021-2027 identified a number of key views and scenic routes that are to be protected. The protected views and scenic routes that are relevant to the study area are discussed later in this section under Visuals 14 – 17 below.

Impact of Visibility into the Site

11.6.23 For this visual impact assessment, viewpoints were selected to represent the likely visual impact from a variety of distances and direction around the site. Priority was given to views from the public domain, such as main roads and to views from potentially sensitive locations such as scenic routes and from the amenity areas. Photomontages were compiled from the viewpoints shown on Figure 11-19. The location of the long-range images are shown on Figure 11-20 and the location of the drone visuals are shown on Figure 11-21 (the visual analysis section below should be read in conjunction with the baseline and proposed visuals produced by Chris Shackleton Consulting, refer to Appendix 4-3).

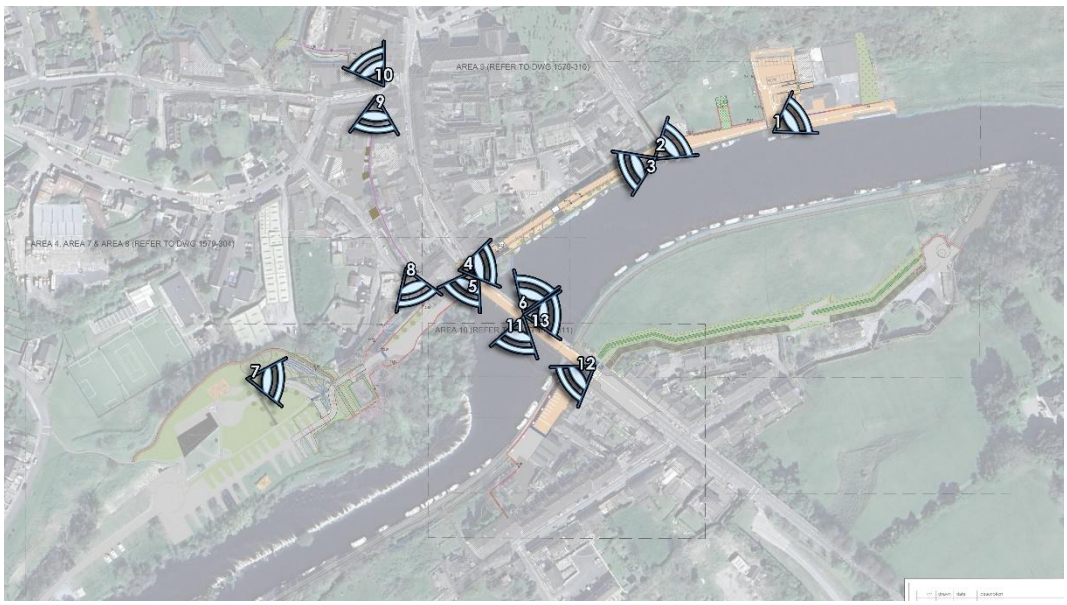


Figure 11-19: Viewpoint Location Map – Short Range

Visual 1: From the slipway along Graiguenamanagh Quay (Area 5: Boat Club), looking north-east

11.6.24 **Existing View:** From this location at the slipway along Graiguenamanagh Quay the boat house, scout hall, car park, boundary walls, railings and gates are the dominant elements. There are various amenities visible from this location also such as steps to the swimming point, seating area built into the wall (across from the swimming point), access to the mooring area for boats and the amenity pathway along the river, which forms part of wider walking trails such as the South Leinster Way. Further views of the surrounding landscape

are screened by the trees on the higher ground north of the boathouse and the mature woodlands located on either side of the river, east of the town.

11.6.25 **Proposed Changes and Visual Impact:** It is anticipated that there will be views of the proposed flood defence walls and gates around the boathouse, the reconfigured car park and the pedestrian route. To minimise the visual impacts of the flood defence proposals and to assist in their successful integration into the surround townscape, the materials chosen e.g. stone cladding to walls are intended to be sympathetic to the existing structures. Glazed panels are proposed within the flood defence walls and gates in order to reduce the visual impact of the wall and to facilitate views from the boathouse towards the river. A new seat wall is also proposed for the same extents of the current seating area in order to retain the current level of amenity.

11.6.26 **Construction Phase:** During the construction phase, due to the presence of construction traffic, machinery, site hoarding and lighting, it is likely that there will be **temporary**, **moderate and negative** impact on views from this location.

11.6.27 **Operational Phase:** It is anticipated that during the operational phase due to the choice of materials and placement of glazed panels within the flood defence walls and the continued access to the amenities in this area, the impacts will be **slight and negative.**



Plate 11-1: Visual 1 – Existing



Plate 11-2: Visual 1 – Proposed

Visual 2: From junction of Graiguenamanagh Quay & Barrow Lane (Area 6: Graiguenamanagh Quay), looking north-east

11.6.28 **Existing View:** The location of this viewpoint near the junction of Graiguenamanagh Quay and Barrow Lane, permits views of the boats moored along the quay between this junction and the boathouse. The corner field/site with various boundary treatments – hoarding, wall, stone wall and remnants of old stone structure, mature hedgerows are also visible from this location. The mature trees and a number of dwellings located on the higher ground within Whitehall, north of this area are visible in the background. The boathouse, mature trees and woodland located either side of the river enclose views to the east from the location on the quay.

11.6.29 **Proposed Changes and Visual Impact:** It is anticipated the flood defence walls with glazed panels and flood gate will be visible from this location on the amenity pathway along the river edge. The proposed seating, tree planting and new boundary around the field at junction of Barrow Lane and Graiguenamanagh Quay, will also be visible from this location. The demarcated pedestrian route and flood defence walls around the boathouse are also visible in the background.

11.6.30 **Construction Phase:** During the construction phase, due to the presence of construction traffic, machinery, site hoarding and lighting, it is likely that there will be **temporary**, **moderate and negative** impact on views from this location.

11.6.31 **Operational Phase:** It is anticipated that during the operational phase while the proposed hard defences will have a negative visual impact on this area, however due to the choice of materials and use of glazed panels within the flood defence walls and the continued access to the amenities in this area, the impacts will be **slight and negative**.



Plate 11-3: Visual 2 - Existing



Plate 11-4: Visual 2 – Proposed

Visual 3: From near the junction of Graig. Quay & Barrow Lane (Area 6: Graiguenamanagh Quay), looking west

11.6.32 **Existing View:** This location affords views of the boats moored along the quay and the various street furniture elements such as lighting, bollards, seating. The buildings fronting onto the river, and those located at the corner of the Lower Main St. and Graiguenamanagh Quay and the access to the car park, are also visible from this location. Graiguenamanagh Bridge and the verdant edges to either side of the river are visible in the background. There are also views of the wider landscape including the lower parts of Brandon Hill in the distant background.

11.6.33 **Proposed Changes and Visual Impact:** It is anticipated that from this location along the proposed pedestrian pathway that the following will be the most noticeable changes:

- Proposed flood walls and gates with glazed panels
- The narrowing of carriageway, changing it from a two-way vehicular route to a one-way system
- Proposed surface treatment changes – resin bound gravel and granite paving to pedestrian areas and crossings, buff coloured asphalt to road
- Proposed tree planting, seating, bollards

11.6.34 **Construction Phase:** During the construction phase, due to the presence of construction traffic, machinery, site hoarding and lighting, it is likely that there will be **temporary**, **moderate-significant and negative** impact on views from this location.

11.6.35 **Operational Phase:** It is anticipated that during the operational phase, while the proposed hard defences will have a negative impact on views from this area, the glazed panels assist in minimising their visual impact, permitting views to and from the river. Also, the reconfiguration/ narrowing of the vehicular route along the quays, the introduction of trees and additional seating may result in a more attractive pedestrian friendly route along the river edge, while still maintaining access to the boats moored along the river. It is likely that views from this area, of the important features of the townscape such as the bridge, weir and buildings and wider views of the surrounding landscape including Brandon Hill, will not be significantly impacted. The proposed works have the potential to have a **slight and negative** impact in the short term, as the proposed tree planting becomes more established the impact will continue to lessen to **not significant and negative** in the long term.



Plate 11-5: Visual 3 – Existing



Plate 11-6: Visual 3 – Proposed

Visual 4: From Main Street (Area 6: Graiguenamanagh Quay), looking east

11.6.36 **Existing View:** From the location of this viewpoint on Main Street looking east along Graiguenamanagh Quay, the dominant features are:

- the stone wall along the edge of the river

- the various street furniture elements and utilities, such as lighting, monk sculpture, signage, bollards, substation/ pumping station
- two-way road system and car parking along the riverside of the road

11.6.37 There are glimpsed views of the river, the boathouse and scout hall beyond the wall and the car parking area. The woodlands areas on either side of the river and the mature trees on the elevated lands behind the boathouse screening further views of the wider landscape, apart from filtered views of the Blackstairs Mountains.

11.6.38 **Proposed Changes and Visual Impact:** It is anticipated that the changes that will be most visible from this location will be:

- Proposed flood wall and gates
- The narrowing of carriageway, changing it from a two-way vehicular route to a one-way system
- Proposed surface treatment changes – resin bound gravel and granite paving to pedestrian areas and crossings, buff coloured asphalt to road
- Proposed tree planting, seating, guardrails, bollards
- Proposed electrical kiosk relating to the pumping station

11.6.39 It is the intention that views of the river and the wider landscape from this location, as discussed in the paragraph above, will be maintained.

11.6.40 **Construction Phase:** During the construction phase, due to the presence of construction traffic, machinery, site hoarding and lighting, it is likely that there will be **temporary, moderate-significant and negative** impact on views from this location.

11.6.41 **Operational Phase:** It is anticipated that during the operational phase, while the proposed hard defences and associated structures such as the electrical kiosk, will have a negative impact on views from this area, the glazed panels assist in minimising their visual impact, permitting views to and from the river. Also, the reconfiguration/ narrowing of the vehicular route along the quays, the introduction of trees and additional seating may result in a more attractive pedestrian friendly route along the river edge, while still maintaining access to the boats moored along the river. It is likely that views from this area, of the important features of the townscape and wider views of the surrounding landscape such as the buildings, river and Silaire Wood, will not be significantly impacted. The proposed works have the potential to have a **slight-moderate and negative** impact in the short term, as the proposed tree planting becomes more established the impact will continue to lessen to **slight and negative** long term.



Plate 11-7: Visual 4 – Existing



Plate 11-8: Visual 4 – Proposed

Visual 5: From Main St near the bridge (Area 4: Turf Market to The Hub (Lower Turf Market), looking south-west

11.6.42 **Existing View:** This viewpoint on Main St, near Graiguenamanagh Bridge, looks south-west along the access route towards The Dock and the Community Hub, which also forms part of wider walking trails such as the South Leinster Way. The walls associated with the bridge and the unoccupied building on the corner are also visible from this location. The gates, walls, lighting, caravans within The Dock and the Community Hub are visible from this location. The mature trees within this area screens views of the wider landscape apart from a partial view of the higher lands west of the town.

11.6.43 **Proposed Changes and Visual Impact:** It is anticipated that from this location, the flood wall that is proposed to the south of this route and the tree planting to the north of this route will be visible. Several trees within The Dock and the Community Hub will need to be removed to facilitate the construction of the flood defence wall, the extents of this tree removal are also shown in this photomontage.

11.6.44 **Construction Phase:** During the construction phase, due to the presence of construction traffic, machinery, site hoarding and other construction related works, it is likely that there will be **temporary, moderate and negative** impact on views from this location

11.6.45 **Operational Phase:** It is anticipated that during the operational phase due to the choice of materials for the flood defence walls and surfaces and the continued access to the amenities in this area, the impacts on views from this area will be **slight and negative** in the short term and will lessen to **not significant and negative** in the long term as the proposed planting becomes established and the existing trees and hedgerows continue to mature.



Plate 11-9: Visual 5 - Existing



Plate 11-10: Visual 5 – Proposed

Visual 6: From Graiguenamanagh Bridge looking north-east (looking towards Area 5: Boat Club & Area 6: Graiguenamanagh Quay)

11.6.46 **Existing View:** The elevated position of this viewpoint at the central location of the bridge affords views of the river, Graiguenamanagh Quay, including the buildings fronting onto the river, the Supervalu car park and the boathouse/ scout hall. The two-way road, street

parking, mooring boats, bollards, lighting are also visible from this location. Duiske Abbey, the buildings and the mature treeline on the higher lands within Whitehall to the east of the town centre are also defining features in the view from this location.

11.6.47 **Proposed Changes and Visual Impact:** It is anticipated that the most discernible changes from this viewpoint will be the flood defence walls and gates that are proposed along much of the quay. The proposed tree planting, seating and the changes to the levels and car park by the boat house/ scout hall will also be visible from this location. It is intended that the views from this location, of the elevated lands east of the town and the wider landscape will not be affected by the flood defence or public realm proposals.

11.6.48 **Construction Phase:** During the construction phase, due to the presence of construction traffic, machinery, site hoarding and other construction related works, it is likely that there will be **temporary**, **moderate-significant and negative** impact on views from this location

11.6.49 **Operational Phase:** It is likely that views from this area, of the important features of the townscape such as the Duiske Abbey and buildings fronting onto the river and wider views of the surrounding landscape including river and the tree covered higher lands east of the town, will not be significantly impacted. The proposed works have the potential to have a **slight and negative** impact in the short term, as the proposed tree planting becomes more established the impact will continue to lessen in the long term to **not significant and negative**.



Plate 11-11: Visual 6 - Existing



Plate 11-12: Visual 6 – Proposed

Visual 7: From (Area 8) The Hub lands, looking south-east

11.6.50 **Existing View:** The roads, caravan parking bays, pathways, pumping station and the trees associated with the Community Hub are visible from this location. There are some filtered views through the trees of river and the boats moored along its edges.

11.6.51 **Proposed Changes and Visual Impact:** The proposed flood defence embankment, wall and associated guardrail will be likely be noticeable changes from this location. The extents of tree removal to facilitate the construction of the flood defence embankment and wall, will also be discernible from this location. The proposed tree and shrub planting and the realignment of the internal (maintenance/ emergency) road and the pathway will be visible from this location.

11.6.52 **Construction Phase:** It is anticipated that during the construction phase of the project that impacts on views from this area will be **temporary**, **moderate-significant and negative** due to the loss of vegetation, ground disturbances and the presence of construction machinery, traffic, site hoarding and other construction related works.

11.6.53 **Operational Phase:** The proposed works have the potential to have a **slight and negative** impact in the short term, as the proposed tree, hedge and shrub planting becomes more established the impact will continue to lessen to **not significant and negative** in the long term.



Plate 11-13: Visual 7 - Existing



Plate 11-14: Visual 7 – Proposed

Visual 8: From Turf Market bridge, looking south-east (from Area 3: Turf Market looking towards Area 4: Turf Market to The Hub (Lower Turf Market)

11.6.54 **Existing View:** The location of this viewpoint, on a bridge over the River Duiske (near Market Square) looking south towards the River Barrow, affords views of the rear of the buildings that back onto the river. The self-seeded vegetation that has grown along the

river's edge, and the trees located along the River Barrow within 'The Dock' area, screens views of the wider landscape.

11.6.55 **Proposed Changes and Visual Impact:** The removal of the existing vegetation along the river edge to facilitate the construction of the flood defence walls to the rear of these buildings, will likely be the most visible change from this location. However, the existing mature trees that line River Barrow will form the background and will continue to screen further views of the wider landscape from this area.

11.6.56 **Construction Phase:** It is anticipated that during the construction phase of the project that impacts on views from the Turf Market area will be **temporary**, **slight-moderate and negative** due to the loss of vegetation and the presence of construction machinery and other construction related works.

11.6.57 **Operational Phase:** The proposed works have the potential to have a **slight and negative** impact in the short term, as the existing vegetation continue to mature the impact will continue to lessen to **not significant and negative** in the long term.



Plate 11-15: Visual 8 - Existing



Plate 11-16: Visual 8 – Proposed

Visual 9: From High Street Bridge over the River Duiske (Area 3: Turfmarket), looking south

11.6.58 **Existing View:** The location of this viewpoint at the bridge looking south along the River Duiske allows view of the various dwellings that back onto the river. The self-seeded trees and shrubs located on both side of the river filters views of the river itself and the private bridges/ access points to the rear of these properties. The tree covered foothills and lower section of Brandon Hill are also visible in the distant background from this location.

11.6.59 **Proposed Changes and Visual Impact:** The clearance of the exiting vegetation and the construction of flood defence wall and augmentation to the existing private bridges and rear walls, will increase the visibility of the river and rear of the buildings that back onto the River Duiske.

11.6.60 **Construction Phase:** It is anticipated that during the construction phase of the project that impacts on views from this part of the Turf Market area will be **temporary**, **moderate and negative** due to the loss of vegetation and the presence of construction machinery and other construction related works.

11.6.61 **Operational Phase:** The proposed works have the potential to have a **slight** and **negative** impact in the short term, as the existing vegetation continues to mature the impact will continue to lessen to **not significant** and **negative** in the long term.



Plate 11-17: Visual 9 - Existing



Plate 11-18: Visual 9 – Proposed

Visual 10: From High Street Bridge over the River Duiske (Area 2: Well Lane to High St. Bridge), looking north

11.6.62 **Existing View:** The location of this visual is from the other side of the bridge that is shown on Visual 9. The weir at the bend in the River Duiske, the stone walls and buildings that back onto the river, are the dominant features from this location and screen views of the

wider area. The pedestrian route linking Main St. to the Clapper Bridge to the west and terrace seating relating to Mick Doyle's public house are also visible from this location.

11.6.63 **Proposed Changes and Visual Impact:** The changes shown in this visual illustrate the proposed increase in height of the wall along the river edge, the reinstated planting area beside the steps at Mick Doyles and the replacement pedestrian bridge linking both sides of the river.

11.6.64 **Construction Phase:** It is anticipated that during the construction phase of the project that impacts on views from this location will be **temporary**, **moderate and negative** due to the presence of construction machinery and other construction related works.

11.6.65 **Operational Phase:** The proposed works have the potential to have a **slight and negative** impact in the short term, as the proposed planting becomes more established the impact will continue to lessen to **not significant and negative** in the long term.



Plate 11-19: Visual 10 - Existing



Plate 11-20: Visual 10 – Proposed

Visual 11: From Graiguenamanagh Bridge looking south (towards Area 10: Tinnahinch Quay)

11.6.66 **Existing View:** The elevated position of this viewpoint on the bridge affords views of the River Barrow, the weir and the boats moored along Tinnahinch Quay, and the dense vegetation located with The Dock area of Graiguenamanagh. The buildings, car parking and fields fronting onto the River Barrow and those along St. Mullins Road are also visible from this location. Brandon Hill and the tree covered lower slopes are visible in the background from this position on Graiguenamanagh Bridge.

11.6.67 **Proposed Changes and Visual Impact:** It is anticipated that the most discernible changes from this location will be the flood wall and gates proposed along Tinnahinch Quay, which will be just visible above the existing wall. A large birch tree that is located just west of the last house along the quay will likely need to be removed to facilitate the construction of the flood wall, that will replace the existing boundary wall to this dwelling.

11.6.68 **Construction Phase:** It is anticipated that during the construction phase of the project that impacts on views from the bridge will be **temporary**, **moderate-significant and negative** due to the loss of vegetation, ground disturbances and the presence of construction machinery, traffic, site hoarding and other construction related works.

11.6.69 **Operational Phase:** It is likely that views from the bridge, of the important features of the townscape such as the quay, buildings fronting onto the river, weir and wider views of the surrounding landscape including river, the higher tree covered lands to the south and Brandon Hill, will not be significantly impacted. The proposed works have the potential to have a **slight and negative** impact in the short term, due to the loss of vegetation and height of flood defence wall, as the existing vegetation continues to mature and the

proposed planting becomes established the impact will continue to lessen in the long term to **not significant and negative.**



Plate 11-21: Visual 11 - Existing



Plate 11-22: Visual 11 – Proposed

Visual 12: From The Quay Tinnahinch (Area 10), near the junction with Main St., looking west

11.6.70 **Existing View:** The location of this viewpoint along Tinnahinch Quay permits views of the car parking area, the boats moored along the navigable section of the river, the weir and the mature vegetation on both sides of the River Barrow. There are also views of the structures, the lock on the river at Tinnahinch Castle and the riverside pathway that forms part of wider walking trails such as the Barrow Way. There are also glimpsed views of dwellings within the elevated lands of Brandondale, including Brandondale House. The tree covered lower slopes of Brandon Hill are visible in the background rom this location.

11.6.71 **Proposed Changes and Visual Impact:** The proposed reconfiguration of the car park, pedestrian route and flood wall will likely be the most visible changes from this location along Tinnahinch Quay. Another noticeable change may be the removable of a large birch tree that is located just west of the last house along the quay will likely need to be removed to facilitate the construction of the flood wall, that will replace the existing boundary wall to this dwelling.

11.6.72 **Construction Phase:** It is anticipated that during the construction phase of the project that impacts on views from this location will be **temporary**, **moderate-significant and negative** due to the loss of vegetation and the presence of construction machinery, traffic, site hoarding and other construction related works.

11.6.73 **Operational Phase:** It is anticipated that during the operational phase, while the proposed flood defence wall will be slightly higher than the existing quay wall and will have an impact on views from this area. However, with the sympathetic choice of materials e.g. wall, surfaces, the reconfiguration of the car park and the segregation of the pedestrian route may result in a more attractive pedestrian friendly route along the river edge, while still maintaining access to the boats moored along the river. It is likely that views from this area, of the important features of the townscape such as the weir and buildings and wider views of the surrounding landscape including the verdant edges to the river, lock and the higher tree covered lands south of the town will not be significantly impacted.

11.6.74 The proposed works have the potential to have a **slight and negative** impact in the short term, due to the loss of vegetation and height of flood defence wall, as the existing vegetation continues to mature and the proposed planting becomes established the impact will continue to lessen in the long term to **not significant and negative.**



Plate 11-23: Visual 12 - Existing



Plate 11-24: Visual 12 – Proposed

Visual 13: From Graiguenamanagh Bridge looking east (towards Area 9: Hotel Street)

11.6.75 **Existing View:** From this location on Graiguenamanagh Bridge there are views of the River Barrow, boats moored on both sides, and Main St., Tinnahinch. The large field in front of the dwellings accessed off Hotel Road and the amenity riverside pathway that forms part of the South Leinster Way and the Barrow Way, are also visible from this location. The tree

covered lands within the Whitehall area, west of the river and within the Tinnahinch/Harristown area, east of the river are visible in the background from this location.

11.6.76 **Proposed Changes and Visual Impact:** It is anticipated that the most visible changes from this location will be the flood embankment and associated fencing and maintenance track that are proposed within the large field that fronts onto the river. Another visible change may be the removal of a tree near Main St., to facilitate the construction of the flood embankment.

11.6.77 **Construction Phase:** It is anticipated that during the construction phase of the project that impacts on views from this area will be **temporary**, **moderate-significant and negative** due to the loss of vegetation, ground disturbances and the presence of the construction compound, construction machinery, traffic, site hoarding and other construction related works.

11.6.78 **Operational Phase:** The proposed works have the potential to have a **slight and negative** impact on views from this area.



Plate 11-25: Visual 12 - Existing



Plate 11-26: Visual 12 – Proposed



Figure 11-20: Viewpoint Location Map – Long Range

Visual 14: From viewing point on the Thomastown/ Graiguenamanagh Road (R703), Tikerlevan, looking south-east

11.6.79 **Existing View:** The location of this view at the designated viewing point on the Thomastown/ Graiguenamanagh Road (R703) represents the protected view V1 (views east and south over the Barrow Valley) listed in the KDP 2021-2027 (Table 11.9) and shown on Figure 11.16. This view towards Graiguenamanagh, affords views of the agricultural fields located on the sloping lands either side of the River Duiske and within the wider Barrow Valley landscape. The fields are subdivided by hedgerows of varying levels of size

and maturity and there are also areas of woodland and scrub vegetation located along the River Duiske. While the town centre of Graiguenamanagh-Tinnahinch is not visible from this viewing point due its location on the lower lands within the Barrow Valley, some of dwellings located on the higher lands west of town are visible in the distance from this location. From this viewpoint point, the Blackstairs Mountains are a dominant feature in the background, enclosing the Barrow Valley landscape.

11.6.80 **Proposed Changes and Visual Impact:** Due to the intervening topography and vegetation located between the proposed flood defence measures and this viewpoint, it is anticipated that the proposed works will not be visible from this location.

11.6.81 **Construction Phase and Operational Phase:** During the construction and operational phases, it is anticipated that the proposed works will not be visible from this location and therefore the visual impact will be **imperceptible and neutral**.



Plate 11-27: Visual 14 - Existing

Visual 15: From Graiguenamanagh/Ullard Road, Knockbodaly looking south

11.6.82 **Existing View:** The location of this view on the Graiguenamanagh/Ullard Road (LS8221) represents the protected view V3 (views east and south-east over the Barrow Valley) listed in the KCDP 2021-2027 (Table 11-8: Protected Views, relevant to the scheme area (Source: Kilkenny County Development Plan 2021-2027)Table 11-8) and shown on Figure 11-14. This location affords views of the steeply sloping land within the Barrow Valley and of Brandon Hill as the dominant feature along the skyline. The wooded area located along the river and known as Silaire Wood is evident from this viewpoint. There are glimpsed views of the River Barrow through breaks in the trees from this elevated position also.

11.6.83 **Proposed Changes and Visual Impact:** Due to the intervening topography and vegetation located between the proposed flood defence measures and this viewpoint, it is anticipated that the proposed works will not be visible from this location.

11.6.84 **Construction Phase and Operational Phase:** During the construction and operational phases, it is anticipated that the proposed works will not be visible from this location and therefore the visual impact will be **imperceptible and neutral.**



Plate 11-28: Visual 15 – Existing

Visual 16: From viewpoint point on the Graiguenamanagh/New Ross Road (R705), Ballinvarry, looking north

11.6.85 **Existing View:** The location of this view at the designated viewing point on the Graiguenamanagh/New Ross Road (R705) represents the protected view V2 (views east over the Barrow Valley & St. Mullins) listed in the KCDP 2021-2027 (Table 11-8) and shown on Figure 11-14. This viewpoint affords views of the Barrow Valley, with glimpsed views of the river through the gaps in the woodlands that line much of the river's banks. The Blackstairs Mountains are also visible in the background.

11.6.86 **Proposed Changes and Visual Impact:** Due to the intervening topography and vegetation located between the proposed flood defence measures and this viewpoint, it is anticipated that the proposed works will not be visible from this location.

11.6.87 **Construction Phase and Operational Phase:** During the construction and operational phases, it is anticipated that the proposed works will not be visible from this location and therefore the visual impact will be **imperceptible and neutral.**



Plate 11-29: Visual 16 - Existing

Visual 17: From Carrigleade, along scenic route (L3008), looking north-west

11.6.88 **Existing View:** The location of this view on the Knockeen Road (L3008), which links Tinnahinch to St. Mullins, represents the scenic route 15 (views west towards Barrow Vallet and Kilkenny Hills) listed in the CCDP 2022-2028 (Table 11-9) and shown on Figure 11-7 and Figure 11-8. The agricultural fields located on the steeply sloping land either side of the River Barrow are a distinguishing feature within this area. The dwellings located on the higher lands near Tinnahinch and Graiguenamanagh are also visible from this location. This route also affords views of the agricultural fields and forested areas on the higher lands at Glencoum, in the distant background.

11.6.89 **Proposed Changes and Visual Impact:** Due to the intervening topography and vegetation located between the proposed flood defence measures and this viewpoint, it is anticipated that the proposed works will not be visible from this location.

11.6.90 **Construction Phase and Operational Phase:** During the construction and operational phases, it is anticipated that the proposed works will not be visible from this location and therefore the visual impact will be **imperceptible and neutral.**



Plate 11-30: Visual 17 - Existing

Aerial/ Drone Images (unverified):

11.6.91 Due to the elevated position of the aerial images, they obviously do not represent a viewpoint that can be experienced by the public and as they are unverified it means that they cannot form part of the visual assessment. These images have been included for the purposes of assisting with the interpretation of the flood defence proposals in the various areas.



Figure 11-21: Viewpoint Location Map – Aerial/ Drone Images

Drone Image 1: View of the flood storage area at Tinnapark, looking north-west

11.6.92 **Existing View:** The location of this drone image affords views over the Duiske valley at Tinnapark and the farms and the agricultural fields bound by hedgerows associated with

this area. This location also allows views of the fields and forested areas on the higher lands at Glencoum and Coppanagh, in the distant background.

11.6.93 **Proposed Changes:** The drone images due to their elevated position obviously do not represent a viewpoint that can be experienced by the general public and are included for the purposes of explaining the flood defence proposals in this area.

11.6.94 It is anticipated that the main visual changes associated with the proposed flood storage area such as:

- Raised earthfill impoundment structure
- Concrete flow control structure and spillway
- Stepped route over the embankment
- New access road
- Tree planting along the access road
- Diversion of ESB lines - removal of the above ground electrical cables and the associated electrical poles, to underground route.



Plate 11-31: Drone Visual 1 – Existing



Plate 11-32: Drone Visual 1 - Proposed



Plate 11-33: Drone Visual 1 – Proposed Flooded

Drone Image 2: View from over the Community Hub area, looking east

11.6.95 **Existing View:** The location of this aerial image permits views of the weir on the River Barrow, Graiguenamagh Bridge, Tinnahinch Quay, the buildings, fields and wooded areas within Tinnahinch north of the bridge. The Blackstairs Mountains are also visible in the distant background.

11.6.96 **Proposed Changes:** It is anticipated that this aerial image would afford views of the flood defence and public realm proposals along Tinnahinch Quay. The flood defence embankment proposed within the field accessed off Hotel Street would also be visible from this viewpoint.



Plate 11-34: Drone Visual 2 - Existing



Plate 11-35: Drone Visual 2 - Proposed

Drone Image 3: View over Hotel St., Tinnahinch, looking north

11.6.97 **Existing View:** This aerial view affords views over the large riverside field that is accessed off Hotel Street. The northern and western extents of Graiguenamagh town are visible from this area, including the Quay, the Boat Club and Duiske Abbey. The elevated lands at Glencoum and Mountneilll are also visible in the background.

11.6.98 **Proposed Changes and Visual Impact:** It is anticipated that the location of the image would permit views of the raised embankment (flood defence proposals) within the field accessed off Hotel Street. The flood defence and public realm proposals, such as flood walls, raised land, road realignment, resurfacing works and tree planting along Graiguenamagh Quay and at the Boat Club may also be visible from this location.



Plate 11-36: Drone Visual 3 - Existing



Plate 11-37: Drone Visual 3 - Proposed

11.7 Mitigation Measures

11.7.1 Consideration was given to the avoidance of impacts wherever possible during the design of the Proposed Scheme. However, as with any development some degree of impact is inevitable. Mitigation measures have been incorporated into the scheme design with the inclusion of glass panels and sympathetic finishes, as well as public realm measures. Wherever possible measures have been proposed to mitigate the adverse nature of these impacts.

Construction Phase

11.7.2 It is proposed that careful attention will be paid to avoiding any potentially adverse construction-related effects on the adjacent residences, rivers, local amenities and the wildlife within the scheme area.

LV_1: Operating a well-managed, organised and planned construction site, with adequate control of construction traffic and working activity, is key to avoiding/minimising such impacts. Daily inspections of site and compounds will be undertaken the site manager to ensure they are tidy.

LV_2: Any lighting required during the construction phase should be located sensitively to avoid unnecessary light spill into the surrounding residential areas, river corridors and into woodlands.

LV_3: The construction works, and the habitat protection measures will be carried out in accordance with measures outlined by the project ecologist and KCC.

LV_4: Existing woodlands, trees and hedgerows to be retained should be protected in accordance with the project arboriculturist recommendations for the full duration of the construction phase e.g. tree protection fencing and no structures, storage of materials or change in ground levels should take place within the tree's root protection areas (RPA). Refer to Chapter 10 – Biodiversity for further details.

LV_5: Following the construction phase, the lands used as site compounds will be restored to their original state e.g. amenity grass lands, grazing lands. Refer to Chapter 10 – Biodiversity for further details.

Operational Phase

11.7.3 The careful and considered approach to the proposed works is to minimise negative visual impact both locally and from the wider surrounding area. The landscape strategy below details the landscape proposals that will assist in mitigating the landscape and visual impacts of the proposed works (should be read in conjunction with the landscape drawings). The key objectives include:

LV_6: Retention and protection of the vegetation along river edges and existing field boundaries where possible.

- This helps to retain a mature, established character to the area and provide a unifying, cohesive landscape framework that relates it to the surrounding landscape and its context, as well as being of ecological benefit.

- Generally, this will involve retention of mature good quality trees within the woodlands, tree belts and hedgerows (as outlined in Chapter 10 – Biodiversity and the Arboricultural Report – Appendix 10-11).

- The design of the flood defence proposals have, where possible, attempted to avoid negative impacts on the existing field boundaries to ensure the retention of the vegetation where possible and to retain the historical patterns of the landscape.

11.7.4 Integration of the flood defence proposals into the surrounding townscape and landscape, minimising landscape and visual impacts, in particular upon nearby residential dwellings, protected views/ scenic routes, views to and from the River Barrow and the various regional and national walking trails. This is largely to be achieved by:

LV_7: Considered approach to the siting and extents of the flood defence proposals, such as aligning flood walls in place of existing walls or following existing boundaries; glazed panels within the walls to facilitate views to and from the river and to assist in retaining the open character of the quays.

LV_8: Planting programme with native species wherever possible, within the scheme area - Planting of trees to compensate for the loss of trees removed due to the proposed works and/ or to assist in the integration of flood defence proposals into the surrounding landscape or town environs. New tree planting is not always possible where it is determined the trees may compromise the flood defence proposals in the future or at times of flooding. Proposed flood defence embankments are to be planted with wildflower meadows wherever possible to assist in their integration into the surrounding landscape. Refer to Chapter 10 – Biodiversity for further details.

LV_9: Utilising materials (e.g. paving, wall cladding) and street furniture that are sympathetic to or from the locality and do not detract from existing significant features or historical structures (in consultation with KCC and CCC).

LV_10: Working with the existing topography of the scheme area as much as possible.

LV_11: Improving pedestrian movement within the town and links to the wider walking trails (e.g. South Leinster Way and the Barrow Way), through segregating pedestrians and vehicles, narrowing road corridor (changing from two-way to one-way system) along Graiguenamanagh Quay, clearly demarked pedestrian route, designated crossing points.

11.8 Monitoring

11.8.1 Construction Phase: Monitoring, particularly during construction phase will be on an ongoing basis and will be crucial at certain stages such as:

- During site establishment stage: prior to any works taking place, clearly identify trees and hedgerows that are to be retained and protected – ensuring tree protection measures are in place. Clearly identify trees and hedgerows that are to be removed.

- During site excavation stage: ensure existing vegetation is being adequately protected and that topsoil is being correctly stripped and stored for landscape reinstatement

- During construction stage: ensure existing vegetation is being adequately protected.

11.8.2 Operational Phase/ Post-construction stage:

- Periodic visits will be required to ensure that the existing woodlands, trees and hedgerows have not been negatively impacted by the construction works.

- Periodic visits will also be required for one year to ensure the successful establishment of the proposed planting and to recommend replacement planting where necessary.

11.9 Residual Impacts and Effects

11.9.1 It is anticipated that after the mitigation measures have been implemented and as the proposed planting matures, which will assist in the integration of the proposed flood defence measures into the surrounding townscape and landscape, that the residual landscape and visual impacts will range from **imperceptible and neutral to slight-moderate and negative**.

11.10 Interactions with other Environmental Effects

11.10.1 Interactions with Cultural Heritage (Chapter 9) comprise the potential for impacts to setting and visual amenity of cultural heritage receptors. Consultation between both disciplines has taken place with regard to potential impacts of the built heritage of G-T. Photomontages (PM01-PM13) demonstrate the level of change to the receiving historic environment and views and how public realm proposal seek to address this. Conservation measures such as the careful choice of material to be used to reflect the existing built heritage environment or introduce a new tone, the use of stone clad walling and flood proofing buildings with traditional materials and mortar to assist in their protection and preservation all seek to preserve and enhance the historic townscape and riverscape of the town.

11.10.2 In terms of Population and Human Health (Chapter 6), there will be some impact on visual amenity during construction for residents living close to the scheme particularly those at Turf Market and customers at the Boat Club. In the operation phase, public realm works at the Quays and the Dock will be most noticed locally. The public realm also opens the Quays for pedestrians but still allows the movement and parking of vehicles through the townlands, providing services for the tourism sector.

11.10.3 With regards to interaction with Biodiversity (Chapter 10), the construction of the scheme requires some tree removal which will impact upon flora and fauna. Native tree and plant species will be planted in the upstream storage area, as well as where public realm works are taking place. Any lighting required during the construction phase will be located sensitively to avoid unnecessary light spill into the surrounding river corridors and into woodlands. Landscaping proposed as part of the public realm improvements will have biodiversity benefit, providing further foraging, nesting and pollinating potential.

11.11 Cumulative Impacts

11.11.1 The projects whose duration of permission overlaps with the likely construction period of the proposed development (i.e., 2026 onwards) are included in developments listed in Chapter16 'Interactions and Cumulative Effects' of this EIAR have been reviewed for potential cumulative impacts.

11.11.2 No cumulative impacts to Landscape and Visual have been identified in the Proposed Scheme.

11.12 Limitations in Preparing this Chapter

11.12.1 There were no limitations encountered in the preparation of this chapter.

11.13 Summary

Table 11-11: Summary of Impacts and Mitigation Measures: Landscape & Visual

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post-Mitigation
'Do Nothing' Scenario Impacts						
Landscape character and visual amenity of the scheme area would remain unchanged and would evolve on current trends. During flood events public open spaces, agricultural lands and buildings would continue to flood, resulting in possible damage to structures and vegetation and limited access to public amenity spaces, resulting in negative impacts on the landscape and visual amenity in the short term.	Public open spaces, agricultural lands and buildings within predicted flood areas.	Low-Medium	Medium	Moderate-Significant and Negative. Temporary during potential flood events	Not applicable.	Moderate-Significant and Negative
Construction Phase Impacts						
Potential impacts on character of the local landscape: • the scale of the proposed flood defence measures • the loss of vegetation and ground disturbances • the presence of construction machinery, traffic, cranes, lighting and construction compound.	**Landscape Character** - Area 1: Upstream storage area	Low	Medium	Temporary, moderate-significant and negative	• Good housekeeping with daily inspections of site compounds by the site manager. • Sensitive lighting placement • Implementing biodiversity and habitat protection mitigation • Protection of existing woodlands, trees and hedgerows. • Restoring lands to original state after use as site compound.	Temporary, moderate-significant and negative
• Changes to townscape public realm – road and pathways	**Landscape Character** - Area 2, Area	Medium - High	Medium	Temporary, moderate-		Temporary, moderate-

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post-Mitigation
• The loss of vegetation and ground disturbances • The presence of construction machinery, traffic, cranes, lighting and construction compound.	3 Area 4, Area 5, Area 6, Area 10			significant and negative		significant and negative
• The presence of construction machinery, traffic, cranes and lighting.	**Landscape Character** - Area 7: The Dock & Area 8: The Hub	Low	Medium	Temporary, moderate and negative		Temporary, moderate and negative
• The loss of vegetation and ground disturbances • The presence of construction machinery, traffic, cranes, lighting and construction compound.	**Landscape Character** - Area 9: Hotel St	Low - Medium	Low - Medium	Temporary, moderate and negative		Temporary, moderate and negative
Changes to **visual amenity** due to: • Temporary construction compounds and construction routes • Temporary site works – hoarding, lighting, cranes, car parking, storage areas • Construction traffic – dust and emissions • Tree and vegetation clearance	**Visual amenity** – Visual 1: Area 5 - Boat Club	Medium	Medium	Temporary, moderate and negative		Temporary, moderate and negative
	Visual amenity – Visual 2: Area 6 - Graig. Quay	Medium	Medium	Temporary, moderate and negative		Temporary, moderate and negative

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post-Mitigation
• Groundworks – excavations, ground raising • Laying of foundations (e.g. walls) and site services	**Visual amenity** – Visual 3: Area 6 - Graig. Quay	High	Medium	Temporary, moderate-significant and negative		Temporary, moderate-significant and negative
	Visual amenity – Visual 4: Area 6 - Graig. Quay	High	Medium	Temporary, moderate-significant and negative		Temporary, moderate-significant and negative
	Visual amenity – Visual 5: Area 4 – Lower Turf Market	Low	Low	Temporary, moderate and negative		Temporary, moderate and negative
	Visual amenity – Visual 6: Area 5 - Boat Club & Area 6 – Graig. Quay	High	Medium	Temporary, moderate-significant and negative		Temporary, moderate-significant and negative
	Visual amenity – Visual 7: Area 8 – The Hub	Low	Medium	Temporary, moderate-significant and negative		Temporary, moderate-significant and negative
	Visual amenity – Visual 8:	Low	Low	Temporary, slight-		Temporary, slight-

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post-Mitigation
	Areas 3 & 4 - Turfmarket			moderate and negative		moderate and negative
	Visual amenity – Visual 9: Area 3 - Turfmarket	Low	Low	Temporary, moderate and negative		Temporary, moderate and negative
	Visual amenity – Visual 10: Area 2 – Well Lane	Low - Medium	Low	Temporary, moderate and negative		Temporary, moderate and negative
	Visual amenity – Visual 11: Area 10 – Tinnahinch Quay	High	Low	Temporary, moderate-significant and negative		Temporary, moderate-significant and negative
	Visual amenity – Visual 12: Area 10 – Tinnahinch Quay	Medium-High	Low	Temporary, moderate-significant and negative		Temporary, moderate-significant and negative
	Visual amenity – Visual 13: Area 9 – Hotel Street	Medium-High	Low	Temporary, moderate-significant and negative		Temporary, moderate-significant and negative

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post-Mitigation
	Visual amenity – Visual 14: Protected View 1 (KDP)	High	Negligible	Imperceptible and neutral		Temporary, imperceptible and neutral
	Visual amenity – Visual 15: Protected View 3 (KDP)	High	Negligible	Imperceptible and neutral		Temporary, imperceptible and neutral
	Visual amenity – Visual 16: Protected View 2 (KDP)	High	Negligible	Imperceptible and neutral		Temporary, imperceptible and neutral
	Visual amenity – Visual 17: Scenic Route 15 (CCDP)	High	Negligible	Temporary, imperceptible and neutral		Temporary, imperceptible and neutral
The extents of existing trees and hedgerows that will need to be removed to facilitate the construction of the flood defence proposals.	Impact on **Existing Trees & Hedgerows**	Medium-High	Medium - High	Permanent, moderate to high (as per Chapter 10)	Tree protection fencing and onsite monitoring by arboriculturist (refer to Chapter 10 'Biodiversity' for further details)	Permanent, moderate to high (as per Chapter 10)
Operation and Maintenance Phase Impacts						
The visual impact of the proposed flood defence measures and the landscape design.	**Landscape Character** - Area 1: Upstream storage area	Low	Medium	Slight-moderate and negative	• Road and associated services into the surrounding landscape, tree, hedge, planting and wildflower meadows have been proposed where feasible	Slight-moderate and negative - will lessen as the existing

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post-Mitigation
					• New tree planting is not always possible where it is determined the trees may compromise the proposed flood defence proposals in the future or at times of flooding. • Limited space for proposed planting, therefore dependent on the continuing maturing of the existing vegetation in this area.	vegetation continues to mature
Localised impacts on the townscape including changes to the road layout, changes to the public realm and the visual impact of the proposed flood defence measures.	**Landscape Character** - Area 2, Area 3 Area 4, Area 5, Area 6, Area 10	Medium - High	Medium	Permanent, slight and negative	• Design sympathetic to or from the locality and do not detract from existing significant features or historical structures, have been proposed. • Glazed panels have been proposed to minimise the visual and physical impact of the proposed walls, • Siting and extents of the flood defence walls followed the current alignment of existing walls or boundaries.	Permanent, slight and negative
Localised impacts on the townscape/ landscape as a result of the proposed flood defence measures as well as the removal of trees and realignment of public and emergency access.	**Landscape Character** - Area 7: The Dock & Area 8: The Hub	Low	Medium	Not significant and negative, in the short term	Proposed tree, hedge and shrub planting and wildflower meadows.	Imperceptible and neutral, in the long term
Localised impacts on the townscape/landscape as a result of the	**Landscape Character** -	Low - Medium	Low - Medium	Slight and negative	N/A	Slight and negative

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post-Mitigation
proposed flood defence measures as well as the removal of trees.	Area 9: Hotel St					
The principal elements which are likely to give rise to landscape and visual impact visual impact in the long term are: • Changes to road layout along Graiguenamanagh Quay • Alterations to ground levels • Height of proposed or amended walls • New structures, lighting, boundaries and pathways • Proposed tree and shrub planting • Flood storage area – embankments; concrete flow control structure; spillway; access road; lighting	**Visual impacts** - General/ All areas				• Retention and protection of the vegetation along river edges and existing field boundaries where possible. • Considered approach to the siting and extents of the flood defence proposals, including glazed panels • Planting programme with native species wherever possible. • Utilising materials (e.g. paving, wall cladding) and street furniture that are sympathetic to or from the locality and do not detract from existing significant features or historical structures. • Working with the existing topography of the scheme area as much as possible. • Improving pedestrian movement within the town and links to the wider walking trails.	
Views of the proposed flood defence walls and gates around the boathouse, the reconfigured car park and the pedestrian route.	**Visual amenity** – Visual 1: Area 5 - Boat Club	Medium	Medium	Slight and negative	• To minimise the visual impacts of the flood defence proposals and to assist in their successful integration into the surround townscape, the materials chosen e.g. stone	Slight and negative

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post-Mitigation
					cladding to walls are intended to be sympathetic to the existing structures. • Glazed panels are proposed within the flood defence walls and gates in order to reduce the visual impact of the wall and to facilitate views from the boathouse towards the river. • A new seat wall is also proposed for the same extents of the current seating area in order to retain the current level of amenity.	
Views of defences and landscape design/public realm	**Visual amenity** – Visual 2: Area 6 - Graig. Quay	Medium	Medium	Slight and negative	Glazed panels are proposed within the flood defence walls and gates in order to reduce the visual impact of the wall and to facilitate views towards the river.	Slight and negative
Views of defences and landscape design/public realm, as well as changes to road surfaces and systems.	**Visual amenity** – Visual 3: Area 6 - Graig. Quay	High	Medium	Slight and negative	• Glazed panels are proposed within the flood defence walls and gates in order to reduce the visual impact of the wall and to facilitate views towards the river. • Narrowing of the vehicular route along the quays, the introduction of trees and additional seating may result in a more attractive pedestrian friendly route along the river edge.	Not significant and negative

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post-Mitigation
Views of defences and landscape design/public realm, as well as changes to road surfaces and systems, and electrical kiosk.	**Visual amenity** – Visual 4: Area 6 - Graig. Quay	High	Medium	Slight-moderate and negative	• Glazed panels are proposed within the flood defence walls and gates in order to reduce the visual impact of the wall and to facilitate views towards the river. • Narrowing of the vehicular route along the quays, the introduction of trees and additional seating may result in a more attractive pedestrian friendly route along the river edge.	Slight and negative
Visual changes as a result of proposed flood defence measures and tree removal.	**Visual amenity** – Visual 5: Area 4 – Lower Turf Market	Low	Low	Slight and negative	• Proposed tree planting	Not significant and negative
Views of defences and landscape design/public realm.	**Visual amenity** – Visual 6: Area 5 - Boat Club & Area 6 – Graig. Quay	High	Medium	Slight and negative	• Glazed panels are proposed within the flood defence walls and gates in order to reduce the visual impact of the wall and to facilitate views towards the river. • Proposed tree planting	Not significant and negative
Views of defences and landscape design/public realm.	**Visual amenity** – Visual 7:	Low	Medium	Slight and negative	• Proposed tree, hedge, shrub planting & wildflower meadow.	Not significant and negative

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post-Mitigation
	Area 8 – The Hub					
Views of defences, landscape design/public realm and tree removal.	**Visual amenity** – Visual 8: Areas 3 & 4 - Turfmarket	Low	Low	Slight and negative	• Maturing and regeneration of existing vegetation	Not significant and negative
Views of defences, landscape design/public realm and tree removal.	**Visual amenity** – Visual 9: Area 3 - Turfmarket	Low	Low	Slight and negative	• N/A	Not significant and negative
Views of defences and landscape design/public realm.	**Visual amenity** – Visual 10: Area 2 – Well Lane	Low - Medium	Low	Slight and negative	• Proposed planting	Not significant and negative
Views of defences, landscape design/public realm and tree removal.	**Visual amenity** – Visual 11: Area 10 – Tinnahinch Quay	High	Low	Slight and negative	• Maturing and regeneration of existing vegetation • Proposed planting	Not significant and negative
Views of defences, reconfigured carpark, landscape design/public realm and tree removal.	**Visual amenity** – Visual 12: Area 10 – Tinnahinch Quay	Medium-High	Low	Slight and negative	• Maturing and regeneration of existing vegetation • Proposed planting • Sympathetic choice of construction materials.	Not significant and negative

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post-Mitigation
Views of defences, reconfigured carpark, landscape design/public realm and tree removal.	**Visual amenity** – Visual 13: Area 9 – Hotel Street	Medium-High	Low	Slight and negative	N/A	Slight and negative
The proposed works will not be visible from these locations.	**Visual amenity** – Visual 14: Protected View 1 (KDP)	High	Negligible	Imperceptible and neutral	N/A	Imperceptible and neutral
	Visual amenity – Visual 15: Protected View 3 (KDP)	High	Negligible	Imperceptible and neutral	N/A	Imperceptible and neutral
	Visual amenity – Visual 16: Protected View 2 (KDP)	High	Negligible	Imperceptible and neutral	N/A	Imperceptible and neutral
	Visual amenity – Visual 17: Protected Scenic Route 15 (CCDP)	High	Negligible	Imperceptible and neutral	N/A	Imperceptible and neutral

11.14 References

Carlow County Development Plan 2022 – 2028

County Carlow Outdoor Recreation Strategy 2020-2023

Graiguenamangh – Tinnahinch Local Area Plan 2021

Guidelines for Landscape and Visual Impact Assessment (Landscape Institute & I.E.M.A., UK 2013)

Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, May, 2022)

Kilkenny City & County Development Plan 2021 - 2027

Landscape Appraisal of County Kilkenny 2003

National Parks & Wildlife Service – location of SPAs, SACs and NHAs

12 Land, Soils, Geology & Hydrogeology

12.1 Scope of the Assessment

12.1.1 This chapter describes the likely significant effects of the Proposed Scheme on land, soils, geology, and hydrogeology. The following aspects have been considered relevant to this assessment:

- Design:
  - Design features of the flood defences that take into account the particular ground conditions, hydrogeology regimes and the properties of the underlying soils and hydrogeology to ensure that works do not have any potentially significant impacts on lands and soils.
- Construction:
  - Excavations, both above and below the water table, that will require special consideration in terms of both the stability of the excavations and the logistics required to facilitate the works, i.e., dewatering.
  - Import and use of soils during construction works. Additionally, disposal of surplus excavated material, including possible contaminated soils and groundwater, are considered.
  - Unplanned spillages and discharges to the soil, geology and groundwater features in the study area.
- Operation and Maintenance Phase:
  - The proposed development will not have any likely significant impacts on subsoils or bedrock once operational. There may be an ongoing effect on hydrogeology levels during the operational stage, and there will be routine maintenance required where there is possibility of localised contamination.

12.2 Statutory and Policy Context

12.2.1 The main legislation which provides for hydrogeological protection in Ireland is the Water Framework Directive (WFD, 2000/60/EC) which establishes a legislative framework and regime which sets groundwater quality standards and introduces measures to prevent or limit inputs of pollutants into groundwater.

12.2.2 Other legislation particularly relevant to the management of groundwater includes:

- The Groundwater Directive, 2006/118/EC.
- European Communities (Water Policy) Regulations 2014 (S.I. No. 350 of 2014).

- European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9 of 2010), as amended by the European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2011 (S.I. No. 389 of 2011), the European Communities Environmental Objectives (Groundwater) (Amendment) Regulations 2012 (S.I. No. 149 of 2012) and the European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (S.I. NO. 366 of 2016).
- European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003) as amended by the European Communities (Water Policy) (Amendment) Regulations, 2005 (S.I. No. 413 of 2005).
- European Communities (Water Policy) (Amendment) Regulations, 2008 (S.I. No. 219 of 2008).
- European Communities (Water Policy) (Amendment) Regulations, 2010 (S.I. No. 93 of 2010).
- Water Services Acts (2007-2019).

12.2.3 Despite the importance of soil, there is little in the way of direct EU or national legislation obliging Ireland to maintain soil quality, however, indirectly issues such as contaminated land have been dealt with through other legislation (e.g. waste) including the 1996 Waste Management Act (as amended) and the EU Council Directive 99/31/EC (the Landfill Directive) on the landfilling of waste. In Ireland some soil protection legislation has been enacted including the 2011 EIA Regulations for On Farm Development which, include a requirement for EIA of soil operations such as soil drainage.

Local Policy

12.2.4 The Graiguenamanagh Tinnahinch Joint Local Area Plan (LAP) 2021-2027 is jointly prepared by the KCC and CCC and sets out an overall strategy for the planning and sustainable development of the town and village. The "Graiguenamanagh-Tinnahinch Land Use Zoning" map demonstrates the zoning of particular lands. The Core Strategy under land zoning references the desire to *''support the sustainable long-term growth of Graiguenamanagh-Tinnahinch and continued consolidation of development within the town boundary''*, and five objectives outline the framework for achieving this. Furthermore, Strategic Objective No. 4 outlines intentions to enhance the green infrastructure of the town and village, creating a cohesive belt for biodiversity gains.

12.2.5 The management of surface water and protection of groundwater is part of KCC and CCC's sustainable water services policy where intentions to ''maintain and enhance the existing surface water drainage systems in Graiguenamanagh-Tinnahinch (G-T) and to protect surface and ground water quality in accordance with the requirements of the Water Framework Directive'' are outlined under the Infrastructure and Environment objective No. 3 (SNF2) and related objective INFO2.2 which states desire to protect groundwater sources (and surface water) in conjunction with the EPA and WFD.

12.2.6 Given the interdependencies, Policies and Objectives related to the management of surface water under the Infrastructure and Environment portion of the LAP (Section 10) are also relevant to this chapter.

12.3 Assessment Methodology

Study Area

12.3.1 The principal Sudy Area is determined by the scheme boundary and generally includes the townlands of G-T and the surrounding environs, the River Duiske and River Barrow, and the environs of the proposed upstream storage area. The study area for the assessment of impacts to land, soil, geology and hydrogeology extends to areas up to 500m outside of the boundary of the site or Work Packages (WP). This area captures the extent of the potential influence of the construction and operation of the Proposed Scheme on these environmental assets. However, some baseline conditions have been discussed on a wider (up to 3km buffer) to provide a thorough review of existing soil, geology and hydrogeology features.

Assessment of Impacts

12.3.2 This chapter examines the existing land, soil, geology and hydrogeological conditions present in the study area along the Rivers Barrow and Duiske, and how these may be impacted during construction and operation of the Proposed Scheme.

12.3.3 The Land, Soils, Geology and Hydrogeology Chapter for this EIAR has been prepared in line with the suggested topics outlined in relation the Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2022), including ‘land’, ‘soil’, ‘geology’ and ‘hydrogeology’. The topic of ‘land’ is defined in the Guidelines as ‘related to issues of land take’ and ‘removal of productive land from potential agricultural or other beneficial use’. The suggested topic of ‘agricultural capability' is not considered due to the nature of the study area as one of suburban development. According to (EPA, 2022), the topic of ‘hydrogeology’ can be covered under the ‘Land and Soils’ or the ‘Water’ chapters of the EIAR; the former (this chapter) is relevant in this case.

Assessment of Impacts to Land

12.3.4 With regards to land, the assessment presents the baseline land uses based upon information received from desk-based review. A review of the ‘land take’ associated with the Proposed Scheme is then reviewed, assessing the likely change from baseline conditions. Further mention of land zoning is included, and how this may be altered from the construction and operation of the Proposed Scheme.

12.3.5 Likely significant effects are categorised in accordance with the EPA 2022 Guidelines (see Table 12-1). Significant effects are compared between the Do-Nothing and the Do-Something scenarios (split into the construction and operation phases) and arise from direct, indirect, secondary and cumulative effects on environmental conditions. Significant effects can be positive, neutral or negative.

Table 12-1: Significance Criteria for Likely Significant Effects on Material Assets

Significance Level	Criteria
Quality of Effects	
Positive Effects	A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).
Neutral Effects	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
Negative/adverse Effects	A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance).
Describing the Significance of Effect	
Imperceptible	An effect capable of measurement but without significant consequences.
Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Significant Effects	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
Profound Effects	An effect which obliterates sensitive characteristics

Assessment of Impacts to Soil, Geology & Hydrogeology

12.3.6 With regards to soils, geology and hydrogeology, the assessment presents the baseline conditions of these features based on readily available information and data provided during the course of the Project (Site Investigation works) and determines how the construction and operation of the Project will cause potential impact to these features. The following guidance was used specifically in the assessment of impacts to soils, geology and hydrogeology:

- NRA (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.
- Institute of Geologists of Ireland (2013) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements.

12.3.7 The impact assessment ranking methodology and terminology used in this section is in line with Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA, 2008). A summary of the NRA (2008)

methodology is provided in (IGI, 2013). The (NRA, 2008) impact assessment methodology provides a robust assessment for ranking potential impacts to geology, soil and hydrogeology and has been successfully adopted for environmental impact assessment outside of road sector projects in Ireland. The process is summarised as follows:

- Step 1: Quantify the 'Importance' of a feature for geology, soils and hydrogeology using criteria based on quality, significance, scale, and extent attributes for a feature. Importance is qualified in terms of 'low', 'medium', 'high', or 'very high' (see Table 12-2) (NRA, 2008).

- Step 2: Estimate the 'Magnitude' of the impact on the feature from the proposed development using criteria based on degree of loss, change of gain in terms of volume, quality or integrity attributes for a feature. Magnitude of impact is qualified in terms of 'large', 'moderate', 'small', or 'negligible' as well as 'beneficial' or 'adverse' (see Table 12-3) (NRA, 2008).

- Step 3: Determine the rating of 'Significance' of the impact using the matrix shown below using the outcome from steps 1 and 2 (see Table 12-4) (NRA, 2008).

Table 12-2: Criteria for Rating Importance of Attribute (NRA, 2008)

Importance	Soils and Geology		Hydrogeology	
	Criteria Description	Typical Examples	Criteria Description	Typical Examples
Extremely High	NA	NA	Attribute has a high quality or value on an international scale.	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g., SAC or SPA status.
Very high	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA). Large existing quarry or pit. Proven economically extractable mineral resource.	Attribute has a high quality or value on a regional or national scale.	Regionally Important Aquifer with multiple wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status. Regionally important potable water source supplying >2500 homes. Inner source protection area for regionally important water source.
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying route is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage. Large recent landfill site for mixed wastes. Geological feature of high value on a local scale (County Geological Site). Well drained and/or highly fertility soils. Moderately sized existing quarry or pit. Marginally economic extractable mineral resource.	Attribute has a high quality or value on a local scale.	Regionally Important Aquifer. Groundwater provides large proportion of baseflow to local rivers. Locally important potable water source supplying >1000 homes. Outer source protection area for regionally important water source. Inner source protection area for locally important water source.

Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and/or soft organic soil underlying route is moderate on a local scale.	Contaminated soil on site with previous light industrial usage. Small recent landfill site for mixed wastes. Moderately drained and/or moderate fertility soils. Small existing quarry or pit. Sub-economic extractable mineral resource	Attribute has a medium quality or value on a local scale.	Locally Important Aquifer. Potable water source supplying >50 homes. Outer source protection area for locally important water source.
Low	Attribute has a low quality, significance or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying route is small on a local scale.	Large historical and/or recent site for construction and demolition wastes. Small historical and/or recent landfill site for construction and demolition waste. Poorly drained and/or low fertility soils. Uneconomically extractable mineral resource	Attribute has a low quality or value on a local scale.	Poor Bedrock Aquifer Potable water source supplying <50 homes.

Table 12-3: Criteria for Rating Magnitude of Impact (NRA, 2008)

Importance	**Soils and Geology**		**Hydrogeology**	
	Criteria Description	**Typical Examples**	**Criteria Description**	**Typical Examples**
Large Adverse	Results in loss of attribute.	Loss of high proportion of future quarry or pit reserves. Irreversible loss of high proportion of local high fertility soils.	Results in loss of attribute and/or quality and integrity of attribute.	Removal of large proportion of aquifer. Changes to aquifer or unsaturated zone resulting in extensive change to

		Removal of entirety of geological heritage feature. Requirement to excavate / remediate entire waste site. Requirement to excavate and replace high proportion of peat, organic soils and/or soft mineral soils beneath alignment.		existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >2% annually.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute.	Loss of moderate proportion of future quarry or pit reserves. Removal of part of geological heritage feature Irreversible loss of moderate proportion of local high fertility soils. Requirement to excavate / remediate significant proportion of waste site. Requirement to excavate and replace moderate proportion of peat, organic soils and/or soft mineral soils beneath alignment.	Results in impact on integrity of attribute or low of port of attribute.	Removal of moderate proportion of aquifer. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >1% annually.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute.	Loss of small proportion of future quarry or pit reserves. Removal of small part of geological heritage feature. Irreversible loss of small proportion of local high fertility soils and/or high proportion of local low fertility soils. Requirement to excavate / remediate small proportion of waste site. Requirement to excavate and replace small proportion of peat, organic soils	Results in minor impact on integrity of attribute or loss of small part of attribute.	Removal of small proportion of aquifer. Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >0.5% annually.

		and/or soft mineral soils beneath alignment.		
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity.	No measurable changes in attributes.	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity.	Calculated risk of serious pollution incident <0.5% annually.
Minor Beneficial	Results in minor improvement of attribute quality.	Minor enhancement of geological heritage feature.	NA	NA
Moderate Beneficial	Results in moderate improvement of attribute quality.	Moderate enhancement of geological heritage feature.	NA	NA
Major Beneficial	Results in major improvement of attribute quality.	Major enhancement of geological heritage feature.	NA	NA

Table 12-4: Rating of Significant Environmental Impacts (NRA, 2008)

		Magnitude of impact			
		Negligible	**Small**	**Moderate**	**Large**
Importance of attribute	**Extremely High**	Imperceptible	Significant	Profound	Profound
	Very high	Imperceptible	Significant/ Moderate	Profound/ Significant	Profound
	High	Imperceptible	Moderate/ Slight	Significant/ Moderate	Profound/ Significant
	Medium	Imperceptible	Slight	Moderate	Significant
	Low	Imperceptible	Imperceptible	Slight	Slight/ Moderate

12.3.8 The significance ranking is initially determined pre-mitigation (i.e. prior to the introduction of mitigation measures) and residual impacts are ranked based on the assumptions that all mitigation measures are adopted.

Data Sources

12.3.9 The appraisal of likely significant effects on land, soils, geology and hydrogeology was conducted through an initial desk-top review of the existing conditions within the study area. Baseline information was sourced from a number of secondary data resources including:

- Aerial Photography: Bing Maps and Google Maps (accessed 2024).
- Geological Survey of Ireland (GSI) (accessed 2024) Online map viewer and associated data products.
- Department of Communication, Climate Action and the Environment (2018, accessed 2022).
- Environmental Protection Agency (EPA) (2012, accessed 2024). EPA Maps, Corine Land Cover.
- EPA (accessed 2024). EPA Maps, Ground Water, Water Framework Directive.
- EPA. Office of Licensing and Permitting (EPA website, accessed 2024).
- GSI (2014). Directory of Active Quarries, Pits and Mines in Ireland (accessed 2024).
- Teagasc and the Environmental Protection Agency (EPA) (2017). Irish Soil Information System (accessed 2024).
- Exploration and Mining Division (EMD) data and map viewer.

Site Visits / Surveys

12.3.10 A number of site visits to the study area were conducted in the period from 2020 to 2024 and included a visual assessment for any evidence of contamination. None were found.

12.3.11 A Site Investigation (SI) Programme was undertaken for the Proposed Scheme between 20th March and 21st March 2023 involving the following:

- 14 no. Trial Pits
- 23 no. Foundation Inspection Pits
- 21 no. Slit Trenches
- 36 no. Boreholes
- Groundwater sampling at 7 boreholes.
- 1 no. Infiltration test
- 4 no plate load tests

12.3.12 A brief summary of the results relevant to the assessment is included in Sections 12.4.24 to 12.4.41 this chapter.

Consultation

12.3.13 During the preparation of this EIAR, consultations were made to seek opinions and input from statutory bodies, regulators, organisations, research bodies, community facilities and residents that have an interest or who may be affected by the Proposed Scheme. Data/information was also provided by stakeholders in some cases, where relevant, for incorporation into the EIA study. This chapter has been prepared with consideration of the outcomes of this consultation, which is detailed further in Chapter 5 'Consultation and Stakeholder Engagement'.

12.3.14 The Geological Survey of Ireland (GSI) was consulted with however no formal response was received from their office. However, the database available from GSI was used to inform the vast majority of the baseline review in this chapter, as outlined in Section 12.3.9. No other responses received (see Chapter 5 'Consultation and Stakeholder Engagement') related specifically to land, soils, geology and/or hydrogeology.

12.4 Baseline Environment

Land Zoning

12.4.1 Graiguenamanagh is classified as a District Town within the Kilkenny County Settlement Hierarchy, while Tinnahinch is designated a Village within the Carlow County Settlement Hierarchy. Land ownership and land use in the scheme study area are varied, including private, public, residential, commercial, and recreational. G-T are surrounded by agricultural land use with the town being largely residential with supporting community

and educational services. Further, there is a significant portion zoned as 'green infrastructure' within a belt surrounding the River Barrow, which supports one of the Strategic Objectives (SO4) of the LAP. The G-T Land Use Zoning map from the LAP is included in Figure 12-1 overleaf.

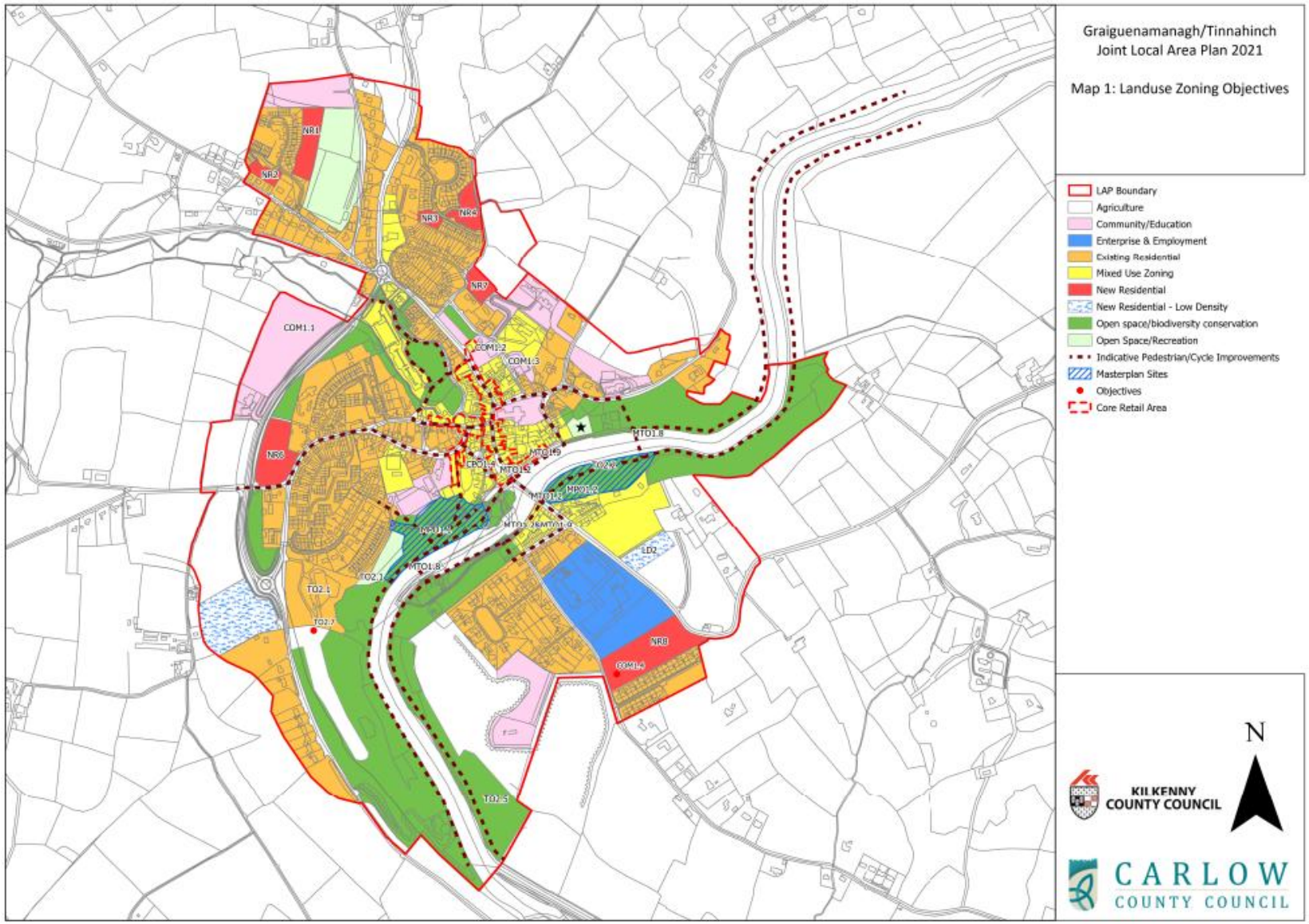


Figure 12-1: Graiguenamanagh-Tinnahinch Land Use Zoning (LCC & CCC Local Area Plan 2021 – 2027)

Regional Geomorphology and Topography

12.4.2 The Barrow catchment has a varied topography. The topography of the Barrow River Basin indicates a general southerly drainage pattern of the area towards the discharge of the River Barrow (principal river) to the Waterford Estuary. Small areas of high ground are present on the eastern and western borders of the River Basin.

12.4.3 The headwaters of the (Barrow River) form in the Slieve Bloom Mountains (Glenbarrow, Laois) at approximately 350m AOD. It flows first in an easterly and then a southerly direction through the towns of Portarlington, Athy, Carlow and Bagenalstown before discharging to the Barrow Estuary at New Ross. It is joined by the Nore River approximately four kilometres upstream of New Ross and is tidal for about another 13km upstream to St. Mullins.

12.4.4 G-T is located between the Brandon Hill to the west and Blackstairs Mountains to the east. Within the town there is relatively limited floodplain extents, however areas of amenity and open space function/capacity as a natural floodplain to deal with exceedance from the river channel.

12.4.5 The elevation of the Duiske Catchment varies from 515m at the peak of Brandon Hill to 10m in Graiguenamanagh Town. The Barrow varies from 530m at the peak of the Slieve Bloom Mountains in County Laois to 10m in Graiguenamanagh Town. The average annual rainfall in the Barrow catchment is 875mm and 1020mm in the Duiske catchment.

Bedrock Geology

12.4.6 The River Barrow rises in the Old Red Sandstone of the Slieve Bloom Mountains before passing through a band of Carboniferous shales and sandstones. The north (upper) part of the Barrow Catchment occurs predominantly in Carboniferous limestones and shales of marine basinal or shelf facies.

12.4.7 The middle reaches and many of the eastern tributaries, sourced in the Blackstairs Mountains, run through Leinster Granite (Caledonian). Granites underlie the Barrow River from the area south of Goresbridge, (Kilkenny) to Graiguenamanagh. South of Graiguenamanagh, the river crosses Ordovician shists (Brownsford Member) and Caledonian granites (Blackstairs Granite). These highly resistant rock types control the ultimate bed level of the river, restricting downcutting and incision. They also constrain the movement of the river across its floodplain in the scheme area, which is in the steep sided valley between Brandon Hill (Kilkenny) and Mount Leinster (Carlow).

12.4.8 South of Ballyanne (Carlow) the river crosses Ordovician slates, siltstones and volcanics until it reaches Arthurstown (Wexford). Waterford Harbour is a deep valley that was excavated by historical glacial floodwaters. The coast shelves quite rapidly along much of the shore. (source: River Barrow and River Nore SAC site synopsis; GSI mapping viewer data for1:100k Bedrock Geology).

12.4.9 The River Duiske rises in, and courses over, the Maulin Formation. This formation is comprised of Ordovician Slates, phyllites, quartzite bands, psammites and schists.

Quartzite and psammite are resistant rock types, whereas slates, phyllites, schist are much less resistant.

12.4.10 GSI data indicates that Quaternary geology in the study area is comprised of gravels derived from limestones broadly located in Tinnahinch and areas in the south east of the study area. Alluvium, formed from previous deposition from the river, is reported underlying and immediately adjacent to the River Barrow and River Duiske. Quaternary geology in Graiguenamanagh is indicated to be composed of areas comprised of till derived from Lower Palaeozoic sandstones and shales or granites and areas of outcrop.

Karst

12.4.11 Karst can form on any rock that is soluble in water and, within Ireland, most karst is found in Carboniferous limestones. Karsts features can cause structural instability to overlying and adjacent land and increase vulnerability to groundwater by creating a pathway for contaminants present on land or surface waters to enter the subsurface.

12.4.12 GSI bedrock mapping data indicates that Carboniferous limestone is not present within the study area. Karst feature data compiled by the groundwater unit at the Department of the Environment, Climate and Communications (DCCAE) indicates that there are no karst features reported from the scheme area or vicinity. The closest recorded karstic feature is a spring in the Heigham Townland (Easting ITM 664776, Northing ITM 650065) located ca. 8.5km northwest of G-T. The closet recorded karstic feature further up the catchment is an ‘enclosed depression’ recorded near Goresbridge (Easting ITM 669165, Northing ITM 653424) c. 9.5km north of G-T. There are no karst features reported in proximity of the lower catchment (source: DCCAE 2022)

Soils and Subsoils

12.4.13 Teagasc Soil Information System, accessed from (Environmental Protection Agency, 2024) data indicates that soils in the study area are generally mineral soils, largely derived from mainly acidic parent materials. Soils range from shallow to deep and poorly to well drained, with the majority of soils present in the study reported to be well draining. Made soils underlie Graiguenamanagh town but are not reported as present within Tinnahinch, however the presence of residential and commercial properties that have been constructed within the area suggests that made ground is probably present as intrusive works would likely have taken place during construction of many more recent properties.

12.4.14 Department of the Environment, Climate and Communications (DCCAE) provide high level soil permeability data. This data indicates that subsoil permeability ranges from low to high in the study area, with:

- Tinnahinch, the section of the River Barrow c. 200 m either side of the bridge, and the southwest of the scheme area reported as having high subsoil permeability.
- Graiguenamanagh and the west of the scheme areas reported as having medium subsoil permeability.

- The most northern extent of Graiguenamanagh town reported as having low permeability.

12.4.15 GSI data indicates that there are no audited or unaudited sites of geological heritage in the study area. The closest sites are an audited site at Inistioge, ca. 6 km and at Blackstairs Mountain, 9 km to the east of the study area. Further, there are no active quarries or areas of active mineral exploitation within the study area (GSI, 2025).

12.4.16 No 'hotspots' of potential historical contamination have been identified in the study area, and EPA data indicates that there are no waste boundaries or dumpsite boundaries within the vicinity. Therefore, the potential for existing contamination is considered low.

Hydrogeology

12.4.17 The hydrological setting in the study area consists of made ground and largely well-draining soils and subsoils of low to high permeability.

Springs and Wells

12.4.18 The Ballyogan springs lie on the flanks of Brandon Hill within the catchment of the River Barrow (western side). These springs form part of the Graiguenamanagh Water Supply Scheme (see Chapter 7 'Material Assets'). The source comprises four springs, forming a line 230m long in Ballyogan townland. The springs all lie close to the 170m contour on the flanks of Brandon Hill, some 1.4km north-east of its peak. These springs and the areas immediately surrounding them are designated a GSI Public Supply Source Protection Area and are owned by KCC (see Figure 12-1). To information is available on the sanitary protection measures at the springs.

12.4.19 OS data indicates that there are two historic wells (springs) located within scheme area in Tinnahinch, Lady's Well and Keeting's Well OS data indicates that eight historic wells, including Michaels Well (see Chapter 9), are located within the scheme area at Tinnahinch with no further details available at the time of writing (OSi, 2020). The archaeological and cultural heritage significance of such structures is discussed in Chapter 9, where relevant.

12.4.20 GSI data indicates that a single borehole well, 'Carlow Co. Council Pump No.183', with a poor yield class is recorded from Tinnahinch and may be located within the study area (location accuracy to 1km). There is no data to indicate if abstraction is taking place at present.

Aquifer Characteristics

12.4.21 GSI has devised a system for classifying the aquifers in Ireland based. The aquifer categories are intended to describe both resource potential (Regionally or Locally important, or Poor), groundwater flow type and attenuation potential (through fissures, karst conduits or intergranular). The three main classifications are 'Regionally Important (R) Aquifers', 'Locally Important (L) Aquifers' and 'Poor (P) Aquifers'. Each of these three types of aquifer is further subdivided and has a specific range of criteria associated with it such as the transmissivity (m^2/day), productivity, yield and the potential for springs

12.4.22 The bedrock units in the study area are classified as both 'Locally Important Aquifer (bedrock) which is moderately productive only in local zones' and 'Poor Aquifer (bedrock) which is generally unproductive except for local zones'. Groundwater recharge as varies across the study area with typical average recharge 129 – 200 mm/year where subsoils is bedrock outcrop and sub-crop, till derived chiefly from Lower Palaeozoic rocks, and made ground. Subsoil permeability is classed at medium to high and groundwater in the study area is classified from medium vulnerability to extreme vulnerability.

12.4.23 The Ground Waterbody WFD Status 2016-2021 for the study area (IE_SE_G_152, New Ross Ground Waterbody) is general classified as good and currently not at risk of meeting these objectives (see below).

Table 12-5 Ground Waterbody WFD Status 2016-2021

Chemical Status	Overall Groundwater Status	Quantitative Groundwater Status	WFD Risk Status
Good	Good	Good	Not at Risk

Site Specific Geotechnical Conditions

12.4.24 A number of ground types were encountered in the exploratory holes excavated and drilled for the project specific Site Investigation. These were presented by Plan Sheet area in the SI Report.

Tinnahinch

12.4.25 Surficial Materials including Bituminous Asphalt were encountered at 50mm to 100mm with thick granular subbase and Topsoil/Made ground 300mm to 4000mm thick at the southwestern end of the project area.

12.4.26 Made Ground was encountered to depths of up to 1.2mBGL including both cohesive and granular soils.

12.4.27 Possible bedrock was encountered below 4.4m BGL at BH04 and at shallower depths of 2.5mBGL and 1.2mBGL in BH/RC06 and RC07 to the southwest. The bedrock consists of a metasedimentary sequence of phyllite and psammite (metamorphosed sandstone) with subordinate quartzite.

Graiguenamanagh Quay

12.4.28 Surface cover materials at Graiguenamanagh Quay consist of Bituminous Asphalt typically in 50mm to 100mm thick, overlying granular subbase, typically to depths varying from 0.15 to 0.25m, but locally overlying cobbles to a depth of 0.6mBGL. Additionally, a former bituminous asphalt road surface and associated granular subbase was encountered locally within the uppermost 0.5m. Made Ground was encountered to depths varying from 0.7mBGL to 2.0mBGL along most of Graiguenamanagh Quay but it is locally as thin as 0.2m towards the northeast of the project area. The made ground commonly consists of granular material, but cohesive material also occurs locally.

12.4.29 Peat was encountered beneath Made Ground from 1.2m to 2.0mBGL in BH13.

12.4.30 Native soils are predominantly cohesive with subordinate sandy to very sandy gravel beds to depths ranging from 4.0 M BGL to 5.6mBGL beneath Graiguenamanagh Quay (eg BH10, BH12, BH13 and BH15). Native soils most commonly range from silty CLAY to slightly sandy, slightly gravelly silty CLAY and locally contain cobbles and occasional organic material. Consistency of the cohesive soils mostly ranges from very soft to firm, but stiffer material occurs locally below depths varying from 3mBGL to 5mBGL.

12.4.31 Granular soils were encountered below depths ranging from 4mBGL to 5.6mBGL beneath Graiguenamanagh Quay and at a shallower depth of 2mBGL to the northeast.

12.4.32 Bedrock was investigated at BH16 near the northeast end of Graiguenamanagh Quay where it was cored from 5.5m to 10.5mBGL. It consisted of strong to very strong dark grey and white granodiorite.

Lower Duiske River

12.4.33 Surface cover materials include Bituminous Asphalt, typically 50mm to 100mm thick, overlying granular subbase. Topsoil with a thickness of 200mm was also encountered locally at the surface.

12.4.34 Made ground was commonly encountered to depths ranging from 0.8mBGL to 2.0m BGL and consists mainly of granular material commonly slightly clayey sandy Gravel with low to high cobble content.

12.4.35 The shallowest native soils at the lowermost portion of the Duiske River valley consist of very loose to medium dense gravelly to very gravelly sand to very sandy gravel with low to high cobble to boulder content and with variable fines content.

12.4.36 Shallow cohesive soil was encountered less frequently in the lowermost Duiske Valley. For example, firm grey mottled slightly gravelly sandy clay with medium cobble content was encountered from 1.2m BGL to refusal on a boulder at 2.1m BGL at BH18 on the west side of the Duiske River.

12.4.37 Weathered bedrock was encountered at depths varying from about 3.0mBGL to 11.0m BGL consisting of phyllite, psammite and quartzite.

Tinnapark-Priestsvalley

12.4.38 Topsoil is soft brown slightly sandy silty clay with frequent rootlets present in 200mm to 400mm thickness. Made Ground from firm greyish brown slightly gravelly sandy clay with medium cobble content and frequent ceramic pipe fragments was encountered from 0.4 to 0.9mBGL in TP19.

12.4.39 Shallow cohesive soils from very soft to firm greyish brown to yellowish to orange brown light grey slightly sandy slightly gravelly silty clay to clayey silt with variable cobble content and with occasional roots and rootlets and vegetation fragment was encountered to depths ranging from 1.1m BGL to 2.55m BGL.

12.4.40 Glacial till was present and was encountered below depths ranging from 1.1mBGL to 2.55 m BGL. Consistency of the glacial till varies from very soft to firm at shallower depths.

12.4.41 Glaciofluvial deposits consisting of dense to very dense brownish slightly silty very sandy Gravel with low cobble content was encountered from 6.7m BGL to the penetrated depth of 7.91mBGL in BH30 and brownish grey to very sandy Gravel with low cobble content was encountered from 12.6mBGL in BH32.

12.5 Sensitive Receptors

12.5.1 Sensitive Receptors for the purposes of land, soils and hydrogeology assessment include the soils within the scheme, the groundwater and abstraction well within the scheme area and the neighbouring residences and properties to the scheme where there may be potential for soil and geological settlement.

12.6 Potential Impacts and Effects

The 'do nothing' Scenario

Land

12.6.1 As outlined in (EPA, 2022), the topic of 'land' requires discussion under this EIAR chapter, defined in the Guidelines as 'related to issues of land take' and 'removal of productive land from potential agricultural or other beneficial use'. The review of impact significance for this impact has been undertaken in line with the (EPA, 2022), modified in Table 1-1 of Chapter 1 'Introduction'. Effects to land (i.e., land take and/or change in zoning) in the 'do nothing' scenario are considered 'neutral' whereby no impacts are assigned. Zoning and land use conditions would remain as they are currently.

Soils, Geology & Hydrogeology

12.6.2 Fluvial systems are dynamic environments that give rise to geomorphological changes overtime. In the 'do nothing' scenario, sediment levels in the river will likely increase over time with the potential for more deposition in some areas. It is likely that materials in the river (e.g., gravel) will continue to build-up on the riverbed overtime, potentially with periodic downstream moment due to large scale flooding events. This could increase sedimentation and build-up of sediment on the riverbed further downriver. In accordance with the impact assessment methodology outlined in Table 12-2, the importance of the feature is considered 'low' and the magnitude of impact is considered **'small adverse'** due to the infrequency of flood events. Consequently, the overall significance rating of the potential impact is considered to be 'imperceptible'. The (NRA, 2008) Guidelines however do not give opportunity to discuss the longevity of impacts, and in this case, would be a long-term concern for the area. Changes to bedrock geology and hydrogeology are considered to be unlikely.

Construction Phase

12.6.3 As outlined in Chapter 4 'Description of Proposed Scheme and Construction Methodology', the works are divided into ten (10) areas corresponding to the Proposed Scheme defence locations (see W3451-AYE-DWG-W-1402), with five (5) site compounds (SC) and five (5) main access routes assigned to support these (see W3451-AYE-DWG-W-1402, W3451-AYE-

DWG-W-1422). Construction is planned from 2027 to 2030 (36 to 42 months), with works packaged and sequenced as below:

- WP1 (site enabling works, and Main Compound):
- WP2 (Areas 1 and SC B):
- WP3 (Areas 2, 3 and 4, and SC C):
- WP4A (Areas 5, 6 7), and SC D:
- WP4B (Areas 8, 9 and 10, and SC E and F):

Land

12.6.4 A schedule of lands to be acquired will need to be developed for each property to include land ownership arrangements both during and after the works are completed. In some cases, it is anticipated that lands will be acquired for the construction and returned to the original owner on completion.

12.6.5 The Proposed Scheme includes the establishment of a flood storage area located ca. 2.5km upstream of G-T (see details in Chapter 4 'Description of Proposed Scheme and Construction Methodology'). This area is situated within several fields that are either currently being utilised for agricultural purposes or have the potential to be. During construction, three of these fields will be inaccessible for the duration of WP2 (18 months), where the retaining embankment structure will be under construction (W3451-AYE-DWG-1422). Further, SC B is proposed to be situated in one of the abovementioned fields. The size of the flood storage area is 75,719 m^2. The size of the CPO area will be 9300m^2 approximately. Landowners impacted by this change have been consulted with throughout and these lands are to be acquired by CPO. The land is currently cultivated for agricultural use. The impact is considered to be imperceptible.

Soils, Geology & Hydrogeology

12.6.6 The potential significant impacts on soils, geology and hydrogeology that could occur during the construction of the Proposed Scheme are:

- Use of imported materials.
- Encountering known or unknown existing contamination.
- Potential impacts of accidental leaks and spills.
- Potential impacts from excavation, loss of soil and bedrock exposure.
- Potential impact on locally important bedrock and/or gravel aquifer.
- Potential impact of soil compaction.
- Potential impact of dewatering.

- Potential impact from importation of invasive species

Potential Impacts Regarding Use of Imported Materials

12.6.7 There are five areas where earthen embankments and raised ground have been proposed as a flood protection measure, including Area 1 (storage area), Area 2 (mass path), Area 5 (the Boat Club), Area 7 (The Hub) and Area 8 (Hotel Street). These are to be constructed with engineering grade fill material which, on the whole, will be imported to site. The quantity of fill material to be imported will be a total of 12,800 m^3 and 2,300 $m^3$of topsoil with the breakdown as follows:

Area	Quantity
Topsoil at 150mm thick	2,300m^3 approx.
Upstream storage embankment	10,500m^3 approx.
The Hub	500m^3 approx.
Boat Club	300m^3 approx.
Thinnahinch Embankment	1,500m^3 approx.

12.6.8 Where materials are imported onto site, standard practice is that these will be sourced from reputable and licensed third parties, will be suitable for use and will have been screened via a Waste Acceptance Criteria (WAC) to determine contamination potential. Accordingly, it is not anticipated that contaminated material derived for geology or soils will be imported to site. In the absence of the aforementioned measures, the potential impact from contaminated soils would be **moderately adverse,** however considering the mitigation proposed the residual potential impacts from importation of soil are considered to be **negligible.**

Potential Impacts from Encountering Existing Contamination

12.6.9 As mentioned, no 'hotspots' of potential historical contamination have been identified in the study area, and EPA data indicates that there are no waste boundaries or dumpsite boundaries within the vicinity. Further, the SI works did not uncover any contaminated soils during their sampling regime. Whilst the risk is overall considered **low**, there is still residual potential for encountering known or unknown contamination at the surface or subsurface within the scheme area during construction. Potential impacts to geology, soils, or hydrogeology could occur through activities in the absence of mitigation where there is:

- direct movement of any contaminated materials on site, if present, during intrusive construction activities or during the movement of vehicles around site; or. There was mention in borehole excavations of a smell of hydrocarbons in some of the exploratory locations in the town. RC29A (Well lane) IP29 Mass Path and RC17 (the Dock). On the Dock it is mentioned that the potential hydrocarbon contamination may be from surface water run-off from cars. On Well lane no significant excavation work is proposed and along Mass Path minimal soil disturbance is proposed.

- changes to the subsurface or surface that may create pathways, mobilisation and migration of contamination, if present, during intrusive construction activities.

- There was made ground with some potential for waste material (non haz) in Area 5 TP08 at the glamping site. This material and any other unsuitable material found will be removed to a licenced facility.

12.6.10 Site compounds are to be developed in the locations shown in W3451-AYE-DWG-W-1402 (Appendix 4-1) and maintained throughout their corresponding WPs. Surplus excavated material or temporarily stored materials at the site compounds will be managed by the classification of the material prior to acceptance. This mitigation measure will prevent interaction of any existing contamination that may be present with other material stored at the site compounds. This will also ensure that potentially contaminated dredge material will not have an impact on the underlying soils or groundwater. In the absence of the aforementioned measures, the potential impact from contaminated materials in the site compounds would be **moderately adverse,** however considering the mitigation proposed the residual potential impacts from importation of soil are considered to be **negligible.**

12.6.11 In accordance with the criteria of assessing the attribute importance, the magnitude of impact and significance rating, the following is concluded for the potential to encounter existing contamination on site, and its impact on soils, geology and hydrogeology.

Receptor / Parameter	Importance of Site Attribute as per Table 12-2	Magnitude of Impact, as per Table 12-3	Significance of impact, as per Table 12-4
Impact to Soils and Geology	Low	Negligible	Imperceptible
Impact to Hydrogeology	Low – Medium	Negligible	Imperceptible

Potential Impacts of Accidental Spills and Leaks

12.6.12 Leakage, accidental discharge or spillage of construction related materials, including fuels and lubricants from vehicles and equipment, on site can cause contamination in geology, soils and hydrogeology.

12.6.13 The pre-mitigation significance ranking of potential impacts from accidental leaks and spills is dependent on the likelihood of the spill occurring, the physio-chemistry of the material released, the potential duration of the event, the potential volume of release, and the physio-chemical properties of underlying material (e.g., soils and geology). Potential impacts to hydrogeology also consider the nature of the underlying aquifers, aquifer connectivity and abstraction activities. Intrusive works during construction can potentially create pathways for any accidental releases in the vicinity of the works to reach the subsurface.

12.6.14 Works during the construction of the scheme could pose a threat to the quality of groundwater bodies within the study area chiefly through unplanned events such as leaks/spills/runoff/accidental release or escape of fuels, oils and lubricants, bulk liquid cement, contaminated leachate. Such leaks and spills could potentially occur at any of the WAs or SCs where there is a potential source material for an accidental release. SCs B, C, D, E and F are earmarked for material storage and as such, are anticipated to store the vast

majority of the potentially contaminating materials, namely diesel and lubricants. Potential significant impacts are leaks and spills leading to contamination of hydrogeology and negatively impacting the aquifer, or contamination of geology and soils.

12.6.15 The following sources are considered plausible for the generation of contamination events during the construction phase:

- Accidental leakage may occur from construction site equipment. As a worst-case scenario an unmitigated leak of 300 litres is considered. This would be a single short-term event.
- Use of freshly mixed concrete is a requirement during construction. Leakages from recent concreted foundations will result in highly alkaline water with high pH. As this would only occur during phases of work this is again considered as a single short-term event rather than an ongoing event.
- The demolition of the existing building units and construction requires soil excavation and removal and import. Unmitigated run-off could contain a high concentration of suspended solids during earthworks. These impacts could be considered as intermittent short-term events.

12.6.16 With regards to soils, geology and hydrogeology, the pathway considered includes the potential for vertical migration of any contaminants into the bedrock aquifer if significant reduced to the recorded 'medium' to 'extreme' vulnerability recorded at the site, which will result in the attenuation of any pollutants. The site is underlain by both Locally Important and Poor Aquifer bedrock, that is classified by the WFD as having a 'good' overall ecological status and is 'not at risk' of meeting these objectives. Therefore, the construction of the Proposed Scheme should make every effort not to jeopardise this current status. Further, groundwater levels encountered during the Site Investigations (OCB Geotechnical 2024) range from 1m to 2m BGL, indicating a relatively high water table in alluvial areas. With this in mind, there is considered to be a moderate potential for offsite migration of any accidentally discharged contaminants within the bedrock.

12.6.17 In accordance with the criteria of assessing the attribute importance, the magnitude of impact and significance rating, the following is concluded for the potential of accidental spills and leaks, and its impact on soils, geology and hydrogeology.

Receptor / Parameter	Importance of Site Attribute as per Table 12-2	Magnitude of Impact, as per Table 12-3	Significance of impact, as per Table 12-4
Impact to Soils and Geology	Low	Small Adverse	Imperceptible
Impact to Hydrogeology	Low to Medium	Small Adverse	Slight

Potential Impacts of Excavation, Loss of Soils and Bedrock Exposure

12.6.18 Excavation and removal of existing topsoil cover is anticipated at the following locations, in the amounts as per Section 12.6.7, and for the following activities:

- Area 1 (Upstream Storage area): Stripping of existing topsoil cover and grassed vegetation below the footprint of the impoundment structure (earthen embankment). Further, excavation required for the creation of a diversion channel for the River Duiske, to allow for the construction of the reinforced concrete flow control structure and downstream flume in 'the dry'.

- Area 2 (Well Lane to High Street Bridge): Excavation within the river bed from The Globe to Clapper Bridge, to allow for the construction of raised defences and replacement of pedestrian bridge.

- Areas 5 (Boat Club), Area 7 (The Dock), Area 8 (Hotel Street) and Area 10 (Tinnahinch Castle): Removal of existing topsoil and grassed vegetation below the footprint of the embankments proposed at these locations.

- Area 7 (The Dock and The Hub), and Area 9 (Tinnahinch Quay): Excavation and open trenching/pits required for the drainage works, pumping stations and some works to existing sewers.

12.6.19 Removal of soil cover will increase the vulnerability of the underlying bedrock and hydrogeology to risk of potential soil erosion and transportation and contamination. The existing vulnerability for much of the area where construction is planned is already classified as 'extreme'. This period however will be temporary, and all areas will be infilled and reinstated post construction.

12.6.20 Therefore, in accordance with the criteria of assessing the attribute importance, the magnitude of impact and significance rating, the following is concluded for the potential of excavation, soil loss and bedrock exposure, and its impact on soils, geology and hydrogeology.

Receptor / Parameter	Importance of Site Attribute as per Table 12-2	Magnitude of Impact, as per Table 12-3	Significance of impact, as per Table 12-4
Impact to Soils and Geology	Low	Negligible	Imperceptible
Impact to Hydrogeology	Low to Medium	Negligible	Imperceptible

Potential Impact of Soil Compaction

12.6.21 Heavy equipment and vehicles will travel through the scheme area potentially causing unwanted compaction and disturbance/erosion of natural ground or any unfinished road surfaces works. The areas where soil compaction is a likelihood area:

- Area 1 (Storage Area) and SC B, within agricultural fields where the works, SC and access road are proposed.

- Areas 5 (Boat Blub) and SC D, within grassed fields where proposed embankments are to be placed and SC is to be located for the duration of WP4A.

- Area 7 (The Dock), within grassed amenity area where embankments and access ramps are to be placed.
- Area 8 (Hotel Street) and SC E, within grassed field where proposed embankment is to be placed and SC is to be located for the duration of WP4B.
- Access road to and extent of SC F: SC F is proposed in a grassed field, and part of the access route to it is unpaved.

12.6.22 The sensitivity of these areas, however, are low, given that the majority are currently unused amenity spaces or through roads. Therefore, in accordance with the criteria of assessing the attribute importance, the magnitude of impact and significance rating, the following is concluded for the potential of soil compaction, and its impact on soils and geology.

Receptor / Parameter	Importance of Site Attribute as per Table 12-2	Magnitude of Impact, as per Table 12-3	Significance of impact, as per Table 12-4
Impact to Soils and Geology	Low	Negligible	Imperceptible

Potential Impacts from Dewatering

12.6.23 Due to the relatively high -water table in the area (approximately 1-2m below ground level), dewatering works may be required for intrusive works in alluvial areas during:

- Installation of pipework and pumping stations, and work to existing sewer lines.
- Excavation of soils for the demolition of existing wall foundations, as required and construction of new foundations.
- Excavation of a channel diversion for the creation of a diversion channel for the River Duiske, to allow for the construction of the reinforced concrete flow control structure and downstream flume in 'the dry'.

12.6.24 Due to the small and local extent of excavation and likely relatively low permeability of the underlying materials it is anticipated that limited pumping of water may be required. The duration of the potential impact for the pumping activity itself is likely to be **short term** and the **impact imperceptible**. There is only one groundwater bore nearby, and as such, impacts to this bore are not considered likely. Similarly, given the limited pumping required, the risk of settlement occurring in adjacent buildings is considered low. Potential impacts to and mitigations for biodiversity and surface water as a result of dewatering are discussed in Chapter 10 'Biodiversity' and Chapter 8 'Hydrology – Surface Water' respectively. These potential impacts are likely to arise from temporarily increased siltation and are **significant negative short-term (small adverse)**. In accordance with the criteria of assessing the attribute importance, the magnitude of impact and significance rating, the following is concluded for the potential of impacts of dewatering on hydrogeology.

Receptor / Parameter	Importance of Site Attribute as per Table 12-2	Magnitude of Impact, as per Table 12-3	Significance of impact, as per Table 12-4
Impact to Hydrogeology	Low to Medium	Negligible	Imperceptible
Impact to surface water and biodiversity	Low to Medium	Small Adverse	Imperceptible

Operation Phase

Land

12.6.25 The Proposed Scheme and associated flood defences within G-T are designed to ensure consistency with the existing land use and zoning of the area and will not result in a change to this. Completion of the Proposed Scheme is cognisant with policy objectives of the LAP and wider national flood risk legislation and planning with regards to the management of flooding. Public realm improvements are proposed in several areas alongside the flood defences, including segregation of pedestrian routes, surface changes, street furniture, planting. Where appropriate materials and street furniture that are sympathetic to or from the locality and do not detract from existing significant features or historical structures, have been proposed, to assist in creating a cohesive townscape and synergy with the LAP. Further detail is included in Chapter 11 'Landscape and Visual'.

12.6.26 As mentioned in Section 12.6.4 and 12.6.5, land encompassing the upstream storage area will be acquired through the CPO process. The CPO footprint for the embankment will be permanent, the remainder of the CPO area will be temporary, with a wayleave for maintenance.

Soils, Geology and Hydrogeology

12.6.27 There are considered to be no likely significant impacts to soils and geology arising from the operation of the flood defences and regular maintenance activities to these and associated landscaping and vegetation. The operation and maintenance phase of the Proposed Scheme will have an **overall neutral long-term impact** on land and soils.

12.7 Mitigation Measures

Construction Phase

12.7.1 A CEMP has been prepared alongside this EIAR (see Appendix 4-4) to provide guidance on the implementation of the mitigation measures, to the appointed contractor(s). The CEMP sets out the mitigation measures identified in this EIAR as well as general site management best practise. The appointed contractor will be responsible for iteration of the CEMP into a dedicated and site-specific CEMP to be considered a 'live' document understood and implemented by all construction staff and sub-contractors throughout the construction process.

12.7.2 During the construction phase, there will be consideration for the standard best international practice including but not limited to:

- CIRIA, (2001), Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors, (C532) Construction Industry Research and Information Association.
- CIRIA (2005), Environmental Good Practice on Site (C650); Construction Industry Research and Information Association.
- BPGCS005, Oil Storage Guidelines.
- CIRIA 697 (2007), The SUDS Manual.
- UK Pollution Prevention Guidelines, (PPG) UK Environment Agency, 2004.

12.7.3 The adopted construction techniques will comply with the requirements of statutory bodies (Health and Safety Authority and the Office of Public Works) and the Employer. The CEMP outlines the implementation of appropriate measures to protect against impact to geology, soils and hydrogeology. During construction, the following generic measures will be used to avoid or reduce the significance of potential impacts:

Land

LSGH_1: The locations of the proposed defences have been defined with consideration of land zoning, with measures implemented to minimise impact where possible. This has been informed by a rigorous consultation programme and continuous coordination with the planning authorities.

LSGH_2: With regard to land take of the green and recreational parkland areas (The Hub), mitigation during construction will consist of land being set out prior to construction in such a manner to minimise the construction footprint and will be clearly demarcated by fencing. There will be provision of safe accesses and egresses through the area, and provision of information to the general public through signage and notices.

Soils, Geology and Hydrogeology

Potential Impacts Regarding Use of Imported Materials

LSGH_3: Appropriate due diligence to be undertaken in the sourcing of materials from responsible and audited suppliers, and in the testing of materials prior to use, to determine both suitability, contamination (Heavy Metals, TRH, PAH, OP/OC Pesticides) and inspected for presence of deleterious materials. Imported discarded soils to be reused/ recovered on site will be certified as suitable for use by a suitably qualified person as per requirements of EPA Guidance on Waste Acceptance Criteria at authorised soil recovery facilities.

Potential Impacts from Encountering Existing Contamination

LSGH_4: If contamination is encountered in the existing geology, soils or hydrogeology, suitable measures will be put in place to avoid mobilising the contamination based on the most appropriate industry best practice guidance for contaminated land management.

LSGH_5: The management of surplus excavated material or temporarily stored materials at the site compounds will be determined by the classification of the material (i.e., contaminated, or not, in line with the European Waste Catalogue and Hazardous Wate List, the Waste Management Act and the Hazardous Waste List), with mitigation measures implemented as appropriate (see Chapter 7 'Material Assets' for mitigation measures regarding the management of hazardous waste). These measures will prevent disturbance of any existing contamination that may be present at the site compounds. They will also prevent interaction between any existing contamination present on the site compounds and materials stored there and will ensure that contaminate excavated material will not have an impact on the underlying soils or hydrogeology.

Potential Impacts of Accidental Spills and Leaks

LSGH_6: A contingency plan for accidental leaks and spillages is included in the CEMP, the implementation of which will be further developed by the contractor prior to the commencement of the works and regularly updated during construction. The CEMP includes the mitigation measures of the EIAR. This contingency plan identifies the actions to be taken in the event of a pollution incident in accordance with the CIRIA guidance 741 *Environmental good practice on site*, and includes:

- Containment measures.
- Emergency discharge routes.
- List of appropriate equipment and clean-up materials.
- Maintenance schedule for equipment.
- Details of trained staff, location and provision for 24-hour cover.
- Details of staff responsibilities.
- Notification procedures to inform the Environment Protection Agency (EPA) or Environmental Department of the Kilkenny County Council.
- Audit and review schedule.
- Telephone numbers of National Parks and Wildlife Services (NPWS) and Inland Fisheries Ireland (IFI).
- List of specialist pollution clean-up companies and their telephone numbers.

LSGH_7: The storage of all fuels, other hydrocarbons and other chemicals shall be within the construction compound only and will be in accordance with relevant legislation and best practice. In particular:

- Fuel storage tanks shall have secondary containment provided by means of an above ground bund to capture any oil leakage.

- Storage tanks and associated provision, including bunds, will conform to the current best practice for oil storage and will be undertaken in accordance with Best Practice Guide BPGCS005 – Oil Storage Guidelines (Enterprise Ireland).

LSGH_8: Apart from the case of water extraction pumps situated by the river, fuel storage, temporary or otherwise, and refuelling will not be permitted within 10m of the watercourse at these locations.

LSGH_9: Provision of an adequate supply of spill kits and hydrocarbon adsorbent packs will be stored at each work area. The Site Environmental Manager will maintain an inventory of spill kits on site to ensure all are properly equipped.

LSGH_10: As part of the site Environmental Induction Training all staff will be informed of the spill contingency plan and the location and use of the spill absorbents.

LSGH_11: If a spillage does occur, the adsorbents will be treated as a hazardous waste and disposed of accordingly (see Chapter 7 for mitigation measures regarding the management of hazardous waste).

LSGH_12: Vehicles and equipment will be maintained by a suitably trained person and checked on a regular basis.

LSGH_13: Daily vehicle and equipment checks will include a visual assessment for oil or lubricant leaks prior to use.

LSGH_14: Vehicles will be parked on hardstanding areas overnight or when not in use, as applicable.

LSGH_15: Re-fuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated area (or where possible off the site) which will be away from any existing surface water gulleys or drains. In the event of a machine requiring refuelling outside of this area, fuel will be transported in a mobile double skinned tank.

LSGH_16: A suitable risk assessment for wet concreting will be completed prior to works being carried out which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil.

LSGH_17: Washout from concrete lorries, with the exception of the chute, will not be permitted on site and will only take place at the construction compound (or other appropriate facility designated by the supplier).

LSGH_18: Chute washout locations will be provided with appropriate designated, contained impermeable area and treatment facilities including adequately sized settlement tanks. The clear water from the settlement tanks will be pH corrected prior to discharge (which shall be by means of one of the construction stage settlement facilities)

or alternatively disposed of as waste in accordance with the Contractor's Waste Management Plan.

Potential Impacts of Excavation, Loss of Soils and Bedrock Exposure

A soil management plan is included in the CEMP which is appended to and supplements this EIAR (Appendix 4-4). The CEMP will be iteratively developed by the contractor prior to the commencement of the works and updated, as required, during construction. This plan identifies the actions that will be taken to avoid significant loss of soils, and the protection of soils and bedrock from exposure to erosion, sediment loss and contamination. Measures include:

LSGH_19: Movement of material will be minimised in order to reduce degradation of soil structure and generation of dust.

LSGH_20: All excavated material will, where possible, be reused as construction fill. The appointed contractor will ensure acceptability of the material for reuse for the Proposed Scheme with appropriate handling, processing and segregation of the material.

LSGH_21: Excavated soil materials will be stockpiled locally within the working area where possible, using an appropriate method to minimise the impacts of weathering. Care will be taken in reworking this material to minimise dust generation, hydrogeology infiltration and generation of runoff. Any surplus suitable material excavated, that is not required elsewhere for the Proposed Scheme, will be used for other projects where possible, subject to appropriate approvals/notifications.

LSGH_22: Precautions will be taken to minimise the runoff of soils into watercourses through the implementation of erosion and sediment control measures.

LSGH_23: Care will be taken to ensure that the side slope surfaces are stable to minimise erosion. This will be achieved through the selection of suitable material and adoption of an appropriate side slopes. If there is insufficient space to allow for a suitable side slope, supports to sides will be provided by precast concrete traffic barriers.

LSGH_24: Soil and materials will be transported in appropriate dump trucks to minimise the loss of material in transport.

LSGH_25: Earthworks operations will be carried out such that surfaces will be designed with adequate falls, profiling and drainage to promote safe runoff and prevent ponding and flooding.

Potential Impact of Soil Compaction

LSGH_26: Significant project vehicle and equipment movements will be along agreed predetermined routes along existing national, regional and local routes. Where compaction occurs due to truck movements and other construction activities on unfinished surfaces, remediation works will be undertaken to reinstate the ground to a condition if at least equal quality to the original surface.

LSGH_27: Vehicles will minimise tracking over natural or unfinished surfaces, where practicable.

LSGH_28: Heavy vehicles and equipment will be parked on hardstanding areas overnight or when not in use, as applicable.

LSGH_29: Where practicable, compaction of any soil or subsoil which is to remain in situ in the works area will be avoided.

LSGH_30: Care will be taken to ensure that the side slope surfaces of bunds and haul roads are stable to minimise erosion.

Potential Impact from Dewatering

LSGH_31: A low impact dewatering methodology such as submersible pumps or dewatering pumps will be selected for the construction. The final construction methodology selected will consider the risk of any ground instability arising from dewatering activities to potentially sensitive receptors in proximity to the works area.

Operation and Maintenance Phase

12.7.4 Mitigation measures proposed for the construction phase are considered to be appropriate for all works required as part of the maintenance regime for the flood defences and will be implemented accordingly.

12.8 Monitoring

12.8.1 Routine site inspections should be undertaken during the construction phase and during maintenance activities by a Health, Safety & Environmental Officer to determine compliance with the suggested mitigation measures described in Section 12.7.

12.8.2 Site records should be inspected to determine history of any contamination / spillages and how these were addressed. Improvements and lessons learnt may be a useful tool to ensure effectiveness.

12.8.3 An independent Environmental Clerk of Works shall be appointed to the project to provide independent environmental oversight of the contractor's team.

12.9 Residual Impacts and Effects

The 'do nothing' Scenario

12.9.1 No residual effects have been assigned with regards to land (i.e., land take and/or change in zoning) in the 'do nothing' scenario. Zoning and land use conditions would remain as they are currently.

12.9.2 Under the 'do nothing' Scenario, the residual impact to soils will remain as 'imperceptible' whereby the likelihood of sediment build-up and potential periodic downstream moment due to large scale flooding events remains, although with minimal consequence. No impact to geology and hydrogeology is predicted.

Construction Phase

12.9.3 The significance ranking of 'imperceptible' and 'slight' are the lowest ranking available in the NRA (2008) impacts assessment methodology. All construction-phase soil impacts are considered to be '**small adverse'** prior to mitigation, with the exception of the potential for accidental spills and leaks. This is on account of the low to medium significance rating of the soil/geology and hydrogeology sources within the area, and small scale works to which these assets may be affected. Residual impacts are considered **'imperceptible'.**

12.9.4 Mitigation measures are proposed to reduce the risk of leaks or spills occurring by adopting measures to avoid leaks or spills occurring and/or to reduce the degree of the potential impact should leaks or spills occur. It is anticipated that the implementation of these measures would reduce the magnitude of attribute to **'negligible**' during all work packages and the residual significance ranking of the potential impact would be **'imperceptible'**. This considers the risk of normal 'day-to-day' activities and minor incidents and does not include major accidents which are discussed in Chapter 17 'Major Accidents and Disasters'.

Operation and Maintenance Phase

Potential Impacts to Soils and Geology

12.9.5 The operation and maintenance phase of the Proposed Scheme will have an overall **neutral long-term residual impact** on soils and geology.

12.10 Interactions with other Environmental Effects

12.10.1 A full review of the potential interactions with other environmental effects is provided in Chapter 16 'Interactions and Cumulative Effects'.

12.10.2 Possible interactions exist between the impacts identified to land, soils and geology and those identified to 'Hydrology - Surface Water' (Chapter 8) and 'Biodiversity' (Chapter 10). A potential effect on the soils and geological environment includes the excavation and removal of made ground and overburden which could potentially increase the sediment loading to the surface water environment and impact to associated aquatic species. Further, contaminated or imported soil has the potential to run off during the construction phase and have negative impacts on surface water environments and associated biodiversity. Imported soil and the possibility of the spread of invasive species is an additional interaction considered in Chapter 10 'Biodiversity'.

12.11 Cumulative Impacts

12.11.1 A full review of the potential cumulative impacts is provided in Chapter 16 'Interactions and Cumulative Effects'.

12.11.2 Cumulative impacts are those which accrue to key land, soil, geology and groundwater receptors as a result of incremental changes caused by other existing and proposed plans or projects together with those caused by the Proposed Scheme.

12.11.3 Cumulatively, the identified projects in combination with the Proposed Scheme may create pressure on the existing soils/geology conditions and underlying aquifer however the combined impact is unlikely to be significant given the nature and scale of the identified projects and ability for all impacts to be sufficiently mitigated through best-practice construction techniques.

12.12 Limitations in Preparing the Chapter

12.12.1 No limitations were encountered in the preparation of this chapter.

12.13 Summary

12.13.1 As mentioned in Section 12.3, the assessment of impacts to land have been conducted in line with the significance ranking methodologies outlined in the EPA 2022 Guidelines. The summary table of impacts, effect significance, mitigation and residual significance is outlined below.

Table 12-6: Summary of Impacts and Mitigation Measures: Land (EPA, 2022)

Receptor	Description of Potential Impact	Pre-Mitigation Significance	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
'Do Nothing' Scenario Impacts					
Land	'Land Take and removal of productive land from potential agricultural and other beneficial use	Neutral	Long-term	Not applicable	None
Construction Phase Impacts					
Land	Several fields currently utilised for agricultural purposes (or have the potential to be) will be taken out of production for the period of WP2	Imperceptible	Temporary	• Consider proposed defences with due consideration of land zoning with measures implemented to minimise impact.	Imperceptible
Land	Portions of land currently utilised for recreational. Leisure use will be unavailable during the construction period	Negative – not significant	Temporary	• Reduce amount of land taken for the construction process, limiting the construction programme where land is taken from other uses.	Imperceptible
Operation and Maintenance Phase Impacts					
Land	General maintenance works	Not applicable	Not applicable	No specific mitigation required for this phase of the project over and above those specified for construction phase impacts	None

12.13.2 As mentioned in Section 12.3, the assessment of impacts to hydrology have been conducted in line with the significance ranking methodologies in NRA 2008 Guidelines. The summary table of impacts, importance ranking, magnitude ranking, effect significance, mitigation and residual significance is outlined below.

Table 12-7: Summary of Impacts and Mitigation Measures: Soils (NRA, 2008)

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significant Pre-Mitigation	Suggested Mitigation and Monitoring	Impact Significant Post-Mitigation
'Do Nothing' Scenario Impacts						
Sediment levels will increase overtime with periodic downstream moment due to large scale flooding events and increased sediment downriver	Soils, Geology and Hydrogeology	Extremely High	Small	Adverse	Not applicable	Not applicable
Construction Phase Impacts						
Use of imported materials	Soils Hydrology and Geology	Extremely High	Moderately	Adverset	• Use of Waste Criteria Assessment to determine contamination status of imported materials • Complete SI works for the project to establish baseline soil conditions • Classify incoming soil materials prior to acceptance • Contaminated land management measures to manage previously unknown contamination if encountered	Negligible/Imperceptible
Encountering known or unknown existing contamination	Soils Hydrology and Geology	Extremely High	Moderate	Adverse		Negligible/Imperceptible

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significant Pre-Mitigation	Suggested Mitigation and Monitoring	Impact Significant Post-Mitigation
Potential impacts of accidental leaks and spills	Soils Hydrology and Geology	Extremely High	Small Adverse	Small Adverse	• The storage of all fuels and other hydrocarbons and other chemicals shall be within the construction compound only and shall be in accordance with best practice. • Fuel storage tanks shall have secondary containment provided by means of an above ground bund to capture any oil leakage. • Storage tanks and bunds will confirm to the current best practice for oil storage and will be undertaken in accordance with Best Practice Guide BPGCS005 – Oil Storage Guidelines • Daily vehicle checks for oil leaks • Spill Kits and absorbent packs will be stored in each work area for use. • Pouring of concrete to take place in a designated area and will only take place at the construction compound.	Slight/Imperceptible
Potential impacts from excavation, loss of soil and bedrock exposure.	Soils Hydrology and Geology	Extremely High	Negligible	Significant	• Movement of material will be minimised in order to reduce degradation of soil structure and generation of dust. • All excavated material shall be reused as fill where possible and precautions will be taken to minimise the runoff of soils into watercourses through the implementation of erosion and sediment control measures. • Earthworks operations will be carried out such that surfaces will be designed with adequate	Negligible/Imperceptible

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significant Pre-Mitigation	Suggested Mitigation and Monitoring	Impact Significant Post-Mitigation
Potential impact on locally important bedrock and/or gravel aquifer	Soils Hydrology and Geology	Extremely High	Negligible	Imperceptible	Not applicable	Negligible/Imperceptible
Potential impact of soil compaction	Soils Hydrology and Geology	Extremely High	Moderate	Profound	• Significant project vehicle and equipment movements will be along agreed predetermined routes along existing national, regional and local routes. Where compaction occurs due to truck movements and other construction activities on unfinished surfaces, remediation works will be undertaken to reinstate the ground to a condition if at least equal quality to the original surface. • Vehicles will minimise tracking over natural or unfinished surfaces, where practicable. • Heavy vehicles and equipment will be parked on hardstanding areas overnight or when not in use, as applicable. • Care will be taken to ensure that the side slope surfaces of bunds and haul roads are stable to minimise erosion.	Moderate/Slight
Potential impact of dewatering	Soils Hydrology and Geology	Extremely High	Imperceptible	Significant	• An appropriate dewatering methodology such as submersible pumps or dewatering pumps will be selected for works. This will consider the risk of any ground instability arising from dewater activities to potentially sensitive	Imperceptible/Negligible

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significant Pre-Mitigation	Suggested Mitigation and Monitoring	Impact Significant Post-Mitigation
Potential impact of dewatering	Biodiversity and Water	Extremely high	Small Adverse	Significant	• Increase siltation leading to temporary reduction in biodiversity and water quality	Imperceptible/Negligible
Potential for import of invasives	Soils Hydrology and Geology	Small Adverse	Small Adverse	Significant	• Classify incoming and inspect soil materials prior to acceptance • Invasives management measures to manage invasives if encountered	Imperceptible/Negligible
Operation and Maintenance Phase Impacts						
General maintenance works	Soils Hydrology and Geology	Extremely high	Negligible	Imperceptible	• Mitigation measures proposed for the construction phase are considered to be appropriate for all works required as part of the maintenance regime for the flood defences and will be implemented accordingly.	Imperceptible/Negligible

12.14 References

CIRIA , 2005. Environmental Good Practice on Site (C650); Construction Industry Research and Information Association., s.l.: s.n.

CIRIA 697 , 2007. The SUDS Manual. , s.l.: s.n.

CIRIA, , 2001. Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors, (C532) Construction Industry Research and Information Association., s.l.: s.n.

Environmental Protection Agency, 2024. Get Data. [Online] Available at: https://gis.epa.ie/GetData/Download

EPA, 2022. Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports , s.l.: s.n.

EPA, 2022. Guidelines on the Information to be Contained in Environmental Impact Assessment Reports, s.l.: s.n.

GSI, 2025. Data and Maps. [Online] Available at: https://www.gsi.ie/en-ie/data-and-maps/Pages/default.aspx

IGI, 2013. Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements. , s.l.: s.n.

Institute of Geologists of Ireland , 2013. Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements. , s.l.: s.n.

NRA, 2008. Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes., s.l.: s.n.

UK Environment Agency, 2004. UK Pollution Prevention Guidelines, (PPG) , s.l.: s.n.

13 Air Quality

13.1 Scope of the Assessment

13.1.1 This chapter focuses on the assessment of potential emissions to air as a result of the construction, operation and maintenance of the Proposed Scheme. The assessment relies on details of the construction methodology provided in Chapter 4 'Description of Proposed Scheme and Construction Methodology'.

13.1.2 The following aspects have been considered relevant to this assessment:

- Design:
  - Proximity of the Proposed Scheme to existing sensitive receptors.
- Construction:
  - The impact of construction works on human receptors, from the perspective of increased particulate matter (PM10 & PM2.5) associated with construction activities.
  - The impact of construction works on human receptors, from the perspective of emissions of pollutants via the exhaust of on-site plant/machinery and vehicles travelling to and from the construction sites.
- Operation and Maintenance Phase:
  - Due to the nature of the scheme, no significant impacts are predicted for the operation and maintenance phase, and therefore this has been scoped out of the EIAR (ByrneLooby, 2023).

13.2 Statutory and Policy Context

International Legislation

13.2.1 The World Health Organisation (WHO) Air Quality Guidelines[1] (AQGs) are a set of evidence-based recommendations of limit values for specific air pollutants developed to help countries achieve air quality that protects public health. The first release of the guidelines was in 1987 and since then, several updated versions have been published. The most recent update, the 2021 update (see Table 13-1), is in response to the real and continued threat of air pollution to public health. The EPA is the responsible agency for air quality in Ireland and reports against the WHO guideline values for air pollutants.

[1] WHO Ambient (outdoor) air pollution – Guideline values (2021) https://www.who.int/news-room/feature-stories/detail/what-are-the-who-air-quality-guidelines

Table 13-1: WHO Air Quality Guidelines 2021

Pollutant	Averaging Time	2021 Air quality standard (µg/m^3)
Particulate Matter ($PM_{2.5}$)	Annual	5
	24-hour[1]	15
Particulate Matter (PM_{10})	Annual	15
	24-hour[1]	45
Ozone (O_3)	Peak Season[2]	60
	8-hour[1]	100
Nitrogen dioxide (NO_2)	Annual	10
	24-hour[1]	25
Sulphur Dioxide (SO_2)	24-hour[1]	40
Carbon Monoxide (CO)	24-hour[1]	4

[1]99th percentile (i.e., 3-4 exceedance days per year).
[2]Average of daily maximum 8-hour mean O_3 concentration in the six consecutive months with the highest six-month running average O_3 concentration.
Note: Annual and peal season is long-term exposure, while 24 hour and 8 hour is short-term exposure.

National Legislation

13.2.2 The relevant Republic of Ireland ambient air standards have been adopted from the European Commission Directives 1996/62/EC, 1999/30/EC and 2000/69/EC and are cited as the Air Quality Standards Regulations which came into force on 17th June 2002 (Irish Legislation S.I. No. 271 of 2002). In May 2008, these European Directives on air quality were replaced with a new Directive on ambient air quality and cleaner air for Europe (2008/50/EC). The Clean Air for Europe (CAFE) Directive (2008/50/EC) (now transposed into Irish Law) sets limits and target values for ambient concentrations of air pollutants harmful to human health and the environment.

13.2.3 Four "daughter" directives lay down limits for specific pollutants:

- 1st Daughter Directive: Sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead
- 2nd Daughter Directive: Carbon monoxide and benzene
- 3rd Daughter Directive: Ozone
- 4th Daughter Directive: Polyaromatic hydrocarbons, arsenic, nickel, cadmium and mercury in ambient air

13.2.4 The CAFE Directive was transposed into Irish legislation by the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011). It replaces the Air Quality Standards Regulations

2002 (S.I. No. 271 of 2002), the Ozone in Ambient Air Regulations 2004 (S.I. No. 53 of 2004) and S.I. No. 33 of 1999.

13.2.5 Under the CAFE Directive, EU member states were required to designate zones for the purpose of managing air quality. For Ireland, four zones (Zones A, B C and D) were defined in the Air Quality Standards Regulations (2011). The zones were amended on 1st January 2013 to take account of population counts from the 2011 CSO Census and to align with the coal restricted areas in the 2012 Regulations (S.I. No. 326 of 2012). The scheme study area is in Zone D: Rural Ireland ('Rural East').

13.2.6 The Air Quality Standards Regulations (2011) specify limit values in ambient air for sulphur dioxide (SO_2), lead (Pb), benzene (C_6H_6), particulate matter (PM_{10} and $PM_{2.5}$) and carbon monoxide (CO), nitrogen dioxide (NO_2) and oxides of nitrogen (NOx). The relevant key pollutants of concern for the development are NO_2, PM_{10} and $PM_{2.5}$. These are shown in the table below.

Table 13-2: Air Quality Standards Regulations 2011 (Ireland)

Pollutant	Averaging Period	Air quality standard (µg.m-3)	Criteria
Nitrogen dioxide (NO_2)	1-hour limit for human health	200	200 $\mu g.m^{-3}$ not to be exceeded more than 18 times a year
	Annual limit for human health	40	40 $\mu g.m^{-3}$
	Annual limit for protection of vegetation	30	30$\mu g/m^3$ NO + NO_2
	24-hour limit for protection of human health	50	50 $\mu g.m^{-3}$ not to be exceeded more than 35 times a year
Particulate Matter (PM_{10})	Annual limit for protection of human health	40	40 $\mu g.m^{-3}$
Particulate Matter ($PM_{2.5}$)	Annual limit for protection of human health	25	25 $ug.m^{-3}$

13.2.7 There is no legislative limit for dust (total suspended particles/total particulate matter), so the guidelines presented by the German Government TA Luft guidance (TA Luft, 2002) are used. Under this guidance the construction contractor would be required to maintain monthly dust levels below the guideline of 350mg/m^2/day as an annual average at sensitive receptors. The EPA have adopted this standard for all licensable activities.

Local Policy

13.2.8 Kilkenny City and County Development Plan sets an objective to "*promote the best ambient air quality compatible achievable with sustainable development*", reducing air

pollution in line with relevant legislation and best practice guidance (Kilkenny County Council, 2021) (p.180).

13.2.9 The Carlow County Development Plan notes that air quality can be impacted and improved by air quality as they note the Removal of pollutants from air and water as a benefit to green infrastructure (Carlow County Council, 2022).

13.2.10 The Graiguenamanagh-Tinnahinch (G-T) Local Area Plam draws attention to the importance of Green Infrastructure for improving air quality by acting as a filter for emissions and dust in the air. "The Green Infrastructure network is the network of natural and semi-natural areas that support the natural environment by providing habitats for wildlife, air and water filtration and surface water management, recreational and tourism opportunities and "greener" neighbourhoods" (Kilkenny County Council and Carlow County Council, 2021) (p.46).

13.3 Assessment Methodology

Study Area

13.3.1 The principal Study Area is determined by the scheme boundary and generally includes the townlands of G-T and the surrounding environs, the River Duiske and River Barrow, and the environs of the proposed upstream storage area. The Study Area for the assessment of construction-based air quality impacts is inclusive of the area which is affected by the rise in particulate matter and pollutant emissions from the construction of the scheme, generally considered within a 500m buffer of the site or WPs (as per the Institute of Air Quality Management).

Assessment of Impacts

Assessment of Construction Dust

13.3.2 The Institute of Air Quality Management's (IAQM) 'Guidance on the Assessment of Dust from Demolition and Construction (IAQM, 2014) has been followed in carrying out this air quality assessment. The IAQM guidance provides a method for classifying the significance of effect from construction activities based on the 'dust magnitude' (high, medium or low) and proximity of the site to the closest receptors. The guidance recommends that once the significance of effect from construction is identified, the appropriate mitigation measures are implemented. The guidance notes that, once the appropriate mitigation measures are applied, in most cases the resulting dust impacts can be reduced to negligible levels.

13.3.3 The IAQM guidance suggests that demolition, earthworks, construction and track-out are assessed individually to determine the overall significance of the construction phase. The main impacts that may arise during construction of the Proposed Scheme are:

- Visible dust plumes and dust soiling effects.
- Elevated PM_{10} concentrations as a result of dust generating activities on site. There are many activities on a construction site that can generate dust emissions

including demolition, cutting, the storage of friable materials, piling, concrete batching, crushing, and screening of wastes, loading and tipping and dry sweeping, amongst others.

- An increase in NO_2 and PM_{10} concentrations due to exhaust emissions from site plant/machinery and vehicles accessing the site.

13.3.4 IAQM guidance recommends that an assessment of construction dust risk should be undertaken where there is:

"a 'human receptor' within:

- 350m of the boundary of the site; or
- 50m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

an 'ecological receptor' within:

- 50m of the boundary of the site; or
- 50m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s)."

13.3.5 As the Proposed Scheme is in an urban area, there are many human receptors in proximity (see Section 13.5). Further, as outlined in Chapters 8 'Hydrology – Surface Water' and 10 'Biodiversity' the site intersects with the River Barrow and River Nore SAC and lies within 15km of other statutory designated ecological sites. As such, the potential for significant impacts on ecological receptors is an important part of this assessment.

13.3.6 Given the above, a construction dust risk assessment is required for the Project. It involves several steps, which are summarised below:

<u>Step 1 (Screen the need for assessment):</u>

13.3.7 The first step is the initial screening for the need for a detailed assessment. According to the IAQM guidance, an assessment is required where there are sensitive receptors within 350m of the site boundary (for ecological receptors, 50m) and/or within 50m of the route(s) used by the construction vehicles on the public highway and up to 500m from the site entrance(s). These thresholds are passed for the Proposed Scheme and therefore a full risk assessment including steps 2-4 is undertaken.

<u>Step 2 (Assess the risk of dust impacts:</u>

13.3.8 This is split into three sections as follows:

13.3.9 **Step 2A (Dust Emission Magnitude):** There are many activities on a construction site that can generate dust emissions including demolition, the storage of friable materials, piling, concrete batching, crushing, and screening of wastes, loading and tipping and dry

sweeping, amongst others. The time of year in which these activities occur can also influence the dust emission magnitude, with drier conditions often favouring dust release. The potential dust emission magnitude for each phase is defined as either 'Small', 'Medium' or 'Large', taking account of the scale and nature of the works. The following guidance is used (IAQM):

Table 13-3: Criteria for Categorising Dust Emission Magnitude

Activity	Dust Emission Magnitude	IAQM and GLA Example Dust Emission Magnitude Criteria
Demolition	Large	Total building volume >50,000 m^3, potentially dusty construction material (e.g., concrete), on-site crushing and screening, demolition activities >20 m above ground level.
	Medium	Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level.
	Small	Total building volume <20,000 m^3, construction material with low potential for dust release (e.g., metal, cladding or timber), demolition activities < 10m above ground, demolition during wetter months.
Earthworks	Large	Total site area >10,000 m^2, potentially dusty soil type (e.g., clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8 m in height, total material moved >100,000 tonnes.
	Medium	Total site area 2,500 m^2 – 10,000 m^2, moderately dusty soil type (e.g,. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4 m - 8 m in height, total material moved 20,000 tonnes – 100,000 tonnes.
	Small	Total site area <2 ,500 m^2, soil type with large grain size (e.g.,

Activity	Dust Emission Magnitude	IAQM and GLA Example Dust Emission Magnitude Criteria
		sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4 m in height, total material moved <20,000 tonnes, earthworks during wetter months.
Construction	Large	Total building volume >100, 000 m^3, on site concrete batching, piling, sandblasting.
	Medium	Total building volume 25,000 m^3 – 100,000 m^3 potentially dusty construction material (e.g. concrete), on site concrete batching.
	Small	Total building volume <25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber).
Track-out	Large	>50 HDV (>3.5t) outward movements of vehicles after moving over unpaved ground in anyone day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m.
	Medium	10-50 HDV (>3.5t) outward movements of vehicles after moving over unpaved ground in anyone day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m.
	Small	<10 HDV (>3.5t) outward movements of vehicles after moving over unpaved ground in anyone day, surface material with low potential for dust release, unpaved road length <50 m.

13.3.10 **Step 2B (Sensitivity of Area):** High sensitivity human receptors include residential dwellings, schools, hospitals, and other places where vulnerable members of the community may spend significant periods of time (e.g., care homes and nurseries). However, places such as car showrooms and museums may also be considered of high sensitivity to dust soiling due to the potential for dusts to diminish the value of property

or significantly impact the enjoyment of a space. Medium sensitivity receptors include areas where people would not reasonably be expected to be present for extended periods of time (e.g., places of work or parks). The sensitivity of the area to dust impacts is identified as either 'Low', 'Medium' and 'High', for each construction phase. This is based on the proximity and number of receptors, their sensitivity to dust, the local PM_{12} background concentrations and any other site-specific factors. The following guidance is used to determine sensitivity (IAQM):

Table 13-4: Criteria for Determining Sensitivity of Area to Dust Soiling Effects

Receptor Sensitivity	Distance from the site source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Table 13-5: Criteria for Determining Sensitivity of Area to Dust Soiling Effects

Receptor Sensitivity	No. of receptors	Distance from works areas			
		<20m	<50m	<100m	<350m
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	<10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 13-6: Sensitivity of the Area to Human Health Impacts

Background PM_{10} Concentrations	No. of receptors	Distance from works areas				
		<20m	<50m	<100m	<200m	<350m
High Receptor Sensitivity						
>32µg/m³	>100	High	High	High	Medium	Low
	10-100			Medium	Low	
	<10		Medium	Low		
28-32µg/m³	>100	High	High	Medium	Low	Low
	10-100		Medium	Low		
	<10					
24-28µg/m³	>100	High	Medium	Low	Low	Low
	10-100					
	<10	Medium	Low			
<24µg/m³	>100	Medium	Low	Low	Low	Low
	10-100	Low				
	<10					
Medium Receptor Sensitivity						
-	>10	High	Medium	Low	Low	Low
	<10	Medium	Low			

Background PM_{10} Concentrations	No. of receptors	Distance from works areas				
		<20m	<50m	<100m	<200m	<350m
Low Receptor Sensitivity						
-	>1	Low	Low	Low	Low	Low

13.3.11 **Step 2C (Assignment of Risk):** The phase specific magnitude is combined with the phase specific sensitivity to provide a phase specific risk profile (Low Risk, Medium Risk and High Risk) for dust soiling, human health effects and ecological impacts (see table below).

Table 13-7: Risk of Dust Impacts

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
Demolition			
High	High risk site	Medium risk site	Medium risk site
Medium	High risk site	Medium risk site	Low risk site
Low	Medium risk site	Low risk site	Negligible
Earthworks			
High	High risk site	Medium risk site	Low risk site
Medium	Medium risk site	Medium risk site	Low risk site
Low	Low risk site	Low risk site	Negligible
Construction			
High	High risk site	Medium risk site	Low risk site
Medium	Medium risk site	Medium risk site	Low risk site
Low	Low risk site	Low risk site	Negligible
Track-out			
High	High risk site	Medium risk site	Low risk site
Medium	Medium risk site	Low risk site	Negligible
Low	Low risk site	Low risk site	Negligible

13.3.12 The construction impact magnitudes outlined in Table 13-7 are assigned EPA impact ratings, as below.

Table 13-8: Risk Rating Relative to EPA Impact Rating

Magnitude of Impact	EPA Impact Rating
Negligible	Imperceptible
Low	Slight
Medium	Moderate
High	Significant

Step 3 (Mitigation):

13.3.13 Site specific mitigation for each of the four construction phases is then identified, based on the outputs of Step 2.

Step 4 (Judgement of Significance):

13.3.14 Professional judgment is then used to examine whether any significant residual risk/ effects are likely.

13.3.15 The above steps are designed to provide a framework for the assessment of construction risk; however, the guidance explicitly states that "professional judgement" should be used when assessing dust risk as no document can cover the full range of situations and projects subject to dust risk. IAQM guidance, however, cautions that all judgements must be fully auditable and where justification cannot be given, a precautionary approach should be taken where the highest level of mitigation is recommended.

13.3.16 The assessment has been conducted with the knowledge that, although the works are anticipated to last 3 years, they will be sequenced into five Works Packages (WP1, WP2, WP3, WP4A and WP4B), not lasting more than 18 months each. Therefore, effects of dust soiling, PM_{10} generation and its impact to human health, and impacts to ecological receptors will last for a shorter period of time and therefore the magnitude would be considered less significant.

Assessment of Construction Traffic and Plant/Machinery

13.3.17 The NRA provides 'Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes' (NRA, 2011). Regarding screening out air quality effects associated with traffic movements it states:

"The significance of impacts due to vehicle emissions during the construction phase will be dependent on the number of additional vehicle movements, the proportion of Heavy Goods Vehicles (HGVs) and the proximity of sensitive receptors to site access routes. If construction traffic would lead to a significant change (> 10%) in average annual daily traffic (AADT) flows near to sensitive receptors, then concentrations of nitrogen dioxide, PM_{10} *and* $PM_{2.5}$ *should be predicted using the approach described previously [detailed modelling]"*

13.3.18 However, the abovementioned guidance is designed for national roads, which include roads managed by Transport Ireland. As such, the guidance is not considered appropriate for the comparatively minor regional and local roads surrounding the Proposed Scheme.

13.3.19 The Environmental Protection UK (EPUK) and IAQM 'Land-use Planning & Development Control: Planning for Air Quality (EPUK & IAQM, 2017) recognises that minor developments, on their own, are highly unlikely to lead to significant increases in local air pollution concentration. EPUK/IAQM guidance advocates a two-staged screening process when assessing a scheme's impact on air quality. It states that the impact of a proposal on air quality cannot be screened out, in the first instance based on size alone, if there are:

- 10 or more residential units or a site area of more than 0.5ha; or
- 1,000 m^2 of floor space for all other uses or a site area greater than 1ha

Coupled with any of the following:

- the development has more than 10 parking spaces
- the development will have a centralised energy facility or

- other centralised combustion process

13.3.20 At the second screening stage, EPUK and IAQM guidance provides indicative criteria which can be used to screen out the potential for significant impacts caused by a proposed development. It recommends that a full air quality assessment should be undertaken if:

- Changes in 24-hour average annual daily traffic (AADT) exceed 500 Light Duty Vehicles (LDVs) and/or >100 Heavy Duty Vehicles (HDV), everywhere; and
- Changes in 24-hour AADT exceed 100 LDV and/or >25 HDV in an area of poor air quality (> 10% below the relevant annual air quality standard).

13.3.21 Total LGV movements during construction of the GTFRS would likely be less than 100, as a daily annual average, across the study area. HGV movements during construction would likely be between 25 and 100 as a daily annual average. As these figures fall below the IAQM's criteria for areas of 'good' air quality, the assessment of the impact of construction traffic has been scoped out of the assessment for air quality. In addition, the entire construction period would last circa three years, divided into four WPs lasting a maximum of 12 months. As such, any increase in traffic would be short-term and localised, with impacts of general nuisance considered greater than the impacts of reduced air quality.

Data Sources

13.3.22 The EPA reports annually on air quality from established air quality monitoring stations that are located across the country under the National Ambient Air Quality Monitoring Programme (AAMP). The EPA report 'Air Quality in Ireland 2022' contains the latest, ratified, data for this network. The closest automatic (continuous) monitoring stations to the study area are the Callan Road in Kilkenny (station no. 36) and Thomastown (station no. TNO4157)[2], and data for these is presented in the baseline section of this chapter. The stations at New Ross and Enniscorthy, previously operational in 2021, have been taken offline, and therefore have not been commented on. In any case, the data from 2021 will unlikely be representative given that a series of COVID-19 lockdowns will have occurred.

13.3.23 In November 2023, data for the LIFE Emerald project, a three-year EU-Irish Government funded forecasting and modelling project, was made available. The key goal of LIFE Emerald is to strengthen air quality management in Ireland to ensure effective implementation of the EU Ambient Air Quality Directives (AAQD) and to help implement the European Green Deal. This data has additionally been used to establish a baseline for this chapter.

13.3.24 To summarise, data sources utilised during the assessment include the following:

- Aerial photography and street imagery: Google Maps.
- Ireland's State of the Environment Report 2024, Air Chapter (EPA, 2024).

[2] The data from these stations is available at www.airquality.ie.

- Air Quality Hourly readings for Station 36, Callan Road, Kilkenny (EPA, 2024-2025).
- Air Quality Hourly readings for Station TN04157, Thomastown (EPA, 2024-2025).
- Outputs of the G-T Flood Relief Scheme Constraints Study (ByrneLooby, 2021).

Site Visits / Surveys

13.3.25 A number of site visits to the study area were conducted in the period from 2020 to 2024 and included a visual assessment of sensitive receptors relative to dust and pollutant generation.

13.3.26 No site-specific baseline monitoring was undertaken for air quality emission sources. The existing publicly available baseline data mentioned in Section 13.3.24 was considered sufficient to undertake the assessment. There are no industrial facilities or significant pollutant emitting activities that needed to be monitored on a site-specific basis in G-T. The main contributing pollutants within the study area are expected to align with those highlighted as the main pollutants of concern in Ireland as a whole, which includes particulate matter (through the burning of fuel for heating), and nitrogen dioxide (via use of petrol and diesel vehicles).

Consultation

13.3.27 During the preparation of this EIAR, consultations were made to seek opinions and input from statutory bodies, regulators, organisations, research bodies, community facilities and residents that have an interest or who may be affected by the Proposed Scheme. Data/information was also provided by stakeholders in some cases, where relevant, for incorporation into the EIA study.

13.3.28 As outlined in Table 5-3 (Chapter 5 'Consultation and Stakeholder Engagement'), the Carlow-Kilkenny Environmental Health Service had several observations for the Scheme in relation to air quality, including the recommendation that the potential for dust generation be included in the assessment of air quality impact, and that a list of dust suppression measures is provided within this EIAR and incorporated into the CEMP (Appendix 4-4).

13.4 Baseline Environment

Ambient Air Quality

National Monitoring

13.4.1 In 2024, Ireland met all of its EU CAFE Directive legal requirements, but not the WHO AQGs. According to the EPA Ireland's State of the Environment Report 2024, the two problem pollutants are particulate matter and nitrogen dioxide. The main source of particulate matter is through the burning of solid fuel, such as smoky coal, wet wood and sod turf to heat homes, and nitrogen dioxide is from petrol and diesel vehicles.

13.4.2 As mentioned, the study area is located in the Air Quality Index Region Zone D: 'Rural East' under the Air Quality Standards Regulations (2011). The EPA's Air Quality Index for Health (AQIH) is a number from 1 to 10 that identifies the current air quality currently in a region and whether or not this might affect human health. A reading of 10 means the air quality is very poor and a reading of 1 to 3 inclusive means that the air quality is good. The AQIH readings are based on five air pollutants which can harm human health: Ozone gas, nitrogen dioxide gas, sulphur dioxide gas, $PM_{2.5}$ particles and PM_{10} particles. The last update to the under this zone was made in May 2021, where the area was recorded as having a '3 'good' result.

Regional Monitoring

13.4.3 As mentioned, the closest automatic (continuous) monitoring stations under the National AAMP, are the Callan Road in Kilkenny (station no. 36) and Thomastown (station no. TNO4157)[3]. The Callan Road Kilkenny station was reported as having an AQIH of '2 - Good', and Thomastown station (Station No. TN0415) as '1 -good' (information accessed in June 2025) (source: EPA air quality zone data and map viewer).

13.4.4 A full database of ambient air quality levels for the two stations during 2024-2025 is available on the EPA website. A snapshot of these is presented in the table below, via monthly averages.

Table 13-9: Ambient Air Quality from Station 36 and TNO415 (Source: EPA, 2025)

Month	Monthly Average				
	Station No. 36 (Callan Road, Kilkenny)			Station No. TNO415 (Thomastown)	
	NO_2 (µg/m³)	O_3 (µg/m³)	PM_{10} (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)
Jan '24	9.0	50.9	19.5	7.1	5.5
Feb '24	4.8	50.9	13.1	8.0	6.6
Mar '24	3.6	61.2	15.5	8.0	7.3
Apr '24	3.0	66.8	11.9	6.6	5.9
May '24	4.1	61.6	11.4	5.5	3.9
Jun '24	2.3	53.3	10.0	5.2	4.0
Jul '24	2.0	43.6	7.6	4.2	3.2
Aug '24	1.5	49.5	10.8	7.5	6.2
Sep '24	5.2	50.9	15.0	7.6	5.6
Oct '24	4.6	48.4	11.3	8.1	6.7
Nov '24	7.6	36.4	12.3	7.7	5.9
Dec '24	6.1	50.9	11.0	6.4	5.4

[3] The data from these stations is available at www.airquality.ie.

Month	Monthly Average				
	Station No. 36 (Callan Road, Kilkenny)			Station No. TNO415 (Thomastown)	
	NO_2 (µg/m³)	O_3 (µg/m³)	PM_{10} (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)
Jan '25	7.9	48.5	15.2	7.7	6.5
Feb '25	6.3	53.3	17.9	10.4	9.3
Mar '25	6.5	58.7	15.7	7.7	6.4
Apr '25	6.0	60.9	13.5	6.5	5.1
May '25	5.0	64.0	9.5	5.8	4.3
Jun '25	2.5	55.4	7.7	5.5	4.2

13.4.5 For both Air Quality Stations across 2024 and 2025 (up to June 2025), Nitrogen Dioxide (NO_2) measurements fall within the 1-hour and 24-hour limit for protection of human health air quality standard, as derived from the Air Quality Index for Health. PM_{10} measurements at both stations and $PM_{2.5}$ measurements at the Thomastown Station fall well within the annual limit for protection of human health, as derived from the Air Quality Index for Health.

Traffic

13.4.6 Chapter 7 'Material Assets' of this EIAR provides a summary of the traffic baseline data Chapter 7 presents data of 7-day traffic counts undertaken in Graiguenamanagh town between 2017 and 2020. Annual Daily Traffic (ADT) ranges from 884 to 3356 and Annual Average Daily Traffic (AADT) between 835 and 3576, with the highest traffic counts recorded on Road No. 705 and the lowest on Road No. 703. The highest vehicle speeds are also recorded on both of these roads, with a moderate to high percentage of speed violations recorded (especially on Road No. 705). Generally, the percentage of Heavy Goods Vehicles (HGVs) travelling through the town is low, ranging from 10 – 1%, with Road No. 705 illustrating the highest percentage.

13.4.7 Traffic data for Tinnahinch has been requested and was not available at the time of writing.

13.5 Sensitive Receptors

13.5.1 Due to the urban location, there are sensitive receptors in close proximity to all locations of proposed works. Following a desktop analysis of available aerial & street photography, and completion of site walkovers, the following potential air quality sensitive receivers have been identified:

- Vulnerable subsets of the population of G-T, including those in poor health, those with breathing difficulties/asthma, the very young, the elderly.
- Residential properties, particularly for those located in flood risk areas and therefore in close proximity to the planned works, construction compounds and

access/haulage routes. These receptors are considered to be highly sensitive to change. Some properties/housing estates of note include properties along the G-T quays, Hotel Street (Tinnahinch), Turf Market (Graiguenamanagh), High Street (Graiguenamanagh), Lower Main Street (Graiguenamanagh) and properties adjacent to the Upstream Storage Area (<10 properties).

- Recreational land uses including areas of open space, facilities of recreational amenity (i.e., parks, playgrounds, sporting facilities) and walking/cycling pathways.
- Schools/colleges (i.e., Duiske College, Brandon Community Playgroup, Graiguenamanagh Boys National School, Scoil Mhuire gan Smál).
- Medical centres/health facilities (i.e., Graiguenamanagh Health Centre, Abbey Hall, Duiske Veterinary).

13.6 Potential Impacts and Effects

13.6.1 The construction and, to a lesser extent, the operation and maintenance phase of the Proposed Scheme are likely to result in emissions of dust, fine particulates and other pollutants associated with construction traffic and non-road mobile machinery (NRMM). Construction dusts and pollutant emissions have the potential to cause local impacts through dust deposition and pollutant exposure at the nearest sensitive receptors. The greatest potential effect of dust and pollutant exposure to sensitive receptors is the deterioration of air quality, giving rise to potential human health concerns, particularly for those receptors considered vulnerable from a health perspective (i.e., those in poor health, those with breathing difficulties/asthma, the very young, the elderly).

13.6.2 Further, there are general nuisance effects caused by the deposition of construction dust whereby there may be a general loss of amenity or additional maintenance may be required on personal dwellings. Direct and indirect effects are also possible to flora and fauna, including damage to foliage/plants, changes in habitat foraging and ingestion of particulate matter or pollutants by fauna. Further detail is included in the subsequent sections.

The 'do nothing' scenario

13.6.3 The 'do nothing' scenario is defined as the option involving no future change to flood defences or maintenance of existing defences/channels. There is no air quality impact from the 'do nothing scenario'.

Construction Phase

13.6.4 As outlined in Chapter 4 'Description of Proposed Scheme and Construction Methodology', the works are divided into ten (10) areas corresponding to the Proposed Scheme defence locations (see W3451-AYE-DWG-W-1402, Appendix 4-1), with five (5) site compounds (SCs) and five (5) main access routes assigned to support these (see W3451-AYE-DWG-W-1402,

W3451-AYE-DWG-W-1422, Appendix 4-1). Construction is planned from 2027 to 2030 (36 to 42 months), with works packaged and sequenced as below:

- WP1 (site enabling works, and Main Compound):
- WP2 (Areas 1 and SC B)
- WP3 (Areas 2, 3 and 4, and SC C)
- WP4A (Areas 5, 6 7, and SC D)
- WP4B (Areas 8, 9 and 10, and SC E and F)

13.6.5 Associated to each Works Package, dust emissions are likely to arise from the following activities:

Table 13-10: Dust Generating Activities per Works Package

Dust Generating Activities	WP1	WP2	WP3	WP4A	WP4B
Site clearance	✓				
Utility diversions	✓			✓	✓
Movement of construction traffic on unpaved or soiled surfaces	✓	✓			✓
Demolition of existing walls and structures (i.e., bridges)			✓	✓	✓
Foundation construction (flood walls)			✓	✓	✓
Earthworks required for the construction of embankments		✓		✓	✓
Site excavation	✓	✓		✓	✓
Sheet piling			✓	✓	✓
Stockpiling of material	✓	✓		✓	✓
Handling of construction materials		✓	✓	✓	✓
Concrete structural works		✓	✓	✓	

13.6.6 The effects of air emissions from onsite generators are not considered significant and have not been assessed.

Dust Magnitude (Step 2A)

13.6.7 The dust emission magnitude ('Small', 'Medium', or 'Large') was categorized using professional judgment in conjunction with the IAQM guidance as per Table 13-3. It has been conducted on those dust-generating activities defined by IAQM, including demolition, earthworks, construction and track-out, as shown below.

Table 13-11: Dust Emission Magnitude for Construction Activities

Activity	Dust Emission Magnitude	Project specific dust Emission Magnitude
Demolition	Small	Total building volume <20,000 m^3. No buildings are to be demolished however some

Activity	Dust Emission Magnitude	Project specific dust Emission Magnitude
		existing concrete and stone walls (maximum height of 1m) are to be demolished to allow construction of new flood walls, particularly under WP4A and WP4B. Further, two bridges are being removed in WP3. This is the extent of demolition works required.
Earthworks	Medium	The total site area is 2,500 m^2 – 10,000 m^2. 5-10 heavy earth moving vehicles are anticipated to be required for each embankment. The total material to be shifted is 20,000 tonnes – 100,000 tonnes.
Construction	Medium	The total volume of concrete to be used is circa 5,000 tonnes. This is required for the construction of flood walls, the construction of the flow control structure at the upstream storage area, and during the replacement of two pedestrian bridges along the River Duiske. The typical density of concrete is 2.3 $g.cm^{-3}$ and therefore, the volume off concrete would equate to circa 2,173m^3 across the entire site. This falls into the 'small category'; however, concrete batching and piling is proposed, and concrete is considered to be a material with a moderate potential for dust release.

Activity	Dust Emission Magnitude	Project specific dust Emission Magnitude
Track-out	Small	Outward movements of <10 HDV anticipated over unpaved ground in anyone day. On the whole, access roads to the 10 nos. Works Areas and 5 nos. SC's are paved, however there are small unpaved stretches of road and where moderate entrainment of dirt might occur. This is particular at Area 1 (upstream storage area), Area 7 (The Dock) and Area 8 (Hotel Street).

Sensitivity of the Area (Step 2B)

13.6.8 The sensitivity of the area to dust soiling, human health impacts and ecological impacts is a function of the inherent sensitivity of individual receptors, local background concentrations of PM_{10} as well as site specific factors such as the prevailing wind.

13.6.9 High sensitivity human receptors include residential dwellings, schools, hospitals, and other places where vulnerable members of the community may spend significant periods of time (e.g., care homes and nurseries). However, places such as car showrooms and museums may also be considered high sensitivity to dust soiling due to the potential for dusts to diminish the value of property or significantly impact the enjoyment of a space. Medium sensitivity receptors include areas where people would not reasonably be expected to be present for extended periods of time (e.g., places of work or parks).

13.6.10 The approximate number of high sensitivity receptors located within 100m of the Works Areas and Site Compounds is set out in Table 13-12 below.

Table 13-12: Approximate of Highly Sensitive Receptors in proximity to the application site.

Distance to Work Areas / Compounds	Number of Receptors	Details
<20m	50-100	- Residential properties along The Quay (both Graiguenamanagh and Tinnahinch side of the River Barrow). - Waterside Guesthouse and Restaurant, the Boat Club/Rowing Club, the Hooftop Café, Supervalu, and other commercial/community properties along The Quay (both Graiguenamanagh and Tinnahinch side of the River Barrow). - Residential properties along Hotel Street (Tinnahinch). - Residential and commercial properties along Well Lane, Turf Market, High Street, Mill Road, and Main Street (Graiguenamanagh). - Residential properties adjacent to Area 1 (upstream storage area).

Distance to Work Areas / Compounds	Number of Receptors	Details
		- Schooling facilities in the town (The Duiske College, Brandon Community Playgroup, Graiguenamanagh Boys National School, Scoil Mhuire gan Smál). - The Hub. - River Barrow and River Nore SAC, and all Qualifying Interests thereof.
<50m	100+	Residential, commercial and community use in the wider area.
<100m	500 +	Residential, commercial and community use in the wider area.
<350m	500+	Residential, commercial and community use in the wider area.

13.6.11 The sensitivity of the area to earthworks, construction and track-out to dust soiling, human health impacts and ecological impacts is set out in Table 13-13 below.

Table 13-13 –Dust Impact Sensitivity by Construction Stage based on the IAQM's dust guidance.

Impact	Sensitivity				Justification
	Demolition	Earthworks	Construction	Track-out	
Dust Soiling	Medium	High	High	Medium	There are many residential and commercial receptors within 20m of the Works Areas and Site Compounds.
Dust soiling has the potential to cause deterioration of air quality, giving rise to potential human health concerns, particularly for those receptors considered vulnerable from a health perspective. These might include those in poor health, those with breathing/asthmatic difficulties, the very young and elderly population. Further, there are general nuisance effects caused by the deposition of construction dust whereby there may be a general loss of amenity or additional maintenance may be required on personal dwellings.					
Human Health Impacts	Low	Medium	Medium	Low	Concentrations of PM_{10} in the vicinity are lower than 24µg.m^{-3} and therefore the risk is considered low. However, the activities associated with earthworks (embankment construction) and construction (concrete works) are considered to have a dust emission potential, therefore the sensitivity for these elements is considered to be medium.

Impact	Sensitivity				Justification
	Demolition	Earthworks	Construction	Track-out	
As mentioned above, dust soiling has the potential to cause deterioration of air quality, giving rise to potential human health concerns, particularly for those receptors considered vulnerable from a health perspective. These might include those in poor health, those with breathing/asthmatic difficulties, the very young and elderly population.					
Ecological Impacts	High	High	High	High	There is one statutory ecological receptor (SAC) that intersects with all of the Works Areas, and within 20m Site Compounds and access routes. The sensitivity of the QIs vary, depending on their distance from the site, or sensitivity to dust soiling. Those afforded a high sensitivity include the fish QIs and otter. There are some habitats afforded a medium sensitivity to dust soiling, including Hydrophilous tall herb fringe communities, Old sessile oak woods, and the Killarney Fern. Other habitats are of low sensitivity as they occur in the low reaches of the SAC, or a significant distance upstream of the works.
Dust soiling has the potential to cause deterioration of air quality and potential sedimentation in watercourses and therefore cause effect to ecological receptors. Potential direct effects include the smothering of plants/habitats with dust resulting in a change in normal biological function, a change in air quality resulting in the ingestion of particulate matter by fauna and sedimentation in watercourses causing effects on fish physiology and habitat. Indirect effects include potential deterioration of foraging habitats for fauna.					

Risk (Step2C)

13.6.12 The risk of dust impacts during each phase of construction, in the absence of mitigation, is summarised in Table 13-14 below.

Table 13-14: Summary of Dust Impact Risk Based on the IAQM's Dust Guidance.

Stage	Dust Impact Risk		
	Dust Soiling	**Human Health**	**Ecology**
Demolition	Low risk site	Negligible	Medium risk site

Stage	Dust Impact Risk		
	Dust Soiling	**Human Health**	**Ecology**
Earthworks	Medium risk site	Medium risk site	Medium risk site
Construction	Medium risk site	Medium risk site	Medium risk site
Track-out	Negligible	Negligible	Low risk site

13.6.13 Overall, the construction phase of the Proposed Scheme is considered to present a 'Low Risk' for demolition, a 'Medium Risk' for earthworks and construction, and 'Negligible' for track-out, in the absence of mitigation. This is summarised below:

Table 13-15: Summary of Dust Impact Risk

Activity	Dust Risk prior to Mitigation	EPA Impact Rating (see Table 13-8)	EPA Impact Duration
Demolition	Low Risk	Negative, slight	Short-term
Earthworks	Medium Risk	Negative, Moderate	
Construction	Medium Risk	Negative, Moderate	
Track-out	Negligible	Imperceptible	

Operation and Maintenance Phase

13.6.14 There will be no significant change in traffic volumes as a result of the operational phase. The only operational air emission sources will be from the emergency pumping station and pumps, only to be operational during a flood event. Therefore, **no impacts** are assigned to the operation and maintenance phase.

13.7 Mitigation Measures

Construction Phase

13.7.1 In accordance with the IAQM Guidance, for proposed mitigation measures, the highest risk category should be applied. These are as follows:

General Measures

13.7.2 **AQ_1:** General:

- Develop and implement a stakeholder communication plan that includes community engagement before work commences on site.
- Display the name and contact details of person(s) accountable for air quality pollutant emissions and dust issues on the site boundary.
- Display the head or regional office contact information.

- Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk and should include as a minimum the highly recommended measures in this document.

13.7.3 **AQ_2:** Site Management:

- Record and respond to all dust and air quality pollutant emissions complaints.
- Make a complaints log available to the local authority when asked.
- Carry out regular site inspections to monitor compliance with air quality and dust control procedures, record inspection results, and make an inspection log available to the local authority when asked.
- Increase the frequency of site inspections by those accountable for dust and air quality pollutant emissions issues when activities with a high potential to produce dust and emissions are being carried out, and during prolonged dry or windy conditions.
- Record any exceptional incidents that cause dust and air quality pollutant emissions, either on or off the site, and the action taken to resolve the situation is recorded in the logbook.
- Hold regular liaison meetings with other high risk construction sites within 500 m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/ deliveries which might be using the same strategic road network routes.

13.7.4 **AQ_3:** Preparing and maintaining the site:

- Plan site layout: machinery and dust causing activities should be located away from receptors.
- Erect solid screens or barriers around dust activities or the site boundary that are, at least, as high as any stockpiles on site.
- Fully enclosure site or specific operations where there is a high potential for dust production and the site is active for an extensive period.
- Avoid site runoff of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on site cover as described below.

- Cover, seed or fence stockpiles to prevent wind whipping.

13.7.5 **AQ_4:** Operating vehicle/machinery and sustainable travel:

- Ensure all on-road vehicles comply with the requirements of the Kilkenny County Council (KCC), in terms of emissions.
- Ensure all vehicles switch off engines when stationary – no idling vehicles.
- Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where possible.
- Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.
- Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).

13.7.6 **AQ_5:** Operations:

- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
- Source water from a clean water source (i.e., screened recycled water, or from local water supply) for safe and effective dust/particulate matter mitigation during dry spells.
- Use enclosed chutes, conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

13.7.7 **AQ_6:** Waste Management:

- Reuse and recycle waste to reduce dust from waste materials.
- No bonfires or burning of waste materials.

13.7.8 **AQ_7:** Demolition:

- Ensure effective water suppression is used during demolition operations. Handheld sprays are more effective than hoses attached to equipment as the

water can be directed to where it is needed. In addition, high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground. Source suppression water from a clean water source (i.e., screened recycled water, or from local water supply) to avoid any contamination.

- Avoid explosive blasting, using appropriate manual or mechanical alternatives.
- Bag and remove any biological debris or damp down such material before demolition.

13.7.9 **AQ_8:** Earthworks:

- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces, where possible.
- Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil.
- Only remove secure covers in small areas during work and not all at once.

13.7.10 **AQ_9:** Construction:

- Avoid scabbling (roughening of concrete surfaces) if possible.
- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
- Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.
- For smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust.

13.7.11 **AQ_10:** Track-out:

- Regularly use a water-assisted dust sweeper on the access and local roads, as necessary, to remove any material tracked out of the site. Source suppression water from a clean water source (i.e., screened recycled water, or from local water supply) to avoid any contamination.
- Avoid dry sweeping of large areas.
- Ensure vehicles entering and leaving sites are securely covered to prevent escape of materials during transport.

- If appropriate and agreed with Kilkenny County Council (KCC), implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
- Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
- Record all inspections of haul routes and any subsequent action in a site logbook.
- Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.
- Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
- Access gates to be located at least 10 m from receptors where possible.

Operation and Maintenance Phase

13.7.12 No specific air quality mitigation measures would be required for the operational phase. However, low emission vehicles and plant/machinery should be considered for maintenance and repairs, to minimise impacts on air quality and climate.

13.8 Monitoring

13.8.1 Daily off-site dust soiling checks and regular site inspections will take place at all works areas and site compounds to monitor compliance with the dust management plan during the construction phase. during the construction phase.

13.8.2 Monthly construction dust monitoring, using dust deposition gauges, is proposed at Area 1 and SC B (upstream storage area), and at Area 8 (Hotel Street), at boundaries of the works area/site compound and nearest sensitive receptors to the works (in both cases, residential dwellings). The TA Luft dust deposition limit values of 350 mg/m2/day will be applied as a 30-day average.

13.9 Residual Impacts and Effects

The 'do nothing' scenario

13.9.1 There is no air quality impact predicted from the do-nothing scenario.

Construction Phase

13.9.2 With the implementation of the mitigation measures outlined in Section 13.7 and 13.8, no significant residual adverse effects on air quality are envisaged during the construction or operation of the Proposed Scheme.

Operation and Maintenance Phase

13.9.3 There is no air quality impact predicted from the operational phase.

13.10 Interactions with other Environmental Effects

13.10.1 A full review of the potential interactions is provided in Chapter 16 'Interactions and Cumulative Effects'.

13.10.2 Interactions exist between the Air Quality assessment and other environmental parameters. Key areas of interaction include:

- Impacts to the health, safety and general wellbeing of the population with regards to the requirement for infrastructure and services, exposure to increase construction congestion and traffic (and the secondary impacts of this with regards to pollutant and noise generation), limitations to access of walkways and cycling routes during construction and exposure to improper construction housekeeping (waste management). This is linked with Chapter 6 'Population and Human Health' and Chapter 15 'Noise and Vibration'.
- Effects to assets of natural origin, outlined in Chapter 10 'Biodiversity'.
- The effects of air pollution with regards to the road, traffic and transportation impacts are outlined in Chapter 7 'Material Assets. Interactions also exist with Chapter 14 'Climate' as significant local air quality emissions can exacerbate potential climate change impacts predominantly through the release of greenhouse gases during the construction stage. However, given the nature of the scheme this potential impact is considered negligible.

13.11 Cumulative Impacts

13.11.1 A full review of the potential cumulative impacts is provided in Chapter 16 'Interactions and Cumulative Effects'.

13.11.2 Cumulative impacts are those which accrue to key air quality receptors as a result of incremental changes caused by other existing and proposed plans or projects together with those caused by the proposed development.

13.11.3 Construction traffic generated by the Proposed Scheme would not have a significant impact on air quality, in isolation, due to insufficient generation rates and the localised nature of impacts (i.e., primarily on roads adjacent to the works). There is no known development in the local area, which would, in combination with the proposal, cause a permanent increase in traffic exceeding the criteria set out in section 13.3. As such, construction traffic is not considered to have the potential to cause significant cumulative effects.

13.11.4 There is the potential for cumulative dust effects where a receptor is located within 350m of more than one construction site. However, if each construction site includes an appropriate level of mitigation there should be no significant cumulative effects.

13.11.5 Cumulatively, the identified projects in combination with the Proposed Scheme may create added pressure upon the air quality receptors (human beings) present in the study area, however the combined impact is unlikely to be significant given the nature and scale of the identified projects and ability for all impacts to be sufficiently mitigated through best-practise construction techniques.

13.12 Limitations in Preparing the Chapter

13.12.1 There were no limitations in the preparation of this chapter. The existing publicly available baseline data was considered sufficient to undertake the assessment, considering the nature of the Proposed Scheme.

13.13 Summary

Table 13-16: Summary of Impacts and Mitigation Measures: Air Quality

Receptor	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
'Do Nothing' Scenario Impacts					
No impacts.					
Construction Phase Impacts					
All, including residents, visitors, business owners and ecological receptors.	Dust emissions from demolition	Negative, Minor	Short-term (construction phase)	• Implementation of best practice construction methods. • Dust monitoring at high dust-generating Works Areas and Site Compounds. • Effective stakeholder management. • Develop and implement a Dust Management Plan (DMP) as part of the CEMP.	Imperceptible
	Dust emissions from earthworks	Negative, Moderate			Negative, slight
	Dust emissions from construction	Negative, Moderate			Negative, slight
	Dust emissions from track-out	Negligible			Imperceptible
	Increased emissions of pollutants (NO_2, CO) from site plant/machinery and site vehicles.	Negligible		• Implementation of best practise construction methods.	Imperceptible
Operation and Maintenance Phase Impacts					
No impacts.					

13.14 References

(DoE), D. o. t. E., 2010. *Local Air Quality Management Policy Guidance – LAQM PGNI (09),* s.l.: s.n.

Anon., n.d. *Air Pollution Act (1987).* [Online] Available at: https://www.irishstatutebook.ie/eli/1987/act/6/enacted/en/html

ByrneLooby, 2021. *Graiguenamanagh-Tinnahinch Flood Relief Scheme, Environmental Constraints Study, W3451-BL-ENV-R001,* s.l.: s.n.

ByrneLooby, 2023. *Environmental Impact Assessment Scoping Report,* s.l.: s.n.

DEFRA, 2002. *Defra. (2018). Part IV of the Environment Act 1995, Environment (Northern Ireland) Order 2002 Part III, Local Air Quality Management, Technical Guidance LAQM. TG(16).,* London: s.n.

Defra, 2022. *Part IV of the Environment Act 1995, Environment (Northern Ireland) Order 2002 Part III, Local Air Quality Management, Technical Guidance LAQM. TG(22).,* s.l.: s.n.

Department of Communications, Climate Action and Environment, 2018. *National Adaptation Framework (NAF), Planning for a Climate Resilient Ireland,* s.l.: s.n.

EMRA , 2019. *Regional Spatial & Economic Strategy 2019-2031,* s.l.: s.n.

Environment Protection Agency, 2005. *Ambient Air Monitoring in Kilkenny.* [Online] Available at: https://www.epa.ie/publications/monitoring--assessment/air/ambient-air-monitoring/EPA_air_assessment_Kilkenny.pdf
[Accessed 19 August 2022].

Environmental Protection Agency, 2011. *Air Quality Standards Regulations,* Ireland: EPA.

Environmental Protection Agency, 2024. *Air Quality Index for Health - EPA.* [Online] Available at: https://www.epa.ie/air/quality/pro/
[Accessed October 2024].

EPA, 2024-2025. *Air Quality.* [Online] Available at: https://airquality.ie/station/EPA-36
[Accessed 19 August 2025].

EPA, 2024. *Ireland's State of the Environment Report 2024,* s.l.: s.n.

EPUK & IAQM, 2017. *Land-Use Planning & Development Control: Planning for Air Quality,* s.l.: s.n.

European Commissions, 2008. *The Ambient Air Quality and Cleaner Air for Europe (CAFE) Directive (2008/50/EC),* s.l.: s.n.

European Communities, 2021. *S.I. No. 735/2021 - European Union (Internal Combustion Engines for Non-Road Mobile Machinery) (Gaseous and Particulate Pollutant Emission Limits and Type-Approval) Regulations,* s.l.: s.n.

German VDI , 2002. *Technical Guidelines on Air Quality Control – TA Luft,* s.l.: s.n.

Greater London Authority, 2014. *The Control of Dust and Emissions During Construction and Demolition.,* s.l.: s.n.

Institute of Air Quality Management, 2014. *Guidance on the Assessment of Dust from Demolition and Construction ,* s.l.: s.n.

NRA, 2011. *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes,* s.l.: s.n.

TA Luft, 2002. *Technical Instructions on Air Quality Control.* [Online] Available at: https://www.euromot.eu/wp-content/uploads/2017/03/GERMAN_TA_Luft_Technical_Instruction_on_Air_Quality_Control_2002-07-24.pdf
[Accessed 18 July 2022].

WHO, 2005. *Air Quality Guidelines: Global Update 2005 : Particulate Matter, Ozone, Nitrogen Dioxide, and Sulfur Dioxide,* s.l.: s.n.

WHO, 2021. *Global Air Quality Guidelines - Particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide,* s.l.: s.n.

14 Climate

14.1 Scope of the Assessment

14.1.1 The scope of this assessment covers effects at the local level, and from a wider regional and national perspective. An assessment has been carried out to determine:

- the contribution by the Proposed Scheme to climate change.
- the vulnerability of the Proposed Scheme to climate change effects.

14.1.2 Through installing flood alleviation measures, the potential impacts associated with flood damages can be largely mitigated, however carbon impacts from construction and operation (the 'carbon cost') have been considered.

14.1.3 This chapter assesses the likely significant effects of the Proposed Scheme on climate.

14.1.4 The impact of climate change in relation to the adaptability of the Proposed Scheme to address an increase in flood events is considered in Chapter 4 'Description of the Proposed Scheme', Chapter 8 'Hydrology – Surface Water' and Chapter 17 'Major Accidents and Disasters'.

14.1.5 The options selection process for the Flood Relief Scheme (FRS) included a climate change vulnerability and risk assessment which accounted for the uncertainty around climate change predictions while keeping with current-day conditions and limitations. This assessment was completed in line with OPW Guidance Note 29 on Climate Change Adaptation.

14.2 Statutory and Policy Context

International

The Intergovernmental Panel on Climate Change

14.2.1 The Intergovernmental Panel on Climate Change (IPCC) has concluded that greenhouse gas emissions due to human activities are having an unprecedented effect on the earth's climate.

14.2.2 Multiple lines of evidence have shown that the climate is already changing across the globe as a result of increased concentrations of greenhouse gases such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The effects of a human induced changing climate are predicted to vary across the globe, resulting in increased frequency of extreme weather and temperature fluctuations outside of the natural climate variability.

14.2.3 According to the IPCC (Intergovernmental Panel on Climate Change , 2014), approximately 60% of greenhouse gas emissions over the last four decades have come from the burning of fossil fuels. Ireland's National Policy Position on Climate change (Department of Communications, Climate Action and the Environment, n.d.) sets out a framework to transition to a low-carbon economy based on:

- A total reduction in carbon dioxide (CO2) emissions of at least 80% (compared to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors, and

- Carbon neutrality across various sectors including the agriculture and land-use sector, including forestry, done in such a way which does not compromise capacity for sustainable food production.

Directive 2014/52/EU

14.2.4 Climate change has been addressed in EU Directives surrounding EIAR, specifically Directive 2014/52/EU which specifies that:

Climate change will continue to cause damage to the environment and compromise economic development. In this regard, it is appropriate to assess the impact of projects on climate (for example greenhouse gas emissions) and their vulnerability to climate change.

14.2.5 EU Guidance on integrating climate change and biodiversity into EIA (2013) recommends that climate change should be addressed in an EIAR through the following approach:

- Consider climate change at the outset of a project,

- Analyse evolving environmental baseline trends by using a vulnerability assessment to help assess the evolution of the baseline environment and identify the most resilient alternative,

- Take an integrated approach to planning and assessment, investigating relevant thresholds and limits,

- Seek to avoid biodiversity and climate change effects from the start, before considering mitigation or compensation,

- Assess alternatives that make a difference in terms of climate change and biodiversity,

- Use ecosystem-based approaches and green infrastructure as part of project design and/or mitigation measures, and

- Assess climate change and biodiversity synergies and cumulative effects, which can be significant.

14.2.6 In addition to assessing the vulnerability of a project to climate change, it is important to assess whether a project is adaptable under changing climate conditions. Climate change mitigation and adaptation actions are framed and informed by policy from within the UN, EU, and have been transposed into Irish Law.

14.2.7 These include the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, the UN Paris Agreement, and the EU Climate and Energy Package.

National

14.2.8 There are national documents that inform climate policy in Ireland that are considered in the preparation of this EIAR. These documents include the National Climate Change Adaptation Framework (2012), the National Policy Position on Climate Change and the Climate Action and Low Carbon Development Act 2015. Other documents include the National Mitigation Plan (2017), the National Adaptation Framework – Planning for a Climate Resilient Ireland (2024), and the Flood Risk Management Climate Change Sectoral Adaptation Plan 2019-2024.

14.2.9 The National Adaptation Framework (2024) recognises that extreme weather and flooding are some of the most likely effects of climate change, to which Ireland will need to adapt in the future. The framework outlines the uncertainty regarding future climate scenarios, as variability is expected due to natural changes in the climate in addition to human induced climate change.

14.2.10 The Government of Ireland's Climate Action Plan (2024) and Climate Action and Low Carbon Development Bill (2020) set out a national objective of transitioning to a low carbon, climate resilient and environmentally sustainable economy and the detailed sectoral road map to deliver a cumulative reduction in emissions.

14.2.11 The Climate Action and Low Carbon Development Act provides for the approval of plans by the Government in relation to climate change for the purpose of pursuing the transition to a low carbon, climate resilient and environmentally sustainable economy; to establish a body to be known as the National Expert Advisory Council on Climate Change; and to provide for matters connected therewith. The Act is Ireland's first framework piece of climate change legislation and lays the ground for transition towards a low carbon economy.

14.2.12 Ireland has a 2030 target to achieve a 30% reduction of non-Emissions Trading Scheme (ETS) sector emissions on 2005 levels with annual binding limits set for each year over the period 2021-2030.

14.2.13 The EU ETS is implemented under SI 490 of 2012 (and amendments) and SI no. 261 of 2010 (and amendments). In 2018, the legislative framework of the EU ETS was revised to enable it to achieve the EU's 2030 emission reduction targets in line with the 2030 Climate and Energy Policy Framework. This also forms part of the EU's contribution to the 2015 Paris Agreement.

Regional

14.2.14 Climate policy is becoming increasingly integrated across local plans. Kilkenny City and County Development plan includes a Strategic Aim "to provide a policy framework with objectives and actions in this City and County Development Plan to facilitate the transition to a low carbon and climate resilient County with an emphasis on reduction in energy demand and greenhouse gas emissions, through a combination of effective mitigation and adaptation responses to climate change" (p.17) including integrating appropriate mitigation and adaptation considerations and measures into all forms of development (Kilkenny County Council, 2021). Climate change adaptation and mitigation is an

overarching consideration in the Carlow County Development Plan as well. In the Environment and Climate Change chapter, two goals of note are those related to:

- Infrastructure and Built Environment: Increased capacity for climate resilient structural infrastructure is centred around the effective management of climate risk, informed investment decisions and positive contribution towards a low carbon society.
- Drainage and Flood Management: Great understanding of risks and consequences of flooding and successful management of a co-ordinated approach to drainage and flooding.

14.2.15 This plan also notes the benefits of flood alleviation in climate adaption and mitigation as "strengthening ecosystems resilience; carbon storage and sequestration; mitigation of urban heat island effects; and disaster prevention (storms, landslides) (Carlow County Council, 2022, p.47).

14.2.16 Kilkenny County Council Climate Action Plan 2024-2029 outlines 95 actions for KCC including how they will reduce greenhouse gas emissions by 51%. KCC will also implement measures to prepare for climate change, support resilience, and provide other benefits such as improved health and wellbeing, enhanced biodiversity, green job creation, sustainable use of materials (including Green Public Procurement) and the circular economy.

Local

14.2.17 The Graiguenamanagh-Tinnahinch (G-T) Local Area Plan reiterates the need for the integration of adaption and mitigation to the effects of climate change.

14.3 Assessment Methodology

14.3.1 The following sections outline the approach taken when assessing climate change vulnerability and adaptability in this EIAR.

Study Area

14.3.2 Given the nature of the topic under consideration, the study area is considered to be the whole of Ireland.

Options Assessment

14.3.3 The options assessment process, as outlined in Chapter 3 'Previous Studies, Alternatives & Options', considered an assessment of climate change vulnerability and risk assessment in line with OPW Guidance Note 29 on Climate change Adaption.

14.3.4 Overall, flood levels on the River Barrow and the River Duiske are not considered to be overly sensitive to climate change.

Vulnerability and Adaptability Assessment

14.3.5 A Climate Change Vulnerability and Risk Assessment was carried out at the options appraisal stage of this project to inform the options development.

14.3.6 The appraisal was completed in line with the OPW Technical Note (Office of Public Works, 2018), Objective 4C (p70-72) – *To ensure flood risk can be managed effectively and sustainably into the future, and the potential impacts of climate change.*

14.3.7 The options scoring was completed using professional judgement, taking into account the guidance and criteria set out in the OPW guidance.

14.3.8 The scoring for each measure reflected the cost and the degree of difficulty and potential impacts (technically, socially, environmentally, legislatively, etc.) of potential future adaptations that would be necessary to maintain the Standard of Protection of the measure under the MRFS and/or HEFS, whereby the greater the cost, difficulty and impact, the lower the score. This assignment of a score took account of the robustness of each option in terms of the need for possible future interventions that may be through additional measures as well direct adaptation of the option under consideration. For example, an option may not be, nor need to, adaptable itself, but may nonetheless score highly if it is shown through a decision-tree analysis that it is very robust in terms of options for future interventions.

Carbon Assessment

14.3.9 A carbon assessment was carried out using the Transport Infrastructure Ireland (TII) Carbon Tool. The purpose of this assessment was to determine the greenhouse gas (GHG) emissions associated with the Proposed Scheme. The results of this are contained in Appendix 14-1 and summarised in the following sections. This allows compliance with the EIA Directive. The TII Carbon Tool is designed to meet the requirement for a lifecycle carbon emissions footprint as part of the revised EIA Directive.

14.3.10 This assessment looks at the carbon cost of the scheme when considering the following aspects:

- Water Usage pre-construction
- Clearance and Demolition
- Embodied Carbon
- Construction Activities
- Energy Consumption
- Baseline Traffic
- Fuel Usage Construction
- Water Usage Construction

- Maintenance Energy Usage

14.4 Baseline Environment

14.4.1 It is acknowledged nationally that climate change is likely to have a significant effect upon flood risk in Ireland due to rising sea levels and more intense rainfall events and storms (Office of Public Works, 2019) however there remains uncertainty in relation to the rate and scale of this change.

14.4.2 Met Éireann has predicted that in Ireland the autumns and winters may see a rise in rainfall events of approximately 20%, and that the summer period may become drier. However, the change in precipitation patterns in Ireland, particularly at a local level and for shorter (sub-seasonal) durations, remains uncertain and is the subject of ongoing research (Office of Public Works, 2019). The Climate Change Sectoral Adaptation Plan for Flood Risk Management (2019 - 2024) reports that since the early 1990s, a rise in mean sea level of approximately 3.5 cm per decade has been observed and various studies have shown that during the 20th century, sea level rise has been accelerating. To add to this, an increase in storm events over the North Atlantic Region are predicted to have a direct impact upon storm surges on the coast of Ireland (Office of Public Works, 2019).

14.4.3 Rising sea levels and increased rainfall predictions place parts of Ireland at greater risk of flooding from coastal, groundwater pluvial and fluvial flooding. Currently, flooding has already been identified as a key concern for County Dublin, and current levels of adaptation are projected to be insufficient to avoid flooding for current global warming. This calls for a greater need for planning and development in vulnerable areas.

CFRAM Strategic Environmental Assessment

14.4.4 The South Eastern CFRAM Study UoM14 SEA Environmental Report (Office of Public Works (OPW), n.d.) includes the following baseline information:

14.4.5 Within the south-eastern region of Ireland, annual average air temperatures on the coast are around 10.6°C (recorded in Rosslare), with an average of 4.3 hours of sunshine (clear sky) per day. Further inland, at Kilkenny, average temperatures are slightly lower at 9.9°C with around 3.6 hours of sunshine per day. Mean annual rainfall at Rosslare for the period 1981 to 2010 was 905 mm, with an average of 56 days per year when rainfall amounts exceed 5 mm. Kilkenny is slightly drier than the coast, with 857 mm and 52 days respectively. In general, the western and northern portions of the study area have lower rainfall than those to the south and east. Areas of higher ground around the Slieve Bloom and Blackstairs Mountains receive greater rainfall. Prevailing weather patterns generally move from the southwest to the northeast.

14.4.6 According to the United Nations Intergovernmental Panel on Climate Change (2007) there is “unequivocal” evidence of climate change and furthermore: *"most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations."* (IPCC, 2007).

14.4.7 Further to this, carbon dioxide levels in the atmosphere were observed at over 400 parts per million in Hawaii. This is considered a milestone threshold and is at a level last thought

to have occurred several million years ago when the arctic was ice free and sea levels were up to 40 m higher.

14.4.8 It is likely that climate change will have a considerable impact on flood risk in Ireland, with sea level rise already being observed and wetter winters being anticipated across the island. These potential impacts could have serious consequences for Ireland, where all of the main cities are on the coast and many of the main towns are on large rivers. While there is uncertainty associated with many aspects of potential climate change and its impacts on flood risk, it would be prudent to take the potential for change into account in the development of Flood Risk Management policies and strategies and the design of Flood Risk Management measures.

14.4.9 The effects of climate change on flood risk management are obvious but in terms of fluvial flooding they are not straightforward to quantify. Changes in sea level have direct impact on coastal flooding and a range of predictions on projected rises are available. A number of meteorological projections are also available for changes in rainfall, but these have a wide degree of variance, particularly from season to season, and are difficult to translate into river flow.

14.4.10 Research into climate change in Ireland is coordinated by Met Éireann through the Community Climate Change Consortium for Ireland (Community Climate Change Consortium for Ireland, n.d.) (www.c4i.ie). Research summarised in the report 'Ireland in a Warmer World – Scientific Predictions of the Irish Climate in the 21st Century' (Mc Grath et al., 2008) seeks to quantify the impact of climate change on Irish hydrology and considers the impacts of nine Irish catchments. The ensemble scenario modelling from the regional climate change model predicts that between the two periods of 1961 – 2000 and 2021 – 2060 Ireland is likely to experience more precipitation in autumn and winter (5 – 10%) and less precipitation in summer (5 – 10%). Between the periods of 1961 – 2000 and 2060 – 2099 this trend is likely to continue with increases of 15 – 20% generally, but up to 25% in the northern half of the country in autumn and drier summers of up to 10 – 18%.

14.4.11 Research from c4i indicates that sea levels around Ireland have been rising at an annual rate of 3.5mm per year for the period 1993 – 2003, which is higher than the longer-term rate of 1.8mm per year for the period 1963 – 2003. This trend is likely to be more modest in the Irish Sea with a 'net trend' (allowing for isostatic adjustment of the earth's crust) of 2.3 – 2.7mm per year. On top of this, the report notes that storm surges are likely to increase in frequency.

Future Trends

14.4.12 The CFRAM SEA Report, outlined in section 14.4.4, (Office of Public Works (OPW), n.d.) goes on to state that the predicted impacts of climate change are likely to include:

- Increases in the frequency and intensity of rainfall,
- Increases in peak flows,
- A rise in sea levels and increased storminess,

- Coastal squeeze impacts on biodiversity associated with sea-level rise,
- Increases in urbanisation,
- Implementation of, or lack of, the strategic CFRAM measures is not expected to affect future climate trends.

14.5 Sensitive Receptors

14.5.1 The receiving environment/receptors consists of the general environment in respect of the climate change impacts, such as GHG emissions, and the surrounding environment and people in respect of vulnerability issues, such as flooding.

14.6 Potential Impacts and Effects

14.6.1 The effects of climate change are likely to result in increased sea level and subsequently increased flood levels and greater frequency of flooding.

14.6.2 Regional Climate Modelling (RCM) simulations for Ireland have predicted a number of changes to various climatic variables by 2050 and beyond, notably:

- Significant projected decreases in mean annual, spring and summer precipitation amounts by mid-century. The projected decreases are largest for summer, with reductions ranging from 0% to 20%. Heavy rainfall events will increase in winter and autumn (Nolan, 2015);
- Storms affecting Ireland will decrease in frequency, but increase in intensity, with increased risk of damage (Nolan, 2015);
- Intensification of the hydrological cycle, leading to both increased incidences of high and low flow periods in rivers and lakes (Nolan, 2015);
- Mean sea level rise by 0.5m in the OPW's Medium Range Future Scenario (MRFS) and 1m in the High End Future Scenario (HEFS);
- Fluvial flows are projected to increase by 20% and 30% respectively; and
- Frost days averaged over the whole country, the number of frost days (defined as a day when the minimum temperature is less than 0°C) is projected to decrease by over 50%.

14.6.3 The purpose of the Proposed Scheme is to provide protection to G-T against flooding. As such, the scheme has been designed specific to the 1% AEP present day flood extent and has provided foundations to be adaptable to the MRFS climate change scenario.

14.6.4 The predicted impacts with regards to climate change vulnerability and adaptability are discussed below for the Do-Nothing Scenario, Construction Phase, and Operation Phase. Potential impacts in relation to climate change can consist of:

- the contribution by the Proposed Scheme to climate change.

- the vulnerability and adaptability of the Proposed Scheme to climate change effects.

The 'do nothing' scenario

14.6.5 The extent of the predicted 1% AEP flood extent under existing conditions on G-T is discussed in Chapter 8 'Hydrology – Surface Water'.

14.6.6 Without adequate intervention to protect G-T from the 1% AEP event, the communities will be vulnerable to the effects of climate change and future flood events. As is, the towns are vulnerable to climate change which will impact human beings including a number of residential homes, public spaces and businesses.

14.6.7 The Do-Nothing Scenario reduces the ability of G-T to adapt to future climate change. In the Do-Nothing Scenario, G-T will experience a **slight negative effect** in its vulnerability and adaptability to climate change.

Construction Phase

Contribution to GHG emissions

14.6.8 Impacts to climate during the construction phase include emissions from transport of materials to the site, embodied CO_2 in construction materials (such as cement, steel, etc.), emissions from plant machinery and other ancillary areas such as contractor compounds, waste management, etc.

14.6.9 The TII tool outlines pre-construction activities related to the use of water for dust suppression, excavation and soil stabilisation as a source of emissions. For the Proposed Scheme, following the Guidance of the TII Carbon Tool, it is assumed that water will be required for earthworks, and for dust control during the excavation of concrete. These activities will generate approximately 38.5 tonnes of CO_2 equivalent (tCO^2e) (See Appendix 14-1).

14.6.10 Secondary contributions as a result of embodied CO_2 in construction materials (such as cement, steel, etc.) will also occur. The TII Carbon Tool found the total embodied carbon associated with the Proposed Scheme was 555 tCO^2e (see Appendix 14-1).

14.6.11 It is predicted that the greatest contribution of GHG emissions during the construction phase will be due to the movement of HGVs to and from the site. Emissions of GHG will also occur as a result of the use of diesel-fuelled generators onsite, and of plant during the construction phase. The total GHG emissions from Construction activities will total 325.6 tCO^2e according to the TII Carbon Tool (see Appendix 14-1). This is assessed in Chapter 13 'Air Quality' and is considered to be **not significant**.

14.6.12 Using the TII Carbon Tool, carbon emissions will occur during the Proposed Scheme as a result of the following:

- Clearance and demolition,
- Land use change and vegetation loss,

- Excavation, and
- Plant use and HGV journeys.

14.6.13 According to the TII Carbon Tool, the construction of the Proposed Scheme, will total 9279.7 tCO^2e as a result of the above-mentioned activities, over the course of the 36 to 42 month construction period. In terms of national emissions, the GHG emissions resulting from the construction of the Proposed Scheme are **not significant** as annual totals of carbon emissions in Ireland in 2023 are 4.0M tCO^2e (EPA, 2024).

Climate change vulnerability and adaptability

14.6.14 The Proposed Scheme will be vulnerable to weather and flood events throughout the construction phase, however as the construction phase will be temporary and short-term (36-42 months), impacts are considered **negligible**.

Operation and Maintenance Phase

Contribution to GHG emissions

14.6.15 The Proposed Scheme will not produce any GHG emissions when in operation other than minor emissions from vehicles utilised to complete minor maintenance and inspection tasks. There will be negligible greenhouse gas emissions from maintenance activities.

14.6.16 These emissions have been calculated by the TII Carbon Tool as 8.6 tCO^2e which are considered to be **not significant**.

Climate change vulnerability and adaptability

14.6.17 The long-term impacts a changing climate change can have on flood levels is uncertain. The Proposed Scheme has been designed with the best available knowledge. Overall, it can be considered that both River Barrow and Duiske are not overly sensitive to climate change.

14.6.18 However, the ability to adapt the flood relief scheme to protect from higher flood levels was considered in the development of the options. The Proposed Scheme was designed to be adaptable to accommodate an increase in flood levels. This is outlined in the Scheme Climate Change Adaption Plan (Appendix 14-2).

14.6.19 The volume of flood storage can be increased to accommodate future increases in flood levels on the River Duiske due to climate change.

14.6.20 On the River Barrow, the wall foundations will be designed to accommodate for future height increases to protect from increased flood levels.

14.6.21 Overall, flood event water levels are not considered to be overly sensitive to climate change on the River Duiske and the River Barrow.

14.7 Mitigation and Monitoring

The 'do nothing' scenario

14.7.1 If the Proposed Scheme were not to go ahead, it is likely that emergency measures would be required to protect G-T from the effects of climate change such as import of sandbags for flood protection, emergency response, evacuation etc. It is unlikely that emergency mitigation will be effective in protecting G-T to the extent required when compared with the effects of flooding. This will result in a series of social, economic and ecological impacts as outlined in other chapters of this EIAR.

Construction Phase

Greenhouse Gas Emissions

C_1: During the construction phase, best environmental practices will be followed in order to mitigate for greenhouse gas emissions. These are detailed in Chapter 13 'Air Quality'.

C_2: KCC will use green public procurement to reduce the environmental impact of the Proposed Scheme. Green Public Procurement is a process where public authorities seek to source goods, services or works with a reduced environmental impact (more resource efficient, less polluting goods, services and works with the marketplace) throughout their life cycle when compared to goods, services and works with the same primary function that would ordinarily be procured.

Operation and Maintenance Phase

14.7.2 The nature of the Proposed Scheme is to provide protection from the effects of the present-day 1 in 100-year flood event. It has been designed to be adaptive to climate change through:

a) providing additional defences in town area and increased wall heights for the River Duiske

b) maximalising the storage area to restrict the flows downstream to maintain the existing effectiveness of the Proposed Scheme flood defences

c) Increasing wall heights on River Barrow.

14.7.3 The details of the scheme and the surface water drainage enhancements are provided in Chapter 4 'Description of the Proposed Scheme and Construction Methodology'.

14.7.4 Appropriate mitigation in the form of regular monitoring, maintenance, and adaptability features can reduce this vulnerability. Monitoring of water levels in the Rivers Duiske and Barrow will take place, as well as monitoring of the structural integrity of the scheme relative to increased water levels. Long-term monitoring will ensure the integrity of embankments and flood walls is maintained and will inform the timing and necessity of raising flood defences. Monitoring will also be used to inform maintenance and refurbishment to prolong the lifetime and resilience of flood defence assets.

14.8 Residual Impacts and Effects

The 'do nothing' scenario

14.8.1 In the Do-Nothing Scenario, there will be significant impacts to the communities of G-T. The residual impact would be a **long-term, significant** impact.

Construction Phase

14.8.2 During the construction phase, HGV movements and machinery operating on site will contribute GHG emissions, which will be managed through mitigation measures as described in Chapter 13 'Air Quality'.

14.8.3 The residual impact during the construction phase is **slight and temporary**, lasting only the duration of the construction phase.

Operation and Maintenance Phase

14.8.4 The nature of the Proposed Scheme is to protect G-T from flooding to the 1% AEP (1 in 100 year) flood event.

14.8.5 It is considered that the Proposed Scheme is not significantly vulnerable to climate change in the long term (approx. 50 years) and is adaptable to climate change. Beyond the appraisal period of 50 years, vulnerability and adaptability will increase, however it is assumed that this will be managed via the implementation of mitigation and monitoring measures to ensure that the FRS remains fit for purpose.

14.9 Interactions with other Environmental Effects

14.9.1 A full review of the potential interactions with other environmental effects is provided in Chapter 16 'Interactions and Cumulative Effects'.

14.9.2 The most significant interactions for the assessment of climate change impacts are those associated with hydrology (Chapter 8 'Hydrology – Surface Water) particularly with regard to flooding.

14.9.3 An interaction exists between the impacts identified to Air Quality (Chapter 13) with regards to GHG emissions during construction.

14.9.4 Further interactions exist with regards to impact to Cultural Heritage assets (Chapter 9), Material Assets (Chapter 7) and Population and Human Health (Chapter 6) under the 'do nothing' scenario, whereby continued and worsening flooding will cause further damage, and further economic and social burden to those assets and communities in the flood risk zone. From the operation phase perspective however, the successful implementation of the Proposed Scheme has significant positive impacts for all of these elements by providing protection against flooding.

14.10 Cumulative Impacts

14.10.1 A full review of the potential cumulative impacts is provided in Chapter 16 'Interactions and Cumulative Effects'.

14.10.2 Cumulative impacts are those which accrue to key receptors as a result of incremental changes caused by other existing and proposed plans or projects together with those caused by the proposed development.

14.10.3 Cumulatively, the identified projects in combination with the Proposed Scheme may create added pressure to the flood capacity in the study area and to GHG emissions, however the combined impact is unlikely to be significant given the nature and scale of the identified projects and ability for all impacts to be sufficiently mitigated through best-practise construction techniques.

14.11 Limitations in Preparing the Chapter

14.11.1 There were no difficulties compiling this chapter.

14.12 Summary

Table 14-1: Summary of Impacts and Mitigation Measures: Climate

Receptor	Description of Potential Impact	Impact significance prior to mitigation	Suggested Mitigation and Monitoring	Residual Impact
Do-nothing Scenario				
GHG Emissions	If the scheme does not progress, there will be no impacts to the national GHG emissions.	None	N/A	N/A
Climate Change Vulnerability and Adaption	The local population will be subject to increased risk from flooding as a result of the increased rainfall caused by a warming climate.	Slight, negative, permanent	N/A	N/A
Construction Phase Impacts				
GHG emissions on general environment, surrounding environment and people	Impacts during the construction phase include emissions from transport of materials to the site, embodied CO2 in construction materials (such as cement, steel, etc.), emissions from plant machinery and other ancillary areas such as contractor compounds, waste management, etc. According to the TII Carbon Tool, the construction of the Proposed Scheme, will total 927.7 tCO^2e	Slight, temporary	During the construction phase, best environmental practices will be followed in order to mitigate for greenhouse gas emissions. These are detailed in Chapter 13 'Air Quality'. Green procurement policies will be employed where possible to source materials and contractors.	Not significant, temporary

Receptor	Description of Potential Impact	Impact significance prior to mitigation	Suggested Mitigation and Monitoring	Residual Impact
Vulnerability and Adaptability to climate change	The local population will be vulnerable to weather and flood events throughout the construction phase.	Negligible	N/A	N/A
Operation and Maintenance Phase Impacts				
GHG emissions on general environment, surrounding environment and people	These emissions have been calculated by the TII Carbon Tool as 8.6 tCO^2e as a result of the operation and maintenance of the Proposed Scheme.	Not Significant	N/A	N/A
Vulnerability and Adaptability to climate change	The scheme will make the local community less vulnerable to the impacts of flooding, which are increasing as a result of climate change. The scheme is also adaptable to future impacts of a warming climate as the flood levels are anticipated to increase.	Significant, positive	Appropriate mitigation in the form of regular monitoring, maintenance, and adaptability features can reduce the vulnerability of the community to increased flood levels.	N/A

14.13 References

Community Climate Change Consortium for Ireland. (n.d.). Community Climate Change Consortium for Ireland. Retrieved July 2022, 14, from www.c4i.ie

Department of Communications, Climate Action and the Environment. (n.d.). Retrieved July 14, 2022, from http://www.dccae.gov.ie/en-ie/climate-action/publications/Pages/National-Policy-Position.aspx

Environmental Protection Agency. (2011). Air Quality Standards Regulations. Ireland: EPA.

Environmental Protection Agency. (2015). Advice Notes on the Current Practice in the Preparation of Environmental Impact Statements. EPA.

Environmental Protection Agency. (2018). Air Quality in Ireland 2017- Indicators of Air Quality. Johnstown Castle Estate: Environmental Protection Agency.

Environmental Protection Agency. (2020). Air Quality Index for Health - EPA. Retrieved October 2020, from https://www.epa.ie/air/quality/pro/

EPA. (2024). Ireland's greenhouse gas emissions in 2023 lowest in three decades. Retrieved from Environmental Protection Agency: https://www.epa.ie/news-releases/news-releases-2024/irelands-greenhouse-gas-emissions-in-2023-lowest-in-three-decades-.php

Intergovernmental Panel on Climate Change . (2014). Report AR5 Mitigation of Climate Change. Cambridge: Cambridge University Press.

IPCC. (2007). Climate Change, Fourth Assessment Report AR4.

Office of Public Works (OPW). (n.d.). Flood Info. Retrieved July 14, 2022, from https://s3-eu-west-1.amazonaws.com/docs.floodinfo.opw/floodinfo_docs/SouthEastern_CFRAM/UOM14/08_SEAEnvironmental/2200_REP_170728_Final_SEA_Environmental_Report_UoM14.pdf

Office of Public Works. (2018). Technical Methodology Note - Option Appraisal and the Multi-Criteria Analysis (MCA) Framework.

Office of Public Works. (2019, 09). Climate Change Sectoral Adaptation Plan 2019-2024. Retrieved from Gov.ie: https://www.gov.ie/en/publication/97984b-climate-change-and-sectoral-adaptation-plan/#sectoral-adaptation-plan

15 Noise and Vibration

15.1 Scope of the Assessment

15.1.1 This chapter describes significant effects which are likely to arise due to noise and vibration from the construction operation and maintenance of the project as detailed in Chapter 4 'Description of the Proposed Scheme and Construction Methodology'. Mitigation measures to reduce effects are identified where necessary and any residual effects which may remain are described.

15.2 Statutory and Policy Context

Legislation

15.2.1 The following national legislation has been referred to as necessary:

- Environmental Noise Regulations 2006.

Local Policy

15.2.2 Local policy has been referred to as necessary, including:

- Kilkenny Noise Action Plan 2018 – 2023, and
- Kilkenny City and County Development Plan 2021-2027
- Carlow County Council Noise Action Plan 2018
- Carlow County Development Plan 2022 - 2028

15.3 Assessment Methodology

Assessment of Impacts

15.3.1 The assessment of impacts has been undertaken, as appropriate, in accordance with:

- EPA (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports,
- EPA (2016) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4),
- WHO Community Guidelines 1999
- WHO Night Guidelines for Europe 2009
- WHO Environmental Noise Guidelines for the European Region 2018
- IEMA Guidelines for Environmental Noise Assessment – October 2014

- Transport Infrastructure Ireland (TII, formerly NRA) (2014) Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes,
- TII (2004) Guidelines for the Treatment of Noise and Vibration in National Road Schemes,
- BS 5228-1 and 2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Noise and Vibration,
- BS 7385-2:1993 Evaluation and measurement for vibration in buildings. Guide to damage levels from ground-borne vibration, and
- ISO 1996-2:2017 Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of sound pressure levels
- ISO 9613-2:1996 Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation
- Design Manual for Roads and Bridges,2020. LA 111 Noise and Vibration.

Fundamentals of Acoustics

15.3.2 Noise can fundamentally be described in terms of its magnitude or loudness and its frequency or character. Because the human ear perceives a vast range of sound pressures, measurements are expressed on a logarithmic scale, which makes the numbers less unwieldy. Changes in magnitude are normally expressed in decibels (dB). Noise in the environment is measured using the dB(A) scale which includes a correction for the response of the human ear to noises with different frequency content. The typical human reactions to changes in sound level are outlined in Table 15-1. It can be observed from Table 15-1 that a change of 1-2dB is generally considered imperceptible, whereas a 10dB change is generally considered as a halving or doubling of loudness of a sound.

Table 15-1 Human perception of change in dB sound pressure level

Subjective Perception of Change	Change in Sound Pressure Level (dB)
Not significant	1
Just perceptible	3
Clearly noticeable	5
Twice or half as loud	10
Much louder or quieter, four times as loud	20

15.3.3 Given the above, if the predicted change due to the Proposed Scheme is less than 1 dB, the change will be regarded as not significant and will not require further assessment.

Comparison with Background

15.3.4 The noise level in a particular location will depend on the type and number of noise sources in the vicinity, as well as the distance to each of the noise sources. Some examples of typical sound levels in dB(A) are shown in Figure 15-1 below.

15.3.5 Because dB(A) sound measurements are on a logarithmic scale, addition and subtraction of sound levels can be counter intuitive. For instance:

- When two sound levels of equal magnitude are added, the summed level is 3dB higher (a 3dB change indicates a doubling of power),
    - e.g. 40dB + 40dB = 43dB
- When the difference between two sound levels is greater than 10dB, the sum of the two levels is effectively equivalent to the higher of the two levels,
    - e.g. 30dB + 40dB = 40.4dB (a 1dB change is, in general, imperceptible)

15.3.6 The second example above is important in environmental noise as when there is a difference of 10dB or more between noise levels from two sources, the louder source dominates.

Construction Noise and Vibration

15.3.7 Construction noise and vibration has been predicted in accordance with the guidance of BS 5228. Construction plant is used for a specific duration during works (i.e.: 4hrs) , and not during all the construction period (08:00 to 19:00 hrs). Generally, percentage on-times for construction plant and equipment are as follows:

- Excavator breakers, piling rigs, concrete saws, power tools: 30% on-time
- Wheeled loaders: 50% on-time
- All other construction plant/equipment: 70% on-time

Construction Noise Limits

15.3.8 The 'ABC' Method detailed in Paragraph E.3.2 of BS 5228-1:2009 has been used to determine acceptable noise levels for day, evening and night time work." Table E. 1 summarises the ABC method and is reproduced in Figure 15-1 below.

Table E.1 **Example threshold of significant effect at dwellings**

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.

Figure 15-1: Table E.1 from BS 5228 detailing ABC method

Construction Vibration Limits

15.3.9 Guidance to vibration effects is available in BS 5228, and information regarding effects of construction vibration levels on residents is summarised in Table 15-2.

Table 15-2: Guidance of effects of construction vibration levels on residents

Vibration Level (ppv[1])	Description
0.14mm/s	Vibration might just be perceptible for frequencies normally associated with construction vibration. People are less sensitive to lower frequency vibration
0.3mm/s	Vibration might just be perceptible in residential environments.
1.0mm/s	It is likely that vibration at this level in a residential environment will cause complaint. Can be tolerated, if prior warning and explanation given to residents.
10.0mm/s	Vibration is likely to be intolerable for any more than a brief exposure to this level.

Traffic Noise and Vibration

15.3.10 The TII guidelines state that increases in Annual Average Daily Traffic (AADT) flows of less than 25% during the operational and construction phases are unlikely to result in significant noise and vibration effects. Given the relatively low traffic levels in the area, the impact of construction vehicles potentially have a significant effect on the surrounding areas. Therefore, a detailed assessment of construction and operational traffic noise and vibration is required.

[1] Ground vibration is measured in terms of peak particle velocity (ppv).

Operational Noise and Vibration

15.3.11 Operational noise and vibration emissions will be limited to occasional activation of pumps (following floods) and periodic maintenance. As such, operational noise and vibration effects would be negligible given durations would be brief and rare, and magnitudes would be low. Detailed assessment of operational noise and vibration effects is therefore unnecessary.

Zone 1

15.3.12 The first area for study is the waterfront either side of the Graiguenamanagh-Tinnahinch bridge. Premises, structures and features on the waterfront may be sensitive to noise and vibration associated with any works being carried out on the river at this location. The existing noise levels in this area are expected to be dominated by road noise from the R703 road which passes over the bridge and the weir located on the south westerly side of the Graiguenamanagh-Tinnahinch Bridge. Figure 15-2 below shows potentially sensitive premises, structures and features at Zone 1 identified during the desktop study, as well as the baseline survey locations. Highlighted buildings in green represent potentially vulnerable structures; in yellow, potentially vulnerable commercial receivers; in blue, potentially vulnerable residential receivers; and in pink, mixed-use buildings potentially vulnerable.



Figure 15-2: Potentially sensitive premises, structures and features at Zone 1 with baseline survey locations.

Potentially Vulnerable Structures Zone 1

15.3.13 There are a number of potentially vulnerable structures on the waterfront at Zone 1. The Graiguenamanagh-Tinnahinch Bridge is over 250 years old and may be vulnerable to excessive vibration. There are a number of ruins and stone buildings on the waterfront as well as Tinnahinch Castle to the southwest of the Graiguenamanagh-Tinnahinch bridge. The potentially vulnerable structures are marked up in Figure 15-2 above and detailed in Table 15-3 below.

Table 15-3: Potentially sensitive premises, structures and features at Zone 1.

Item	Comment
Graiguenamanagh-Tinnahinch Bridge	 Stone bridge more than 250 years old - potentially sensitive to vibration.
Ruins	 Ruins on the waterfront adjacent to the Graiguenamanagh-Tinnahinch bridge - potentially sensitive to vibration.
Stone building	 Stone building on the waterfront at Graiguenamanagh - potentially sensitive to noise and vibration.

Item	Comment
Derelict building	 Derelict building at the waterfront - potentially sensitive to vibration.
Waterfront shops/residential property	 Residential and commercial properties on the waterfront in Graignuemanagh - potentially sensitive to noise and vibration.

Baseline Noise Survey Results Zone 1

15.3.14 Table 15-4 below summarises the ambient noise levels at measurement point MP1 measured during the baseline survey.

Table 15-4: Daytime ambient conditions measured at measurement point MP1 on 21/06/2023.

Period	Measurement Duration	Time	Measured level (dB)		
			L_{Aeq}[2]	L_{Amax}[3]	L_{A90}[4]
Daytime	15min	10:48	46	58	43

15.3.15 Observations made during the survey include:

[2] LAeq. Equivalent A-weighted Noise Level—Energy averaged, a-weighted noise level over the measurement time (t).
[3] LAmax. The maximum A-weighted instantaneous noise level.
[4] LA90. A-weighted Noise level exceeded for 90% of the measurement time. The L_{90} level is commonly referred to as the background noise level.

- Noise levels at this location were very low, only affected by town traffic and distant pedestrians.
- Low levels of traffic noise were audible emanating from the Graiguenamanagh-Tinnahinch Bridge.
- Bird noise/song present.
- Thermo King refrigerated truck was audible from across the river.

15.3.16 Table 15-5 below summarises the ambient noise levels at measurement point MP2 measured during the baseline survey.

Table 15-5: Daytime ambient conditions measured at measurement point MP2 on 21/06/2023.

Period	Measurement Duration	Time	Measured level (dB)		
			L_{Aeq}	L_{Amax}	L_{A90}
Daytime	15min	11:08	62	69	61

15.3.17 Noise sources observed during the survey included:

- The adjacent river weir was the dominant noise source.
- Bird noise/song.
- Distant traffic was audible at this location.

15.3.18 Table 15-6 below summarises the ambient noise levels at measurement point MP3 measured during the baseline survey.

Table 15-6: Daytime ambient conditions measured at measurement point MP3 on 21/06/2023.

Period	Measurement Duration	Time	Measured level (dB)		
			L_{Aeq}	L_{Amax}	L_{A90}
Daytime	15min	10:20	51	69	48

15.3.19 Noise sources observed during the survey included:

- The adjacent coffee shop customers at the terrace were the dominating source.
- Frequent car passes.
- Thermo King refrigerated truck was audible from measurement position.
- Constant river weir noise contributed to L90, background noise levels.

Data Sources

15.3.20 Data sources utilised during the assessment include the following:

- Aerial photography and street imagery: Google Maps5,
- BS 5228-1 and 2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Noise and Vibration6, and
- Aerial photography: ESRI ArcGIS basemaps7,
- Publicly available information regarding potential sources of commercial or industrial noise identified from aerial photography, and
- Outputs of the Graiguenamanagh-Tinnahinch FRS Archaeology and Cultural Heritage Constraints Study.

15.3.21 The above have been supplemented by the extensive experience of Amplitude's staff and Amplitude's library of noise data and observations for similar sites in Ireland.

Expected Sources of Ambient Noise and Vibration

Road Traffic Noise and Vibration

15.3.22 Roads within the Graiguenamanagh – Tinnahinch study area can be broken down into 2 classes:

- Regional Roads: major routes linking the national route network which experience high volumes of traffic – road traffic noise levels are typically highest in close proximity to regional routes.
- Local roads: local roads provide access to traffic emanating from properties along them and discharge it onto regional routes – these generally have occasional traffic and therefore lower associated road traffic noise levels.

15.3.23 Depending on proximity to each class of road listed above, locations may be expected to be exposed to high, medium or low ambient road traffic noise levels. The level of existing ambient road traffic noise contributes, in an inversely proportional relationship, to the sensitivity of receivers to both noise and vibration. This is because existing ambient noise and vibration may mask emissions from any new sources (within certain limits of magnitude and proximity) which may be introduced.

[5] https://www.google.com/maps
[6] BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Noise and BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Vibration
[7] Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

15.3.24 Road traffic, in particular heavy goods vehicles (HGVs), is also a potential source of ground-borne vibration.

Industrial, Commercial, Domestic, Natural Features

15.3.25 In a similar way to the case for road traffic noise, other sources of noise within the urban or rural environment may have the effect of reducing sensitivity of receivers. Sources of noise in the urban or rural environment include industrial and commercial noise, domestic noise sources and natural features such as watercourses. Locations in the study area can be broadly categorised into the following zones:

- Industrial,
- Commercial,
- Residential,
- Rural,
- Agricultural, and
- Combinations of the above.

Acoustic and Psychoacoustic Factors

15.3.26 Finally, in assessing the potential sensitivity of receivers it is necessary to consider the following factors:

- Separation distance: with sufficient separation of source and receiver, distance attenuation (geometric spreading, atmospheric absorption, ground effects) will result in significantly reduced noise levels at the receiver.
- Acoustic screening – acoustic barriers may take the form of walls, topography, buildings etc. and, once line-of-sight is blocked, may become increasingly effective with increases of height and extent.
- Character of the new noise source under consideration, i.e. are there similar sources in the existing ambient environment or will the new source be unusual and therefore potentially more prominent/identifiable.

Desktop Study

15.3.27 In assessing potential sensitivity of receivers to construction noise emanating from any proposed works, the following stepwise methodology is adopted:

1. Premises, structures and features in proximity to proposed works are identified.
2. Google Maps Street View is used to classify premises as either residential, commercial, or healthcare/places of worship.

3. Expected levels of ambient noise for each location based upon proximity to other potential sources of noise is assessed.

4. Relative proximity of proposed vs existing sources is considered.

5. Separation distances, acoustic screening and character of existing vs proposed sources of noise are considered.

15.3.28 In order to afford receivers, the highest level of protection from noise nuisance due to proposed works, baseline noise survey locations are selected based on the following principles:

- Baseline noise levels should be measured at the nearest sensitive receiver which would be expected to experience the lowest existing ambient noise levels.
- Assessment of expected existing ambient noise levels is based upon:
    - Separation distance from existing sources of ambient noise,
    - Acoustic screening,
    - Site observations.

15.3.29 In assessing sensitivity to vibration, the following factors are considered:

- Humans are sensitive to vibration and experience discomfort at levels much lower than those required for damage to structures.
- Heritage structures and features may be vulnerable to vibration from proposed construction works, therefore potentially vulnerable structures have been identified using:
    - Aerial photography and Google Maps Street View,
    - Outputs of the Archaeological and Cultural Heritage assessment,
    - Site observations obtained during the baseline surveys.

15.3.30 In assessing potential sensitivity of receivers to construction vibration emanating from any proposed works, the following stepwise methodology is adopted:

1. Premises, structures and features in proximity to proposed works are identified.

2. Google Maps Street View is used to classify premises as either residential, commercial, or healthcare/places of worship.

3. Outputs of the Archaeological and Cultural Heritage assessment are reviewed, and vulnerable features are included in the desktop study.

4. All potential vibration sensitive receivers are GIS mapped to allow early indication of potential construction vibration effects.

Baseline Survey

Study Area

15.3.31 The study area comprises the geographic boundary created for the purposes of this assessment based on the proposed flooding control works in Graiguenamanagh-Tinnahinch.

15.3.32 For the purposes of the desktop study and baseline surveys, 3 locations or zones have been defined where potential construction works may have noise and vibration effects. These assessment areas are highlighted in Figure 15-3 and Figure 15-4.

15.3.33 Also shown are the baseline noise locations that have been distributed as follows:

- Zone 1: measurement point 1-3.
- Zone 2: measurement point 4.
- Zone 3: measurement point 5.

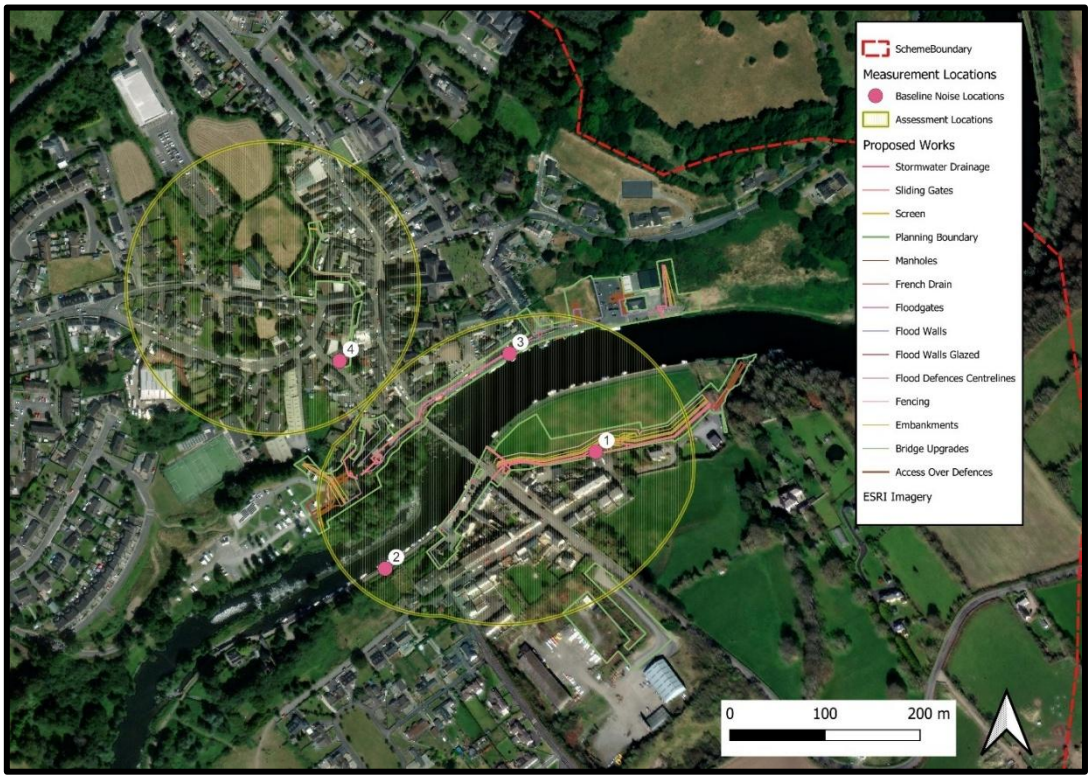


Figure 15-3. Proposed construction development in assessment Zone 1 and 2.



Figure 15-4. Proposed construction works in assessment Zone 3.

Survey Description and measurement location selection

15.3.34 In order to characterise the existing soundscape attended noise measurements were taken at five representative locations. Noise monitoring locations were selected to be representative of the typical ambient noise levels at the nearest receptors to the proposed construction activities. These monitoring locations were strategically selected to provide a comprehensive understanding of the noise environment in the vicinity of the construction site. Important factors considered are:

- Construction activities: Different construction activities can produce varying levels of noise and by considering the specific construction activities taking place, the monitoring locations have been chosen to capture the highest noise sources and represent the overall noise characteristics during the construction process.
- Proximity to works: The distance between the monitoring locations and the construction activities is crucial for understanding how noise propagates and attenuates as it travels away from the source.
- Representativeness: The goal of noise monitoring is to gather data that accurately represents the noise exposure experienced by people and sensitive receptors near the construction site.

15.3.35 The baseline survey was carried out on 21st June 2023, between 10:00 and 12:30 hrs. One 15 minute attended measurement was taken in each area. Baseline survey has been conducted as an updated version of previous survey conducted by Amplitude Acoustics in

October 2020 which was affected by the Covid19 circulation restrictions and therefore, new baseline survey was conducted. All measurements were undertaken in accordance with the guidance of ISO 1996-2:2017.

15.3.36 The baseline noise environment in the vicinity of proposed works was generally dominated by local road traffic noise and city hum created by a combination of commercial and residential noises as would be expected of an urban location. The River Barrow itself is a source of ambient noise, particularly at the location of river weirs or fast flow, as well as sounds from wildlife in the river environs.

Instrumentation

15.3.37 A Class 1 sound level meter/noise logger in accordance with IEC 61672-1:2013 was used for all measurements. Table 15-7 below summarises the measurement equipment used.

Table 15-7: Measurement equipment

Description	Manufacturer	Model	Serial Number
Sound Level Meter	Svantek	971	77796
Calibrator	Larson Davies	Cal 200	13592

15.3.38 All equipment has calibration certificates traceable back to the relevant Standard. A calibration check of the sound level meter was conducted prior to and following the assessment using an external acoustic calibrator, with no significant drift in calibration observed. Calibration certificates are included in Appendix 15-1.

Procedure

15.3.39 Noise measurements at the various locations were undertaken in accordance with the following:

- For noise measurements the microphone of the sound level meter was at a height of approximately 1.3 metres.
- One 15-minute measurement was conducted at each position during the daytime.
- Care was taken to avoid any effect on the measurement of extraneous noise, acoustic vibration or electrical interference.
- A wind shield was used during all measurements, and the measurements were undertaken during calm, still weather (for which the wind velocity did not exceed 5 m/s).

15.3.40 Surveys have been conducted in accordance with the guidance of ISO 1996-2:2017 Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of sound pressure levels.

Weather Conditions During Survey

15.3.41 Weather conditions during the attended survey were as follows:

- Wind: little to no wind observed/measured.
- Precipitation: none.
- Other: no additional weather effects noted.

15.4 Baseline Environment and Sensitive Receptors

15.4.1 BS 5228 defines noise-sensitive premises (NSP's) as "any occupied premises outside a site used as a dwelling (including gardens), place of worship, educational establishment, hospital or similar institution, or any other property likely to be adversely affected by an increase in noise level. Note: This can include national parks, areas of outstanding natural beauty or other outdoor spaces where members of the public might reasonably expect quiet enjoyment of the area".

15.4.2 Due to the urban location, there are NSP's in close proximity to all locations of proposed works.

15.4.3 Following a desktop analysis of available aerial & street photography, the following potential noise and vibration sensitive receivers have been identified:

Zone 2

15.4.4 Zone 2 encompasses a central portion of the town of Graiguenamanagh. There are a number of potentially sensitive premises, structures and features, surrounding the potential locations of the flood storage, detailed below in Figure 15-5 and Table 15-8. Highlighted buildings in green represent potentially vulnerable structures; in yellow, potentially vulnerable commercial receivers; in blue, potentially vulnerable residential receivers; and in pink, mixed-use buildings potentially vulnerable.



Figure 15-5: Potentially sensitive premises, structures and features at Location 2 with baseline survey location.

Potentially Vulnerable Structures Zone 2

15.4.5 There are a number of potentially vulnerable structures at Zone 2. Firstly, the Clapper Bridge is a narrow granite bridge which is partially collapsed and may be sensitive to vibration. Graiguenamanagh Mill is a semi-collapsed building on Mill Road. There is a small bridge near the junction between Mill Road and High Street which may be of similar age to the Graiguenamanagh-Tinnahinch Bridge. The bridge spans a small tributary which runs in the direction of the River Barrow, there are a number of properties which are above or immediately adjacent to the tributary which should be given due consideration as they may be vulnerable to excessive vibration.

Table 15-8: Potentially sensitive premises, structures and features at Zone 2.

Item	Comment
Clapper Bridge	 Narrow granite bridge, potentially sensitive to vibration.
Graiguenamanagh Mill	 Partially collapsed Mill building, potentially sensitive to vibration.

Item	Comment
Barrow tributary bridge and adjacent buildings	  A bridge spanning a tributary flowing down to the River Barrow. The bridge itself is potentially sensitive to vibration. A number of residential buildings are overhanging the tributary and are also potentially sensitive to noise and vibration.
Brick Chimney	 Brick chimney located adjacent to Aldi entrance - potentially sensitive to vibration.

Item	Comment
Graiguenamanagh Abbey	 fCEMPLarge Limestone Church, parts of the building constructed in the 13th century - potentially sensitive to vibration.

Baseline Noise Survey Results Location 2

15.4.6 Table 15-9 below summarises the ambient noise levels at measurement point MP4 measured during the baseline survey.

Table 15-9: Daytime ambient conditions measured at measurement point MP4 on 21/06/2023.

Period	Measurement Duration	Time	Measured level (dB)		
			L_{Aeq}	L_{Amax}	L_{A90}
Daytime	15min	11:29	54	70	47

15.4.7 Observations made during the survey include:

- Constant traffic noise audible from R703 and High Street.
- Tributary river flow at low noise level.
- Bird noise/song.
- Goods truck delivering at proximity contributing to L_{Amax}.

Zone 3

15.4.8 Zone 3 encompasses some of the same residential properties as Zone 2 as well as more rural residential properties further out of Graiguenamanagh within the potential audible range of construction of the proposed flood storage locations. Road noise is likely to be the dominant existing noise source at this location.

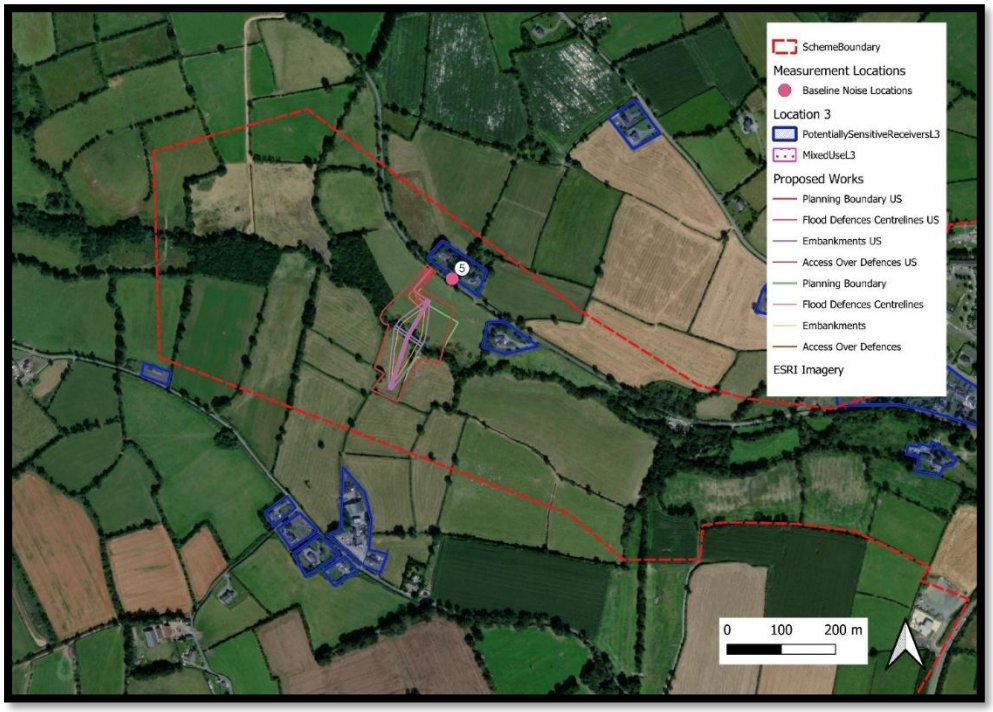


Figure 15-6: Potentially sensitive premises, structures and features at Location 3 with baseline survey location.

Baseline Noise Survey Results Location 3

15.4.9 Table 15-10 below summarises the ambient noise levels at measurement point MP5 measured during the baseline survey.

Table 15-10: Daytime ambient conditions measured at measurement point MP5 on 21/06/2023.

Period	Measurement Duration	Time	Measured level (dB)		
			L_{Aeq}	L_{Amax}	L_{A90}
Daytime	15min	12:12	40	59	32

15.4.10 Observations made during the survey include:

- Frequent car passes.
- Farm machinery audible from across valley briefly (distance roughly 400m).
- Bird noise/song present.
- Low noise levels in general.

15.5 Potential Impacts and Effects

Construction Noise Limits

15.5.1 Using the BS 5228 ABC method, the daytime threshold value for onset of significant effects has been determined to be 65dBA for all NSP's located nearest to works. Given the low-

moderate baseline noise levels measured at all survey locations, the 65dBA lower cut-off value has been applied. This implies that further survey efforts would not result in lower noise limits for any NSP's.

15.5.2 Where site noise levels are expected to exceed 65dBA, BS5228 states that 75dBA $L_{eq,10\ hours}$ is the level at which noise insulation, or the reasonable costs thereof, should be offered to the nearest sensitive receptors. The standard states that noise insulation should be provided where the 75dBA level is exceeded for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any 6 consecutive months.

15.5.3 Based on the noise measurements, the construction noise criteria for the site have been set, as shown in Table 15-11.

Table 15-11: Construction Noise Limits

Construction Noise Limits			
	Measured Ambient Noise dB L_{Aeq}	BS5228 Construction Noise Threshold for onset of Significant Effects, dB L_{Aeq}	BS5228 Construction Noise Limit at which Additional Mitigation Measures should be Provided, dB L_{Aeq}
All nearest NSP's	<60	65*	75

* 65dBA lower threshold cut-off value

The 'do nothing' Scenario

15.5.4 In the scenario where the Proposed Scheme did not proceed as proposed, none of the described construction noise and vibration effects would occur and the baseline conditions described in Section 15.4 would continue.

Construction Phase

Construction Phasing

15.5.5 As a reference, the Proposed Scheme described in Chapter 4 'Description of the Proposed Scheme and Construction Methodology', Section 4.3.2 is outlined in Table 15-12 with an additional column indicating the Zone designated for each area of work as well as the most representative measurement position (MP) to determine construction noise limits.

Table 15-12: Proposed scheme overview as per Table 4-1

Area No.	Survey Zone No. and MP	Description	Aspects of Work
Area 1	Zone 3 MP5	Storage Area	Raised earthfill impoundment structure. Reinforced concrete flow control structure with hydraulic control and downstream flume for flow control. Spillway Section over southern part of storage embankment New access roads, lighting and mechanical and electrical equipment to storage area. Diversion of ESB poles/cables.
Area 2	Zone 2 MP4	Well Lane to High Street Bridge	Raised defence on the left bank from The Globe upstream to the first pedestrian access bridge. Waterproofing works to the existing wall upstream as far as Clapper Bridge. Local land raising/steps to tie into new raised flood defences. Replacement pedestrian access bridge deck Local waterproofing of existing walls and raising of windowsills Debris Trap at Well Lane Installation of Non-Return Valves (NRVs) at outfalls.
Area 3	Zone 2 MP4	Turf Market	Raised defences on left bank from High Street Bridge downstream to first pedestrian access bridge. Replacement pedestrian access bridge and parapets. Installation of NRVs at outfalls on left bank. Improvement to the existing riverside walls to including removal of vegetation, lime mortar-based repointing and replacement of missing masonry. Provision of replacement waterproof doors in lieu of existing doors. Provision of pump sumps to drain low lying ground during flood events.
Area 4	Zone 2 MP4	Turf Market to The Hub (Lower Turfmarket)	Raised defences on both banks from Turfmarket Bridge to the bridge at The Hub. Drainage system at Peg Washingtons Lane
Area 5	Zone 1 MP3	Boat Club	Raised embankment on the right bank in the field north of the boat club.

Area No.	Survey Zone No. and MP	Description	Aspects of Work
			Raised defence on the right bank, to include glass panels, from upstream of the boat club to Graiguenamanagh Quay. Installation of non-return valves on outfalls to the River Barrow. Drainage system to include pumped rising main Local land raising to facilitate orderly completion of flood defences whilst maintaining access. Public Realm/landscaping works
Area 6	Zone 1 MP3	Graiguenamanagh Quay	Raised defence on the right bank along Graiguenamanagh Quay to include glass wall section and sliding flood gates. Installation of non-return valves on outfalls to the River Barrow. Drainage system Utility diversion (Foul, ESB, Public Lighting) Public Realm/Landscaping Works to include revised vehicular 1-way system on Graiguenamanagh Quay
Area 7	Zone 1 MP3	The Dock	Raised defence on the right bank from Graiguenamanagh Quay to the bridge at The Hub to include hinged flood gate for access to historic dock. Drainage system and a pumping station. Landscape and Public Realm Works
Area 8	Zone 1 MP3/MP4	The Hub	Raised defence on the right bank from the bridge at The Dock to the rear of the IW pumping station. Raised embankment on the right bank within the ground of The Hub. Local land raising to facilitate orderly completion of flood defences whilst maintaining access. Drainage System Install NRVs at outfalls.
Area 9	Zone 1 MP1	Hotel Street	Raised embankment and defence wall on the left bank in the field upstream of Graiguenamanagh Bridge. Groundwater drainage systems to tie into drainage on Tinnahinch Quay.

Area No.	Survey Zone No. and MP	Description	Aspects of Work
			Local ramps to maintain access to Barrow River. Install NRVs at outfalls.
Area 10	Zone 1 MP2	Tinnahinch Quay	Raised defences on the left bank at Tinnahinch Quay tying into high ground at a private residence on Tinnahinch Quay, adjacent to the Millrace. Drainage systems including small pump station (underground). Flood gate fitted to the Quay Road at existing Millrace sluice gate. Kiosk relocation Install NRVs at outfalls.

15.5.6 Work packages as described in Chapter 4 'Description of the Proposed Scheme and Construction Methodology', Section 4.7.6, indicates the duration and the areas involved in the construction per phase.

Table 15-13: Work packages as per Table 4-17

Works Package No.	Works Package Duration	Works Package Description	Area No.	Site Compound to be Used
WP1	3months	Site set-up, enabling works and early landowner accommodation works	-	Main Compound (A)
WP2	18 months	Construction of the storage areas to include power supply, access roads, embankment, flow control structure, spillway and associated works.	Area 1	Storage Area (B)
WP3	12 months	Construction of all flood defence walls on the Duiske River, replacement of 2no. Bridges, reinstatement of footpaths and private land and associated works.	Area 2 Area 3 Area 4	Well Lane to High Street Bridge (C)
WP4a	18 months	Construction of all flood defence walls on the River Barrow right bank, including drainage and pumping stations, sheet piling, utility diversions, public realm works, flood barriers, glass wall, boardwalk, public lighting,	Area 5 Area 6 Area 7 Area 8	Boat Club (D)

		seating, trees and planters and associated works.		
WP4b	18 months	Construction of all flood defence walls on the River Barrow left bank, including drainage and pumping stations, utility diversions, reinstatement of roads and associated works.	Area 9 Area 10	Hotel Street (E)

Construction Plant and Equipment

15.5.7 Table 15-14 shows the assumed plant, equipment and duration of operation for each area of works based on the construction methodology provided and outlined in Table 15-12 and Table 15-13 above.

Table 15-14: Assumed construction equipment for each construction area.

Area 1 - Storage Area				
BS 5228 ref.	**Description**	**Qty**	**LAeq @ 10m**	**% on-time**
F.1	Landscaping equipment (EU limit values)	2	70	30
C.2.26	Wheeled loader	1	79	30
C2.12	Dozer 20t	1	81	30
D.6.52	Electric percussion drills (2)	2	78	30
C.2.16	30 t Tracked excavator	3	75	50
C.2.30	Dump truck (tipping fill) 29t	10	79	15
C.4.24	Concrete pump	1	67	5
C.2.39	Vibratory roller 4t	1	74	50
C.4.73	Hand-held circular saw (cutting paving slabs)	1	84	10
Area 2 - Well Lane to High Street Bridge				
BS 5228 ref.	**Description**	**Qty**	**LAeq @ 10m**	**% on-time**
C.2.25	14 t Tracked excavator	1	69	30
F.1	Landscaping equipment (EU limit values)	2	70	30
C.5.2	(1.5 t) 44 mm diameter / 115 bar / 120 kg Mini excavator with hydraulic breaker	1	83	30
C.4.73	7.6 kg / 235 mm diameter Hand-held circular saw (cutting paving slabs)	1	84	10
C.4.88	Water pump (diesel)	1	68	50
C.4.8	5 t Dumper (idling)	4	56	30
C.4.24	8 t / 350 bar Concrete pump + cement mixer truck (discharging)	1	67	30
c.12.100	Bauer BG36 coring reinforced concrete pile	1	87	10
Area 3 - Turf Market				

BS 5228 ref.	Description	Qty	L_{Aeq} @ 10m	% on-time
C.5.2	(1.5 t) 44 mm diameter / 115 bar / 120 kg Mini excavator with hydraulic breaker	1	83	30
C.2.25	14 t Tracked excavator (used as equivalent for mini piling rig)	1	69	70
F.1	Landscaping equipment (EU limit values)	2	70	70
C.4.8	5 t Dumper (idling)	4	56	30
C.2.30	29 t Dump truck (tipping fill)	1	79	10
C.4.88	Water pump (diesel)	1	68	50
Area 4 - Turf Market to The Hub (Lower Turf Market)				
BS 5228 ref.	**Description**	**Qty**	**L_{Aeq} @ 10m**	**% on-time**
C.5.2	(1.5 t) 44 mm diameter / 115 bar / 120 kg Mini excavator with hydraulic breaker	1	83	20
C.2.25	14 t Tracked excavator	1	68	70
F.1	Landscaping equipment (EU limit values)	2	70	70
C.4.8	5 t Dumper (idling)	4	56	30
C.2.30	29 t Dump truck (tipping fill)	1	79	20
C.4.88	Water pump (diesel)	1	68	50
Area 5 - Boat Club				
BS 5228 ref.	**Description**	**Qty**	**L_{Aeq} @ 10m**	**% on-time**
C.5.2	(1.5 t) 44 mm diameter / 115 bar / 120 kg Mini excavator with hydraulic breaker	1	83	20
C.2.39	Vibratory roller 4t	1	74	50
C.4.73	Hand-held circular saw (cutting paving slabs)	1	84	10
C.3.8	Sheet steel piling – vibratory	1	88	100
C.2.25	14 t Tracked excavator	1	69	30
F.1	Landscaping equipment (EU limit values)	2	70	70
C.4.8	5 t Dumper (idling)	4	56	30
C.4.5	Dumper (Idling) 9t	1	63	30
C.4.88	Water pump (diesel)	1	68	50
Area 6 - Graiguenamanagh Quay				
BS 5228 ref.	**Description**	**Qty**	**L_{Aeq} @ 10m**	**% on-time**
F.1	Landscaping equipment (EU limit values)	2	70	30
C.3.8	Sheet steel piling – vibratory	1	88	100
C.5.2	(1.5 t) 44 mm diameter / 115 bar / 120 kg Mini excavator with hydraulic breaker	1	83	20
C.3.31	Hand-held welder	1	73	30
C.4.88	Water pump (diesel)	1	68	50

C.2.39	Vibratory roller 4t	1	74	50
C.4.73	Hand-held circular saw (cutting paving slabs)	1	84	10
D.6.52	Electric percussion drills (2)	2	78	30
C.2.25	14 t Tracked excavator	1	69	30
C.4.8	5 t Dumper (idling)	10	56	10
C.4.43	Wheeled mobile crane 35t	1	70	10
C.4.44	Wheeled mobile crane 35t (idling)	1	60	30
Area 7 - The Dock				
BS 5228 ref.	**Description**	**Qty**	**L_{Aeq} @ 10m**	**% on-time**
F.1	Landscaping equipment (EU limit values)	2	70	30
C.3.8	Sheet steel piling – vibratory	1	88	100
C.5.2	(1.5 t) 44 mm diameter / 115 bar / 120 kg Mini excavator with hydraulic breaker	1	83	10
C.3.31	Hand-held welder	1	73	30
D.6.52	Electric percussion drills (2)	2	78	30
C.2.25	14 t Tracked excavator	1	69	30
C.2.45	Water pump	1	65	50
C.4.8	5 t Dumper (idling)	1	56	30
C.2.30	29 t Dump truck (tipping fill)	1	79	10
C.4.41	Mobile telescopic crane 100t	1	71	30
C.4.73	Hand-held circular saw (cutting paving slabs)	1	84	10
Area 8 - The Hub				
BS 5228 ref.	**Description**	**Qty.**	**L_{Aeq} @ 10m**	**% on-time**
F.1	Landscaping equipment (EU limit values)	2	70	30
C.3.8	Sheet steel piling – vibratory	1	88	80
C.5.2	(1.5 t) 44 mm diameter / 115 bar / 120 kg Mini excavator with hydraulic breaker	1	83	10
C.3.31	Hand-held welder	1	73	30
C.2.30	29 t Dump truck (tipping fill)	1	79	10
D.6.52	Electric percussion drills (2)	2	78	30
C.4.68	5 t Mini tracked excavator	1	65	30
C.2.45	Water pump	1	65	50
Area 9 - Hotel Street				
BS 5228 ref.	**Description**	**Qty**	**L_{Aeq} @ 10m**	**% on-time**
C.2.25	14 t Tracked excavator	1	69	30
F.1	Landscaping equipment (EU limit values)	2	70	30
C.3.8	Sheet steel piling – vibratory	1	88	40
C.5.2	(1.5 t) 44 mm diameter / 115 bar / 120 kg Mini excavator with hydraulic breaker	1	83	10

C.4.68	5 t Mini tracked excavator	1	65	30
C.4.8	5 t Dumper (idling)	1	56	30
C.4.24	8 t / 350 bar Concrete pump + cement mixer truck (discharging)	1	67	30
D.6.52	Electric percussion drills (2)	2	78	30
C.2.25	14 t Tracked excavator	1	69	70
C.2.45	Water pump	1	65	50
C.2.39	Vibratory roller 4t	1	74	50
C.4.73	Hand-held circular saw (cutting paving slabs)	1	84	10
Area 10 - Tinnahinch Quay				
BS 5228 ref.	**Description**	**Qty**	**L_{Aeq} @ 10m**	**% on-time**
C.2.25	14 t Tracked excavator	1	69	30
C.3.8	Sheet steel piling – vibratory	1	88	100
F.1	Landscaping equipment (EU limit values)	2	70	30
C.5.2	(1.5 t) 44 mm diameter / 115 bar / 120 kg Mini excavator with hydraulic breaker	1	83	10
C.4.68	5 t Mini tracked excavator	1	65	30
C.4.8	5 t Dumper (idling)	1	56	30
C.4.24	8 t / 350 bar Concrete pump + cement mixer truck (discharging)	1	67	30
D.6.52	Electric percussion drills (2)	2	78	30
C.2.45	Water pump	1	65	50
C.2.39	Vibratory roller 4t	1	74	50
C.4.73	Hand-held circular saw (cutting paving slabs)	1	84	10

Construction Noise Effects

15.5.8 Table 15-15 shows the construction noise levels predicted at NSP's nearest to works based on the average distance from works. It should be noted that the predictions do not account for concentration of works at positions on sites closest to receivers but rather predict the average noise level ($L_{Aeq,10hr}$) expected over the duration of works as activity moves through the various sites.

15.5.9 All receivers are predicted to exceed the threshold for significant effects (65dBA) using the BS5228 ABC method. All construction noise effects will be temporary and limited to daytime construction hours. Predicted significance of effects due to construction noise are Slight up to 65dBA $L_{Aeq,10hr}$, Moderate in the range 65 - 70dBA, Significant in the range 70 – 75dBA and Very Significant for levels above 75dBA.

Table 15-15: Predicted construction noise levels without mitigation.

Location	Average distance to centre of works (m)	Predicted L_{Aeq} without mitigation (dB)	EPA Predicted Significance
Area 1 - Storage Area	150	64	Slight
Area 2 - Well Lane to High Street Bridge	30	75	Significant
Area 3 - Turf Market	30	73	Significant
Area 4 - Turf Market to The Hub (Lower Turf Market)	30	72	Significant
Area 5 - Boat Club	25	84	Very Significant
Area 6 - Graiguenamanagh Quay	30	82	Very Significant
Area 7 - The Dock	40	80	Very Significant
Area 8 - The Hub	25	83	Very Significant
Area 9 - Hotel Street	50	75	Significant
Area 10 - Tinnahinch Quay	25	84	Very Significant

15.5.10 Augered micropiles have been specifically selected for areas where structures are at particular risk such as heritage buildings and/or buildings that are not potentially structurally unsound.

15.5.11 Predicted **very significant effects** are due to sheet piling, with **significant effects** typically from concrete breaking, concrete saws, scabbling concrete walls, or demolition. It should be noted that, with the exception of sheet piling, these noisy activities would not be expected to occur for long durations on consecutive days, e.g., use of concrete breaking and concrete saws is expected in relation to movement of services and would be expected to be brief. They are therefore considered **temporary** in their effect.

15.5.12 As stated earlier in this chapter, based on the guidance of BS5228, 75dBA $L_{Aeq,10hr}$ (08:00 – 18:00) is in general the upper trigger value, or threshold above which noise insulation or temporary rehousing should be offered to affected residents. BS5228 states that insulation or relocation should be offered when the 75dBA $L_{Aeq,10hr}$ upper trigger value is exceeded for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any 6 consecutive months. Should it, for instance, be necessary because of local soil conditions to conduct impact sheet piling at sites adjacent to receivers, the above guidance should be considered in terms of the duration of works for which the upper trigger value will be exceeded.

Construction Vibration Effects

15.5.13 Augered piling will be implemented at sensitive sites which will reduce the likelihood of impact on sensitive areas. In addition, vibratory rollers, excavators and dump trucks have also been identified as potential vibratory sources however the impact from these activities is considered to result in an **imperceptible** impact.

15.5.14 The small separation distance between sheet piling works and NSP's would make avoidance of perceptible vibration highly unlikely, and complaints may occur without implementation of the recommended mitigation measures detailed in Section 15.6.

Operation and Maintenance Phase

15.5.15 Operational noise and vibration emissions will be limited to occasional activation of pumps (following floods) and periodic maintenance. As such, operational noise and vibration effects would be negligible given durations would be brief and rare, and magnitudes would be low. Detailed assessment of operational noise and vibration effects is therefore unnecessary.

15.6 Mitigation Measures

Construction Phase

15.6.1 Various mitigation strategies may be employed to reduce construction noise to the target lower threshold cut-off value of 65dBA and within the upper limit of 75dBA $L_{eq,10\ hours}$ including the following:

NV_1: Erection of site hoarding or local noise barriers which block line of sight to noisy activities (specifically on the loudest sources i.e.: hydraulic breaker, sheet piling).

NV_2: Where possible limit the operation of noisiest activities to exclude periods identified through consultation with residents. Where this is not possible prior notification shall be provided.

NV_3: Selection of items of plant with lower noise levels.

NV_4: Engagement and dialogue between construction contractor and local community.

NV_5: Assign responsibility for issues relating to noise to a competent member of site staff.

NV_6: Monitoring of site noise and vibration levels against the guidance and coordination with community and enable implementation of further measures, if required.

NV_7: If necessary, install local noise barriers with absorptive linings near to specific sources, during construction works.

NV_8: Provide enclosures around generators.

NV_9: Switch off engines and equipment when not required.

NV_10: Warning reversing alarms should give adequate warning but have minimum impact on people outside site.

NV_11: Plant and activities shall be reviewed so that noise is reasonably minimised (and therefore demonstrate use of best practicable means).

NV_12: Good practice for development of good community relations:

- advise residents when works are due to start.
- provide site contact details if neighbours want to complain about the noise.

- establish a site point of contact for dealing with noise complaints.
- have an established procedure for dealing with complaints, recording time/details and responding within a certain time period.

NV_13: Further guidance on construction noise reduction is available in BS5228 and will be implemented as necessary for control of construction noise from the Proposed Scheme.

Operation and Maintenance Phase

15.6.2 No mitigation measures are proposed for the operation or maintenance phase of the Proposed Scheme.

15.7 Monitoring

15.7.1 Noise and vibration monitoring of works will be conducted at the boundary of the works or at the nearest noise sensitive properties for the duration of the construction works. Measurements will confirm if site noise and vibration limits are being met and where required can enable improvements to be recommended to the noise and vibration mitigation scheme, such as the installation of noise barriers (ref. NV_6&7) or adjustment in piling methodology. BS5228 states that insulation or relocation should be offered when the 75dBA $L_{Aeq,10hr}$ upper trigger value is exceeded for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any 6 consecutive months.

15.7.2 Vibration monitoring will take place on neighbouring structures and walling of a heritage and historic interest to limit accelerations to 3mm/s of any pile driven works. Buildings and structures where vibration monitoring will take place are detailed in Appendix 9-8 and Table 9-9 of Chapter 9 'Cultural Heritage' (including CH04, CH05, CH06, CH07, CH08, CH10, CH15, CH17, KK029-018008, C125, C149, C140, C635, C17, C18, C648, D152, C647, C654 rear of and C134 rear of).

15.7.3 Should site constraints make hydraulic press piling impossible, thereby necessitating vibratory or impact piling, vibration monitoring will be required at residences/structures close to piling works.

15.8 Residual Impacts and Effects

Construction Phase

15.8.1 Following implementation of construction noise and vibration mitigation efforts, some impacts will remain. Site hoarding and local barriers (screening) blocking line of site to works will be instated and therefore provide 10dB attenuation as per the guidance of BS 5228 and reduce the noise impact to below the 75dB 75dB $L_{Aeq,10hr}$ upper trigger limit. Although these impacts remain, and in some instances, could be **significant** at times particularly at areas close to sheet piling. Given the **temporary** nature of the activities, effective communication and considerate scheduling will reduce the impact further.

15.8.2 Table 15-16 shows the construction noise levels predicted at NSP's nearest to works based on the average distance from works.

Table 15-16: Predicted construction noise levels with mitigation.

Location	Average distance to centre of works (m)	Predicted L_{Aeq} with screening (dB)	EPA Predicted Significance
Area 1 - Storage Area	150	54	Slight
Area 2 - Well Lane to High Street Bridge	30	65	Moderate
Area 3 - Turf Market	30	73	Significant
Area 4 - Turf Market to The Hub (Lower Turf Market)	30	62	Slight
Area 5 - Boat Club	25	74	Significant
Area 6 - Graiguenamanagh Quay	30	72	Significant
Area 7 - The Dock	40	70	Moderate
Area 8 - The Hub	25	73	Significant
Area 9 - Hotel Street	50	65	Moderate
Area 10 - Tinnahinch Quay	25	74	Significant

Operation and Maintenance Phase

15.8.3 There are **no significant** residual noise or vibration impacts predicted for the operation or maintenance phase of the Proposed Scheme.

15.9 Interactions with other Environmental Effects

15.9.1 A full review of the potential interactions is provided in Chapter 16 'Interactions and Cumulative Effects'.

15.9.2 Interactions exist between the Noise and Vibration assessment and other environmental parameters. Key areas of interaction include:

- Impacts to the health, safety and general wellbeing of the population with regards to the requirement for infrastructure and services, exposure to increase construction congestion and traffic (and the secondary impacts of this with regards to pollutant and noise generation). This is linked with Chapter 6 'Population and Human Health' and Chapter 13 'Air Quality'.
- Effects to animal species sensitive to noise and vibration as outlined in Chapter 10 'Biodiversity'.
- Impacts to cultural heritage structures sensitive to vibration as outlined in Chapter 9 'Cultural Heritage'.
- The effects of road, traffic and transportation impacts are outlined in Chapter 7 'Material Assets.

15.10 Cumulative Impacts

15.10.1 There are no known additional projects that may have a significant impact on the NSP's.

15.11 Limitations in Preparing the Chapter

15.11.1 Plant and equipment for construction noise and vibration assessments have been assumed based on experience, professional judgement, and local authority guidance. Actual equipment used on site will be determined by site conditions and availability.

15.12 Summary

Table 15-17: Summary of Impacts and Mitigation Measures: Noise and Vibration

Receptor	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
'Do Nothing' Scenario Impacts					
All receivers	No predicted impacts	-	Long term	-	-
Construction Phase Impacts					
Noise sensitive properties adjacent to works	Negative	Slight – Very Significant	Temporary	Hoarding, local barriers, limiting hours, select quiet equipment, good relations with residents, informing residents of noisy/vibration inducing works	Significant reduced to moderate if managed
Operation and Maintenance Phase Impacts					
All receivers	No predicted impacts	-	Long term	-	-

15.13 References

S.I. No. 140/2006 - Environmental Noise Regulations 2006

Kilkenny Noise Action Plan 2018 – 2023

Kilkenny City and County Development Plan 2021-2027

Carlow County Council Noise Action Plan 2018

Carlow County Development Plan 2022 – 2028

WHO Community Guidelines 1999

WHO Night Guidelines for Europe 2009

WHO Environmental Noise Guidelines for the European Region 2018

IEMA Guidelines for Environmental Noise Assessment – October 2014
EPA (2022) *Guidelines on the information to be contained in Environmental Impact Assessment Reports*

EPA (2016) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)

Transport Infrastructure Ireland (TII) (2014) *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes*

TII (2004) Guidelines for the Treatment of Noise and Vibration in National Road Schemes

BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Noise and BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Vibration

BS 7385-2:1993 Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration

Design Manual for Roads and Bridges,2020. LA 111 Noise and Vibration

https://www.google.com/maps

ISO 1996-2:2017 Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of sound pressure levels

16 Interactions and Cumulative Effects

16.1 Interaction between Environmental Aspects

16.1.1 The EIA Directive (2014/52/EU) requires a description of *'the interaction between any of the foregoing aspects'.* Interactions can occur when a predicted impact causes interaction or dependency with other environmental aspects.

16.1.2 This chapter discusses the interactions between aspects and assesses them as positive, negative or neutral (as having no interaction or interdependency). The interactions of environmental effects were considered throughout the design development for the proposed flood relief scheme and adjustment were made to the design of the layout to mitigate impacts arising from these interactions.

16.1.3 In Table 16-1, interactions between certain environmental aspects are marked with a 'Y' and discussed in the text below.

Table 16-1 Interactions between Environmental Topics

	Population and Human Health	Material Assets	Surface Water	Cultural Heritage	Biodiversity	Landscape and Visual	Land, Soils, Geology and Hydrogeology	Air Quality	Climate	Noise and Vibration
Population and Human Health										
Material Assets	Y									
Surface Water	Y									
Cultural Heritage	Y		Y							
Biodiversity			Y	Y						
Landscape and Visual	Y			Y	Y					
Land, Soils, Geology and Hydrogeology			Y		Y					
Air Quality	Y	Y			Y					
Climate	Y	Y	Y	Y		Y				
Noise and Vibration	Y	Y		Y	Y					

Population/Human Health and Material Assets

16.1.4 Interactions include impacts to the population with regards to the requirement for infrastructure and services, exposure to increase construction congestion, limitations to access of walkways and cycling routes during construction and exposure to improper construction housekeeping (waste management). All are outlined in Chapter 7 'Material Assets' The impact on traffic network will be felt most at the Quay areas with road and parking closures. These impacts will also be experienced within Tinnahinch as Site Compound A, which will serve as the main compound. Residents in this area will be affected for the 36-42 months of construction which is considered a short-term impact as per the EPA Guidelines 2022.

16.1.5 With the adoption of appropriate construction phasing and sequencing, and mitigation measures outlined in Chapter 7 'Material Assets', the significance of impact is reduced.

Population/Human Health and Surface Water

16.1.6 Contamination of water bodies (namely the River Duiske and River Barrow) is possible via construction-related septic waste and hydrocarbons, possible through accidental overflows, mismanagement, equipment faults, and spillage and because G-T has a direct connection to the rivers, impact of this to human health is possible. However, as part of best practice construction, the implementation of mitigation regarding the management of septic facilities and hydrocarbons storage, and the maintenance of plant and equipment will reduce this impact entirely.

Population/Human Health and Cultural Heritage

16.1.7 Impacts on tourism and general amenity with regards to any alterations/impacts to specific Cultural Heritage assets, and the historic character of the towns. The settlement of G-T is renowned for its heritage and tourist attractions which has now evolved the settlement into an attractive tourist destination. Main assets that are nationally and internationally renowned include the Duiske Abbey, Tinnahinch Castle and St. Michael's Well.

Population/Human Health and Landscape/Visual

16.1.8 There will be some impact on visual amenity during construction for residents living close to the scheme particularly those at Turf Market and customers at the Boat Club. In the operation phase, public realm works at the Quays and the Dock will be most noticed locally. The public realm also opens the Quays for pedestrians but still allows the movement and parking of vehicles through the townlands, providing services for the tourism sector.

Population/Human Health and Air Quality

16.1.9 Concerns are largely in regard to the temporary generation of particulate matter (dust) during key construction activities, and how this has potential to cause negative effect to the health and wellbeing of those identified as the closest sensitive residential receptors. This is particularly relevant for those receptors in a higher age bracket (i.e., 60+) or with

underlying health conditions (i.e., asthma) where changes to air quality could result in respiratory concerns.

16.1.10 Extensive mitigation including the implementation of a Dust Management Plan (DMP) and a dust monitoring programme, as outlined in Chapter 13 'Air Quality' will reduce human health impacts significantly.

Population/Human Health and Noise/Vibration

16.1.11 Increase in noise pollution during the construction phase (from construction related heavy-goods traffic, haulage, deliveries and collections etc., and construction related activities, namely excavations and earthworks, sheet piling and concrete pouring) has the potential to influence human health. Particularly for those properties located in close proximity to the noise generating activity, the potential for noise related health implications arises (i.e., headache, alteration of sleep, lack of concentration). Very significant to significant effects are predicted as a result of sheet piling works, particularly for those receptors in Areas 3, 4, 5, 6, 7, 8 and 10.

16.1.12 Following implementation of construction noise and vibration mitigation efforts, as outlined in Chapter 15 'Noise and Vibration' some residual impacts are predicted.

Population/Human Health and Climate

16.1.13 Further interactions exist with regards to impact to Climate under the 'do nothing' scenario, whereby continued and worsening flooding will cause further economic and social burden to those communities in the flood risk zone. From the operation phase perspective however, the successful implementation of the Proposed Scheme has significant positive impacts by providing protection against flooding.

Material Assets and Air Quality

16.1.14 The Outward movements of <10 HDV anticipated over unpaved ground in anyone day. On the whole, access roads to the Work Areas are paved, however there are small unpaved stretches of road and where moderate entrainment of dirt might occur. This is particular at Area 1 (upstream storage area), and Area 8 (Hotel Street). The magnitude of risk is small and therefore does not give rise to significant impacts.

Material Assets and Climate

16.1.15 Further interactions exist with regards to impact to Climate under the 'do nothing' scenario, whereby continued and worsening flooding will cause further damage and economic stress to infrastructure in the flood risk zone. From the operation phase perspective however, the successful implementation of the Proposed Scheme has significant positive impacts by providing protection against flooding.

Material Assets and Noise/Vibration

16.1.16 The movement of HGV's along construction delivery route would likely cause noise and impacts to nearby buildings. An assessment of the impacts from the construction phase of

the proposed scheme shows that the increases in traffic noise will not give rise to significant impacts.

Surface Water and Cultural Heritage

16.1.17 Archaeological test trenching and excavation form an important part of the mitigation pre-construction, in order to identify any archaeological finds/features. Test-trenching and excavation presents potential for silt-laden run-off to enter the watercourses, particularly during events of rainfall and/or flood. Dewatering of trenches and/or excavations gives further cause for in-river sedimentation, whereby direct pumping from sumps into the river may result in sedimented dewater effluent, if not appropriately monitored.

Surface Water and Biodiversity

16.1.18 The waterbodies in the scheme area offer valuable habitats for a number of significant and protected species, including Qualifying Interests of the River Barrow and River Nore SAC. Impacts on waterbodies will have associated impacts with fish, mammals and vegetation within the rivers. Mitigation measures have been recommended to reduce these impacts, as outlined in Chapter 10 'Biodiversity'.

Surface Water and Land/Soils/Geology/Hydrogeology

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

Surface Water and Climate

16.1.20 Changes in precipitation patterns will result in increased water levels, as well as a higher frequency of intense storms. This was considered at the design stage.

Cultural Heritage and Biodiversity

16.1.21 As also discussed in Section 16.1.17, Archaeological test trenching and excavation form an important part of the mitigation pre-construction, in order to identify any archaeological finds/features. Test-trenching and excavation presents potential for silt-laden run-off to enter the watercourses, particularly during events of rainfall and/or flood. Dewatering of trenches and/or excavations gives further cause for in-river sedimentation, whereby direct pumping from sumps into the river may result in sedimented dewater effluent, if not appropriately monitored. Increased turbidity can impact upon fisheries and Qualifying Interests (QIs) of the Special Area of Conservation (SAC) of which the River Barrow and Duiske are associated.

Cultural Heritage and Landscape/Visual

16.1.22 Interactions with Landscape and Visual comprise the potential for impacts to setting and visual amenity of cultural heritage receptors. Conservation measures such as the careful choice of material to be used to reflect the existing built heritage environment or introduce a new tone, the use of stone clad walling and flood proofing buildings with traditional

materials and mortar to assist in their protection and preservation all seek to preserve and enhance the historic townscape and riverscape of the town.

Cultural Heritage and Climate

16.1.23 An interaction exists with regards to Climate under the 'do nothing' scenario, whereby continued and worsening flooding will cause further damage to those assets in the long-term. From the operation phase perspective however, the successful implementation of the Proposed Scheme has significant positive impacts for cultural heritage assets by providing protection against flooding.

Cultural Heritage and Noise/Vibration

16.1.24 Vibration has the potential to impact upon nearby cultural heritage assets. This will be managed by vibration monitoring where works occur close to protected structures.

Biodiversity and Landscape/Visual

16.1.25 The construction of the scheme requires some tree removal which will impact upon flora and fauna. Native tree and plant species will be planted in the upstream storage area, as well as where public realm works are taking place. Any lighting required during the construction phase will be located sensitively to avoid unnecessary light spill into the surrounding river corridors and into woodlands.

16.1.26 Landscaping proposed as part of the public realm improvements will have biodiversity benefit, providing further foraging, nesting and pollinating potential.

Biodiversity and Land/Soils/Geology/Hydrogeology

16.1.27 A potential effect on the soils and geological environment includes the excavation and removal of made ground and overburden which could potentially increase the sediment loading to the surface water environment and impact to associated aquatic species. Contaminated or imported soil has the potential to run off during the construction phase and have negative impacts on surface water environments and associated biodiversity, or cause spread of invasive species. Appropriate measures outlined in Chapter 12 'Land, Soils, Geology & Hydrogeology' to mitigate.

Biodiversity and Air Quality

16.1.28 The River Barrow and River Nore SAC passes through Graiguenamanagh-Tinnahinch, and the proposed construction works will take place within or adjacent to the SAC throughout the proposed scheme. Direct and indirect effects are possible to flora and fauna, including damage to foliage/plants, changes in habitat foraging and ingestion of particulate matter or pollutants by fauna. Therefore, sensitivity of ecological receptors to dust is considered high. Appropriate construction phase mitigation measures have been outlined in Chapter 13 'Air Quality' to ensure that the potential impacts of dust on the SAC will be negligible.

Biodiversity and Noise/Vibration

16.1.29 The construction of the scheme will result in noise and vibration impacts that will have a temporary-short term impact upon birds and otter, amongst other species. Appropriate mitigation measures are outlined in Chapter 10 'Biodiversity'.

Landscape/Visual and Climate

16.1.30 The height of defences have been designed to accommodate rising water levels and a potential increase in flood intensity. The storage option was chosen as this allowed for a reduction in the height of the defences within the townlands and therefore lessened the visual impact.

16.2 Cumulative Effects

16.2.1 Cumulative Impacts are effects that result from incremental changes caused by other past, present or reasonably foreseeable developments together with the proposed flood relief development. Cumulative impacts were assessed by looking at all current developments for which planning has been approved within 1km of the proposed site location. A consideration of development objectives in the current development plans in the area was also carried out. This cumulative assessment has considered cumulative impacts that are:

a) Likely;

b) Significant; and

c) Relating to an event which has either occurred or is reasonably foreseeable together with the impacts from this development.

16.2.2 A search in relation to plans and projects that may have the potential to result in cumulative impacts was carried out.

16.2.3 The following sources were consulted in order to determine if there were any other plans or projects in the area which could result in cumulative impacts:

- EIA Portal (DHPLG, 2024)
- Carlow Council - Planning System (Carlow County Council, 2024)
- Kilkenny Council - Planning System (Kilkenny County Council, 2024)
- Graiguenamanagh-Tinnahinch Local Area Plan 2021-2027 (Kilkenny County Council and Carlow County Council, 2022)

16.2.4 All committed/approved developments are for individual residential properties.

16.2.5 There are nine recently lodged planning applications located in close proximity to the proposed scheme works. These are outlined in Table 16-2. Only one of the projects in the vicinity of the proposed works required completion of an AA/NIS (see applications 2460326 and 0560086 in Table 16-2) however this site is located downstream of the proposed flood relief works. None required completion of an EIA.

Uncommitted Developments/Plans

16.2.6 There are future plans within the local authorities to prepare the following plans:

- A joint tourism initiative for a hub and proposed pedestrian bridges across the river – the location of these works are unknown currently but will have to consider the flood relief works in their development. There is a potential for impacts to surface water if the construction phases overlaps. However, with the implementation of mitigation measures outlined in 'Chapter 8 – Hydrology – Surface Water', no cumulative impacts are expected from the proposed scheme.

- Uisce Éireann have a scheme to upgrade watermains on the St Mullins Road and the Ring Housing Estate – the details of this plan are not yet known but communication is ongoing with Uisce Éireann to ensure there are no cumulative impacts from any interactions of these projects.

- Waterways Ireland intend to repair the Quay Wall at Tinnahinch – the timing of these works are not yet known. Ongoing communication with Waterways Ireland is taking place to ensure there are no cumulative impacts from any interactions of these projects.

16.2.7 No other live or recently approved planning applications were identified in the vicinity of the proposed works. Therefore, as none of these developments are within or adjacent to the proposed working areas, and none will involve further modification of the watercourse, there is not considered to be a risk of in-combination effects with these other plans or projects.

Table 16-2: Summary of Impacts and Mitigation Measures: Cumulative Impacts

Applicant [Application number]	Overview	Status (date)	Potential significant effects from plan/project	Potential in-combination effects
Tinnahinch (Carlow County Council)				
Tinnahinch Accommodation [2460053]	Located adjacent to the Graiguenamanagh Bridge. This application involves "change of use from restaurant to short term holiday accommodation including internal alterations to provide a studio apartment on the ground floor and a two-bedroom (3 person) apartment on the first floor, communal storage space in the basement and all associated site works". There are proposed scheme works proposed immediately adjacent to this development. This involves the upgrading of an existing wall and the construction of an embankment. The timing of construction of these works is unknown.	Conditional approval (26/04/2024)	Minor construction dust and traffic impacts anticipated	Given the small-scale nature of works for the above-mentioned planning application, it is not anticipated that these projects will significantly interact with one another causing negative impact on surrounding environment. However, due to the location of the works, in the town centre and proximal to Graiguenamanagh Bridge, there is potential for impacts to local traffic if construction works overlap. It is therefore determined that there is **limited potential for cumulative effects.**
Private Residence [2360309]	Located at The Ring, Tinnahinch. This application involves "the erection of an extension and alterations to existing dwelling and all associated site works".	Conditional approval (20/02/2024)	Minor construction dust and traffic impacts anticipated	There are flood relief works proposed in close proximity to this development. This involves the upgrading of an existing wall and implementation of flood gates. Moreover, the location of Site Compound A, the main compound, is adjacent to this development. Given the small-scale nature of upgrading the existing wall located north of the above-mentioned planning application, it is not anticipated that these projects will significantly interact with one

				another causing negative impact on surrounding environment. It is therefore determined that there is **limited potential for cumulative effects.**
Tinnahinch Lock Keeper's House [2460326]	Located along the Tinnahinch Quay, at the Lock Keeper's House. This application involves refurbishment works to the existing protected Lock House structure (NBHS Ref:10302408) and the construction of a 116.5m^2, single-storey extension located within the River Barrow and River Nore Special Area of Conservation (NPWS Site Code:002162), the decommissioning of an existing not fit for purpose septic tank and construction of a new EPA code of practice secondary and tertiary treatment system. A Natura Impact Statement (NIS) has been prepared in relation to the project and accompanies this planning application.	Conditional approval (19/05/2025)	Minor surface water and biodiversity impacts possible.	Located 1.9km downstream of flood scheme works. There is a small chance of in-combination impacts to surface water through sedimentation, and potential accidental contamination, given that the application also involves works adjacent to the river bank and a tributary of the River Barrow, the Knockeen Stream. However, with the implementation of mitigation outlined in this EIAR, and the distance of the flood relief works from this application (which allows for dilution of impact), there is **limited potential for cumulative effects.**
Tinnahinch Lock Keeper's House [2560086]	Located along the Tinnahinch Quay, at the Lock Keeper's House. The development consists of the retention of a 20.3m^2 garden storage shed, concrete footing and associated site works located within the River Barrow and River Nore Special Area of Conservation (NPWS Site Code:002162). This retention is for a temporary structure for domestic storage provision required until the completion of the works associated with the application for planning permission 24/60326 (see row above).	Conditional approval (30/05/2025)		
Graiguenamanagh (Kilkenny County Council)				
Peg Washington's Lane [2460122]	This application involves "the change of use of existing store to short term let with extension to rear of building. (2) Proposed new entrance gate. (3) New roof over existing stone wall building to be used as store/garage and connection to all existing services and all associated site works".	Conditional approval (03/05/2024)	Minor construction dust and traffic impacts anticipated	There are proposed scheme works planned on the development site boundary of the above-mentioned planning application. This involves the creation of a new flood defence wall. However, it is anticipated that collaboration with the developers

				will ensure works do not take place concurrently. Therefore, it is not anticipated that these projects will significantly interact with one another causing negative impact on surrounding environment. It is therefore determined that there is **no potential for cumulative effects.**
The Hub [22477].	This application involves "new stand-alone amenities, including new toilets and showering facilities, campers' kitchen, laundry room and a dog washing station, all of which will be connected to all of the existing services and all associated works".	Conditional approval (08/03/2023)	Minor construction dust and traffic impacts anticipated	There are flood relief works proposed within this development site. This involves the construction of an embankment and ramp. It is anticipated that collaboration with the developers will ensure works do not take place concurrently. Therefore, it is not anticipated that these projects will significantly interact with one another causing negative impact on surrounding environment. It is therefore determined that there is **no potential for cumulative effects.**
Private Residence [2460038]	Located at Bray's Lane, Graiguenamanagh. This application involves "renovation and extension to existing derelict cottage and permission to demolish existing shed to rear and all associated site works".	Conditional approval (20/03/2024)	Minor construction dust and traffic impacts anticipated	There are flood relief works proposed in close proximity of this development. This involves the placement of a debris trap and the upgrading of an existing wall. The timing of construction works for this development is unknown. Given the small-scale nature of the works proximal to the above-mentioned

				planning application, it is anticipated that these projects will not significantly interact with one another nor cause a negative impact on surrounding environment. It is therefore determined that there is **limited potential for cumulative effects.**
Graiguenamanagh Canoe Club [2460375]	Located on The Quay, Graiguenamanagh. This application is "to construct assessable floating pontoon & disabled kayak launch and all associated site works Protected Structure (RPS Ref No: D152)".	Conditional approval (26/09/2024)	Minor construction dust and traffic impacts anticipated	There are flood relief works proposed in close proximity of this development. This involves the construction of flood defence walls and embankments at the clubhouse. Given the small-scale and temporary nature of the above-mentioned planning application, it is not anticipated that these projects will significantly interact with one another causing negative impact on surrounding environment. It is therefore determined that there is **limited potential for cumulative effects.**
Primary Healthcare Building [2560412]	Located on the Graiguenamanagh Relief Road near to the Fire Station. This application involves ''the construction of a) a two-storey primary healthcare building, including roof plant area and building signage, b) a single storey service building, including ESB sub-station and service yard, (c) a gas fuel storage compound, d) car and bicycle parking, a set down area, footpaths, public site lighting, pumping station, SuDS drainage, and water mains works; and (f) Totem pole signage, site boundary treatments, landscaping, and all associated site development works to facilitate the development''. Proposed to make use of existing site	Decision pending (due 01/09/2025)	Minor construction traffic impacts possible.	This planning application is located >400m from the closest flood relief works, and therefore direct cumulative impacts are unlikely. The construction of this application will likely utilise some of the same local roads as the flood relief scheme, and therefore minor traffic impacts may result however this will be minimal. It is therefore

	entrance off the Graiguenamanagh Relief Road (R705), and to include an extension of the access road and pedestrian footpath; (e). The Primary Healthcare Centre facility will provide for HSE health and social care services, dental, and general practice with associated meeting rooms, administrative offices, staff accommodation, receptions and ancillary uses.			determined that there is **no potential for cumulative effects.**

16.3 References

Carlow County Council, 2024. *eplanning.* [Online] Available at: http://www.eplanning.ie/CarlowCC/SearchExact

DHPLG, 2024. *EIA Portal.* [Online] Available at: https://www.housing.gov.ie/planning/environmental-assessment/environmental-impact-assessment-eia/eia-portal

Kilkenny County Council and Carlow County Council, 2022. *Graiguenamanagh-Tinnahinch Joint Local Area Plan 2021-2027.* [Online] Available at: https://kilkennycoco.ie/eng/services/planning/development-plans/local-area-plans/graiguenamanagh-local-area-plan-2021.pdf

Kilkenny County Council, 2024. *eplanning.* [Online] Available at: https://planning.kilkennycoco.ie/SearchExact.aspx

17 Major Accidents and Disasters

17.1 Scope of the Assessment

17.1.1 This Chapter describes likely significant effects on the environment arising from the vulnerability of the Proposed Scheme to risks of major accidents and/or natural disasters, and the potential for the Proposed Scheme to cause major accidents and/or disasters. The underlying objective of this assessment is to ensure that appropriate precautionary actions are taken for those projects where their vulnerability to major accidents and/or natural disasters may result in significant adverse effects on the environment.

17.1.2 The purpose of the Proposed Scheme is to provide protection to Graiguenamanagh Tinnahinch (G-T) against flooding, which in itself is a disaster. As such, the scheme has been designed specific to the 1% AEP present day flood extent and has provided foundations to be adaptable to the MRFS climate change scenario. This has been considered in further detail in this EIAR including in Chapter 6 'Population and Human Health' and Chapter 14 'Climate'.

17.1.3 The assessment of the vulnerability of the Proposed Scheme to major accidents and natural disasters is carried out in compliance with the EIA Directive whereby the chapter will seek to:

- Identify potential major accidents and/or disasters, if any, that the Proposed Scheme could be vulnerable to,
- Determine whether these major accidents and/or disasters are likely to result in significant adverse environmental impacts, and
- Define the measures in place, or need to be in place, to prevent or mitigate the possible significant adverse effects of such events on the environment.

17.1.4 The scope and methodology of this assessment is centred on the understanding that the Proposed Scheme will be designed, built and operated in line with best international current practice. As such, major accidents resulting from the Proposed Scheme will be very unlikely.

17.2 Statutory and Policy Context

Legislation

17.2.1 The scope and methodology presented in the following sections is based on the provisions of the EIA Directive, the EPA Guidelines 2022 and other published risk assessment methodologies as described in the following sections.

17.2.2 Article 3 of the EIA Directive requires that the EIAR shall identify, describe and assess in the appropriate manner, the direct and indirect significant effects on population and

human health, biodiversity, land, soil, water, air and climate, material assets, cultural heritage and landscape deriving from (amongst other things) the "vulnerability of the project to risks of major accidents and/or disasters that are relevant to the project concerned".

17.2.3 The information relevant to major accidents and/or disasters to be included in the EIAR is set out in Section 8 of Annex IV of the EIA Directive as follows:

"(8) A description of the expected significant adverse effects of the project on the environment deriving from the vulnerability of the project to risks of major accidents and/or disasters which are relevant to the project concerned. Relevant information available and obtained through risk assessments pursuant to Union legislation such as Directive 2012/18/EU of the European Parliament and of the Council or Council Directive 2009/71/Euratom or relevant assessments carried out pursuant to national legislation may be used for this purpose provided that the requirements of this Directive are met. Where appropriate, this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies".

Local Policy

17.2.4 Kilkenny County Council (KCC) have published a Fire and Emergency Operations Plan 2022-2026 (Kilkenny County Council, 2022). The purpose of the plans is to set out the arrangements for an effective and efficient response to fire and major emergencies. Section 14: Major Emergency Management has been prepared in accordance with the National Framework for Major Emergency Management (Department of Environment, Heritage and Local Government, 2006) and covers the following:

- Immediate response,
- Extinguishing fires,
- Rescue,
- Dealing with flooding incidences,
- Dealing with spillages / hazardous materials,
- Storm / severe weather response,
- Provision of storm tankers,
- Provision of an on-site controller of operations / onsite co-ordinator,
- Provision of onsite co-ordination facilities (including an incident command unit vehicle; and
- Facilitating and Participating in the Crisis Management Team.

17.2.5 Carlow County Council (CCC) have published a Major Emergency Plan 2020 (Carlow County Council, 2020), also prepared in accordance with the requirements of A Framework for Major Emergency Management (2006). Similarly, the purpose of the plan is to set out the arrangements for an effective and efficient response to fire and major emergencies. The systems approach to Major Emergency Management involves a continuous cycle of activity. The principal elements of the systems approach are:

- Hazard Analysis/ Risk Assessment,
- Mitigation/ Risk Management,
- Planning and Preparedness,
- Co-ordinated Response, and
- Recovery.

17.2.6 The identified emergencies and risks associated to both authority areas are outlined in Section 17.4 to give context as part of the Stage 1 risk assessment process (more detail below).

17.3 Assessment Methodology

Guidance

17.3.1 The assessment of the risk of major accidents and/or disaster considers all factors defined in the EIA Directive that have been considered in this EIAR, i.e. population and human health, biodiversity, land, soil, water, air and climate and material assets, cultural heritage and the landscape.

17.3.2 The EIAR already includes an assessment of some potential accidents and disaster scenarios that might arise from the Proposed Scheme, such as potential contamination to soils, groundwater and surface water, as well as assessment of flooding events. These are described in detail in the relevant EIAR assessment chapters (refer to Chapter 8 'Hydrology-Surface Water', Chapter 12 'Land, Soils, Geology and Hydrogeology' and Chapter 10 'Biodiversity').

17.3.3 A risk analysis-based methodology that covers the identification, likelihood and consequence of major accidents and/or disasters has been used for this assessment. The Department of Environment, Heritage and Local Government (DoEHLG) published 'A Framework for Major Emergency Management Guidance Document' in 2010 (The Department of Environment, Housing and Local Government, 2010). The document provides guidance on the various stages of the risk assessment process and how it should be employed to inform mitigation and detailed planning during major emergency situations.

Risk Assessment Methodology

17.3.4 As defined in the DoEHLG Guidance (The Department of Environment, Housing and Local Government, 2010), the risk assessment process is guided by four stages, including:

Stage 1: Establish context and describe the area.
Stage 2: Identify potential hazards.
Stage 3: Assess each hazard for potential consequences and likelihood.
Stage 4: Plot each hazard on a risk matrix (evaluating risk).

17.3.5 These are described in greater detail in the following sections.

Stage 1 Establish context and describe the area.

17.3.6 The purpose of this stage is to describe the characteristics of the area for which the risk assessment is being completed, as this will influence both the likelihood and the impact of a major emergency. Establishing the local/regional context enables a better understanding of the vulnerability and resilience of the area to emergencies.

17.3.7 This has been achieved through (i) reviewing the baseline conditions identified during the preparation of this EIAR (chapters 6 to 15), and (ii) reviewing the local policy with regards to major accidents and disasters (see Section 17.2).

Stage 2 Identify potential hazards

17.3.8 Risks have been reviewed through the identification of plausible risks in consultation with relevant specialists. The identification of risks has focused on non-standard but plausible incidents that could occur at the Proposed Scheme during construction and operation.

17.3.9 Risks have been identified as such, in respect of the Proposed Scheme:

1. Potential vulnerability to disaster risks; and
2. Potential to cause accidents and/or disasters.

Stage 3: Assess each hazard for potential consequences and likelihood.

17.3.10 In accordance with the DoEHLG Guidelines (The Department of Environment, Housing and Local Government, 2010), risks are assessed through an examination of the potential impact (severity of consequences to life and health, property and infrastructure, and the environment) of the hazards identified. The likelihood (probability) of the hazard occurring also has to be considered and the resulting judgement recorded on a risk matrix in the next stage. The impact and likelihood criteria as outlined in Table 17-1 and Table 17-2 below are used to position all the identified hazards on the risk matrix.

Table 17-1: Risk Classification Table - Likelihood (The Department of Environment, Housing and Local Government, 2010)

Ranking	Likelihood	Description
1	Extremely Unlikely	May occur only in exceptional circumstances; once every 500 or more years
2	Very Unlikely	Is not expected to occur; and/or no recorded incidents or anecdotal evidence; and/or very few incidents in associated organisations, facilities or communities; and / or little opportunity, reason or means to occur; may occur once every 100-500 years.
3	Unlikely	May occur at some time; and/or few, infrequent, random recorded incidents or little anecdotal evidence; some incidents in associated or comparable organisation's worldwide; some opportunity, reason or means to occur; may occur once per 10-100 years.
4	Likely	Likely to or may occur; regular recorded incidents and strong anecdotal evidence and will probably occur once per 1-10 years
5	Very Likely	Very likely to occur; high level of recorded incidents and/or strong anecdotal evidence. Will probably occur more than once a year.

Table 17-2: Risk Classification Table – Consequence (The Department of Environment, Housing and Local Government, 2010)

Rank	Consequence	Impact	Description
1	Minor	Life, Health & Welfare	Small number of people affected; no fatalities and small number of minor injuries with first aid treatment.
		Environment	No contamination, localised effects
		Infrastructure	<€0.5M
		Social	Minor localised disruption to community services or infrastructure (<6 hours).
2	Limited	Life, Health & Welfare	Single fatality; limited number of people affected; a few serious injuries with hospitalisation and medical treatment required. Localised displacement of a small number of people for 6-24 hours. Personal support satisfied through local arrangements.
		Environment	Simple contamination, localised effects of short duration.
		Infrastructure	€0.5-3M.
		Social	Normal community functioning with some inconvenience.
3	Serious	Life, Health & Welfare	Significant number of people in affected area impacted with multiple fatalities (<5), multiple serious or extensive injuries (20), significant hospitalisation.

Rank	Consequence	Impact	Description
			Large number of people displaced for 6-24 hours or possibly beyond; up to 500 evacuated. External resources required for personal support.
		Environment	Simple contamination, widespread effects or extended duration
		Infrastructure	€3-10M
		Social	Community only partially functioning, some services available.
4	Very Serious	Life, Health & Welfare	5 to 50 fatalities, up to 100 serious injuries, up to 2000 evacuated
		Environment	Heavy contamination, localised effects or extended duration
		Infrastructure	€10-25M
		Social	Community functioning poorly, minimal services available
5	Catastrophic	Life, Health & Welfare	Large numbers of people impacted with significant numbers of fatalities (>50), injuries in the hundreds, more than 2000 evacuated.
		Environment	Very heavy contamination, widespread effects of extended duration.
		Infrastructure	>€25M
		Social	Serious damage to infrastructure causing significant disruption to, or loss of, key services for prolonged period. Community unable to function without significant support.

Stage 4: Plot each hazard on a risk matrix (evaluating risk).

17.3.11 Once classified, the likelihood and consequence ratings have been multiplied to establish a 'risk score' to support the evaluation of risks by means of a risk matrix, sourced from the DoEHLG Guidelines (The Department of Environment, Housing and Local Government, 2010) (Figure 17-1). The risk matrix is colour coded to provide a broad indication of the critical nature of each risk:

- The red zone represents 'high risk scenarios'.
- The amber zone represents 'medium risk scenarios'.
- The green zone represents 'low risk scenarios'.

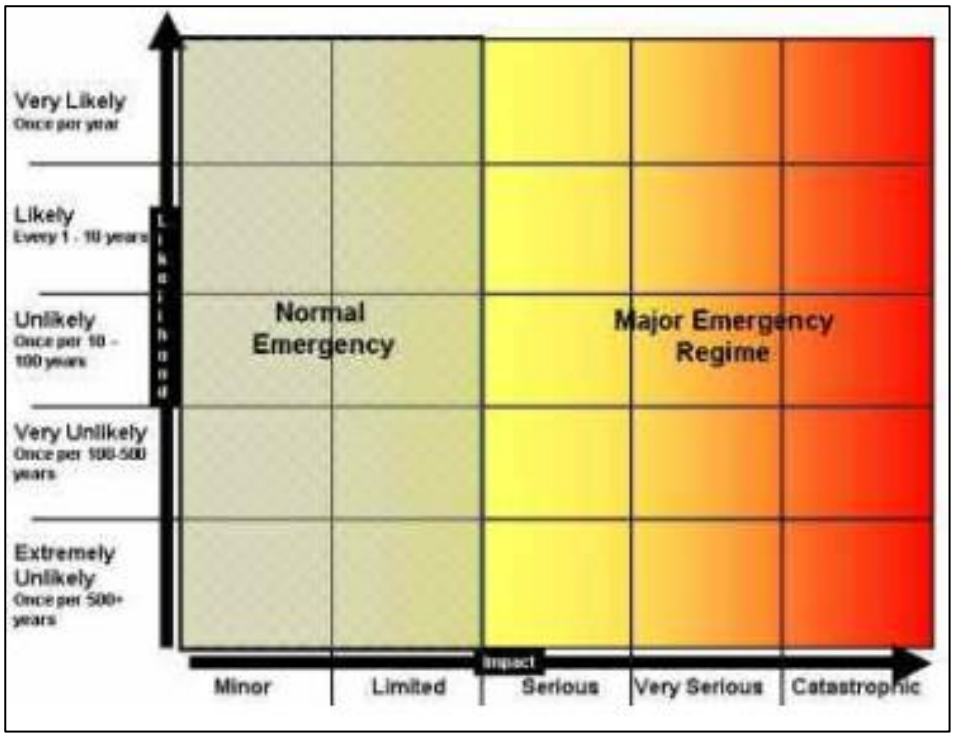


Figure 17-1: Risk Matrix (The Department of Environment, Housing and Local Government, 2010)

17.4 Baseline Environment

17.4.1 Chapter 6 to 15 of this EIAR provide detailed information on the baseline conditions of the study area with regards to population, material assets, surface water, land, soils, geology, hydrogeology, archaeology, cultural heritage, biodiversity, landscape, air quality, climate and noise.

17.4.2 The KCC Fire and Emergency Operations Plan 2022-2026 does not provide detail as to which emergencies and risks are particular to the County but rather focuses largely on fire associated risks. The Interim HSE South East (Area 5) Emergency Plan however, which covers the geographical areas of Counties Carlow, Kilkenny, South Tipperary, Waterford and Wexford, includes a review of the following risks which may potentially arise in these areas:

1. Major road traffic accident.
2. Major rail accident.
3. Air accident / incident.
4. Incident involving ship/boat/ferry near shore/offshore.
5. Fire / explosion.
6. Release of toxic gas/ fluids.
7. Release of harmful substances during transportation.
8. Building collapse.
9. Pollution of water / land.
10. Contamination of drinking water.
11. Emerging viral threats.
12. Civil terrorism.

13. Loss of critical infrastructure.
14. Public event/crowd safety.
15. Animal disease.
16. Meteorological risks.

17.4.3 The CCC Major Emergency Plan (2020) has identified the following as being the most relevant risks to Carlow County:

1. Critical infrastructure emergencies (roads, railways),
2. Flooding / Pollution / Animal Disease,
3. Utility company emergencies, and
4. Aviation & Chemical, Biological, Nuclear & Radiological (CBRN) emergencies.

17.4.4 The following have been selected as exemplars on which preparedness has been based in the report, and for which dedicated risk assessments are provided for Carlow County.

1. Severe Weather/Urban Flooding,
2. Aircraft Collision / Loss,
3. Water Contamination,
4. Fire / Major Crowd Safety and Civil Disorder,
5. Major Road Traffic Accident (RTA) / Hazmat[1],
6. Rail Accident,
7. Industrial Fire / Explosion,
8. Critical Infrastructure,
9. Methane Explosion.
10. Gas Explosion on main Cork to Dublin gas line,
11. Bridge Collapse, and
12. Structural Collapse

17.4.5 According to the CCC Major Emergency Plan (2020), there are no Seveso sites in CCC's functional area, however, according to the Kilkenny City and County Development Plan 2021-2027, there are two Seveso[2] sites in the County.

- Grassland Fertilisers located on the Tullaroan Road in Kilkenny City, approx. 23km from the Proposed Scheme; and
- 5 Trans-Stock Warehousing and Cold Storage Ltd located at Christendom in the Ferrybank area in the environs of Waterford City, approx. 32km from the Proposed Scheme.

17.4.6 As there are no Seveso sites near the Proposed Scheme, there is no likely significant impact from such facilities.

[1] HAZMAT is an abbreviation for "hazardous materials"—substances in quantities or forms that may pose a reasonable risk to health, property, or the environment. HAZMATs include such substances as toxic chemicals, fuels, nuclear waste products, and biological, chemical, and radiological agents.
[2] A Seveso establishment is an establishment which has an activity linked to handling, manufacturing, using or storing dangerous substances (i.e. refineries, petrochemical sites, oil depots or explosives depots).

17.4.7 Severe weather conditions pose one of the most common accident & disaster risks in Ireland and to the Proposed Scheme. In recent times there has been an increase in storm rainfall during severe weather events in the country (Met Eireann, 2024). The increased storm rainfall increases chances of flooding and flash flood incidents.

17.4.8 The closest industrial site which is subject to Industrial Emissions Directive ('IE') Licences from the EPA is the Alltech Farming Solutions Limited (P0555, industry) in Borris (EPA, 2022). This is located >6km from the Proposed Scheme, however, and is not considered to be a risk for the Proposed Scheme based on the site being an acceptable distance from the scheme.

17.5 Sensitive Receptors

17.5.1 The sensitive receptors in this regard are those likely to be affected by the occurrence of a major accident or disaster during either the construction phase or operation and maintenance phase, and includes:

- Local residents and visitors, as outlined in Chapter 6 'Population and Human Health'.
- Those receptors within the flood risk zone, as outlined in Chapter 6 'Population and Human Health'.
- Ecological receptors, as outlined in Chapter 10 'Biodiversity'.
- Surface water receptors, as outlined in Chapter 8 'Hydrology – Surface Water'.
- Ground and groundwater receptors, as outlined in Chapter 12 'Soils, Geology, Hydrology & Hydrogeology'.
- Infrastructure and material assets, as outlined in Chapter 7 'Material Assets'.

17.6 Risk Assessment and Mitigation

17.6.1 A risk register has been developed which contains all the potential, relevant risks identified during the construction and operation phase of the Proposed Scheme. These are presented in the tables overleaf.

Table 17-3: Risk Register – Construction Phase

Risk ID	Potential Risk	Possible Cause	Possible Impacts	Mitigation
	Potential vulnerability to accidents and/or disasters			
R1	Flooding of site/ working areas during construction works	• Periods of extended rainfall	**Biodiversity, Surface Water & Groundwater:** Sediment loading is a typical consequence of flood events. If a flood event were to occur during the construction works for the scheme, there would be potential to further increase sediment loading into the river where there are exposed soils on the riverbanks as a result of the works. This would further negatively impact on the water quality and aquatic species. Further, contaminating material contained within compound areas and run-off associated to this may be washed into the river or onto the topsoil during the flood event, causing impact to sensitive flora and fauna, and potentially seep into shallow groundwater systems. **Material Assets, Population and Human Health:** In certain areas of the scheme it is proposed to temporarily remove boundary walls and fences to allow access. These properties (gardens, property boundaries, etc.) and those who live at these properties, may be more vulnerable to the effects of flooding during these works.	It is intended that the Proposed Scheme will enhance and strengthen the existing flood measures in place and be able to withstand the likely increased frequency and severity of future flooding events. The works have been designed and developed with a primary focus to protect the affected areas against fluvial flooding. However, to avoid impact of flooding during construction, the contractor(s) will be required to review weather conditions and plan for potential flood events as part of their routine risk assessments. A Flow Management Plan will be implemented during the construction stage. This plan will outline some measures that will be put in place in anticipation of a flood event. These measures will be in place to avoid loss of sediment (i.e., removal or shifting of stockpiles in flood zone), impact to properties/buildings (i.e., sandbags) and potential for contaminated run off (i.e., removal of contaminating materials in flood zone).
	Potential for major accidents and/or disasters			
R2	Traffic accidents resulting from construction phase traffic or temporary	• HGVs navigating along local roads/within towns.	Potential for accidents to cause injury or fatalities to community members, visitors and/or construction staff.	The construction phase of the Proposed Scheme will be carried out in accordance with best practise construction methodologies, all relevant health and safety guidance and

Risk ID	Potential Risk	Possible Cause	Possible Impacts	Mitigation
	construction traffic management measures	• Machinery navigating riverbank and river pathways. • Driver error- not abiding by traffic re-routing or road closures		legislation, as well as the provisions of the Construction Environmental Management Plan (CEMP) and Traffic Management Plan (TMP).
R3	Contamination of the groundwater/ surface water	• Spill or leakage of oils or hydrocarbons from construction machinery and vehicles	The risk of accidental spillage of fuels/oils/wastewater etc. is considered in detail in Chapter 8 'Hydrology – Surface Water', Chapter 12 'Land, Soils, Geology and Hydrogeology' and Chapter 10 'Biodiversity'. Essentially, impacts are associated to the possible reduction in water quality for surface and groundwater sources and prevention to meet WFD and EPA standards, and possible impact to flora and fauna.	The construction phase of the Proposed Scheme will be carried out in accordance with best practice construction methodologies, all relevant health and safety guidance and legislation, as well as the provisions of the CEMP and oil spill contingency plan.
R4	General accidents	• Sinking/flooding of plant/machinery in river. • Working near to excavations. • Working near water. • Fire. • Improper handling of chemicals. • Slits, trips and falls.	Potential to cause harm (injury or fatality) to construction workers, or passers-by.	The construction phase of the Proposed Scheme will be carried out in accordance with best practice construction methodologies, all relevant health and safety guidance and legislation. Risk assessments will be undertaken prior to each construction activity to identify potential hazards and ways to mitigate their occurrence. Personal Protective Equipment (PPE) to be provided appropriate to the task at hand.

Table 17-4: Risk Register – Operation and Maintenance Phase

Risk ID	Potential Risk	Possible Cause	Possible Impacts	Mitigation
	Potential vulnerability to accidents and/or disasters			
R5	Flooding of site.	• Periods of extended rainfall	Impacts to population (residences, businesses, community facilities), human health, utilities, roads, transportation networks, surface water, flora and fauna.	It is intended the Proposed Scheme will enhance and strengthen the existing flood measures in place and be able to withstand the likely increased frequency and severity of future flooding events. The works have been designed and developed with a primary focus to protect the affected areas against fluvial and tidal flooding.
	Potential for major accidents and/or disasters			
R6	Public safety along river walks or in the open space with presence of flood defences.	• Design error. • Human error/ accident/slipping/ falling.	Potential to cause harm (injury) to community members.	The Proposed Scheme will be designed and operated in line with best international current practice, and with appropriate health and safety checks in place.
R7	Failure of flood defences	• Structural failure due to design error, construction error or material failure	Potential to cause harm (injury or fatality) to public and damage to property and infrastructure.	The Proposed Scheme will be designed and operated in line with current best international practice, and with appropriate health and safety checks in place. Any failure will be local in nature.
R8	Flood event in excess of design flood event resulting in overtopping of defences	• Periods of extreme extended rainfall	Potential to cause harm (injury or fatality) to public and damage to property and infrastructure.	The Proposed Scheme will be designed to allow adaptation for increase in flows due to climate change. Early warning systems will be in place to ensure evacuation of the public when and where necessary. Continuation of policy of ensuring that properties in the 0.1% AEP flood extent will be constructed or upgraded to be flood resilient. Temporary flood defence measures will be utilised where possible.

17.6.2 The potential risks identified have been assessed in accordance with the relevant classification (refer to Table 17-1 and Table 17-2) and the resulting risk analysis is given in Table 17-5 and Table 17-6. The risk register is based upon possible risks associated the Proposed Scheme. The consequence rating assigned to each potential risk assumes that all proposed mitigation measures and safety procedures have failed to prevent the major accident and/or disaster. Table 17-6 shows the level of risk where high risks are in red, moderate risks in yellow (amber), and low risks in green.

Table 17-5: Project Risk Scores

Risk ID	Potential Risk	Likelihood Rating	Consequence Rating	**Risk Score**
Construction Phase				
R1A	Minor flooding (20% Annual Exceedance Probability - AEP) of site/ working areas during construction works.	4	1	**4**
R1B	Major flooding (1% AEP) of site/ working areas during construction works.	2	2	**4**
R2	Traffic accidents resulting from construction phase traffic or temporary construction traffic management measures.	3	1	**3**
R3	Contamination of the groundwater/ surface water.	3	2	**6**
R4	Construction based accidents.	3	1	**3**
Operational Phase				
R5	Flooding of the Scheme Area.	1	1	**1**
R6	Public safety along river walks or in the open space with presence of flood defences.	1	1	**1**
R7	Failure of the flood defences	1	4	**4**
R8	Overtopping of the flood defences	2	3	**6**
Note: Risk = Likelihood x Consequence				

Table 17-6: Project Risk Matrix

Likelihood Rating							
	Very likely	5					
	Likely	4	**R1A**				
	Unlikely	3	**R2, R4**	**R3**			
	Very unlikely	2		**R1B**	**R8**		
	Extremely Unlikely	1	**R5, R6**			**R7**	
			Minor	Limited	Serious	Very Serious	Catastrophic
			1	2	3	4	5
			Consequence Rating				

17.7 Discussion

Construction Phase

17.7.1 From examining the plausible risks presented in Table 17-5, the scenarios with the highest risk score in terms of a major accident and/or disaster during the construction phase of the Proposed Scheme was identified as being R3 'Contamination of the groundwater/ surface water'.

17.7.2 The risk of 'Contamination of the groundwater/ surface water' during construction was given a risk score of 3 indicating a scenario that is 'unlikely' to occur, given that best practice measures will be put into place as standard. The area is already subject to contamination due to existing traffic contamination combining with surface water. The consequence of construction is considered to be 'limited' on account of the low contaminant potential (low quantities stored on site), temporary nature, and ability to rectify in a relatively quick fashion. Therefore, this is indicative of a 'low risk scenario.'

17.7.3 The risk of R1A 'Minor flooding (20% AEP) of site/working areas during construction works' during construction was given a risk score of 4 indicating a scenario that is 'likely' to occur, given that some of the work is located in the 20% AEP. The consequence is considered to be 'minor' on account of the low impact potential (works will be on hold for a limited time), temporary nature, and ability to rectify in a relatively quick fashion. Therefore, this is indicative of a 'low risk scenario.'

17.7.4 R1B 'Major flooding (1% AEP) of site/working areas during construction works' was given a risk score of 4 indicating a scenario that is 'unlikely' to occur, given that some of the work is located in the 1% AEP, but it is a low frequency event. The consequence is considered to be 'limited' on account of the low impact potential (works will be on hold for a limited time), temporary nature, and ability to rectify in a relatively quick fashion. Therefore, this is indicative of a 'low risk scenario.'

Operational Phase

17.7.5 From examining the plausible risks presented in Table 17-5, the lowest rating in terms of likelihood and consequence was given to the R5 'Flooding of the Scheme Area' and R6 'Public safety along river walks or in the open space with the presence of flood defences' scenarios identified, representing a 'low risk scenario'.

17.7.6 It is important to note that, regarding R5, the Proposed Scheme contributes to the reduction of risk of flooding in the scheme area during the operation phase. The risk presented to the G-T community is distinctly higher without the Proposed Scheme. The purpose of the Proposed Scheme is to provide protection to G-T against flooding, which in itself is a disaster. As such, the scheme has been designed specific to the 1% AEP present day flood extent and has provided foundations to be adaptable to the MRFS climate change scenario. This offers a long-term positive impact as a result of the scheme in managing major accidents/disasters.

17.7.7 The risk of R7 'Failure of the flood defences' during operation was given a risk score of 4 indicating a scenario that is 'extremely unlikely' to occur, given that the design of the

defences will be designed in line with current best international practice, and with appropriate health and safety checks in place. The consequence is considered to be 'serious' on account of the high impact potential to those communities living within the risk area. However, given the likelihood, the risk remains within the 'low risk scenario.'

17.7.8 The risk of R8 'Flood event in excess of design flood event, resulting in overtopping of the flood defences' during operation was given a risk score of 6 indicating a scenario that is 'very unlikely' to occur, given that the scheme will be designed to allow adaptation for increase in flows due to climate change. The consequence is considered to be 'serious' on account of the high impact potential to those communities living within the risk area. However, given the likelihood, the risk remains within the 'low risk scenario.'

17.8 Mitigation Measures and Monitoring

17.8.1 Recommended mitigation and monitoring measures are outlined in Table 17-3 and Table 17-4.

17.9 Residual Impacts and Effects

17.9.1 The risk of a major accident and/or disaster occurring during either the construction or operational phases of the proposed development is considered low, and the completion of the Proposed Scheme will in itself reduce the risk of flooding to the Study Area.

17.10 Cumulative Impacts

17.10.1 No likely risks of a major accident/disaster occurring are identified in respect of the Proposed Scheme. Thus, no cumulative effects are identified.

17.11 References

Carlow County Council, 2020. *Major Emergency Plan 2020,* s.l.: s.n.

Department of Environment, Heritage and Local Government, 2006. *National Framework for Major Emergency Management ,* s.l.: s.n.

EPA, 2022. *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports,* s.l.: s.n.

Kilkenny County Council, 2022. *Fire and Emergency Operations Plan 2022-2026,* s.l.: s.n.

Met Eireann, 2024. *Human-caused Climate Change Brings Increased Storm Rainfall.* [Online]
Available at: https://www.met.ie/human-caused-climate-change-brings-increased-storm-rainfall

The Department of Environment, Housing and Local Government, 2010. *A Framework for Major Emergency Management, Guidance Document 1-A Guide to Risk Assessment in Major Emergency Management ,* s.l.: s.n.

The European Parliament and the Council of the European Union, 2014. *Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 ammending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment.,* s.l.: s.n.

18 Summary of Effects and Schedule of Environmental Commitments

18.1 Summary of Effects

18.1.1 The following tables provide a summary of environmental impacts predicted to arise as a result of the Proposed Scheme, outlining the pre-mitigation significance and post-mitigation residual impact significance.

Population and Human Health

Table 18-1: Summary of Impacts and Mitigation Measures: Population and Human Health

Location	Receptor/ Population Subset	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
'Do Nothing' Scenario Impacts						
General, Study Area	All, including residents, visitors/, business owners.	Maintenance of current flood risk condition causing disruption and implications for human health and wellbeing.	Negative, significant	Long-term/ permanent in effect, but brief during potential flood events	Mitigation not applicable in 'do nothing' scenario.	Negative, long-term/permanent in effect, but temporary during potential flood events
Construction Phase Impacts						
General, Study Area	All, including residents, visitors/, business owners.	General nuisance impacts from increased traffic movements, annoyance, alteration of journey plans, alteration of pedestrian walkways.	See Chapter 7 'Material Assets'.			
		Health impacts from air emissions (pollutants and dust).	See Chapter 13 'Air Quality'.			
		Noise nuisance, loss of concentration and health implications of vibration annoyance.	See Chapter 15 'Noise and Vibration'.			
		Worsened visual amenity	Chapter 11 'Landscape and Visual'.			
		Improper waste management leading to odour and pest issues.	See Chapter 7 'Material Assets' and Chapter 13 'Air Quality'.			

Location	Receptor/ Population Subset	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
Graiguenamanagh Quay. Tinnahinch Quay. Main Street. High Street.	Business owners, users or commercial properties.	• Use of local accommodation and businesses by contractor staff. • Direct and indirect employment opportunities around the construction phase (i.e., waste collection).	Positive, Slight	Short-term (construction phase)	Not Applicable (positive impact).	Positive, Slight
Graiguenamanagh Quay.	Local amenity users and tourists	Closure of Graiguenamanagh Quay.	Negative, Moderate	Short-term (WP 4A duration of 18 months).	• Maintaining access points. • Appropriate construction sequencing. • Safe pedestrian access. • Limit land grab associated with amenity/green areas. • Avoidance of summer months for closure period.	Negative, Slight
		Closure of concrete steps opposite the Boat Club (recreational river access).	Negative, Moderate	Short-term (WP 4A duration of 18 months).	• Minimisation of closure period through construction sequencing.	Negative, Slight
	Boat owners and users	Removal of mooring facilities and required relocation of boats.	Negative, Significant	Short-term (WP 4A duration of 18 months).	• Plan, in consultation with Waterways Ireland and other stakeholders, to ensure some mooring is available for the duration of the works.	Negative, Moderate

Location	Receptor/ Population Subset	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
					• Minimisation of closure period through construction sequencing.	
	Boat owners and users. Boat Club.	Closure of slipway.	Negative, Slight	Temporary (12 weeks)	• Plan, in consultation with Waterways Ireland and other stakeholders, to minimise impact. • Minimisation of closure period through construction sequencing.	Negative, Not Significant
Tinnahinch Quay.	Local amenity users and tourists	Closure of Tinnahinch Quay.	Negative, Moderate	Temporary (WP 4B duration of 12 months).	• Maintaining access points. • Appropriate construction sequencing. • Safe pedestrian access. • Limit land grab associated with amenity/green areas. • Avoidance of summer months for closure period.	Negative, Slight
		Closure of concrete steps opposite lock gates (recreational river access).	Negative, Moderate	Temporary (WP 4B duration of 12 months).	• Minimisation of closure period through construction sequencing.	Negative, Slight

Location	Receptor/ Population Subset	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
	Boat owners and users	Removal of mooring facilities and required relocation of boats.	Negative, Significant	Temporary (WP 4B duration of 12 months).	• Plan, in consultation with Waterways Ireland and other stakeholders, to ensure some mooring is available for the duration of the works. • Minimisation of closure period through construction sequencing.	Negative, Moderate
General, Study Area	All, including residents, visitors/, business owners.	Safety implications of construction-related presence.	Negative, significant	Short-term (construction phase)	• Implementation of best practise construction methods. • Preparation of Health & Safety Plan / Programme and implementation of best practise safety procedures. • Implementation of CEMP & TMP.	Imperceptible
Site Compound D (Boat Club) Site Compound E (Hotel Street)	All, including residents, visitors, business owners.	Loss of amenity green space.	Negative, Not Significant	Short-term, limited to construction of WP 4A and WP 4B.	• Maintain compounds to the minimum size required.	Imperceptible
Operation and Maintenance Phase Impacts						
Flood Risk Zone	All, including residents, visitors, business owners.	Reduced vulnerability of the affected population, commercial businesses/ activity and homes to flooding events.	Positive, Significant	Permanent in effect	Not Applicable (positive impact).	Positive, Significant

Location	Receptor/ Population Subset	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
General, Study Area	Residents and visitors.	Roads previously vulnerable to flooding no longer subject to closure.	Positive, Significant	Permanent in effect	Not Applicable (positive impact).	Positive, Moderate
The Quays		Altered access to mooring facilities by controlled flood gates.	Negative, Slight	Permanent	Mitigation not possible without alteration in flood defence design (and possible reduction in effectiveness).	Negative, Slight
General, Study Area		Reduction in visual amenity and effect to the intangible connection to the river, particularly for those properties with river view.	See Chapter 11 ‘Landscape and Visual’.			

Material Assets (Built Services; Roads, Traffic and Transportation; Waste Management)

Table 18-2: Summary of Impacts and Mitigation Measures: Material Assets

Receptor	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
'Do Nothing' Scenario Impacts					
Existing infrastructure, services & utilities	Maintenance of current flood risk condition causing disruption and damage to infrastructure and utilities.	Negative, Moderate to Significant	Temporary during potential flood events, but permanent in effect.	Mitigation not applicable in 'do nothing' scenario.	Negative, Moderate to Significant
Construction Phase Impacts					
Local Road Users, Residents and transportation networks	Lane/Road Closures	Negative, Moderate	Temporary	• Implementation of best practise traffic management, as outlined within a CSTMP. • Appointment of person responsible for traffic management. • Construction phasing/planning. • Clear signage system. • Appropriate consultation and notice provision to the public, the Local Authority and Gardai.	Negative, Slight
	Parking changes	Negative, Moderate	Temporary	• Appropriate consultation and notice provision to the residents the Local Authority and Gardai. • Provision of suitable and convenient alternative parking.	Negative, Slight
	Trip generation and impact on existing road traffic.	Negative, Moderate	Short Term	• Implementation of best practise traffic management, as outlined within a CSTMP.	Negative, Slight

Receptor	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
				• Appointment of person responsible for traffic management. • Construction phasing/planning. • Implementation of traffic safety measures.	
Pedestrian and Cycling	Complete or partial closure of walkways, pedestrian access routes and/or cycling routes during period of the construction phase.	Negative, Slight	Temporary	• Minimisation of walkway/cycling route closure, where possible. • Appropriate placement of compounds/laydown areas. • Appropriate construction phasing / sequencing. • Provision of safe alternative routes/diversions to minimise nuisance.	Negative, Not Significant
Utilities and services	Disruption to WTP and WWTPs.	Positive Significant Impact.	Temporary	• Water quality monitoring before and during construction – Refer EIAR Chapter 8.	No residual impact
	Disruption to gas networks.	No impact.	Not applicable	Not applicable.	No residual impact
	Disruption to foul and storm water sewers.	Negative, Not Significant	Temporary	• Design and pre-construction due diligence. • Coordination with utility network providers. • Adoption of appropriate construction phasing to limit impact of utility shutdowns.	Negative, Not Significant
	Disruption to water utilities.	Negative, Not Significant	Temporary		Negative, Not Significant
	Disruption to electricity supply.	Negative, not significant	Temporary		Negative, Not Significant
	Disruption to digital infrastructure.	Negative, Not Significant	Temporary		Negative, Not Significant

Receptor	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
Waste Management	Site Clearance & Demolition Waste	Negative, not significant	Temporary	• Adoption of Waste Management Plan (WMP). • Appointment of Waste Manager. • Provision of waste management infrastructure and appointment of regular collection services. • Retention of collection receipts and record keeping of where wastes are being transported and disposed of. • Implementation of waste segregation practises. • Implementation of waste re-use and recycling practises. • Implementation of appropriate hazardous waste management.	Negative, Not Significant
	Excavation Materials	Negative, not significant	Temporary		Negative, Not Significant
	General Construction Waste	Negative, Not Significant	Temporary		Negative, Not Significant
Operation and Maintenance Phase Impacts					
Graiguenamanagh Quay road system and parking	One way-system and loss of all parking along Graiguenamanagh Quay.	Negative, Moderate	Permanent	Not applicable.	Negative, Moderate

Receptor	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
Roads, traffic and transportation	Protection during flood events, resulting in little to no disruption to normal traffic flow and/or use of transport and road infrastructure.	Positive, moderate	Permanent	Not applicable.	Positive, moderate
Utilities and services	Protection during flood events resulting in little to no disruption to normal use of utility services.	Positive, moderate	Permanent	Not applicable.	Positive, moderate
Waste Management	Generation of solid, liquid and hazardous waste streams.	Imperceptible	Brief	Adoption of construction phase mitigation in the management of waste streams.	No residual impact

Hydrology – Surface Water

Table 18-3: Summary of Impacts and Mitigation Measures: Hydrology (NRA, 2008)

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation and Monitoring	Impact Significance Post-Mitigation
'Do Nothing' Scenario Impacts						
Maintenance of flood risk and resulting water quality impacts	River Barrow and River Duiske.	High	Moderate	Short and long-term Significant / Moderate Negative	Not applicable.	Significant / Moderate
Construction Phase Impacts						
Uncontrolled spillage of herbicides (for treatment of invasives)	River Barrow and River Duiske.	High	Small Adverse	Temporary Moderate / Slight Negative	Implementation of measures to ensure the careful use of herbicides, as outlined in the Invasive Alien Species Management Plan (see CEMP).	Imperceptible
	River Barrow and River Nore SAC	Extremely High	Small Adverse	Temporary Significant Negative		Imperceptible
Uncontrolled siltation / sedimentation	River Barrow and River Duiske.	High	Moderate	Short-term Significant Negative	• Instream works will only be carried out between July and September. • Construction methodology to avoid direct contact with the waterbodies as much as possible.	Moderate / Slight

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation and Monitoring	Impact Significance Post-Mitigation
	River Barrow and River Nore SAC	Extremely High	Moderate	Short-term Profound Negative	• Stockpile away from watercourses. Where stockpiles are located near watercourses, appropriate protection will be provided to avoid run-off. • All works undertaken near the riverbanks to prevent scour and run-off of silt. • A silt fence will be included around the site perimeter. • Allow settling of fine sediments prior to pumping to the local stormwater system/river. • All earthworks to be carried out in periods of dry weather. • An appropriate dewatering methodology will be selected. • Dewatering to suitably sized propriety sediment removal system. • Ecological Clerk of Works to oversee and monitor all measures taken to protect the aquatic environment.	Significant
Uncontrolled spillage / leakage of hydrocarbons, lubricants, oils, wastewater and/or concrete residue.	River Barrow and River Duiske.	High	Small to Moderate	Temporary Moderate / Slight to Significant/ Moderate Negative	Refer to Chapter 12 'Land, Soils, Geology and Hydrogeology' and the mitigation measures proposed for the prevention and management of accidental releases / spillages.	Imperceptible
	River Barrow and River Nore SAC	Extremely High	Small to Moderate	Temporary Significant to Profound Negative		Imperceptible
Operation and Maintenance Phase Impacts						

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation and Monitoring	Impact Significance Post-Mitigation
Increased Water Levels and Velocity	River Barrow and River Duiske	High	Negligible	Imperceptible	Appropriate design of flood defence measures.	Imperceptible
Changes to Hydro-morphology	River Barrow (Barrow_230)	High	Moderate	Temporary Slight Negative	Not applicable.	Temporary Slight Negative
	River Duiske (Duiske_020)	High	Moderate	Moderate Negative	Not applicable.	Moderate Negative
Sedimentation during Maintenance	River Barrow and River Duiske	High	Small	Moderate / Slight Negative	Mitigation measures outlined for the control of sedimentation during construction.	Imperceptible
Uisce Éireann assets	WWTP Foul Pumping Station and Abstraction Points	High	Major Beneficial	Significant Positive	Not applicable.	Significant Positive
Water Quality improvements as a result of flood defences preventing negative impacts with current flooding events	River Barrow (Barrow_230)	High	Major Beneficial	Significant Positive	Not applicable.	Significant Positive
	River Duiske (Duiske_020)	High	Major Beneficial	Significant Positive	Not applicable.	Significant Positive
	River Barrow and River Nore SAC	Very High	Major Beneficial	Profound Positive	Not applicable.	Profound Positive

Cultural Heritage

Table 18-4: Summary of Impacts and Mitigation Measures: Cultural Heritage

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Construction Phase Impacts						
Upstream storage area –	Area 1 - CHZ01 – River Duiske	Low	Low	Slight, direct and negative	• Archaeological monitoring by a licenced archaeologist	No Impact
Upstream storage area - Main Compound A	Area 1 - CHZ09- Greenfield potential	Low	Low	Slight, direct and negative	• Archaeological test excavation • Archaeological monitoring by a licenced archaeologist	No Impact
Debris Trap –	Area 2 - CHZ02 – River Duiske riverine potential	Low	Low	Slight, direct and negative	• Archaeological monitoring by a licenced archaeologist	No Impact
Flood proofing	Area 2 - CH01 – Riverside wall	Low	Low	Slight, positive	• Detailed recording of the boundary wall is recommended. • All works to the carried out to a specified and approved method statement. • Building works to be supervised and recorded by a conservation engineer or a suitably qualified and experience professional subject to agreement with the statutory authorities • Limited excavation adjacent to the wall will be required to protect the foundations of the structures. Archaeological monitoring of this work will take place.	Slight, positive, permanent impact

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Flood proofing	Area 2 - CH02 – Stone Building	Low	Low	Slight, positive	• Detailed recording of the boundary wall is recommended. • All works to the carried out to a specified and approved method statement. • Building works to be supervised and recorded by a conservation engineer or a suitably qualified and experience professional subject to agreement with the statutory authorities. • Limited excavation adjacent to the wall will be required to protect the foundations of the structures. Archaeological monitoring of this work will take place by a licenced archaeologist.	Slight, positive, permanent impact
Raising the ground level locally and flood proofing of adjacent buildings (CH01, CH02)	Area 2 - CH03 – Riverside walk	Low	medium	Direct, Slight, Negative and Short Term	• Archaeological monitoring will take place throughout all earthmoving and in water river works. • Reinstatement of existing walk to original form.	No impact

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
No infrastructure works in vicinity of the well. Tanking of CH01.	Area 2 - KK029-018008 – Clapper Bridge	High	Low	Indirect, Moderate, Negative and Short Term	• Identified to the contractors (enabling and main works) as a recorded monument. • During the course of the works, temporary protection measures will be placed around the bridge including signage. • Vibration monitoring is recommended as works will take place up and down stream in the Duiske River. • A visual archaeological instream inspection to recover displaced stone lintels.	Moderate, positive, long term/ permanent impact
No infrastructure works in vicinity of the well	Area 2 - KK029-018007 – Holy Well	Medium	No impact	No impact	• Identified to the contractors (enabling and main works) as a recorded monument. • All proposed landscaping works in the wider setting of the monument to be approved by the Project Archaeologist and the statutory authorities.	Slight, positive and long term/ permanent impact
Flood proofing works to a protected structure	Area 2 - C133 – The Globe (Protected Structure) Work will be carried out to a modern extension to the rear of the structure	Low	Low	Direct, Slight and Negative	• All works to the carried out to a specified and approved method statement. • As the fabric to the removed is not historic in nature no further oversight is required by a conservation engineer. • Archaeological monitoring by a licenced archaeologist.	Moderate, positive, permanent impact

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
No flood relief works	Area 2 - C647 – High Street Bridge (Protected Structure)	Medium	No impact	No impact	• Vibration monitoring is recommended as works will take place up and down stream in the Duiske River. • Localised pointing in lime mortar on the upstream spandrel wall will assist in the long-term protection of the bridge. • All repair works to be carried out via an agreed method statement with the authorities.	Slight/ Moderate, positive, long-term impact
Raised defences	Area 3 - C654, C134 (Protected Structures) and rubble stone outhouses.	Low	Low	Slight, indirect, negative	• Archaeological monitoring by a licenced archaeologist • Flood defence wall to be designed to the specifications of the conservation architect. • Vibration monitoring on neighbouring structures to limit accelerations to 3mm/s	Slight, positive
Raised defences	Area 3 - C648 Protected Structure	Medium	Negligible	Not Significant, indirect	• Vibration monitoring on neighbouring structures to limit accelerations to 3mm/s	No impact
Raised defences	Area 4 – CH04 Bridge The structure is in proximity to piling works in the river further downstream	Low	Low	Slight, indirect, negative	• Vibration monitoring on neighbouring structures to limit accelerations to 3mm/s	No impact

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Raised wall defences	Area 4 - C138 – Protected Structure, Step House	High	Low/ Negligible	Slight, indirect, negative	• Archaeological monitoring by a licenced archaeologist • Flood defence wall to be designed to the specifications of the conservation architect. • Vibration monitoring on neighbouring structures to limit accelerations to 3mm/s	Slight, positive
To the north of the proposed FRS works	C137 The Market House This is located to the north of Area 4 Turf market to the Hub	High	Very Low/ Negligible	Not Significant	• Vibration monitors will be placed on this structure to limit accelerations to 3mm/s	No impact

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Raised wall defences	Area 4 Stone walls (CH05) and former stone stores/ warehouses (CH06 and CH07)	Medium	Medium	Moderate, indirect, negative	• Archaeological monitoring by a licenced archaeologist • Flood defence wall designed to the specifications of the conservation architect. • Vibration monitoring on neighbouring structures to limit accelerations to 3mm/s • Any repairs required to existing stone walls as a result of the proposed works will be undertaken by experienced stone masons. • In advance of the works, all vegetation is be cleared from the existing stone walls and the walls are be recorded by laser scan digital survey and appropriately annotated by a conservation engineer or experienced professional. A digital and written record is to take place, so the existing built environment is fully recorded.	Slight, positive

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Raised wall defences	Area 4 - CH08 – Peg Washington's Lane	Medium	Low	Slight, indirect, negative	• Vibration monitoring will take place of the structures (CH06 and CH07) adjacent to the laneway to ensure that if there is any movement recorded as a result of the works, amelioration procedures can be put in place to protect the masonry structures. • Archaeological monitoring by a licenced archaeologist • Flood defence wall designed to the specifications of the conservation engineer.	Slight, negative
Storm Drains	Area 4 - CH09 – gated private property and stone wall	Low	Low	Slight, direct and negative	• A full architectural heritage survey (scaled drawing and written description) will take place of the section of stone wall in advance of its removal. • The wall will be reinstated to the requirements of a conservation engineer with the assistance of stone masons. • All excavation works associated with the storm drainage will be archaeologically monitored.	Slight, direct and negative

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Raised wall defences	Area 4 - CH10 Bridge and supporting stone wall	Low/ Medium	Medium	Direct, negative and moderate	• The stone wall will be subject to a full photographic and descriptive survey. Its removal, safe storage of the stone blocks for reuse and reinstatement where possible will take place under the supervision of a conservation engineer. • Vibration monitors will be put in place to ensure that there is no damage as a result of sheet-piling in the vicinity of the structure. • Where works are taking place, archaeological monitoring and recording will take place within the river channel.	The wall will be removed as a result of the scheme.
Proposed Flood Gate	Area 4 and Area 8-CHZ02 – Duiske River	Low	Low	Slight, direct and negative	• Archaeological monitoring by a licenced archaeologist.	No impact
Embankment and compound	Area 5 – CH04 – greenfield potential	Low	Low	Slight, direct and negative	• Archaeological monitoring by a licenced archaeologist.	No impact
Raised flood defences and outfall pipes	Area 5 – CH12	Low	Low	Slight, direct and negative	• Archaeological monitoring to take place in the green field environment and any excavation works required for the quay road. The removal of the stone wall and seating will be recorded by a description and photographic record. Area to be archaeologically monitored.	No impact

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Flood defence wall	Area 6 – NIAH 1218003 – gates/ railings/ walls	Medium	Low	Slight, indirect and negative	• A full architectural heritage survey (scaled drawing, written description and photographic record) will take place of the stone wall and gate. • New defence walling to the conservation engineers' specification. • Vibration monitors will be put in place to ensure that there is no damage • All excavation works will be archaeologically monitored.	Retained and Slight, indirect and negative
Flood defence wall	Area 6 – CH13 – Wall of a former building	Low	Low	Slight, direct and negative	• A full architectural heritage survey (scaled drawing, photographic record and written description) will take place of the stone wall. • All excavation works will be archaeologically monitored.	This will be recorded and removed.

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Flood defence wall, storm drainage, lighting, utility changes and public realm works	Area 6 Graiguenamanagh Quay (D152)	High	High	Significant, direct and permanent	• The quay wall and environment are to be retained and a designed solution where the flood defence wall is set back from the water's edge is preferred. • Vibration monitors will be put in place to ensure that there is no damage damage to the structural integrity of the protected quay. • Archaeological Monitoring of SI works and testing under Ministerial Consent has taken place. Organic deposits and walls have been revealed in Trenches A-E. • Prior to construction, advance archaeological excavation will take place where these features will be affected by the proposed development. • Archaeological monitoring will take place along the quay and on Main Street where there will be opening up/ excavation works.	Providing a further understanding of the below ground archaeology of the quay and possible association with Duiske Abbey. Public realm proposals to provide a cohesiveness and enhance the historic structures along the quay

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Flood defence wall, storm drainage, lighting, utility changes and public realm works	Area 6 Graiguenamanagh Quay – properties - (C149, C635, C140/ NIAH 1218005)	High	Low	Negative, Indirect, negligible and temporary	• Vibration monitors will be put in place to ensure that there is no damage to the structural integrity of the dwellings, properties and retail outlets that align the quay road. • Archaeological monitoring will take place along the quay and on Main Street where there will be opening up/ excavation works.	Protection against flooding will be positive, direct and permanent
Flood Defence Walling, public realm works and utility relocation	Area 6 and Area 7 Graiguenamanagh Bridge (C125)	High	Medium	Indirect, moderate positive	• A full architectural heritage survey (scaled drawing, photographic record and written description) will take place of the approach stone wall. • Vibration monitors will be put in place on the bridge to ensure that there is no damage due to works in proximity to the structure. • All excavation works in the vicinity of the bridge will be archaeologically monitored. • Modern sculptures will be removed, securely stored and reinstated in a location agreed with the local authorities.	Public realm proposals to enhance the setting of the historic bridge

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Flood defence wall and storm drainage	Area 7 – The Dock The Dry Dock (D160)	High	Neutral or negligible	Indirect negative and imperceptible-not significant	• This area lies outside the proposed flood relief works. • Ultimately the physical site and this important aspect of the Barrow Navigation and the ingenuity of 18th century engineering will probably be lost over time as it remains unprotected by the proposed works.	No change in impact level
Flood defence wall and storm drainage	Area 7 – The Dock Vernacular structures including Fenlon's dwelling (CH11A)	Low	High	Moderate/ Significant	• A scaled drawing survey, photographic and descriptive record is proposed of the structure and its surrounds prior to any work taking place in this area. • Archaeological monitoring to take place of any excavation works required for the Dock Road. • The removal of the structure to be archaeologically monitored.	The structure will be removed as a result of the scheme.
Storm drainage	Area 8 – The Hub Entrance gate, ashlar pillars and walling (CH11)	Low	Medium	Slight-Moderate, direct and negative	• It is proposed to record this modern entrance features and rebuild it at an appropriate location.	The entrance feature will be reinstated slight, direct and negative
Embankment, walling, and public realm upgrades,	Area 8 – CHZ08 The Hub. Green field potential	Low	Low	Not significant/ slight, direct and negative	• Archaeological Monitoring during the construction programme. • Archaeological monitoring will take place to works adjacent and within the River Duiske.	No further impact
Flood Gate –	Area 2 - CHZ02 – River Duiske riverine potential	Low	Low	Slight, direct and negative	• Archaeological monitoring by a licenced archaeologist	No further Impact

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Outfall as part of the storm drainage	Area 9 – Hotel Street-Tinnahinch Riverbank East	Low-medium	Low	Slight, direct and negative	• All earthmoving and excavation works will be archaeologically monitored.	No further impact
Flood Defence Wall/Drainage/ Public Realm Works	Area 10 – CH17 (ADCO 17) Tinnahinch Quay	Low-medium	Medium	Slight-Moderate, direct and negative	• New defence walling will be to the conservation engineers' specification. • Vibration monitors will be put in place to ensure that there is no damage to adjacent structures such as Graiguenamanagh Bridge and the former boathouse • All excavation works will be	Slight and Positive
Flood Defence Wall	Area 10 – CH15 (ADCO 18) Tinnahinch Quay - Mill Race	Low-medium	Negligible	Not significant and indirect	• New defence walling will be to the conservation engineers' specification. • Vibration monitors will be put in place to ensure that there is no damage All excavation works will be archaeologically monitored.	No further impact
Compound/ Earthen embankment/ walling	CHZ 06 Compound E (Area 9) – Hotel Street-Tinnahinch Riverbank East	Medium	Medium-High	Moderate, direct and negative	• Archaeological geophysical survey and test excavation when the lands become available in advance of construction. • Archaeological monitoring during the construction programme. • Memorials to be removed, securely stored and reinstated.	No further impact

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Mitigation and Monitoring	Impact Significance Post-Mitigation
Compound	CHZ 04 and CHZ05 Compound D (Area 5) – Boat Club Area proposed for welfare and plant and Material storage	Low	Low	Slight, direct and negative	• All excavation works will be archaeologically monitored. • Access to the field will be through an existing modern entrance so there will be no impact to the low stone wall that fronts onto the quay (see drawing 1424) (NIAH 1218003)	No impact
Compound	C651 Compound C Well Lane at Mill Road proposed for welfare and plant and Material storage	Low	Medium	Slight-Moderate direct and negative	• A full architectural heritage survey (scaled drawing, photographic record and written description) will take place of the surrounding stone walls. • All topsoil stripping works will be archaeologically monitored.	No impact

Biodiversity

Table 18-5: Summary of Impacts and Mitigation Measures: Biodiversity

Ecological Receptor	Characterisation of Impact	Effect Without Mitigation	Mitigation	Residual Impacts – Significance of effects after mitigation
Construction Phase Impacts				
River Barrow and River Nore SAC	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of construction within the river Duiske. Species loss – due to disturbance, habitat loss, direct mortality or indirect mortality as result of the construction. Reduction in water quality – resulting in habitat degradation, direct mortality or indirect mortality.	Temporary, negative impact, significant at an international scale	Mitigation measures are outlined in the Natura Impact Statement included as part of the planning application from the Proposed Scheme. All mitigation measures outlined in Section 10.8 should be followed to reduce impacts to the River Barrow and River Nore SAC.	The Proposed Scheme will not have any long-term recurring significant impacts on water quality within the river Barrow and river Duiske. There also will not be any significant negative impacts on the Qualifying interests for which the SAC is designated. Therefore, there will be no significant adverse impact on the integrity of the River Barrow and Nore SAC. Residual effects are considered not significant.
River Nore SPA	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of construction within the river Duiske. Species loss – due to disturbance, habitat loss, direct mortality or indirect mortality as result of the construction. Reduction in water quality – resulting in habitat degradation, direct mortality or indirect mortality.	Temporary, negative impact, significant at an international scale	Mitigation measures are outlined in the Natura Impact Statement included as part of the planning application from the Proposed Scheme. All mitigation measures outlined in Section10.8 should be followed to reduce impacts to the River Nore SPA.	The Proposed Scheme will not have any long-term recurring significant impacts on water quality within the river Barrow and river Duiske. There also will not be any significant negative impacts on the Qualifying interests for which the SPA is designated. Therefore, there will be no significant adverse impact on the integrity of the River Nore SPA. Residual effects are considered not significant.

Ecological Receptor	Characterisation of Impact	Effect Without Mitigation	Mitigation	Residual Impacts – Significance of effects after mitigation
Linear habitats/Wooded areas	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of loss of treeline/hedgerow habitat in upstream storage area and several trees in town area.	Permanent, negative impact, significant at a regional/ county scale.	Tree protective measures will be put in place to protect trees to be retained during construction. Removal of trees will be timed appropriately to reduce impacts on the species that rely upon them for habitats. Planting of native species vegetation will be undertaken compensate for those to be removed.	Planting of new native tree species will maintain biodiversity in the area. Residual effects are considered not significant.
Rivers and streams	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of construction within the river Duiske. Species loss – due to disturbance, habitat loss, direct mortality or indirect mortality as result of the construction. Disturbance to faunal species – due to disturbance, habitat loss/disturbance, direct mortality or indirect mortality. Reduction in water quality – resulting in habitat degradation, direct mortality or indirect mortality.	Permanent, negative impact, significant at a local-international scale.	Mitigation measures to protect surface water, and freshwater fish and to protect watercourse during instream works have been outlined. These include measures to reduce the risk of pollution and invasive species such as the use of silt fences, bunds, fuel spill kits etc.	With the exception of a small stretch in the upstream area (less than 60m), the river Duiske will be reinstated to the same as its current state. Residual effects are considered not significant.

Ecological Receptor	Characterisation of Impact	Effect Without Mitigation	Mitigation	Residual Impacts – Significance of effects after mitigation
Grassland habitats	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of the spread of invasive species and the reduction in floral diversity from work compound areas. Species loss – due to disturbance, habitat loss, direct mortality or indirect mortality as result of the spread of invasive species and the reduction in floral diversity from work compound areas.	Permanent, slight negative impact, significant at a local scale.	Implementation of biosecurity measures during construction, and periodic monitoring for new growth. The reinstatement of site compounds to their original state. Creation of pollinator friendly meadows post construction.	Significant reduction in risk from invasive species. Floral diversity will be maintained or enhanced as a result of the creation of pollinator meadows. Net biodiversity levels will not reduce significantly. Residual effects are considered not significant
Terrestrial mammals (non-volant) (otter/badger)	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of construction (scrub, trees, resting spots for otters). Species loss – due to disturbance, habitat loss, direct mortality or indirect mortality as result of the noise emissions from construction activity and hazardous storage of machinery. Reduction in water quality – resulting in habitat degradation, direct mortality or indirect mortality as a result of surface water contamination.	Permanent, significant negative impact at a local scale.	The full list of mitigation measures are included in Section 10.8 but those measures include: - Pre-construction mammal survey to be carried out to ensure that protected species have not taken up residence at the site in the interim period. - Noise control measures. - Surface water control measures. - Careful Storage of Machinery.	Terrestrial mammal mitigation measures will ensure mammals will not be significantly impacted on by the works. Residual effects are considered not significant.

Ecological Receptor	Characterisation of Impact	Effect Without Mitigation	Mitigation	Residual Impacts – Significance of effects after mitigation
Bats	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of the scheme resulting in a loss of roosting/foraging habitat with clearance of treelines/hedgerows. Species loss – due to disturbance, habitat loss from the construction noise and light pollution.	Permanent and negative, significant at a county scale.	The full list of mitigation measures are included in Section 10.8 but those measures include: - Avoidance of tree removal during bat hibernation season. Inspecting trees for the presence of bats before vegetation removal. - Lighting control measures. - Replanting of removed trees to reinstate commuting corridors for bats. - Retention of mature trees that provide suitable roosting potential for bats.	Bat mitigation measures will ensure bats will not be significantly impacted on by the works. Residual effects are considered not significant.
Overwintering / breeding birds	Habitat loss/disturbance – due to habitat loss, fragmentation or degradation as a result of the clearance of vegetation during breeding season and potential surface water pollution. Species loss – due to disturbance, habitat loss from noise emissions from construction activity.	Permanent, significant negative impact at a local scale.	The full list of mitigation measures are included in Section 10.8 but those measures include: - Noise control measures. - Surface water control measures.	Works to take place outside of the breeding season with the implementation of noise control and surface water control measures. Significant effects are avoided entirely.

Ecological Receptor	Characterisation of Impact	Effect Without Mitigation	Mitigation	Residual Impacts – Significance of effects after mitigation
Freshwater Fish (including brook lamprey, river lamprey, twaite shad and salmon)	Habitat/species loss/disturbance – due to habitat loss, fragmentation or degradation and disturbance as a result of surface water pollution and damage to riverbed/potential spawning locations during instream works.	Permanent, significant negative impact at a local scale	The full list of mitigation measures are included in Section 10.8 but those measures include: - Standard surface water pollution control measures. - In-stream temporary access platforms will be built where necessary. These shall be lined with terram such that original bed is unaffected and can be reinstated in orderly fashion. - Immediately prior to rivers/streams being diverted into a newly constructed river channel, electrofishing should be conducted to capture and transfer fish from the original channel to the new one. - No instream works will be carried out between the months of October and June (inclusive) to avoid the most sensitive time for fish species and fish species movements.	The implementation of the flow control structure will slightly restrict the habitat potential for fish in the upstream storage area where the flow control structure is in place. Freshwater fish mitigation measures will ensure fish species will not be significantly impacted on by the works. Residual effects are considered not significant.
Operation Phase Impacts				
Linear habitats/Wooded areas/grassland habitats	The planting of native saplings and immature trees will have a last positive impact on the scheme area as they continue to grow. The introduction of pollinator-friendly dry meadows will also result in an	Permanent, positive impact, significant at a local scale.	N/A	Planting of new native tree species will maintain biodiversity in the area. Residual effects are considered negative but becoming neutral imperceptible as the trees

Ecological Receptor	Characterisation of Impact	Effect Without Mitigation	Mitigation	Residual Impacts – Significance of effects after mitigation
	enhancement of habitat opportunities for native bees. Once mature they offer habitat and foraging opportunities for a large number of species.			mature, although they will be subject to maintenance such as tree trimming.
Freshwater Fish (including brook lamprey, river lamprey, twaite shad and salmon)	The flow control structure in the upstream storage will not restrict the movement of the fish through the river Duiske. However, it does require for riverbed reinforcements which will alter the natural riverbed and flow over a short stretch (less than 60m) of the river.	Permanent imperceptible impact at a local scale.	N/A	The alteration of a short stretch (less than 60m of a 23km river) of the riverbed will be permanent to facilitate the upstream storage area. Residual effects are considered imperceptible.
Rivers and streams	Stormwater drainage impacts watercourse turbidity, primarily by introducing suspended sediments and pollutants. This runoff, carrying materials from urban surfaces, increases the cloudiness of the water, reducing light penetration and potentially harming aquatic life.	Infrequent, slight negative impacts at a local scale.	N/A	These infrequent impacts will be temporary, only during times of flood. Residual effects are considered imperceptible.
All other ecological receptors	The largest impacts are anticipated in the construction phase. The ecological receptors are anticipated to return to their normal state/habits following the completion of construction.	Neutral effect	N/A	Residual effects are considered neutral.

Landscape and Visual

Table 18-6: Summary of Impacts and Mitigation Measures: Landscape and Visual

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post- Mitigation
'Do Nothing' Scenario Impacts						
Landscape character and visual amenity of the scheme area would remain unchanged and would evolve on current trends. During flood events public open spaces, agricultural lands and buildings would continue to flood, resulting in possible damage to structures and vegetation and limited access to public amenity spaces, resulting in negative impacts on the landscape and visual amenity in the short term.	Public open spaces, agricultural lands and buildings within predicted flood areas.	Low-Medium	Medium	Moderate-Significant and Negative. Temporary during potential flood events	Not applicable.	Moderate-Significant and Negative
Construction Phase Impacts						
Potential impacts on character of the local landscape: • the scale of the proposed flood defence measures • the loss of vegetation and ground disturbances • the presence of construction machinery, traffic, cranes, lighting and construction compound.	**Landscape Character** - Area 1: Upstream storage area	Low	Medium	Temporary, moderate-significant and negative	• Good housekeeping with daily inspections of site compounds by the site manager. • Sensitive lighting placement • Implementing biodiversity and habitat protection mitigation • Protection of existing woodlands, trees and hedgerows. • Restoring lands to original state after use as site compound.	Temporary, moderate-significant and negative
• Changes to townscape public realm – road and pathways • The loss of vegetation and ground disturbances	**Landscape Character** - Area 2, Area 3 Area 4,	Medium - High	Medium	Temporary, moderate-significant and negative		Temporary, moderate-significant and negative

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post- Mitigation
• The presence of construction machinery, traffic, cranes, lighting and construction compound.	Area 5, Area 6, Area 10					
• The presence of construction machinery, traffic, cranes and lighting.	**Landscape Character** - Area 7: The Dock & Area 8: The Hub	Low	Medium	Temporary, moderate and negative		Temporary, moderate and negative
• The loss of vegetation and ground disturbances • The presence of construction machinery, traffic, cranes, lighting and construction compound.	**Landscape Character** - Area 9: Hotel St	Low - Medium	Low - Medium	Temporary, moderate and negative		Temporary, moderate and negative
Changes to **visual amenity** due to: • Temporary construction compounds and construction routes • Temporary site works – hoarding, lighting, cranes, car parking, storage areas • Construction traffic – dust and emissions • Tree and vegetation clearance • Groundworks – excavations, ground raising • Laying of foundations (e.g. walls) and site services	**Visual amenity** – Visual 1: Area 5 - Boat Club	Medium	Medium	Temporary, moderate and negative		Temporary, moderate and negative
	Visual amenity – Visual 2: Area 6 - Graig. Quay	Medium	Medium	Temporary, moderate and negative		Temporary, moderate and negative
	Visual amenity – Visual 3: Area	High	Medium	Temporary, moderate-		Temporary, moderate-

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post- Mitigation
	6 - Graig. Quay			significant and negative		significant and negative
	Visual amenity – Visual 4: Area 6 - Graig. Quay	High	Medium	Temporary, moderate-significant and negative		Temporary, moderate-significant and negative
	Visual amenity – Visual 5: Area 4 – Lower Turf Market	Low	Low	Temporary, moderate and negative		Temporary, moderate and negative
	Visual amenity – Visual 6: Area 5 - Boat Club & Area 6 – Graig. Quay	High	Medium	Temporary, moderate-significant and negative		Temporary, moderate-significant and negative
	Visual amenity – Visual 7: Area 8 – The Hub	Low	Medium	Temporary, moderate-significant and negative		Temporary, moderate-significant and negative
	Visual amenity – Visual 8: Areas 3 & 4 - Turfmarket	Low	Low	Temporary, slight-moderate and negative		Temporary, slight-moderate and negative
	Visual amenity – Visual 9:	Low	Low	Temporary, moderate and negative		Temporary, moderate and negative

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post- Mitigation
	Area 3 - Turfmarket					
	Visual amenity – Visual 10: Area 2 – Well Lane	Low - Medium	Low	Temporary, moderate and negative		Temporary, moderate and negative
	Visual amenity – Visual 11: Area 10 – Tinnahinch Quay	High	Low	Temporary, moderate-significant and negative		Temporary, moderate-significant and negative
	Visual amenity – Visual 12: Area 10 – Tinnahinch Quay	Medium-High	Low	Temporary, moderate-significant and negative		Temporary, moderate-significant and negative
	Visual amenity – Visual 13: Area 9 – Hotel Street	Medium-High	Low	Temporary, moderate-significant and negative		Temporary, moderate-significant and negative
	Visual amenity – Visual 14: Protected View 1 (KDP)	High	Negligible	Imperceptible and neutral		Temporary, imperceptible and neutral

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post- Mitigation
	Visual amenity – Visual 15: Protected View 3 (KDP)	High	Negligible	Imperceptible and neutral		Temporary, imperceptible and neutral
	Visual amenity – Visual 16: Protected View 2 (KDP)	High	Negligible	Imperceptible and neutral		Temporary, imperceptible and neutral
	Visual amenity – Visual 17: Scenic Route 15 (CCDP)	High	Negligible	Temporary, imperceptible and neutral		Temporary, imperceptible and neutral
The extents of existing trees and hedgerows that will need to be removed to facilitate the construction of the flood defence proposals.	Impact on **Existing Trees & Hedgerows**	Medium-High	Medium - High	Permanent, moderate to high (as per Chapter 10)	Tree protection fencing and onsite monitoring by arboriculturist (refer to Chapter 10 'Biodiversity' for further details)	Permanent, moderate to high (as per Chapter 10)
Operation and Maintenance Phase Impacts						
The visual impact of the proposed flood defence measures and the landscape design.	**Landscape Character** - Area 1: Upstream storage area	Low	Medium	Slight-moderate and negative	• Road and associated services into the surrounding landscape, tree, hedge, planting and wildflower meadows have been proposed where feasible • New tree planting is not always possible where it is determined the trees may compromise the proposed flood defence	Slight-moderate and negative - will lessen as the existing vegetation continues to mature

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post- Mitigation
					proposals in the future or at times of flooding. • Limited space for proposed planting, therefore dependent on the continuing maturing of the existing vegetation in this area.	
Localised impacts on the townscape including changes to the road layout, changes to the public realm and the visual impact of the proposed flood defence measures.	**Landscape Character** - Area 2, Area 3 Area 4, Area 5, Area 6, Area 10	Medium - High	Medium	Permanent, slight and negative	• Design sympathetic to or from the locality and do not detract from existing significant features or historical structures, have been proposed. • Glazed panels have been proposed to minimise the visual and physical impact of the proposed walls, • Siting and extents of the flood defence walls followed the current alignment of existing walls or boundaries.	Permanent, slight and negative
Localised impacts on the townscape/ landscape as a result of the proposed flood defence measures as well as the removal of trees and realignment of public and emergency access.	**Landscape Character** - Area 7: The Dock & Area 8: The Hub	Low	Medium	Not significant and negative, in the short term	Proposed tree, hedge and shrub planting and wildflower meadows.	Imperceptible and neutral, in the long term
Localised impacts on the townscape/landscape as a result of the proposed flood defence measures as well as the removal of trees.	**Landscape Character** - Area 9: Hotel St	Low - Medium	Low - Medium	Slight and negative	N/A	Slight and negative

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post- Mitigation
The principal elements which are likely to give rise to landscape and visual impact visual impact in the long term are: • Changes to road layout along Graiguenamanagh Quay • Alterations to ground levels • Height of proposed or amended walls • New structures, lighting, boundaries and pathways • Proposed tree and shrub planting • Flood storage area – embankments; concrete flow control structure; spillway; access road; lighting	**Visual impacts** - General/ All areas				• Retention and protection of the vegetation along river edges and existing field boundaries where possible. • Considered approach to the siting and extents of the flood defence proposals, including glazed panels • Planting programme with native species wherever possible. • Utilising materials (e.g. paving, wall cladding) and street furniture that are sympathetic to or from the locality and do not detract from existing significant features or historical structures. • Working with the existing topography of the scheme area as much as possible. • Improving pedestrian movement within the town and links to the wider walking trails.	
Views of the proposed flood defence walls and gates around the boathouse, the reconfigured car park and the pedestrian route.	**Visual amenity** – Visual 1:	Medium	Medium	Slight and negative	• To minimise the visual impacts of the flood defence proposals and to assist in their successful integration into the surround	Slight and negative

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post- Mitigation
	Area 5 - Boat Club				townscape, the materials chosen e.g. stone cladding to walls are intended to be sympathetic to the existing structures. • Glazed panels are proposed within the flood defence walls and gates in order to reduce the visual impact of the wall and to facilitate views from the boathouse towards the river. • A new seat wall is also proposed for the same extents of the current seating area in order to retain the current level of amenity.	
Views of defences and landscape design/public realm	**Visual amenity** – Visual 2: Area 6 - Graig. Quay	Medium	Medium	Slight and negative	Glazed panels are proposed within the flood defence walls and gates in order to reduce the visual impact of the wall and to facilitate views towards the river.	Slight and negative
Views of defences and landscape design/public realm, as well as changes to road surfaces and systems.	**Visual amenity** – Visual 3: Area 6 - Graig. Quay	High	Medium	Slight and negative	• Glazed panels are proposed within the flood defence walls and gates in order to reduce the visual impact of the wall and to facilitate views towards the river.	Not significant and negative

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post- Mitigation
					• Narrowing of the vehicular route along the quays, the introduction of trees and additional seating may result in a more attractive pedestrian friendly route along the river edge.	
Views of defences and landscape design/public realm, as well as changes to road surfaces and systems, and electrical kiosk.	**Visual amenity** – Visual 4: Area 6 - Graig. Quay	High	Medium	Slight-moderate and negative	• Glazed panels are proposed within the flood defence walls and gates in order to reduce the visual impact of the wall and to facilitate views towards the river. • Narrowing of the vehicular route along the quays, the introduction of trees and additional seating may result in a more attractive pedestrian friendly route along the river edge.	Slight and negative
Visual changes as a result of proposed flood defence measures and tree removal.	**Visual amenity** – Visual 5: Area 4 – Lower Turf Market	Low	Low	Slight and negative	• Proposed tree planting	Not significant and negative
Views of defences and landscape design/public realm.	**Visual amenity** –	High	Medium	Slight and negative	• Glazed panels are proposed within the flood defence walls	Not significant and negative

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post- Mitigation
	Visual 6: Area 5 - Boat Club & Area 6 – Graig. Quay				and gates in order to reduce the visual impact of the wall and to facilitate views towards the river. ▪ Proposed tree planting	
Views of defences and landscape design/public realm.	**Visual amenity** – Visual 7: Area 8 – The Hub	Low	Medium	Slight and negative	• Proposed tree, hedge, shrub planting & wildflower meadow.	Not significant and negative
Views of defences, landscape design/public realm and tree removal.	**Visual amenity** – Visual 8: Areas 3 & 4 - Turfmarket	Low	Low	Slight and negative	• Maturing and regeneration of existing vegetation	Not significant and negative
Views of defences, landscape design/public realm and tree removal.	**Visual amenity** – Visual 9: Area 3 - Turfmarket	Low	Low	Slight and negative	• N/A	Not significant and negative
Views of defences and landscape design/public realm.	**Visual amenity** – Visual 10: Area 2 – Well Lane	Low - Medium	Low	Slight and negative	• Proposed planting	Not significant and negative
Views of defences, landscape design/public realm and tree removal.	**Visual amenity** – Visual 11: Area 10 –	High	Low	Slight and negative	• Maturing and regeneration of existing vegetation • Proposed planting	Not significant and negative

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post- Mitigation
	Tinnahinch Quay					
Views of defences, reconfigured carpark, landscape design/public realm and tree removal.	**Visual amenity** – Visual 12: Area 10 – Tinnahinch Quay	Medium-High	Low	Slight and negative	• Maturing and regeneration of existing vegetation • Proposed planting • Sympathetic choice of construction materials.	Not significant and negative
Views of defences, reconfigured carpark, landscape design/public realm and tree removal.	**Visual amenity** – Visual 13: Area 9 – Hotel Street	Medium-High	Low	Slight and negative	N/A	Slight and negative
The proposed works will not be visible from these locations.	**Visual amenity** – Visual 14: Protected View 1 (KDP)	High	Negligible	Imperceptible and neutral	N/A	Imperceptible and neutral
	Visual amenity – Visual 15: Protected View 3 (KDP)	High	Negligible	Imperceptible and neutral	N/A	Imperceptible and neutral
	Visual amenity – Visual 16: Protected View 2 (KDP)	High	Negligible	Imperceptible and neutral	N/A	Imperceptible and neutral

Impact Description	Receptor	Importance Ranking	Magnitude of Impact Ranking	Impact Significance Pre-Mitigation	Suggested Mitigation	Impact Significance Post- Mitigation
	Visual amenity – Visual 17: Protected Scenic Route 15 (CCDP)	High	Negligible	Imperceptible and neutral	N/A	Imperceptible and neutral

Land, Soils, Geology and Hydrogeology

Table 18-7: Summary of Impacts and Mitigation Measures: Land, Soils, Geology and Hydrogeology

Receptor	Description of Potential Impact	Pre-Mitigation Significance	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
'Do Nothing' Scenario Impacts					
Land	'Land Take and removal of productive land from potential agricultural and other beneficial use	Neutral	Long-term	Not applicable	None
Construction Phase Impacts					
Land	Several fields currently utilised for agricultural purposes (or have the potential to be) will be taken out of production for the period of WP2	Imperceptible	Temporary	• Consider proposed defences with due consideration of land zoning with measures implemented to minimise impact.	Imperceptible
Land	Portions of land currently utilised for recreational. Leisure use will be unavailable during the construction period	Negative – not significant	Temporary	• Reduce amount of land taken for the construction process, limiting the construction programme where land is taken from other uses.	Imperceptible
Operation and Maintenance Phase Impacts					
Land	General maintenance works	Not applicable	Not applicable	No specific mitigation required for this phase of the project over and above those specified for construction phase impacts	None

Air Quality

Table 18-8: Summary of Impacts and Mitigation Measures: Air Quality

Receptor	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
'Do Nothing' Scenario Impacts					
No impacts.					
Construction Phase Impacts					
All, including residents, visitors, business owners and ecological receptors.	Dust emissions from demolition	Negative, Minor	Short-term (construction phase)	• Implementation of best practice construction methods. • Dust monitoring at high dust-generating Works Areas and Site Compounds. • Effective stakeholder management. • Develop and implement a Dust Management Plan (DMP) as part of the CEMP.	Imperceptible
	Dust emissions from earthworks	Negative, Moderate			Negative, slight
	Dust emissions from construction	Negative, Moderate			Negative, slight
	Dust emissions from track-out	Negligible			Imperceptible
	Increased emissions of pollutants (NO_2, CO) from site plant/machinery and site vehicles.	Negligible		• Implementation of best practise construction methods.	Imperceptible
Operation and Maintenance Phase Impacts					
No impacts.					

Climate

Table 18-9: Summary of Impacts and Mitigation Measures: Climate

Receptor	Description of Potential Impact	Impact significance prior to mitigation	Suggested Mitigation and Monitoring	Residual Impact
Do-nothing Scenario				
GHG Emissions	If the scheme does not progress, there will be no impacts to the national GHG emissions.	None	N/A	N/A
Climate Change Vulnerability and Adaption	The local population will be subject to increased risk from flooding as a result of the increased rainfall caused by a warming climate.	Slight, negative, permanent	N/A	N/A
Construction Phase Impacts				
GHG emissions on general environment, surrounding environment and people	Impacts during the construction phase include emissions from transport of materials to the site, embodied CO2 in construction materials (such as cement, steel, etc.), emissions from plant machinery and other ancillary areas such as contractor compounds, waste management, etc. According to the TII Carbon Tool, the construction of the Proposed Scheme, will total 927.7 tCO^2e	Slight, temporary	During the construction phase, best environmental practices will be followed in order to mitigate for greenhouse gas emissions. These are detailed in Chapter 13 'Air Quality'. Green procurement policies will be employed where possible to source materials and contractors.	Not significant, temporary
Vulnerability and Adaptability to climate change	The local population will be vulnerable to weather and flood events throughout the construction phase.	Negligible	N/A	N/A

Receptor	Description of Potential Impact	Impact significance prior to mitigation	Suggested Mitigation and Monitoring	Residual Impact
Operation and Maintenance Phase Impacts				
GHG emissions on general environment, surrounding environment and people	These emissions have been calculated by the TII Carbon Tool as 8.6 tCO^2e as a result of the operation and maintenance of the Proposed Scheme.	Not Significant	N/A	N/A
Vulnerability and Adaptability to climate change	The scheme will make the local community less vulnerable to the impacts of flooding, which are increasing as a result of climate change. The scheme is also adaptable to future impacts of a warming climate as the flood levels are anticipated to increase.	Significant, positive	Appropriate mitigation in the form of regular monitoring, maintenance, and adaptability features can reduce the vulnerability of the community to increased flood levels.	N/A

Noise and Vibration

Table 18-10: Summary of Impacts and Mitigation Measures: Noise and Vibration

Receptor	Description of Potential Impact	Significance Pre-Mitigation	Impact Duration	Suggested Mitigation and Monitoring	Residual Significance
'Do Nothing' Scenario Impacts					
All receivers	No predicted impacts	-	Long term	-	-
Construction Phase Impacts					
Noise sensitive properties adjacent to works	Negative	Slight – Very Significant	Temporary	Hoarding, local barriers, limiting hours, select quiet equipment, good relations with residents, informing residents of noisy/vibration inducing works	Significant reduced to moderate if managed
Operation and Maintenance Phase Impacts					
All receivers	No predicted impacts	-	Long term	-	-

18.2 Schedule of Environmental Commitments

18.2.1 The Schedule of Environmental Commitments outlines the mitigation commitments required during the pre-construction, construction and operational phases of the Proposed Scheme. Table 18-11 presents the recommended pre-construction mitigation, and Table 18-12 the construction and operational phase mitigation recommendations.

18.2.2 A CEMP has been prepared alongside the EIAR (see Appendix 4-4) to provide guidance to the appointed contractor(s), setting out the mitigation measures identified in this EIAR as well as general site management best practise. The appointed contractor will be responsible in taking ownership of future iteration of this document and implementing all mitigation measures contained therein. It should be understood and implemented by all construction staff and sub-contractors throughout the construction process.

18.2.3 Prior to the commencement of construction, the appointed contractor will be required to obtain formal agreement from the Local Authority on pollution prevention measures as well the overall approach and emergency procedures for all construction stages.

18.2.4 Potential community safety risks associated with construction will be minimised through the implementation of standard industry best practises, to be outlined in a site-specific and comprehensive Health and Safety Plan/Programme. This is the responsibility of the appointed contractor(s) to prepare, in line with their respective company health and safety policies as well as the requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. No. 291 of 2013). This Plan will detail measures for the management of both worker and community safety and will be implemented and monitored on site throughout the construction process, overseen by a dedicated Health, Safety and Environment Officer.

18.2.5 Additionally, the following reinstatement commitments must be fully implemented upon completion of the construction phase:

- All temporary construction compounds are to be removed upon completion of the construction phase. Such areas are to be reinstated in accordance with the landscape architects plan and engineer's drawings.
- All construction waste and / or scrapped building materials are to be removed from Site on completion of the construction phase.
- Oil, fuel etc. storage areas are to be decommissioned on completion of the construction phase.
- Any remaining liquids are to be removed from Site and disposed of at an appropriate licenced facility

18.2.6 A number of mitigation and monitoring items have been recommended pre-construction and have been separately outlined in Table 18-12.

Table 18-11: Pre-Construction Mitigation

Reference	Pre-Construction Mitigation
Population and Human Health	
See mitigation reference **PHH_1** with regards to finalisation of the Health & Safety Plan/Programme, CEMP and TMP.	
Material Assets	
See mitigation reference **RTT_1** with regards to the preparation of a Traffic Management Plan (TMP).	
See mitigation reference **U&S_1** and **U&S_2** with regards to management of utilities.	
See mitigation reference **WM_1** with regards to the preparation of a Waste Management Plan (WMP).	
Hydrology – Surface Water	
See pre-construction monitoring recommendation in Table 18-13.	
Cultural Heritage	
See mitigation reference **CH_4a** and **CH-4b** with regards to archaeological and architectural recording.	
See mitigation reference **CH_7** with regards to archaeological testing.	
See mitigation reference **CH_8** with regards to archaeological excavation.	
See mitigation reference **CH_11** with regards to archaeological wade survey.	
See mitigation reference **CH_15** with regards to agreement of all method statements for archaeological works.	
See mitigation reference **CH_17** with regards to advancing of archaeological mitigations/resolutions.	
Biodiversity	
See mitigation reference **Bio_3** with regards to pre-construction ecology surveys.	

Table 18-12: Schedule of Environmental Commitments (Mitigation Measures) for the Construction and Operation/Maintenance Phases

Reference	Schedule of Environmental Commitments – Mitigation Measures
Population and Human Health	
Construction Phase	
PHH_1	During the pre-construction phase, the Health & Safety Plan/Programme, CEMP and TMP will be finalised. The documents shall reference commitments made as part of this EIAR for the protection of the environment and community throughout the construction process and will be updated as necessary through the entire construction stage.
PHH_2	Alongside the CEMP, appropriate health and safety planning and risk assessments shall be undertaken for the works planned, with appropriate training provided to workers and appropriate mitigation assigned to eliminate impacts as much as possible. All construction works will be managed in accordance with these plans, and the Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. No. 291 of 2013).
PHH_3	Safety shall be at the forefront of construction management. A representative in charge of health, safety and environmental shall be appointed to manage all requirements of the Health & Safety Plan and CEMP. It will be their responsibility to ensure that all workers operating on the Proposed Scheme are aware of their requirements with regards to health and safety management both on site, and in the community. Where training is required, this will be provided by this representative, or specialist external parties, as appropriate.
PHH_4	The construction areas, including all laydown areas and haulage routes, will be managed in accordance with best practise safety operations, ensuring that all areas are demarcated with appropriate fencing and warning signage, kept tidy with a regular housekeeping regime, and restricted for entry to ensure safety of the general public.
PHH_5	The construction sequencing will be subject to review, to ensure that public safety and convenience is maintained, particularly where construction areas intersect with walkways and/or amenity areas. Appropriate diversion or closure of these will be required, completed in a safe manner and to avoid disturbance as much as possible.
PHH_6	The Contractor will be responsible for the security of the site during each phase. The Contractor will be required to: • Operate a site induction process for all site staff. • Ensure all site staff shall have current 'safe pass' cards. • Install adequate site hoarding to the site boundary. • Maintain site security staff at all times. • Provision of separate pedestrian access from construction and safe walkway for pedestrians along the main roads in Study Area. • Ensure restricted access is maintained to the works.
PHH_7	The Contractor(s) will be required to implement the Pest Control Plan (PCP), as detailed in the CEMP.
PHH_8	Accesses shall be constructed, as designed, to ensure existing pedestrian/cycling/vehicular linkages are maintained.

Reference	Schedule of Environmental Commitments – Mitigation Measures
PHH_9	A Public Liaison Officer will be assigned by the Contractor(s) to deal with public queries and relations matters etc. The Public Liaison Officer will hold monthly 'open' evenings for 1 hour for community to offer feedback. They shall manage all consultations with the general public, including the receipt and management of any public complaints/concerns. Appropriate record keeping and response procedures will be required.
Operation and Maintenance Phase	
PHH_10	The Project will be subject to safety design review, to ensure all defences have been designed with appropriate public safety measures in mind, particularly given the nature of the area as a public amenity. Any access ways that will be constructed as part of the Project will also be subject to review.
PHH_11	When the Scheme is operational, a maintenance and monitoring schedule will be put in place to verify that the proposed flood defences are operating to the appropriate design standard. Repairs will be made as necessary. This will ensure that there is no risk to human health as the scheme ages. All mitigation measures outlined for the construction process (PHH1-9) shall apply, where relevant, to the maintenance and monitoring regime.
Material Assets	
Roads, Traffic and Transportation - Construction Phase	
RTT_1	The appointed contractor will be required to prepare a Traffic Management Plan (TMP) for the construction phase, in accordance with appropriate guidance and requirements of the Department of Transport, National Roads Authority and the Local Government and Transport Infrastructure Ireland (TII). The "Guidance for the Control and Management of Traffic at Road Works – Second Edition 2010", published jointly by the Department of Transport, National Roads Authority and the Local Government Management Services Board should be referenced, in particular. The plan shall include an overview of the works sequence and vehicle requirements, provisions for managing access around construction sites and through residential/commercial areas and managing road safety with regards to the operation of construction vehicles in residential areas. The TMP will clearly identify the routes to be used to access the site for different types of traffic as appropriate, i.e. haul routes and construction staff access routes, as well as those sections of road which are not to be used. Access routes to and from the site, delivery times and off-loading proposals will be formally agreed with the Local Authority as part of the CSTMP. In developing the construction and logistics plans, the Contractor will fully include representatives of the Kilkenny and Carlow County Councils Roads Department, and other interested parties, in a consultation process to ensure that intentions are properly communicated, agreed and do not unduly affect the surrounding residential and retail properties. The contractor will ensure that all relevant mitigation measures identified in the EIAR and as part of the consenting process (e.g. planning conditions) are, where relevant, included in the plan.
RTT_2	A system of clear signage relating to the project, both temporary and permanent, will be agreed with the planning authority. These signs will also identify those roads to be used (and not to be used) for accessing the site in line with the objectives of the TMP. All signage will be provided as per Chapter 8 of the Traffic Signs Manual and the "Guidance for the Control and Management of Traffic at Roadworks 2010".

Reference	Schedule of Environmental Commitments – Mitigation Measures
	Temporary signage will be provided as per TS-3 1986 Specification for the Construction of Traffic Signs. All signage is to be easily visible at night, kept in a clean and legible condition and located facing approaching traffic.
RTT_3	The appointed contractor will provide a competent person with responsibility for traffic management coordination for the duration of the project. This person will be the main point of contact for all matters relating to traffic management on the project.
RTT_4	All workers will receive a comprehensive site induction which shall include, as appropriate, a section on traffic management and clear guidance on the routes which shall and shall not be used. All workers should be aware of the requirements of the TMP.
RTT_5	Where static lane and full road closures are anticipated, these will be appropriate for works where minimum lane widths can be maintained, and crews will be working progressively along the pipeline route. Static lane closures will be undertaken to a specific safety methodology (to be outlined in the TMP) including use of stop/go traffic signals, provision of adequate warning signage and cones, limiting of lane closure lengths and maintaining temporary lane widths. Full lane closures will be undertaken to a specific safety methodology (to be outlined in the TMP) including provision of advanced signage in verges to allow positioning of crew, provision of road traffic cones and appropriate road closure signage at the location of the closure, conduct regular inspections of the road closure signage during works, and removal of signage and cones in a reverse manner.
RTT_6	Prior to any works commencing, all notifications required under the contract requirements and/or road opening license conditions shall be provided to the public.
RTT_7	Any location where removal of parking is required will be discussed appropriately with the local Gardai and Kilkenny and Carlow County Council's Roads Department. Public notice will be provided.
RTT_8	Steel tracked excavators will be moved to and from the Site on low-loaders and will not be permitted to drive onto the adjacent roadway.
RTT_9	Pedestrians will be diverted around the works area. Barriers will be erected, and a footpath will be available for pedestrians, at all areas except Area 2 (Well Lane to High Street Bridge), where pedestrian access will be closed off for approximately 3 months.
RTT_10	Adequate parking and set-down areas shall be provided for personnel and deliveries to avoid queuing at the site entrances and prevent disruption to neighbouring business and local traffic.
RTT_11	Public roads outside the Site will be regularly inspected for cleanliness, as a minimum on a daily basis, and cleaned as necessary. A road sweeper will be made available to ensure that public roads are kept free of debris.
RTT_12	The contractor will confine his activities to the area of the Site occupied by the works and the builders' compound, as far as practicably possible, during any phase of the works.

Reference	Schedule of Environmental Commitments – Mitigation Measures
RTT_13	All construction workers will be encouraged to use public transport, and also to car share where appropriate. On site staff car parking will also be provided to ensure no construction workers will be required to park on adjacent roads or streets.
RTT_14	Construction work will be limited to normal working hours; that are 08.00 – 19.00 on weekdays and 08.00 – 14.00 on Saturdays. All deliveries of materials, plant and machinery to the Site and removals of waste or other material will take place within the permitted hours of work. Vehicle movements will be planned to ensure arrival and departure times are maintained inside the agreed working hours.
RTT_15	Deliveries will be co-ordinated to prevent queuing of vehicles adversely affecting traffic flow and to minimise disruption to local traffic. They will be timed and coordinated to avoid conflict with collection of waste, other deliveries (particularly to adjoining owners), and rush hour traffic. Large deliveries will be scheduled outside peak traffic hours to minimise disruption. The Contractor will consider out of hours deliveries and collections to facilitate the smooth continuation of works and minimise disruption.
RTT_16	Properly designed and designated access and egress points to the construction site will be used to minimise impact on external traffic.
RTT_17	Attention will be given to the loading of lorries carrying bulk materials into the Site and spoil from the Site to ensure that these will not be overloaded or are loaded in such a way that spillage is avoided.
RTT_18	All open load trucks entering and exiting the site will be covered with a tarpaulin.
RTT_19	The Contractor is required to ensure that the condition and surface of the existing roads within the works area are not affect by works vehicle. Cleaning systems and wheel wash systems are to be agreed with the Client.
RTT_20	All site staff including delivery drivers are required to abide by the normal rules of the road.
RTT_21	All vehicles entering site will be restricted to suitable speed limits and will be directed to the relevant area by signage, flags persons or security personnel.
RTT_22	All deliveries of materials, plant and machinery to the site and removals of waste or other material, will take place within the permitted hours of work. Vehicle movements will be planned to ensure arrival and departure times are maintained inside the agreed working hours. No day-time or night-time parking of vehicles will be permitted outside agreed areas.
RTT_23	Contractor staff who direct vehicle movements will be trained and authorized to do so.
RTT_24	The Contractor will provide induction training for drivers, workers and visitors and send relevant instructions out to visitors before attending site. The Contractor will make sure that all the drivers and supply chain personnel are competent and have relevant training and certification appropriate for their job.

Reference	Schedule of Environmental Commitments – Mitigation Measures
Pedestrian and Cycling Networks - Construction Phase	
P&C_1	Where pedestrian and cycling paths are required to be closed, specific pedestrian management plans will be developed, and any footpath closures will need to be approved by the council area engineer and the local Garda. Appropriate signage will be placed to advise of closure and/or diversion and warning will be provided to the public ahead of these works commencing.
P&C _2	All cycling and footpaths shall be kept entirely free of excavated materials, debris and rubbish. All shall be regularly inspected for cleanliness, as a minimum on a daily basis, and cleaned as necessary. A sweeper will be made available to ensure that pathways are kept free of debris.
P&C _3	Footpaths will not be blocked resulting in pedestrians having to step onto roads. If a pedestrian access is required to be provided, firm, level, and well-drained pedestrian walkways will be provided.
Utilities and Services - Construction Phase	
U&S_1	All utilities and services located within the area are to be considered as part of the engineering design of the Proposed Scheme, including where diversion or alterative provisions are required, and where flood protection is to be provided. Consultation with the affected utility providers / operators will be undertaken during this process.
U&S_2	All utilities and service diversions will be agreed in coordination with the design/engineering team, KCC, CCC and any operators (i.e., Uisce Éireann, Electricity Supply Board, Gas Networks Ireland etc.) and undertaken as part of the enabling works in advance of the commencement of construction activities.
U&S_3	The contractor will take all actions to avoid unplanned disruptions to any services during the construction phase of the project through identifying the location of all utility infrastructure within the work areas, ensuring that all works undertaken in and around known utility services are be carried out using strict and robust Method Statements and that the major services suppliers will be contacted in advance of ground works proceeding in an area.
U&S_4	Services disruptions impacting on residents or commercial outlets will only happen where unavoidable. In this scenario, residents and commercial outlets will be given advanced warning of the date, time and expected duration of the disruption. The contractor will be responsible for all underground services for which diversions are not required.
U&S_5	Provision of utilities will be carried out in accordance with the recommendations of the relevant statutory bodies (ESB, Gas Networks Ireland, Uisce Éireann, EIR, Virgin, County Councils etc.).
Waste Management - Construction Phase	
WM_1	The contractor(s) will prepare a Waste Management Plan (WMP) for the construction process, in order to define the main guidelines and procedures to be adopted for the effective reduction, management and disposal of waste material generated. A dedicated Waste Manager will be appointed to oversee and have overall responsibility of waste management during the construction phase however it will be the

Reference	Schedule of Environmental Commitments – Mitigation Measures
	responsibility of all personnel working on site to understand the waste management requirements and implement recycling, separation etc. and all other methods described within the WMP.
WM_2	The following methods will be implemented for general best practise management of waste: • Contractor will appoint a dedicated Waste Manager responsible for the implementation of the WMP, provision of waste training and keeping of all records associated to waste. • Provision of toolbox talks and awareness training to staff regarding waste management, particularly hazardous waste. • Provision of appropriate waste management infrastructure on site including receptacles for construction and demolition waste, general inert waste, recyclable waste and hazardous waste. • For the collection and movement of waste offsite, specialist waste service contractors will be engaged to transport material to appropriately certified and permitted facilities. • Maintain logs of all waste removed off-site to a licensed transfer station. • Conduct regular inspections and audits to monitor the effectiveness of the waste management programme.
WM_3	The following methods will be implemented to minimise waste: • Completion of scheme design with the prevention of waste as a core principle, considering options for material reuse (i.e., excavated soils). • Order materials and resources onto site on an 'as needed' basis through proper resource management and planned sequencing of works, to avoid wastage
WM_4	The following methods will be implemented to recycle and reuse waste: • Implement an achievable system of recycling on site through provision of appropriate training and collection infrastructure. • Reuse materials on site, where possible.
WM_5	Hazardous waste materials arisings are not anticipated, however should they arise during construction, the following methods will be implemented to manage hazardous waste: • Hazardous waste materials will be removed from site on a regular basis. • Only store approved quantities of hazardous waste on site and separated from other waste streams. • Ensure that all materials are appropriately stored in accordance with the Material Safety Data Sheet (MSDS), with relevant risk measures put into place (i.e., warning signage, fire safety equipment, spill kit and procedures). • All hazardous wastes will be in sealed labelled drums and stored in lockable chemical cabinets. Wastes should not come into contact with soils and should be stored either in drums or on hardstand areas. • The Contractor will ensure that all hazardous waste producers keep specified records of any hazardous waste arising from the site / premises. These records will set out the quantity, nature and origin of the waste, any treatment carried out and the quantity, nature, destination, frequency of collection and mode of transport of any hazardous waste transferred to another person.

Reference	Schedule of Environmental Commitments – Mitigation Measures
	• Appropriate completion of the Waste Transfer Form (Department of Environment, Community and Local Government under Legislation S.I. No. 324 of 2011 European Communities Shipments of Hazardous Wate Exclusively within Ireland). Waste producers and collectors need to keep copies of the completed forms for at least five years.
Operation and Maintenance Phase	
MA_1	Any lighting removed as part of the construction works will be reinstated or replaced during operation.
MA_2	Maintenance of flood defence measures that intersect with built services (i.e., roads & pathways) are to be inspected and maintained in accordance with the Operations & Maintenance Plan to avoid any impact to these services.
Note	The mitigation measures outlined for the construction phase will be applicable for any waste streams generated through routine maintenance works at operation phase.
Hydrology - Surface Water	
Construction Phase	
Note	During the construction phase, there will be consideration for the standard best international practice including but not limited to: • CIRIA, (2001), Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors, (C532) Construction Industry Research and Information Association. • CIRIA (2005), Environmental Good Practice on Site (C650); Construction Industry Research and Information Association. • BPGCS005, Oil Storage Guidelines. • CIRIA 697 (2007), The SUDS Manual. • UK Pollution Prevention Guidelines, (PPG) UK Environment Agency, 2004. • Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters. Inland Fisheries Ireland, 2016. • Fishery guidelines for Local Authority works. Department of Marine and Natural Resources 1998.
SW_1	In order to further reduce any potential effect of the works on occurring fish species in the area (Brown Trout, Atlantic Salmon), instream works will only be carried out between July and September.
SW_2	The choice of construction methodology will emphasise the requirement to avoid direct contact with the waterbodies in the study area.
SW_3	Excavated and imported soil materials will be stockpiled away from watercourses. Where stockpiles are located near watercourses, appropriate protection will be provided to avoid run-off (i.e., blanketing with geotextile layer, inclusion of run-off sumps).
SW_4	Wet stockpiles will include appropriate drainage sumps to avoid run-off of silt-laden material into watercourses.
SW_5	All works undertaken near the riverbanks will be fully consolidated to prevent scour and run-off of silt. Consolidation may include use of protective and biodegradable matting or geotextiles on the banks and the sowing of grass seed on bare soil.

Reference	Schedule of Environmental Commitments – Mitigation Measures
SW_6	A silt fence will be included around the site perimeter in the vicinity of earth works, where possible, to retain silts onsite. Otherwise, silt fences will be placed along the riverbank to avoid run-off.
SW_7	If ponding occurs onsite during periods of heavy rainfall, water will be pumped into a pond or sedimentation tank to allow settling of fine sediments prior to pumping to the local stormwater system.
SW_8	All earthworks will aim to be carried out in periods of dry weather (from April to September inclusive) to avoid potential for suspended sediment runoff.
SW_9	An appropriate dewatering methodology will be selected for works. This will consider the risk of any ground instability arising from dewater activities to potentially sensitive receptors in proximity to the works area.
SW_10	If required, dewatering will be achieved using a series of sump and submersible pumps and discharging through a suitably sized propriety sediment removal system. The contractor will regularly maintain the sedimentation tank to ensure that it is not full of sediment. This aims to prevent pollution of the river through the release of sediments.
SW_11	A suitably qualified Ecological Clerk of Works shall be appointed to oversee and monitor all measures taken to protect the aquatic environment.
Operation and Maintenance Phase	
SW_12	A regular maintenance regime will be implemented by the developer to ensure that all environmental protection measures are maintained at the development, that all infrastructure is kept in good working condition, and that the surface water and drainage networks are tended to as appropriate to avoid flood risk.
SW_13	The river flow will be maintained at the upstream storage area to allow Qmed (or near to it) flow through the dam at all times. This is the largest flood that occurs every 2 years statistically. This will maintain sediment equilibrium within the river channel.
SW_14	Should aggradation occur in the vicinity of the river flow control structures, removal of gravel will be carried out when river level is low. There will be no instream works. The top of the accumulated gravels will be removed leaving the low water channel unaffected. All gravels removed will be made available to Inland Fisheries Ireland (IFI) for use in fisheries enhancement elsewhere in the catchment and will be stored on site for this purpose. It is not anticipated that this maintenance will be required on a regular basis.
Note	The mitigation measures outlined for the construction phase are sufficient to ensure protection of water quality during maintenance events (i.e., riverbank clearing, debris removal etc).
Cultural Heritage	
Construction Phase	
CH_1	Due to the complex nature of the work packages proposed for this scheme, it is proposed that an OPW Project Archaeologist (PA) will be made available to provide oversight of all archaeological, architectural and cultural heritage commitments.

Reference	Schedule of Environmental Commitments – Mitigation Measures
CH_2	A competent archaeologist experienced in riverine and terrestrial archaeology will be appointed directly by the client to advise the project team on archaeological and cultural heritage matters during construction; to acquire any consents required to conduct the work, and to supervise and direct the archaeological measures associated with the scheme, coordinate the archaeological element of individual work packages and to ensure that all work is carried out to the required standard (i.e. a scheme wide Project Archaeologist). The appointment of the experienced riverine/underwater archaeologist will be separate to the appointment of a project archaeologist by the Office of Public Works or other project sponsor to oversee those parties' interests in the scheme.
CH_3	As recommended by the National Built Heritage Service (NBHS), a project conservation engineer will be retained where appropriate during the preparation of the tender/ works package, construction and reinstatement stages of the FRS. The conservation engineer will ensure that the specifications and methodologies outlined in Drawings 1441 and 1442 are carried out in full and that the work is to an appropriate standard. Methodologies are to be agreed with the NBHS in advance of works.
CH_4a	Recording of upstanding walls and bridge side walls to be replaced and reinstated as part of the proposed FRS will be recorded in advance of construction. This will include a written and photographic record and scaled drawings and will serve to provide a record of the past. The record will note the capping stones, the coursing of the original masonry, where it exists or is preserved. Random rubble masonry will require the retention of all pinning stones so that the rhythm and texture of the original may be replicated and where it is built to courses, the same attention to coursing is essential. The dismantling will be carried out by hand. When construction of the flood walls are complete, the boundary walls will be rebuilt to match the original wall construction. Where a boundary wall will be removed and will not be rebuilt such as CH13 on Graiguenamanagh Quay the stone will be salvaged and reused within the scheme.
CH_4b	Recording of buildings and areas – CH11A Removal of vegetation and full recording of structure by scaled drawing, laser scan and written record will ensure that there is a record for posterity. Mitigation measures to include a written and photographic record and scaled drawings (plan and elevation) of the structure and an internal record, will serve to provide a record of the past.
CH_5	Vibration monitoring will take place on neighbouring structures and walling of a heritage and historic interest to limit accelerations to 3mm/s of any pile driven works. Buildings and structures where vibration monitoring will take place are detailed in Appendix 9-8 and Table 9-9 (including CH04, CH05, CH06, CH07, CH08, CH10, CH15, CH17, KK029-018008, C125, C149, C140, C635, C17, C18, C648, D152, C647, C654 rear of and C134 rear of). See also Chapter 15 'Noise and Vibration'.
CH_6	The safe storage and reuse of historic material, specifically stone (salvaged stone) will take place throughout the project as directed by the conservation engineer and where detailed in Table 9-9 and in agreement with the statutory authorities. For further information see also Appendix 9-8.
CH_7	Archaeological Testing was not suitable for some areas of the scheme due to restricted access to private lands, restricted spaces, existing walls, roads and services. Archaeological test excavation is proposed to take place in the following locations: • Area 7 - Dock Road to assess the below ground potential of the proposed storm drainage infrastructure and pumping station.

Reference	Schedule of Environmental Commitments – Mitigation Measures
	• Area 9 – Assess the greenfield environment of Hotel Street/ Tinnahinch Landscape East Zone and the archaeological potential of the lands where a raised embankment and subsurface drainage and pumping station is proposed. • Area 1 – Upstream storage area, even though the impact is slight, test excavation of the proposed works (Drawing 1421) has the potential to identify small and isolated features of an archaeological nature (if they exist), gather more information about the stratigraphy and soil and to inform the design and construction tender specifications. • Area 6 – Further assessment of the Graiguenamanagh Quay Public Realm Zone (Duiske Abbey Precinct Area) in the form of wider box trenches in order to reach deeper levels to ascertain if features associated with a precinct wall and abbey or earlier quay side features exist. This work is to be carried out under Ministerial Consent (see CH_8: Archaeological excavation). Testing is to take place in advance of construction and site enabling works. The results will inform the construction stage tender packages and will allow for the appropriate timing of the archaeological resolution once agreed with the National Monuments Service (NMS). Mitigation of the impact of development on the archaeological resource can take the form of 'preservation by record' (full hand excavation); and 'preservation in situ by design' (excluded from development and avoided through design measures) or a combination of both. Where archaeological features revealed by the test-trenching, are directly impacted by the proposed works and cannot be avoided (preserved in-situ), they will be preserved by record by means of archaeological excavation, recording and publication of results.
CH_8	Archaeological excavation ensures that the removal of any archaeological soils, features, finds and deposits is systematically and accurately recorded, drawn and photographed, providing a paper and digital archive and adding to the archaeological knowledge of a specified area (i.e., preservation by record). As archaeological excavation involves the removal of the archaeological soils, features, finds and deposits, following this mitigation measure there is no further impact on the archaeological heritage. It is proposed that archaeological excavation along Graiguenamanagh Quay will take place as an advance contract to further understand and record the organic deposits and walls that were revealed from archaeological testing along the road where excavation works will take place for the development of the flood defence works. Prior to construction, further archaeological investigation will be undertaken at the quayside through an advance archaeological contract. This will involve the excavation of features previously identified during testing, where they are likely to be affected by the proposed development. Subject to agreement with the National Monuments Service (NMS), the excavation will follow a wider box trenching layout to facilitate access to deeper levels and enable more comprehensive archaeological inspection and recording. This approach is intended to prevent delays during the construction phase by ensuring that any archaeological features encountered can be addressed in a considered and timely manner.

Reference	Schedule of Environmental Commitments – Mitigation Measures
	The targeted areas for further investigation include extensions to Trenches A–E along the alignment of the proposed works, including the sheet piling. The proposed box trenches, to be agreed with the NMS, will typically measure approximately 5 metres southeast–northwest by 2–3 metres northwest–southeast. Additionally, a trench of similar dimensions will be opened outside the entrance to the supermarket car park, where previous archaeological testing could not be carried out.
CH_9	Archaeological monitoring. The construction phase will involve earthmoving activities including excavations for the construction of flood walls and provision of construction compounds and storm drainage, pumping stations and alterations and upgrades to utility services. All earthmoving activities within Area 1 – Area 10 and site clearance works and compound areas will be subject to archaeological monitoring under licence from the NMS of the DHLGH. Archaeological monitoring will ensure the full recognition of, and the proper excavation and recording of, all archaeological soils, features, finds and deposits which may be disturbed below the ground surface. Work will also take place instream along the River Duiske and these works will be archaeologically monitored. The licensed archaeologist will have provision to inspect all excavation to the formation level for the proposed works and to temporarily halt the excavation work, if and as necessary. They will be given provision to ensure the temporary protection of any features of archaeological importance identified.
CH_10	Archaeological Metal Detection will take place in conjunction with other forms of archaeological investigation in order to identify and recover metallic artefacts. This will take place where archaeological monitoring of the works are taking place under licence to the National Monuments Service and the National Museum of Ireland.
CH_11	Archaeological Wade Survey A visual archaeological instream inspection of the Duiske River will take place in advance of construction works and during vegetation clearance works. This is designed to assess the dynamic riverine environment and its potential, recover stray finds or items of a cultural heritage interest and identify and recover stone lintels (if they are present) that have become displaced, upstream or downstream of the Clapper Bridge.
CH_12	Modern Memorials, Statues and street furniture such as the statue of the monk at Graiguenamanagh Bridge (C125), at Graiguenamanagh Quay 9D152, the bollards and lighting and memorials at Tinnahinch (CH16 and CHZ06) will be removed to a secure location during the enabling and construction works and will be reinstated as required to an agreed location once the works have ceased if they cannot be adequately protected in situ during the course of the works.
CH_13	Consultation and notification. In the event of the discovery of archaeological finds or remains, the OPW PA, NMS and the National Museum of Ireland (NMI) will be notified immediately. If features are revealed, the immediate area will be investigated, allowing no further development to take place until the site is fully identified, recorded and excavated the satisfaction of the statutory authorities. The provision (time and funding) will be made for the full recording and, if necessary, excavation of the archaeological material in compliance with any measures that the DHLGH and the relevant local authority deem appropriate. This possibility will be accounted for

Reference	Schedule of Environmental Commitments – Mitigation Measures
	in the Project programme and budget and will be undertaken at the earliest phases of the development to allow the archaeologists sufficient time to record/excavate as required.
CH_14	The flood relief scheme will make provision to allow for, and to fund, the necessary heritage works including but not limited to architectural heritage recording, archaeological monitoring, inspection and excavation works that will be needed on-site during and prior to construction, either directly or indirectly via the appointed contractor.
CH_15	Agreement of Method Statements. All method statements for archaeological works will be reviewed by the OPW PA and approved and amended as necessary before being submitted to the NMS for approval as set out in section 4.2 of the archaeology and Flood Relief Schemes Guidelines.
CH_16	As stated in CH_9, all phases of the development including site clearance and enabling works, for example, the preparation of site compound areas, the removal and clearance of scrub and the demolition of existing structures will be appropriately monitored, supervised and assessed where necessary by a competent archaeologist and /or conservation engineer.
CH_17	Archaeological Resolution Contract. As demonstrated in this chapter, there are significant archaeological and cultural heritage assets within the footprint of the works. In order to reduce risk post planning, some of the archaeological mitigations/resolution proposed in the mitigation recommendations of this chapter may be advanced before a main works contract, or as an early part of a main works contract before the flood defence works are commenced. This may include additional geophysical surveys and archaeological excavations/testing. This will ensure a timely resolution of any newly revealed archaeological features and that this work is carried out to the requirements of the National Monuments Service and the Local Authorities. Follow up archaeological, architectural heritage and cultural heritage inspections (terrestrial and/or underwater) to assess that there are no residual impacts due to the operation of the FRS works.
CH_18	**Preservation in situ**. This is a primary objective of the archaeological heritage assessment component of FRS projects (NMS 2023). This approach was adhered to with this scheme and where possible and preservation by design have been availed of in order to maintain the historic character and individual archaeological, architectural and cultural heritage elements that contribute to this significant heritage town. Mitigations include: avoiding locations or designs containing or effecting archaeological heritage features, minimising impacts on such features and remedying any changes in context or fabric that may occur.
Operation and Maintenance Phase	
CH_19	KCC will be responsible for the maintenance of the scheme in full. As a result of the scheme being developed and in operation, it must be ensured that archaeological monuments, protected structures and features of cultural heritage importance are maintained or enhanced as described in the post mitigation impacts.

Reference	Schedule of Environmental Commitments – Mitigation Measures
Biodiversity	
Construction Phase	
Bio_1	All construction will be undertaken in accordance with the CIRIA (2015) Environmental Good Practice on Site (Charles and Edwards 2015); • Mitigation described in this report will be followed during site construction and operation phases; • A site-specific Construction Environmental Management Plan (CEMP) will be written by the contractor prior to site works commencing. This CEMP will incorporate the mitigation measures listed here.
Bio_2	The site compound shall be located within the site boundary. • The compounds are sited as far from any water course where possible in order to minimise any potential impacts, leaving an appropriate buffer (typically 3m) of natural bed and banks undisturbed allowing a natural bank-path. Silt fences will be erected to prevent any run-off from the perimeter of the compounds. • Site compounds site shall be restored to their original state following the construction phase.
Bio_3	A pre-construction survey of the scheme will be undertaken by an experienced Ecologist in order to to confirm the baseline and refine environmental mitigation as required. Once planning permission has been secured, pre-construction ecology surveys will be carried out within the Proposed Scheme area well in advance (ideally 3-4 months prior to construction works) in order to ensure that sufficient updated information is available to inform derogation licence applications, as required.

Bio_4	An Ecological Clerk of Works (ECoW) should be employed to monitor the works and to inform the team through Ecological Toolbox Talks during the proposed works and tree felling activities. A species protection plan will be designed by a professional ecologist to ensure that works related to this proposal take into account any protected bird species present on site and the nearby surroundings.
	• A minimum of 1 no. ECoW visit shall be conducted per week during the course of the construction works at this site during the construction phase. The ECoW shall be present on-site during commencement of works. As such the following points must be adhered to for this scheme:
	  • An ECoW will be involved as required during the construction period for this scheme, in order to ensure that the required mitigation is implemented.
	  • The ECoW and the Contractor will walk the Proposed Scheme together prior to work commencing on the site, in order to discuss the ecological constraints, to highlight all required mitigation and to demarcate exclusion zones appropriately.

Bio_5	To minimise exacerbated adverse effects, the removal of vegetation, soil, existing concrete will not take place during periods of heavy rain. Weather forecasts will be considered during the construction works and works will be minimised when there is forecast for heavy rain.

Reference	Schedule of Environmental Commitments – Mitigation Measures
Bio_6	Earth moving works will be avoided during very wet weather conditions to minimise the occurrence of sediment and/or contaminant mobilisation.
Bio_7	Fuels, lubricants and hydraulic fluids for equipment used on the construction site, as well as any solvents and oils, will be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, provided with spill containment.
Bio_8	Fuelling and lubrication of equipment may be conducted on the site but within designated areas and in conjunction with appropriate spill prevention measures (e.g., drip trays, plant nappies, etc).
Bio_9	Oil and fuel stored in bunded areas shall be stores an appropriate distance from any discharge point as to prevent accidental spills entering the aquatic environment.
Bio_10	Refuelling must be carried out using 110% capacity double bunded mobile bowsers. The refuelling bowser must be operated by trained personnel. The bowser must have spill containment equipment which the operators must be fully trained in using.
Bio_11	A fuel spill kit shall be retained on the site for the period of construction.
Bio_12	Any spillage of fuels, lubricants, or hydraulic oils should be immediately contained, and immediate emergency control measures implemented to ensure no ingress into the aquatic environment. The nearby dirty water drain outlet must be blocked with an oil absorbent boom until the fuel/oil spill has been cleaned up and all oil and any contaminated material removed from the area. This contaminated material must be properly disposed of in a licensed facility.
Bio_13	The site Environmental representative must be immediately informed of the oil leak/spill and must assess the cause and the management of the clean-up of the leak or spill. They must inspect nearby drains for the presence of oil and initiate the cleanup if necessary.
Bio_14	The washing of vehicles and/or construction machinery and/or HGVs must occur within designated wash areas (i.e., away from watercourses or areas connected to nearby watercourses).
Bio_15	Moreover, wash down water from exposed aggregate surfaces, cast-in-place concrete and from concrete trucks should be trapped on-site in a dedicated area, to allow sediment to settle out and reach neutral pH before clarified water is allowed to percolate into the ground.
Bio_16	Discharge from site will be discharged to silt bag with overflows directed to land before being discharged to the river.

Reference	Schedule of Environmental Commitments – Mitigation Measures
Bio_17	During the works, best practice noise reduction measures described in British Standard 5228-12009+A1:2009, Code of Practice for Noise and Vibration Control on Construction and Open Sites must be incorporated into the Construction and Environmental Management Plan.
Bio_18	For mobile plant items such as cranes, HGV's, excavators and loaders, maintaining enclosure panels closed during operation can reduce noise levels over normal operation.
Bio_19	Mobile plant will be switched off when not in use and not left idling.
Bio_20	For steady continuous noise, such as that generated by diesel engines, noise reduction must be achieved by fitting a more effective exhaust silencer system
Bio_21	Acoustic screens are required to be erected in certain locations for the duration of the redevelopment works. These screens shall be carefully positioned to be as effective as possible. In general, the barrier shall have no gaps or openings in the joins of the barrier material. The barrier material shall have a minimum mass per unit area of 7 kg/m2 and minimum recommended height of 2.4m.
Bio_22	Low decibel machinery must be used for those that will be used continuously such as water pumps to limit any noise emissions from the site in the late evenings and early mornings when mammal (i.e., otter) activity is at a higher level.
Bio_23	Best practice construction measures should be taken to avoid the spread of invasive plant species during the construction phase as they can quickly out-compete native plant species in Ireland. Construction workers onsite must be made aware of the location of invasive species before construction activity commences and consider that Physical removal and treatment of the invasive species should be undertaken only in areas where they invasives cannot be avoided by construction activities.
Bio_24	It is advised that the contractor refers to the following documents, which provide detailed recommendations for the control of invasive species and noxious weeds: Chapter 7 and Appendix 3 of 'The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads' (NRA, 2010) and the Invasive Species Management Plan appended to the Outline CEMP (Appendix 4-5 of this EIAR).
Note	Surface water protective measures outlined in Bio_5 to Bio_16 of the specific mitigation measures will be adhered to for the protection of watercourses used by otters. This will help avoid the contamination of prey that otters feed on as well as maintaining the water quality of the river in which the otters forage.
Note	Noise emission measures outlined in Bio_17 to Bio_22 of the specific mitigation measures will be adhered to for the protection of mammals including otters. This will help avoid significant negative impacts to surrounding mammal species from potential noise emissions from the site.

Reference	Schedule of Environmental Commitments – Mitigation Measures
Bio_25	Careful storage of machinery by cordoning off of hazardous machinery with temporary fencing at the end of the working day and the restriction of works to daylight hours (otters and badgers are largely nocturnal) should be implemented by the contractor on site. These mitigation works will necessarily be implemented throughout the entire construction period.
Bio_26	In the event that new holt / couch / evidence of Otter is identified during the construction phase, the guidance within the "Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes" (NRA, 2008) will be followed, accordingly.
Bio_27	Culvert crossing and instream works must be designed such that they do not impede the movement of Otter along watercourse. Instream works will allow enough space for otters to pass through without having to divert onto land and back onto the watercourse downstream. This is not possible for the flow control structure in the upstream storage are, however, all other instream works will allow free passage of otters.
Bio_28	No night lighting/security lights shall be directed towards the river in a way that causes artificial illumination of the river corridor.
Bio_29	Where construction lighting is required, light spill should be minimised as much as possible. This can be achieved by the use of directional lighting (i.e. lighting which only shines on the proposed works and not nearby countryside) to prevent overspill. This should be achieved by the design of the luminaire and by using accessories such as hoods, cowls, louvres, and shields to direct the light to the intended area only. Lighting should be minimised in potential foraging and commuting areas, and the times during which the lighting is on should be limited to provide some dark periods. Lights should be positioned to avoid sensitive areas and restricted so that there are dark areas. The timing of lights should be restricted to avoid bat activity (i.e. from dusk until dawn).
Bio_30	Where possible, mature trees and treelines that are located immediately adjacent to planned work areas or are not directly impacted should be avoided and retained intact. Overall impacts on these sites should be reduced through modified design and sensitivity during works. Retained trees should be protected from root damage by machinery by an exclusion zone of at least c. 7 metres or equivalent to canopy height. Such protected trees should be fenced off by adequate temporary fencing prior to other works commencing. This will ensure that bat transport and foraging routes (treelines) remain intact and unharmed from the works.
Bio_31	Any mature broadleaved tree(s) scheduled for removal as part of the proposed development plans will be surveyed for bat presence by a suitably experienced specialist immediately prior to felling. If bats are found, an application for a derogation licence should be made to the National Parks and Wildlife Service to allow its legal removal. Such trees should ideally be felled in the period late August to late October, or early November, in order to avoid disturbance of any roosting bats as per National Roads Authority (NRA) guidelines and also to avoid the bird breeding seasons. Tree felling should be completed by mid-November at the latest as bats roosting in trees are vulnerable to disturbance during their hibernation period (November - April). If trees are to be removed outside of these periods extra care should be taken prior to felling to ensure no protected species are present. Trees with ivy cover, once felled, should be left intact onsite for 24 hours prior to disposal to allow any bats beneath foliage to escape overnight.

Reference	Schedule of Environmental Commitments – Mitigation Measures
Bio_32	Linear features such as treelines and hedgerows serve as commuting corridors for bats (and other wildlife). The onsite boundary vegetation especially that bordering the Duiske and Barrow Rivers should be retained and/or replaced once construction ends. Native species will be chosen in all landscaping schemes. Planting schemes attempt to link in with existing wildlife corridors (hedgerows and treelines) to provide continuity of wildlife corridors.
Bio_33	Mitigation to prevent a reduction in water quality and damage to the river channel habitats following the works include improved fencing along the riverbank and riparian zone, along with provision of drinking troughs, in order to prevent the poaching from livestock which was evident at a number of locations along the channel surveyed, in the upstream storage area.
Bio_34	No instream works will be carried out between the months of October and June (inclusive) to avoid the most sensitive time for fish species and fish species movements, unless agreed otherwise with IFI in writing.
Bio_35	Although Salmonids were only identified during fish community surveys in the lower reaches of the River Duiske, the ECoW should undertake an assessment of proposed sites for the watercourse diversion and culvert crossing works to determine the suitability of the site as Salmonid spawning habitat. River flow, depth and substrate will be assessed in these areas to determine suitability for salmonid spawning.
Bio_36	The final placement of the inlet for the upstream storage flow control structure instream should be in such a way that the natural flow of water is not significantly altered nor impedes the movement of fish species along the watercourse.
Bio_37	Bankside disturbance should be kept to an absolute minimum to avoid bank slumping and / or significant sediment influxes
Bio_38	The proposed temporary watercourse diversion works should occur along a stretch of lowest gradient (where feasible) to minimise significant alteration in surface water flow and / or sediment run-off / transport.
Bio_39	The proposed temporary watercourse diversion will be lined with an appropriate substrate mix (gravels-sand-cobbles) to reflect the natural substrate composition of the watercourse.
Bio_40	The stretch of river planned for temporary diversion measures will be investigated for the presence of fish species (e.g., Salmon, Trout, Lamprey, etc) by an appropriately qualified fisheries/aquatic ecologist prior to any diversion works commencing. This should occur: • Immediately prior to rivers/streams being diverted into a newly constructed river channel, electrofishing should be conducted to capture and transfer fish from the original channel to the new one. • Once the watercourse has been diverted, a manual search of the original watercourse must be made to transfer any remaining fish and / or crustaceans to the new river/stream channel.
Bio_41	For any temporary river diversion works, specific attention must be given to the avoidance of unnecessary vegetation clearance.
Bio_42	Watercourse diversion works and culvert crossing works should take place during periods of low flow.

Reference	Schedule of Environmental Commitments – Mitigation Measures
Bio_43	Minimal excavation works be undertaken to minimise potential sediment run-off into watercourses where culvert crossing and diversion will occur.
Bio_44	Where feasible, soil excavation will be completed during dry periods.
Bio_45	Where required, silt fences will be used along the banks of watercourses and instream where instream diversion works will occur to limit the runoff / influx of disturbed sediment. Additionally, silt fences will be used in areas proximal to excavation / diversion works that are susceptible to sediment influx (e.g., drainage lines, natural depressions, tributaries, etc).
Bio_46	Site clearance for river diversion works will only commence and be undertaken when works are required, adopting a planned approach to avoid mass site clearing that will ultimately result in exposed ground for long periods of time.
Bio_47	Any / all protected habitats / species will be identified and zoned as “no-go” areas established and suitably isolated from works using fences, barriers, screens and signage.
Bio_48	Invasive or noxious plants (e.g. Japanese knotweed, Himalayan balsam, etc.) will be removed through appropriate means from the river diversion course before works commence.
Bio_49	The timing of vegetation removal will be carefully considered to avoid particularly sensitive periods of the year (e.g., bird nesting season, high flow periods).
Bio_50	During site clearance operations, appropriate measures must be taken to ensure the stability of the bank, particularly where there is a risk of raised water levels (i.e. seasonal high flows) until the vegetation is re-established or prior to the placement of concrete support infrastructure.
Bio_51	Appropriate flow regulator infrastructure will be placed into the river diversion pathway, either as natural infrastructure (e.g., rock / boulders) or artificial infrastructure (e.g., concrete blocks) to maintain the natural flow of the diverted river, which will also minimise unnecessary sediment removal and flow downstream. This is particularly pertinent to consider during potential periods of higher flow following precipitation events. Alteration in the natural flow regime may result in increased sedimentation of river stretches or erosion of key habitats and / or riverbanks downstream.
Bio_52	All temporary crossing structures used to cross watercourses during construction will be designed in accordance with the Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016) and Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes (NRA, 2005) to maintain fish and macroinvertebrate passage, and to prevent sedimentation and erosion.
Bio_53	Vertical barriers and/or ground protection must protect all trees proximal to the proposed works that are being retained on site. It is essential that these provisions be put in place prior to any development work or soil excavations are carried out. The purpose of protective barriers is to exclude any harmful construction activity that may damage the Root Protection Area (RPA). A root protection area is calculated as using the diameter of the tree trunk at 1.5 meters height x12 (Woodland Trust, 2021). These barriers help protect the main

Reference	Schedule of Environmental Commitments – Mitigation Measures
	stem of the tree. Tree protection barriers should be fit for the purposes of excluding construction activities and be durable to withstand an impact. The barrier should consist of a vertical and horizontal frame and should be at least 2.3m in height.
Bio_54	To ensure the protection barriers are respected, clear concise signage must be affixed to the barrier in an unrestricted easily viewed location. The signage must specify that no construction activity is to take place within the RPA. This should remain the case until completion of all works unless certain works are deemed acceptable following consultation with an arborist. The signage must also state that no materials of any description are to be stored or the "spilling out" of materials should not occur within the RPA. Site personnel must be made aware of the importance of the protective barrier.
Bio_55	Any excavation works carried out within the RPA should be undertaken with extreme care and should be carried out with due diligence, avoiding damage to the protective bark covering larger roots. This may involve excavation by mini-digger and/or hand as deemed appropriate.
Bio_56	Where works occur in very close proximity to trees to retained, trunk protection will also be put in place using hessian sacking and timber strips clad around the tree, in order to mitigate any potential damage that may occur.
Bio_57	Alteration of ground levels within the RPA will only be carried out following a considered assessment of the likely impact on the tree. In general, a ground alteration in excess of 75mm will be avoided. Changes in ground levels in the vicinity of a tree may alter the existing soil hydrology and necessitate the incorporation of adequate drainage around the tree. New impermeable surfaces will not cover more than 20% of the RPA. An increase in ground level up to a maximum of 1m is tolerable for certain species using specific techniques (beech and oak are not amenable to such a level of disturbance). This involves the construction of a dry well around the tree trunk allowing for future growth and the incorporation of coarse aggregates to provide sufficient drainage and allow for gaseous diffusion in the raised ground.
Bio_58	A number of areas have been identified as suitable for replanting as outlined in Section 10.8 and in Chapter 11 – Landscape and Visual. The species assemblage will broadly resemble what currently exists onsite along with other native hedgerow species which will be added to the mix.
Bio_59	To limit the potential impact of construction on breeding birds, removal of woody vegetation will be restricted to the non-breeding season (September to February, inclusive). Where the construction programme does not allow this, an ecologist will undertake a breeding bird check immediately prior to vegetation clearance. Where no breeding birds are present, clearance may proceed without requiring a derogation licence from the NPWS. However, given that breeding birds and the nests of all bird species are protected under the Wildlife Acts, a licence would be required from the NPWS to permit the destruction of nest sites. NPWS will be consulted prior to disturbance of breeding birds during the breeding season (1st of March to the 31st of August).
Bio_60	If the contractor intends to carry out clearance works during the bird breeding season, guidance will be sought from the NPWS with regard to compliance with Section 40 (1) and Section 40 (2) (e) of the Wildlife Acts.

Reference	Schedule of Environmental Commitments – Mitigation Measures
Bio_61	Treelines and areas of scrub offer birds suitable nesting habitat locations. These areas will be protected and remain untouched during construction. The proposed works will be carried out with the aim of avoiding as much damage to this potential bird nesting habitat as possible.
Bio_62	Any trees or scrub in the way of the development layout are to be removed in such a manner not to cause damage to those trees to be retained. Root protection areas will be marked out around the trees to be retained. No machinery will enter these areas
Note	Surface water protective measures outlined in Bio_5 to Bio_16 of the specific mitigation measures will be adhered to for the protection of watercourses used by waterbirds.
Note	Noise emission measures outlined in Bio_17 to Bio_22 of the specific mitigation measures will be adhered to for the protection of surrounding waterbirds. This will help avoid significant negative impacts to surrounding bird species from potential noise emissions from the site.
Operation and Maintenance Phase	
Bio_63	Mitigation measures for the protection of surface water (Bio_5 to Bio_16) and for the protection of freshwater fish (Bio_33 to Bio_53) should be followed for the clearance of the debris trap and any long-term vegetation maintenance during the operational phase.
Landscape and Visual	
Construction Phase	
LV_1	Operating a well-managed, organised and planned construction site, with adequate control of construction traffic and working activity, is key to avoiding/minimising such impacts. Daily inspections of site and compounds will be undertaken the site manager to ensure they are tidy.
LV_2	In addition, any lighting required during the construction phase should be located sensitively to avoid unnecessary light spill into the surrounding residential areas, river corridors and into woodlands.
LV_3	The construction works and the habitat protection measures will be carried out in accordance with measures outlined by the project ecologist and KCC.
LV_4	Existing woodlands, trees and hedgerows to be retained should be protected in accordance with the project arboriculturist recommendations for the full duration of the construction phase e.g. tree protection fencing and no structures, storage of materials or change in ground levels should take place within the tree's root protection areas (RPA). Refer to Biodiversity mitigations for further details.
LV_5	Following the construction phase, the lands used as site compounds will be restored to their original state e.g. amenity grass lands, grazing lands. Refer to Biodiversity mitigations for further details.

Reference	Schedule of Environmental Commitments – Mitigation Measures
Operation and Maintenance Phase	
The careful and considered approach to the proposed works is to minimise negative visual impact both locally and from the wider surrounding area. The landscape strategy below details the landscape proposals that will assist in mitigating the landscape and visual impacts of the proposed works (should be read in conjunction with the landscape drawings). The key objectives include:	
LV_6	Retention and protection of the vegetation along river edges and existing field boundaries where possible. • This helps to retain a mature, established character to the area and provide a unifying, cohesive landscape framework that relates it to the surrounding landscape and its context, as well as being of ecological benefit. • Generally, this will involve retention of mature good quality trees within the woodlands, tree belts and hedgerows (as outlined in the Arboricultural Report). • The design of the flood defence proposals have, where possible, attempted to avoid negative impacts on the existing field boundaries to ensure the retention of the vegetation where possible and to retain the historical patterns of the landscape.
Integration of the flood defence proposals into the surrounding townscape and landscape, minimising landscape and visual impacts, in particular upon nearby residential dwellings, protected views/ scenic routes, views to and from the River Barrow and the various regional and national walking trails. This is largely to be achieved by:	
LV_7	Considered approach to the siting and extents of the flood defence proposals, such as aligning flood walls in place of existing walls or following existing boundaries; glazed panels within the walls to facilitate views to and from the river and to assist in retaining the open character of the quays.
LV_8	Planting programme with native species wherever possible, within the scheme area - Planting of trees to compensate for the loss of trees removed due to the proposed works and/ or to assist in the integration of flood defence proposals into the surrounding landscape or town environs. New tree planting is not always possible where it is determined the trees may compromise the flood defence proposals in the future or at times of flooding. Proposed flood defence embankments are to be planted with wildflower meadows wherever possible to assist in their integration into the surrounding landscape. Refer to Chapter 10 – Biodiversity for further details.
LV_9	Utilising materials (e.g. paving, wall cladding) and street furniture that are sympathetic to or from the locality and do not detract from existing significant features or historical structures (in consultation with KCC and CCC).
LV_10	Working with the existing topography of the scheme area as much as possible.
LV_11	Improving pedestrian movement within the town and links to the wider walking trails (e.g. South Leinster Way and the Barrow Way), through segregating pedestrians and vehicles, narrowing road corridor (changing from two-way to one-way system) along Graiguenamanagh Quay, clearly demarked pedestrian route, designated crossing points.

Reference	Schedule of Environmental Commitments – Mitigation Measures
Land, Soils, Geology and Hydrogeology	
Construction Phase	
LSGH_1	The locations of the proposed defences have been defined with consideration of land zoning, with measures implemented to minimise impact where possible. This has been informed by a rigorous consultation programme and continuous coordination with the planning authorities.
LSGH_2	With regard to land take of the green and recreational parkland areas (The Hub), mitigation during construction will consist of land being set out prior to construction in such a manner to minimise the construction footprint and will be clearly demarcated by fencing. There will be provision of safe accesses and egresses through the area, and provision of information to the general public through signage and notices.
LSGH_3	Appropriate due diligence to be undertaken in the sourcing of materials from responsible and audited suppliers, and in the testing of materials prior to use, to determine both suitability, contamination (Heavy Metals, TRH, PAH, OP/OC Pesticides) and inspected for presence of deleterious materials. Imported discarded soils to be reused/ recovered on site will be certified as suitable for use by a suitably qualified person as per requirements of EPA Guidance on Waste Acceptance Criteria at authorised soil recovery facilities.
LSGH_4	If contamination is encountered in geology, soils or hydrogeology, suitable measures will be put in place to avoid mobilising the contamination based on the most appropriate industry best practice guidance for contaminated land management.
LSGH_5	The management of surplus excavated material or temporarily stored materials at the site compounds will be determined by the classification of the material (i.e., contaminated, or not, in line with the European Waste Catalogue and Hazardous Wate List, the Waste Management Act and the Hazardous Waste List), with mitigation measures implemented as appropriate (see Chapter 7 for mitigation measures regarding the management of hazardous waste). These measures will prevent disturbance of any existing contamination that may be present at the site compounds. They will also prevent interaction between any existing contamination present on the site compounds and materials stored there and will ensure that contaminate excavated material will not have an impact on the underlying soils or hydrogeology.
LSGH_6	A contingency plan for accidental leaks and spillages is included in the CEMP, the implementation of which will be further developed by the contractor prior to the commencement of the works and regularly updated during construction. The CEMP will include the mitigation measures of the EIAR. This contingency plan identifies the actions to be taken in the event of a pollution incident in accordance with the CIRIA guidance 741 *Environmental good practice on site*, and includes: • Containment measures. • Emergency discharge routes. • List of appropriate equipment and clean-up materials. • Maintenance schedule for equipment. • Details of trained staff, location and provision for 24-hour cover. • Details of staff responsibilities.

Reference	Schedule of Environmental Commitments – Mitigation Measures
	• Notification procedures to inform the Environment Protection Agency (EPA) or Environmental Department of the Kilkenny County Council. • Audit and review schedule. • Telephone numbers of National Parks and Wildlife Services (NPWS) and Inland Fisheries Ireland (IFI). • List of specialist pollution clean-up companies and their telephone numbers
LSGH_7	The storage of all fuels, other hydrocarbons and other chemicals shall be within the construction compound only and shall be in accordance with relevant legislation and best practice. In particular: • Fuel storage tanks shall have secondary containment provided by means of an above ground bund to capture any oil leakage. • Storage tanks and associated provision, including bunds, will conform to the current best practice for oil storage and will be undertaken in accordance with Best Practice Guide BPGCS005 – Oil Storage Guidelines (Enterprise Ireland).
LSGH_8	Apart from the case of water extraction pumps situated by the river, fuel storage, temporary or otherwise, and refuelling shall not be permitted within 10m of the watercourse at these locations.
LSGH_9	Provision of an adequate supply of spill kits and hydrocarbon adsorbent packs will be stored at each work area. The Site Environmental Manager will maintain an inventory of spill kits on site to ensure all are properly equipped.
LSGH_10	As part of the site Environmental Induction Training all staff will be informed of the spill contingency plan and the location and use of the spill absorbents.
LSGH_11	If a spillage does occur, the adsorbents will be treated as a hazardous waste and disposed of accordingly (see mitigation measure WM_5 regarding the management of hazardous waste).
LSGH_12	Vehicles and equipment will be maintained by a suitably trained person and checked on a regular basis.
LSGH_13	Daily vehicle and equipment checks will include a visual assessment for oil or lubricant leaks prior to use.
LSGH_14	Vehicles will be parked on hard standing areas overnight or when not in use, as applicable.
LSGH_15	Re-fuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated area (or where possible off the site) which will be away from any existing surface water gulleys or drains. In the event of a machine requiring refuelling outside of this area, fuel will be transported in a mobile double skinned tank.
LSGH_16	A suitable risk assessment for wet concreting will be completed prior to works being carried out which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil.
LSGH_17	Washout from concrete lorries, with the exception of the chute, will not be permitted on site and will only take place at the construction compound (or other appropriate facility designated by the supplier).

Reference	Schedule of Environmental Commitments – Mitigation Measures
LSGH_18	Chute washout locations will be provided with appropriate designated, contained impermeable area and treatment facilities including adequately sized settlement tanks. The clear water from the settlement tanks shall be pH corrected prior to discharge (which shall be by means of one of the construction stage settlement facilities) or alternatively disposed of as waste in accordance with the Contractor's Waste Management Plan.
LSGH_19	Movement of material will be minimised in order to reduce degradation of soil structure and generation of dust.
LSGH_20	All excavated material will, where possible, be reused as construction fill. The appointed contractor will ensure acceptability of the material for reuse for the proposed development with appropriate handling, processing and segregation of the material.
LSGH_21	Excavated soil materials will be stockpiled locally within the working area where possible, using an appropriate method to minimise the impacts of weathering. Care will be taken in reworking this material to minimise dust generation, hydrogeology infiltration and generation of runoff. Any surplus suitable material excavated, that is not required elsewhere for the proposed development, will be used for other projects where possible, subject to appropriate approvals/notifications.
LSGH_22	Precautions will be taken to minimise the runoff of soils into watercourses through the implementation of erosion and sediment control measures.
LSGH_23	Care will be taken to ensure that the side slope surfaces are stable to minimise erosion. This will be achieved through the selection of suitable material and adoption of an appropriate side slopes. If there is insufficient space to allow for a suitable side slope, supports to sides will be provided by precast concrete traffic barriers.
LSGH_24	Soil and materials will be transported in appropriate dump trucks to minimise the loss of material in transport.
LSGH_25	Earthworks operations will be carried out such that surfaces will be designed with adequate falls, profiling and drainage to promote safe runoff and prevent ponding and flooding.
LSGH_26	Significant project vehicle and equipment movements will be along agreed predetermined routes along existing national, regional and local routes. Where compaction occurs due to truck movements and other construction activities on unfinished surfaces, remediation works will be undertaken to reinstate the ground to a condition if at least equal quality to the original surface.
LSGH_27	Vehicles will minimise tracking over natural or unfinished surfaces, where practicable.
LSGH_28	Heavy vehicles and equipment will be parked on hard standing areas overnight or when not in use, as applicable.
LSGH_29	Where practicable, compaction of any soil or subsoil which is to remain in situ in the works area will be avoided.
LSGH_30	Care will be taken to ensure that the side slope surfaces of bunds and haul roads are stable to minimise erosion.

Reference	Schedule of Environmental Commitments – Mitigation Measures
LSGH_31	A low impact dewatering methodology such as submersible pumps or dewatering pumps will be selected for the construction. The final construction methodology selected will consider the risk of any ground instability arising from dewatering activities to potentially sensitive receptors in proximity to the works area.
Operation and Maintenance Phases	
Mitigation measures proposed for the construction phase are considered to be appropriate for all works required as part of the maintenance regime for the flood defences and will be implemented accordingly.	
Air Quality	
	Construction Phase
AQ_1	General: • Develop and implement a stakeholder communication plan that includes community engagement before work commences on site. • Display the name and contact details of person(s) accountable for air quality pollutant emissions and dust issues on the site boundary. • Display the head or regional office contact information. • Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk and should include as a minimum the highly recommended measures in this document.
AQ_2	Site Management: • Record and respond to all dust and air quality pollutant emissions complaints. • Make a complaints log available to the local authority when asked. • Carry out regular site inspections to monitor compliance with air quality and dust control procedures, record inspection results, and make an inspection log available to the local authority when asked. • Increase the frequency of site inspections by those accountable for dust and air quality pollutant emissions issues when activities with a high potential to produce dust and emissions are being carried out, and during prolonged dry or windy conditions. • Record any exceptional incidents that cause dust and air quality pollutant emissions, either on or off the site, and the action taken to resolve the situation is recorded in the logbook. • Hold regular liaison meetings with other high risk construction sites within 500 m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/ deliveries which might be using the same strategic road network routes.

Reference	Schedule of Environmental Commitments – Mitigation Measures
AQ_3	Preparing and maintaining the site: • Plan site layout: machinery and dust causing activities should be located away from receptors. • Erect solid screens or barriers around dust activities or the site boundary that are, at least, as high as any stockpiles on site. • Fully enclosure site or specific operations where there is a high potential for dust production and the site is active for an extensive period. • Avoid site runoff of water or mud. • Keep site fencing, barriers and scaffolding clean using wet methods. • Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on site cover as described below. • Cover, seed or fence stockpiles to prevent wind whipping.
AQ_4	Operating vehicle/machinery and sustainable travel: • Ensure all on-road vehicles comply with the requirements of the KCC, in terms of emissions. • Ensure all vehicles switch off engines when stationary – no idling vehicles. • Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where possible. • Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials. • Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).
AQ_5	Operations: • Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems. • Source water from a clean water source (i.e., screened recycled water, or from local water supply) for safe and effective dust/particulate matter mitigation during dry spells. • Use enclosed chutes, conveyors and covered skips. • Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate. • Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.
AQ_6	Waste Management: • Reuse and recycle waste to reduce dust from waste materials. • No bonfires and burning of waste materials.
AQ_7	Demolition: • Ensure effective water suppression is used during demolition operations. Handheld sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition, high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.

Reference	Schedule of Environmental Commitments – Mitigation Measures
	• Avoid explosive blasting, using appropriate manual or mechanical alternatives. • Bag and remove any biological debris or damp down such material before demolition
AQ_8	Earthworks: • Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces, where possible. • Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil. • Only remove secure covers in small areas during work and not all at once.
AQ_9	Construction: • Avoid scabbling (roughening of concrete surfaces) if possible. • Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place. • Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery. • For smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust.
AQ_10	Track-out: • Regularly use a water-assisted dust sweeper on the access and local roads, as necessary, to remove any material tracked out of the site. • Avoid dry sweeping of large areas. • Ensure vehicles entering and leaving sites are securely covered to prevent escape of materials during transport. • Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable). • Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable. • Record all inspections of haul routes and any subsequent action in a site logbook. • Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned. • Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits. • Access gates to be located at least 10 m from receptors where possible.
Operation and Maintenance Phases	
No specific air quality mitigation measures would be required for the operational phase. However, low emission vehicles and plant/machinery should be considered for maintenance and repairs, to minimise impacts on air quality and climate.	

Reference	Schedule of Environmental Commitments – Mitigation Measures
Climate	
Construction Phase	
C_1	During the construction phase, best environmental practices will be followed in order to mitigate for greenhouse gas emissions. These are detailed under 'Air Quality'.
C_2	KCC will use green public procurement to reduce the environmental impact of the Proposed Scheme. Green Public Procurement is a process where public authorities seek to source goods, services or works with a reduced environmental impact (more resource efficient, less polluting goods, services and works with the marketplace) throughout their life cycle when compared to goods, services and works with the same primary function that would ordinarily be procured.
Operation and Maintenance Phases	
No mitigation is proposed. The nature of the Proposed Scheme is to provide protection from the effects of the present-day 1 in 100-year flood event. It has been designed to be adaptive to climate change.	
Noise and Vibration	
Construction Phase	
NV_1	Erection of site hoarding or local noise barriers which block line of sight to noisy activities (specifically on the loudest sources i.e.: hydraulic breaker, sheet piling).
NV_2	Where possible limit the operation of noisiest activities to exclude periods identified through consultation with residents. Where this is not possible prior notification shall be provided.
NV_3	Selection of items of plant with lower noise levels.
NV_4	Engagement and dialogue between construction contractor and local community.
NV_5	Assign responsibility for issues relating to noise to a competent member of site staff.
NV_6	Monitoring of site noise and vibration levels against the guidance and coordination with community and enable implementation of further measures, if required.
NV_7	If necessary, install local noise barriers with absorptive linings near to specific sources, during construction works.
NV_8	Provide enclosures around generators.
NV_9	Switch off engines and equipment when not required.
NV_10	Warning reversing alarms should give adequate warning but have minimum impact on people outside site.

Reference	Schedule of Environmental Commitments – Mitigation Measures
NV_11	Plant and activities shall be reviewed so that noise is reasonably minimised (and therefore demonstrate use of best practicable means).
NV_12	Good practice for development of good community relations: • advise residents when works are due to start. • provide site contact details if neighbours want to complain about the noise. • establish a site point of contact for dealing with noise complaints. • have an established procedure for dealing with complaints, recording time/details and responding within a certain time period.
NV_13	Further guidance on construction noise reduction is available in BS5228 and will be implemented as necessary for control of construction noise from the Proposed Scheme.
Operation and Maintenance Phases	
No mitigation measures are proposed for the operation or maintenance phase of the Proposed Scheme.	

18.3 Monitoring

18.3.1 Monitoring measures have been proposed to ensure compliance with the findings of this EIAR. The measures for monitoring are outlined in the following table.

Table 18-13 Monitoring Measures

Schedule of Environmental Commitments – Monitoring Measures
Population and Human Health
No specific monitoring recommended. In the context of the impact upon population and human health, it is considered that the monitoring measures set out in relation to the other environmental topics assessed within this EIAR are sufficient to address monitoring requirements.
Material Assets
Most of the monitoring will be completed through routine site inspections undertaken by the contractor(s) QHSE Team, whereby the implementation of associated mitigation measures outlined in the CEMP will be verified, and areas of improvement identified. Specifically appointed staff will ensure appropriate monitoring of respective measures, including those assigned to manage traffic management and those assigned to manage waste management.
Contracting staff's adherence to measures outlined in the TMP (i.e., use of safety belts, adherence to speed limits, use of haulage routes) will be monitored by the appointed traffic management officer through routine checks. Public roads, cycling paths and walkways outside of the site compounds shall be regularly inspected for cleanliness, as a minimum on a daily basis, and cleaned as necessary. A sweeper will be made available to ensure that these are kept free of debris.
The management of waste during the construction phase will be monitored by the Contactor's appointed Waste Manager to ensure compliance with the above-listed mitigation measures, and relevant waste management legislation and local authority requirements, including maintenance of waste documentation. Waste generation and associated collection shall be recorded throughout the construction process, with all collection receipts and transfer notes maintained on site for record.
Hydrology – Surface Water
This element is also presented in the pre-construction mitigation recommendations (Table 18-11). A water quality monitoring regime will be established and agreed with the NPWS and IFI in advance of works commencing. Monthly water quality sampling should take place for a minimum of 12 months pre-construction. The following parameters should be recorded in surface waters: • Suspended solids • Dissolved oxygen • Temperature • pH • Turbidity • BOD5 • Orthophosphate • Dissolved inorganic nitrogen Appropriate monitoring locations would be: 1. Upstream of the construction area for the proposed upstream storage area on the River Duiske, 2. Within the river channel where the proposed flow control structure is to be located, 3. Upstream of the proposed debris trap, 4. Within the River Duiske in Graiguenamanagh town,

Schedule of Environmental Commitments – Monitoring Measures
5. Upstream of the proposed works on the River Barrow, 6. Within the River Barrow from Graiguenamanagh bridge, 7. Downstream of the proposed works on the River Barrow. The reporting procedures should be agreed with the NPWS and IFI before commencement of the work. All monitoring records should be maintained by the Project Manager or their nominated assistant.
Routine site inspections should be undertaken during the construction phase and during maintenance activities by a Health, Safety & Environmental Officer to determine compliance with the suggested mitigation measures.
Site records should be inspected to determine history of any contamination / spillages and how these were addressed. Improvements and lessons learnt may be a useful tool to ensure effectiveness.
Cultural Heritage
Archaeological monitoring of ground disturbances associated with the construction of the flood relief scheme will take place (see CH_9 in Table 18-12). Archaeological monitoring is licensed by the DHLGH and managed by the National Monuments Service.
The scheme will be audited for compliance, and a post construction review will be undertaken to ensure that all is as predicted and committed to in relation to the level of impact on the receiving archaeological, architectural and cultural heritage environment.
Biodiversity
An Ecological Clerk of Works (ECoW) will be employed to monitor the works and to inform the team through Ecological Toolbox Talks during the proposed works and tree felling activities. A species protection plan will be designed by a professional ecologist to ensure that works related to this proposal take into account any protected species, including birds and bats, present on site and the nearby surroundings.
A pre-construction survey of the scheme will be undertaken by an experienced Ecologist in order to confirm the baseline conditions and refine environmental mitigation as required prior to construction works commencing on the site. A minimum of 1 no. ECoW visit shall be conducted per week during the course of the construction works at this site during the construction phase. The ECoW shall be present on-site during commencement of works. As such the following points must be adhered to for this scheme: • An ECoW will be involved as required during the construction period for this scheme, in order to ensure that the required mitigation is implemented. • Once planning permission has been secured, pre-construction ecology surveys will be carried out within the proposed scheme area well in advance (ideally 3-4 months prior to construction works) in order to ensure that sufficient updated information is available to inform derogation licence applications as required. • The ECoW and the Appointed Contractor will walk the proposed scheme together prior to work commencing on the site, in order to discuss the ecological constraints, to highlight all required mitigation and to demarcate exclusion zones appropriately.
Landscape and Visual
During site establishment stage: prior to any works taking place, clearly identify trees and hedgerows that are to be retained and protected – ensuring tree protection measures are in place. Clearly identify trees and hedgerows that are to be removed.
During site excavation stage: ensure existing vegetation is being adequately protected and that topsoil is being correctly stripped and stored for landscape reinstatement
During construction stage: ensure existing vegetation is being adequately protected.
Periodic visits will be required to ensure that the existing woodlands, trees and hedgerows have not been negatively impacted by the construction works.

Schedule of Environmental Commitments – Monitoring Measures
Periodic visits will also be required for one year to ensure the successful establishment of the proposed planting and to recommend replacement planting where necessary.
Land, Soils, Geology & Hydrogeology
Routine site inspections should be undertaken during the construction phase and during maintenance activities by a Health, Safety & Environmental Officer to determine compliance with the suggested mitigation measures.
Site records should be inspected to determine history of any contamination / spillages and how these were addressed. Improvements and lessons learnt may be a useful tool to ensure effectiveness.
An independent Environmental Clerk of Works shall be appointed to the project to provide independent environmental oversight of the contractor's team.
Air Quality
Daily off-site dust soiling checks and regular site inspections will take place at all works areas and site compounds to monitor compliance with the dust management plan during the construction phase.
Monthly construction dust monitoring, using dust deposition gauges, is proposed at Area 1 and SC B (upstream storage area), and at Area 8 (Hotel Street), at boundaries of the works area/site compound and nearest sensitive receptors to the works (in both cases, residential dwellings). The TA Luft dust deposition limit values of 350 mg/m2/day will be applied as a 30-day average
Climate
Monitoring of water levels in the Rivers Duiske and Barrow will take place, as well as monitoring of the structural integrity of the scheme relative to increased water levels. Long-term monitoring will ensure the integrity of embankments and flood walls is maintained and will inform the timing and necessity of raising flood defences. Monitoring will also be used to inform maintenance and refurbishment to prolong the lifetime and resilience of flood defence assets.
Noise and Vibration
Noise and vibration monitoring of works will be conducted at the boundary of the works or at the nearest noise sensitive properties for the duration of the construction works. Measurements will confirm if site noise and vibration limits are being met and where required can enable improvements to be recommended to the noise and vibration mitigation scheme, such as the installation of noise barriers (ref. NV_6&7) or adjustment in piling methodology. BS5228 states that insulation or relocation should be offered when the 75dBA LAeq,10hr upper trigger value is exceeded for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any 6 consecutive months.
Vibration monitoring will take place on neighbouring structures and walling of a heritage and historic interest to limit accelerations to 3mm/s of any pile driven works. Buildings and structures where vibration monitoring will take place are detailed in Appendix 9-8 (including CH04, CH05, CH06, CH07, CH08, CH10, CH15, CH17, KK029-018008, C125, C149, C140, C635, C17, C18, C648, D152, C647, C654 rear of and C134 rear of).
Should site constraints make hydraulic press piling impossible, thereby necessitating vibratory or impact piling, vibration monitoring will be required at residences/structures close to piling works.

19 Reference List

ACSU , 2024. *Archaeological Monitoring of Geotechnical Site Investigations (Licence 21E0256). Unpublished report.,* s.l.: s.n.

ADCO, 2021. *Graiguanamanagh-Tinnahinch Flood Relief Scheme, Underwater Archaeological Impact Assessment, Duiske/Douske River and River Barrow, 21D0047, 21R0082,* s.l.: s.n.

ADCO, 2022. *Underwater Archaeological Impact Assessment (UAIA) (Licence 21D0047 and 21R0082) for the River Duiske and River Barrow. Unpublished report.,* s.l.: s.n.

ADCO, 2024. *Underwater Archaeological Impact Assessment (UAIA) (Licence 24D0149, 24R0195) Upstream Storage Area. Unpublished report.,* s.l.: s.n.

APEM, 2023. *Graiguenamanagh-Tinnahinch Flood Relief Scheme - Aquatic Ecology Surveys Report - P00012428. ,* s.l.: s.n.

Aquafact International Services Ltd. , 2020. *Ecological Report on the River Barrow at Graiguenemanagh, Co. Kilkenny,* s.l.: s.n.

Aquafact International Services Ltd. , 2021. *ElectrofishingSurvey of the Duiske River, Graiguenemanagh, Co. Kilkenny ,* s.l.: s.n.

Aquafact International Services Ltd, 2021. *Graiguenamanagh Q-Value,* s.l.: s.n.

Archdall, M. , 1786. *Monasticon Hibernicum: or, an history of the abbies, priories, and other religious houses in Ireland. Dublin. Luke White.,* s.l.: s.n.

Ayesa, 2025. *Graiguenamanagh/Tinnahinch Flood Relief Scheme. Ecology Surveys 2020-2024,* s.l.: s.n.

Ayesa, 2025. *Graiguenamanagh-Tinnahinch Flood Relief Scheme, Natura Impact Statement, W3394-BL-ENV-R-010,* s.l.: s.n.

Ayesa, 2025. *Graiguenamanagh-Tinnahinch Flood Relief Scheme, Options Report, W3451-BLP-R-W-009, Rev07,* s.l.: s.n.

Ayesa, 2025. *Public Consultation Report 03, Summary Report, Report no. W3451-W-R017, s.l.: s.n.,* s.l.: s.n.

Birdwatch Ireland, 2012. *CBS Manual Guidelines for Countyside Bird Survey Participants,* s.l.: s.n.

Bolger, T, 2002. *Archaeological Assessment: Quay Street, Graiguenamanagh, Co. Kilkenny (Licence 02E0214). Unpublished report submitted to the DoEHLG.,* s.l.: s.n.

Boon, P. J., Cooksley, S. L., Geist, J., Killeen, I. J., Moorkens, E., & S. I. , 2019. *Developing a standard approach for monitoring freshwater pearl mussel (Margaritifera margaritifera) populations in European rivers. Aquatic Conservation: Marine and Fre,* s.l.: s.n.

Bradley, J. & Manning, C. , 1980. *"Excavations at Duiske Abbey, Graiguenamanagh, Co. Kilkenny", Proceedings of the Royal Irish Academy, 81C, pp 397-426. ,* s.l.: s.n.

Brooks E.St. J. (ed.) , 1950. *Knights' fees in Counties Wexford, Carlow and Kilkenny (13th-15th century). Dublin. Stationery Office.,* s.l.: s.n.

BS 5228-1:2009+A1:2014, n.d. *Code of practice for noise and vibration control on construction and open sites. Noise and BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Vibration.* s.l.:s.n.

BS 7385-2:1993, n.d. *Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration.* s.l.:s.n.

BTO, 2023. *Breeding Bird Survey: Methodology and survey design. ,* s.l.: s.n.

Butler, C. M. and Bernard, J. H. , 1918. *The charters of the Cistercian Abbey of Duiske in the County of Kilkenny. Proceedings of the Royal Irish Academy 35 C, 1-188.,* s.l.: s.n.

Byrne, A. W., Sleeman, D. P., O'Keeffe, J., & Davenport, J. , 2012. *The ecology of the European badger (Meles meles) in Ireland - a review. BIOLOGY AND ENVIRONMENT: PROCEEDINGS OF THE ROYAL IRISH ACADEMY, VOL. 112B.,* s.l.: s.n.

ByrneLooby, 2020. *Public Consultation Report 01, Report no. W3451-W-PCD02,* s.l.: s.n.

ByrneLooby, 2020. *Graiguenamanagh/Tinnahinch Flood Relief Scheme, Bat Survey Report, W3451-ENV-R001,* s.l.: s.n.

ByrneLooby, 2020. *Graiguenamanagh-Tinnahinch Flood Relief Scheme, Hydrological Method Statement, W3451-W-R001.,* s.l.: s.n.

ByrneLooby, 2020. *Graiguenamanagh-Tinnahinch Flood Relief Scheme, Hydromorphology Baseline Report, W3451-W-R005.,* s.l.: s.n.

ByrneLooby, 2021. *Graiguenamanagh-Tinnahinch Flood Relief Scheme, EIAR Screening Report, W3451-ENV-R002,* s.l.: s.n.

ByrneLooby, 2021. *Graiguenamanagh-Tinnahinch Flood Relief Scheme, Environmental Constraints Study, W3451-BL-ENV-R001,* s.l.: s.n.

ByrneLooby, 2021. *Graiguenamanagh-Tinnahinch Flood Relief Scheme, Habitats and Species Baseline Survey Report, W3394-BLP-R-ENV-005,* s.l.: s.n.

ByrneLooby, 2022. *Graiguenamanagh-Tinnahinch Flood Relief Scheme, Hydrology Report, W3451-W-R002.,* s.l.: s.n.

ByrneLooby, 2022. *Public Consultation Report 02, Summary Report, Report no. W3451-PCD-03,* s.l.: s.n.

ByrneLooby, 2023. *Graiguenamanagh-Tinnahinch Flood Relief Scheme, EIAR Scoping Report, W3451-ENV-R007,* s.l.: s.n.

Carlow County Council , 2018. *Carlow County Council Noise Action Plan 2018.* s.l.:s.n.

Carlow County Council , 2022. *Draft Carlow Biodiversity Action Plan 2023-2028,* s.l.: s.n.

Carlow County Council , 2024. [Online] Available at: http://www.eplanning.ie/CarlowCC/SearchExact

Carlow County Council, 2018. *Noise Action Plan 2018-2023,* s.l.: s.n.

Carlow County Council, 2020a. *County Carlow Tourism Strategy and Action Plan 2020-2025,* s.l.: s.n.

Carlow County Council, 2020b. *County Carlow's Outdoor Recreation Strategy 2020-2023,* s.l.: s.n.

Carlow County Council, 2020. *Major Emergency Plan 2020,* s.l.: s.n.

Carlow County Council, 2022. *Carlow County Development Plan 2022 – 2028,* s.l.: s.n.

Carlow County Council, n.d. *Carlow Wonder off the Track.* [Online] Available at: https://carlowtourism.com

Carlow-Kilkenny County Council, 2021. *The Graiguenamanagh-Tinnahinch Mobility Management Study 2021-2026,* s.l.: s.n.

Carrigan, Rev. W. , 1905. (Reprint 1981). *The history and antiquities of the diocese of Ossory, 4 vols. Kilkenny. Roberts Books and Wellbrook Press.,* s.l.: s.n.

Carrigan, Rev. W. , 1905. . *Vol. I, 31, Vol. II, 258.,* s.l.: s.n.

Carville, G., , 1979.. *Norman Splendour Duiske Abbey Graiguenamanagh. Belfast: Blackstaff Press,* s.l.: s.n.

CDHC 2023. , 2023. *Archaeological Baseline Report Graiguenamanagh-Tinnahinch Flood Relief Scheme, Upstream Storage Area. Unpublished report.,* s.l.: s.n.

CDHC , 2024. *Archaeological Testing Report – Pre-planning Graiguenamanagh Quay, Co Kilkenny, Excavation Licence No. E005772, R000749, Ministerial Consent C001049. Unpublished report.,* s.l.: s.n.

Central Statistics Office, 2022. *Central Statistics Office.* [Online] Available at: https://www.cso.ie/en/index.html

CIEEM, 2018. *Guidelines for Ecological Impact Assessment in the UK and Ireland: terrestrial, freshwater and Coastal. 2nd Edition.,* Winchester: s.n.

CIEEM, 2024. *Guidelines for Ecological Impact Assessment in the UK and IReland: Terrestrial, Freshwater, Coastal and Marine. ,* s.l.: s.n.

CIRIA , 2005. *Environmental Good Practice on Site (C650); Construction Industry Research and Information Association.,* s.l.: s.n.

CIRIA 697 , 2007. *The SUDS Manual. ,* s.l.: s.n.

CIRIA, , 2001. *Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors, (C532) Construction Industry Research and Information Association.,* s.l.: s.n.

Cleary, R. , 2003. *Graiguenamanagh: historic town. In I. Bennett (ed.), Excavations 2001: summary accounts of archaeological excavations in Ireland, 207, No. 691. Bray. Wordwell.,* s.l.: s.n.

Colhoun, K., & Cummins, S. , 2013. *Birds of Conservation Concern in Ireland 2014-2019. Irish Birds, 9, 523-544.,* s.l.: s.n.

Community Climate Change Consortium for Ireland. (n.d.). , 2022. *Community Climate Change Consortium for Ireland..* [Online] Available at: www.c4i.ie

Curtis, E. (ed.) , 1932. *Calendar of Ormond Deeds 1172-1350 A.D. Vol. 1. Dublin. The Stationery Office.,* s.l.: s.n.

Curtis, E. (ed.) , 1937. *Calendar of Ormond Deeds 1509-1547 A.D. Vol. 4. Dublin. The Stationery Office.,* s.l.: s.n.

DEFRA, 2002. *Part IV of the Environment Act 1995, Environment (Northern Ireland) Order 2002 Part III, Local Air Quality Management, Technical Guidance LAQM. TG(16)., London: s.n.,* s.l.: s.n.

DEFRA, 2010. *Circular NPW1/10 & PSSP 2/10 Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities, Dublin: DEHLG,* s.l.: s.n.

Defra, 2022. *Part IV of the Environment Act 1995, Environment (Northern Ireland) Order 2002 Part III, Local Air Quality Management, Technical Guidance LAQM. TG(22).,* s.l.: s.n.

Department of Climate, Energy and the Environment, 2022. *Climate Action Plan,* s.l.: s.n.

Department of Climate, Energy and the Environment, 2024. *National Adaptation Framework,* s.l.: s.n.

Department of Communications, Climate Action & Environment, 2018. *National Adaptation Framework, Planning for a Climate Resilient Ireland,* s.l.: s.n.

Department of Environment, Heritage and Local Government, 2006. *National Framework for Major Emergency Management ,* s.l.: s.n.

Department of Housing, Local Government and Heritage, 2000. *Planning and Development Act 2000,* s.l.: s.n.

Department of Housing, Local Government and Heritage, 2001. *Planning and Development Regulations 2001, S.I. No. 600 of 2001,* s.l.: s.n.

Department of Housing, Local Government and Heritage, 2018. *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment,* s.l.: s.n.

Department of Housing, Local Government and Heritage, 2022. *Planning and Development Regulations 2001-2022 (Unofficial Consolidation) ,* s.l.: s.n.

Department of Housing, Local Government and Heritage, 2022. *River Basin Management Plan (RBMP) for Ireland 2022-2027,* s.l.: s.n.

Department of Housing, Local Government and Heritage, 2022. *River Basin Management Plan (RBMP) for Ireland 2022-2027 ,* s.l.: s.n.

Department of Housing, Local Government and Heritage, 2024. *The Water Action Plan 2024: A River Basin Management Plan for Ireland,* s.l.: The Government of Ireland.

Department of Housing, Local Government and Heritage, n.d. *myplan.ie - National Planning Application Database.* [Online] Available at: myplan.ie/national-planning-application-map-viewe [Accessed 2024].

Department of Public Expenditure, Infrastructure, Public Service Reform and Digitisation, 2021. *National Development Plan 2021-2030,* s.l.: Government of Ireland.

Department of the Climate, Energy and the Environment, 2024. *Climate Action Plan 2024,* s.l.: Government of Ireland.

Department of the Environment, Climate & Communications, 2013. *National Policy Position on Climate Action and Low Carbon Development,* s.l.: s.n.

Department of the Environment, Community and Local Government, 2012. *National Climate Change Adaptation Framework (NCCAF),* s.l.: s.n.

Department of Transport, Health and Safety Authority, National Roads Authority and the Local Government Management Services Board, 2010. *Guidance for the Control and Management of Traffic at Road Works – Second Edition 2010,* s.l.: s.n.

Department of Transport, 2010. *Traffic Signs Manual,* s.l.: s.n.

DHPLG, 2018. *Guidelines for Planning Authorities and An Bord Pleanala on Carrying out Environmental Impact Assessment,* Dublin: Department of Housing, Planning and Local Government.

DHPLG, 2024. *EIA Portal.* [Online] Available at: https://www.housing.gov.ie/planning/environmental-assessment/environmental-impact-assessment-eia/eia-portal

DoE, 2010. *Local Air Quality Management Policy Guidance – LAQM PGNI (09),* s.l.: s.n.

Dolan, A. , 1994. *"The large medieval churches of the dioceses of Leighlin, Ferns and Ossory: a study of adaptation and change", in Irish Architectural and Decorative Studies: The Journal of the Irish Georgian Society, Vol 2.,* s.l.: s.n.

EMRA , 2019. *Regional Spatial & Economic Strategy 2019-2031,* s.l.: s.n.

Environmental Protection Agency, 2006. *EU Water Framework Directive Monitoring Programme - EPA.* [Online] Available at: https://www.epa.ie/pubs/reports/water/other/wfd/ [Accessed 2020].

EPA. , 2020. *Urban Waste Water Treatment in 2020.* [Online] Available at: https://www.epa.ie/publications/monitoring--assessment/waste-water/Urban-Waste-Water-Treatment-in-2020-report.pdf

EPA, 2011. *Air Quality Standards Regulations,* s.l.: s.n.

EPA, 2011. *Air Quality Standards Regulations, Ireland: EPA.,* s.l.: s.n.

EPA, 2015. *Advice Notes on the Current Practice in the Preparation of Environmental Impact Statements,* s.l.: EPA.

EPA, 2016. *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4).* s.l.:s.n.

EPA, 2016. *Ireland's Environment - An Assessment 2016,* s.l.: s.n.

EPA, 2017. *Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports ,* s.l.: s.n.

EPA, 2017. *National Salmon Monitoring Programme.* [Online] Available at: http://gis.epa.ie/GetData/Download

EPA, 2021. *Best Practise Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects.,* s.l.: s.n.

EPA, 2021. *Ireland's Greenhouse Gas Emissions Projections 2020 - 2040,* Ireland: s.n.

EPA, 2021. *Ireland's National Inventory Report 2021 - Greenhouse Gas Emissions 1990-2019,* s.l.: s.n.

EPA, 2022. *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports,* s.l.: s.n.

EPA, 2024. *Cycle 3: HA 14 Barrow Catchment Report, May 2024. Environmental Protection Agency.,* s.l.: s.n.

EPA, 2024. *Ireland's State of the Environment Report 2024,* s.l.: s.n.

EPA, 2024. *Ireland's State of the Environment Report 2024,* s.l.: s.n.

EPA, n.d. *Air Quality Index for Health - EPA. [Online].* [Online] Available at: https://www.epa.ie/air/quality/pro [Accessed 2024].

EPA, n.d. *Ambient Air Monitoring in Kilkenny.* [Online] Available at: https://airquality.ie/station/EPA-36 [Accessed 2025].

EPA, n.d. *Ambient Air Monitoring in Thomastown.* [Online] Available at: https://airquality.ie/station/TNO4157 [Accessed 2025].

EPUK & IAQM , 2017. *Land-Use Planning & Development Control: Planning For Air Quality,* s.l.: s.n.

European Commission, 2024. *Interpretation of definitions of project categories of annex I and II of the EIA Directive,* s.l.: s.n.

European Commissions, 2008. *The Ambient Air Quality and Cleaner Air for Europe (CAFE) Directive (2008/50/EC),* s.l.: s.n.

European Communities (Assessment and Management of Flood Risks) Regulations 2010, 2010. *S.I. No. 122 of 2010,* s.l.: s.n.

European Communities , 2014. *(Drinking Water) Regulations 2014 (S.I. No. 122 of 2014).,* s.l.: s.n.

European Communities, 1988. *(Quality of Salmonid Waters) Regulations,* s.l.: s.n.

European Communities, 2011. *(Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations, 2011 (S.I. No. 489 of 2011).,* s.l.: s.n.

European Communities, 2014. *(Water Policy) Regulations, 2014 (S.I. No. 350 of 2014),* s.l.: s.n.

European Communities, 2016. *Environmental Objectives (Groundwater) (Amendments) Regulations, 2016 (S.I. No. 366 of 2016).,* s.l.: s.n.

European Communities, 2019. *Environmental Objectives (Surface Waters) (amendments) Regulations, 2019 (S.I. No. 77 of 2019).,* s.l.: s.n.

European Communities, 2020. *Good Agricultural Practice for Protection of Waters) (Amendments) Regulations, 2020 (S.I. No. 40 of 2020).,* s.l.: s.n.

European Communities, 2021. *S.I. No. 735/2021 - European Union (Internal Combustion Engines for Non-Road Mobile Machinery) (Gaseous and Particulate Pollutant Emission Limits and Type-Approval) Regulations,* s.l.: s.n.

European Union , 2018. *European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296/2018).* [Online] Available at: https://www.irishstatutebook.ie/eli/2018/si/296/made/en/print

European Union, 1985. *EIA Directive (85/337/EEC) as amended in 2011 Directive 2011/92/EU and 2014 Directive 2014/52/EU under Article 6.,* s.l.: s.n.

European Union, 1992. *EU Directive 92/43/EEC on the Conservation of Habitats and Wild Flora and Fauna ,* s.l.: s.n.

Fáilte Ireland, 2011. *Guidelines on the Treatment of Tourism in an Environmental Impact Statement,* s.l.: s.n.

Farrelly, J., O'Reilly, B., and Loughran, A. , 1993. *Urban archaeological survey - county Kilkenny (2 vols.). Unpublished report commissioned by the Office of Public Works, Dublin.,* s.l.: s.n.

Fossitt, J. , 2000. *A Guide to Habitats in Ireland. Dublin : The Heritage Council.,* s.l.: s.n.

Gammell, M., McFarlane, A., Brady, D., O'Brien, J., Mirimin, L., Graham, C., O'Connor, I. , 2017. *White-clawed Crayfish Austropotamobius Pallipes Survey in Designated SACs in 2017. NPWS.,* s.l.: s.n.

Geological Survey Ireland, n.d. *Data and Maps.* [Online] Available at: https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228
[Accessed 2024].

German VDI , 2002. *Technical Guidelines on Air Quality Control – TA Luft,* s.l.: s.n.

Government of Ireland, 2025. *Public Consultation on the Designation of Heavily Modified Water Bodies for Ireland's third cycle River Basin Management Plan.* [Online] Available at: https://www.gov.ie/en/department-of-housing-local-government-and-heritage/

Government of Ireland, n.d. *Air Pollution Act (1987),* s.l.: [Available online: https://www.irishstatutebook.ie/eli/1987/act/6/enacted/en/html].

Grose, F. , 1791. *The Antiquities of Ireland – Volume 1, London,* s.l.: s.n.

Gwynn, A. and Hadcock, R.N. , 1970. (Reprint 1988). *Medieval religious houses of Ireland. Dublin. Irish Academic Press.,* s.l.: s.n.

Harvey, J., & Cowx, I. , 2003. *Monitoring the River, Sea and Brook Lamprey, Lampetra fluviatilis, L. ,* s.l.: s.n.

Hayden, A. , 1990. *Excavations bulletin 1990:075 Duiske Abbey, Graiguenamanagh, Co. Kilkenny.,* s.l.: s.n.

Highways England, 2020. *Design Manual for Roads and Bridges,2020. LA 111 Noise and Vibration.* s.l.:s.n.

Holth, T. F., Thorsen, A., Pal, A. O., & Ketil, H. , 2010. *Long-term exposure of Atlantic cod (Gadus morhua) to components of produced water: condition, gonad maturation, and gene expression. Canadian Journal of Fisheries and Aquatic Sciences.,* s.l.: s.n.

IEMA, 2014. *Guidelines for Environmental Noise Assessment.* s.l.:s.n.

IEMA, 2017. *Health in Environmental Impact Assessment - A Primer for a Proportionate Approach. . ,* s.l.: s.n.

IGI, 2013. *Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements. ,* s.l.: s.n.

Institute of Air Quality Management, 2014. *Guidance on the Assessment of Dust from Demolition and Construction ,* s.l.: s.n.

Institute of Geologists of Ireland , 2013. *Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements. ,* s.l.: s.n.

Intergovernmental Panel on Climate Change, 2014. *Report AR5 Mitigation of Climate Change,* s.l.: s.n.

IPCC, 2007. *Climate Change, Fourth Assessment Report AR4. ,* s.l.: s.n.

ISO 1996-2:2017, n.d. *Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of sound pressure levels.* s.l.:s.n.

Joyce, J. , 2000. *Graiguenamanagh-A Town and its people: An Historical and Social Account of Tinnahinch, Graigue Publications.,* s.l.: s.n.

Kahl, S., Wood, C. M., Eibl, M., & Klinck, H. , 2021. . *BirdNET: A deep learning solution for avian diversity monitoring. ,* s.l.: s.n.

Kilkenny & Carlow County Council, 2020. *Graiguenamanagh-Tinnahinch Joint Local Area Plan (LAP) 2020 – 2026,* s.l.: s.n.

Kilkenny County Council , 2003. *Landscape Appraisal of County Kilkenny,* s.l.: s.n.

Kilkenny County Council , 2018. *Kilkenny Noise Action Plan 2018 – 2023.* s.l.:s.n.

Kilkenny County Council , 2019. *Noise Action Plan 2019-2023,* s.l.: s.n.

Kilkenny County Council , 2025. *Kilkenny Biodiversity Action Plan 2025-2030,* s.l.: s.n.

Kilkenny County Council and Carlow County Council., 2020. *Environmental Report (SEA) of Graiguenamanagh-Tinnahinch Draft Joint Local Area Plan 2020- 2026,* s.l.: s.n.

Kilkenny County Council., 2021. *Kilkenny City and County Development Plan 2021-2027,* s.l.: s.n.

Kilkenny County Council, 2014. *Kilkenny County Council County Development Plan 2014 – 2020.,* s.l.: s.n.

Kilkenny County Council, 2022. *Fire and Emergency Operations Plan 2022-2026,* s.l.: s.n.

Kilkenny County Council, 2024. [Online] Available at: https://planning.kilkennycoco.ie/SearchExact.aspx

Kilkenny County Council, n.d. *Graiguenamanagh / Tinnahinch Tourism and Recreational Project Concept Study ,* s.l.: s.n.

Kilkenny County Council, n.d. *In Focus: Graiguenamanagh Regeneration,* s.l.: s.n.

Killeen, I., & Moorkens, E. , 2020. *MApping Juvenile Habitat for the Freshwater Pearl Mussel. Journal of Conchology.,* s.l.: s.n.

Landscape Institute & IEMA, 2013. *Guidelines for Landscape and Visual Impact Assessment ,* s.l.: s.n.

Lawton, C., Hanniffy, R., Molloy, V., Guilfoyle, C., Stinson, M., & Reilly, E., 2019. *All-Ireland Squirrel and Pine Marten Survey 2019. NPWS.,* s.l.: s.n.

Leask, H.G. , 1960 (Reprint 1967 and 1990). *Irish churches and monastic buildings, vol. II. Gothic architecture to A.D. 1400. Dundalk. Dundalgan Press. ,* s.l.: s.n.

Lor, Y. S. , 2020. *Using environmental DNA (eDNA) to detect the endangered Spectaclecase Mussel (Margaritifera monodonta). Freshwater Science.,* s.l.: s.n.

Maitland, P.S, 1980. *Scarring of whitefish (Coregonus lavaretus) by European river lamprey (Lampetra fluvatilis) in Loch Lomond, Scotland. Canadian Journal of Fisheries and Aquatic Sciences. ,* s.l.: s.n.

Matson, R., Delanty, K., Shephard, S., Coghlan, B., & Kelly, F. , 2018. *Moving from multiple pass depletion to single pass timed electrofishing for fish community assessment in wadeable streams. Fisheries Research.,* s.l.: s.n.

Met Eireann, 2024. *Human-caused Climate Change Brings Increased Storm Rainfall.* [Online] Available at: https://www.met.ie/human-caused-climate-change-brings-increased-storm-rainfall

Mills, J. (ed.) , 1914. *Calendar of the justiciary rolls, or proceedings in the court of the justiciar of Ireland preserved in the Public Record Office of Ireland. Edward I, part 2, 1305-7. Dublin. HMSO. ,* s.l.: s.n.

Moorkens, E. , 2008. *NS II Freshwater Pearl Mussel Sub-basin Management Plans: Monitoring of the. Unpublished Report to the National Parks and Wildlife.,* s.l.: s.n.

Moorkens, E. , 2009a. *NS II Freshwater Pearl Mussel Sub-basin Management Plans: Monitoring of the Freshwater Pearl Mussel in the Mountain River. Unpublished Report to the National Parks and Wildlife.,* s.l.: s.n.

Moorkens, E. , 2009b. . *NS II Freshwater Pearl Mussel Sub-basin Management Plans: Monitoring of the Freshwater Pearl Mussel in the Ballymurphy River. Unpublished Report to the National Parks and Wildlife.,* s.l.: s.n.

Moorkens, E. C.., 2018. *Margaritifera margaritifera (errata version published in 2018). The IUCN Red List of Threatened Species 2018. ,* s.l.: s.n.

National Biodiversity Data Centre. , 2024. *Biodiversity maps.* [Online] Available at: https://www.biodiversityireland.ie/ [Accessed 2024].

National Roads Authority (now TII), 2005. *Guidelines for the Assessment of Architectural Heritage Impacts of National Road Schemes.,* s.l.: s.n.

National Roads Authority , 2008. *Environmental Impact Assessment of National Road Schemes – A Practical Guide. ,* s.l.: s.n.

National Roads Authority , 2009. *Guidelines for Assessment of Ecological Impacts of National Road Schemes, Revision 2,* s.l.: s.n.

NBDC., 2016. *Councils: Actions to Help Pollinators . ,* s.l.: s.n.

NBDC, 2019. *Pollinator-friendly management of Transport Corridors. ,* s.l.: s.n.

NIEA, 2014. *River Hydromorphology Assessment Technique - Training Guide. Northern Ireland Environment Agency.,* s.l.: s.n.

NMS, 2022. *Wreck Viewer.* [Online].

NMS, 2023. *Archaeology and Flood Relief Schemes: Guidelines. Government of Ireland. ,* s.l.: s.n.

NPWS, 2004. *Margaritifera margaritifera. Stage 1 and Stage 2 Survey Guidelines ,* s.l.: s.n.

NPWS, 2011. *River Barrow and River Nore SAC – Conservation Objectives.* [Online] Available at: https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO002162.pdf [Accessed 27 7 2022].

NPWS, 2011. *River Barrow and River Nore SAC - Conservation Objectives Supporting Document - Woodland Habitats, Version 1.* [Online] Available at: https://www.npws.ie/sites/default/files/publications/pdf/002162_Barrow%20Nore%20SAC%20Woodlands%20Supporting%20Doc_V1.pdf [Accessed 27 7 2022].

NPWS, 2016. *River Barrow and River Nore SAC – Site Synopsis.* [Online] Available at: https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY002162.pdf
[Accessed 7 2022].

NRA, 2008a. *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes. ,* s.l.: s.n.

NRA, 2008b. *Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes. ,* s.l.: s.n.

NRA, 2008. *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.,* s.l.: s.n.

NRA, 2009. *Guidelines for Assessment of Ecological Impacts of National Roads Scheme. ,* s.l.: s.n.

NRA, 2011. *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes,* s.l.: s.n.

O'Meara B. & O' Frazer W. , 2006. *Archaeological Impact Assessment, Main Street Graiguenamanagh Co Kilkenny Ministerial Consent Ref. C041, Planning Ref. 04/2003.,* s.l.: s.n.

O'Meara, B. , 2006. *Excavations bulletin: 2006:1035. Graiguenamanagh, Quay Street, Co. Kilkenny.,* s.l.: s.n.

Office of the Planning Regulator, 2021. *OPR Practise Note PN01, Appropriate Assessment Screening for Development Management.,* s.l.: s.n.

O'Leary, P. , 1892 . *Notes on the Cistercian Abbey of Graignamanagh. Journal of the Royal Society of Antiquaries of Ireland 22, 237-47.,* s.l.: s.n.

O'Leary, P. , 1892. *Tinnehinch Castle. Miscellanea. Journal of the Royal Society of Antiquaries of Ireland 22, 203-4.,* s.l.: s.n.

OPW, 2011. *hannon CFRAM Study - Hydrology Report for Unit of Management 25-26,* s.l.: s.n.

OPW, 2011. *South Eastern CFRAM Study – Flood Risk Review - Final Report, IBE060-Rp0001-F01/Nov 2011,* s.l.: s.n.

OPW, 2012. *PFRA Main Report ,* s.l.: s.n.

OPW, 2012. *The National Preliminary Flood Risk Assessment (PFRA) Designation of the Areas for Further Assessment ,* s.l.: s.n.

OPW, 2016. *South Eastern CFRAM Study - Hydrology Report for UoM14, IBE0601Rp0011,* s.l.: s.n.

OPW, 2016. *South Eastern CFRAM Study - Preliminary Options Report UoM14, IBE060Rp0024,* s.l.: s.n.

OPW, 2016. *South-Eastern CFRAM Study UoM14 Flood Risk Management Plan, Natura Impact Statement ,* s.l.: s.n.

OPW, 2017. *South Eastern CFRAM Study UoM14 Strategic Environmental Assessment Statement,* s.l.: s.n.

OPW, 2018. *Appropriate Assessment Determination in accordance with Regulation 42(11) of the European Communities (Birds and Natural Habitats) Regulations 2011 – 2015 for Flood Risk Management Plan for the Erne River Basin (UoM 36) ,* s.l.: s.n.

OPW, 2018. *Flood Risk Management Plan for the Barrow River Basin (UOM14),* s.l.: s.n.

OPW, 2018. *Flood Risk Management Plan Shannon Upper & Lower,* s.l.: s.n.

OPW, 2018. *Technical Methodology Note - Option Appraisal and the Multi-Criteria Analysis (MCA) Framework. ,* s.l.: s.n.

OPW, 2019. *Climate Change Sectoral Adaptation Plan 2019-2024..* [Online] Available at: https://www.gov.ie/en/publication/97984b-climate-change-and-sectoral-adaptation-plan/#sectoral-adaptation-plan

P. Toner, J. Bowman, K. Clabby, J. Lucey, M. McGarrigle, C. Concannon, C. Clenaghan, P. Cunningham, J. Delaney, S. O'Boyle, M. MacCárthaigh, M. Craig and R. Quinn , 2005. *Water Quality in Ireland 2001-2003: Appendix 1. Published by the Environmental Protection Agency, Ireland. ,* s.l.: s.n.

Peay, S., 2003. *Monitoring the white-clawed crayfish Austropotamobius pallipes. . Conserving Natura 2000, English Nature.,* s.l.: s.n.

Pont, D. R. , 2018. *Environmental DNA reveals quantitative patterns of fish biodiversity in large rivers despite its downstream transportation. ,* s.l.: s.n.

Preece, E. P. , 2020. *Monitoring for freshwater mussel presence in rivers using environmental DNA. Environmental DNA.,* s.l.: s.n.

Reynolds, J., O'Connor, W., O'Keeffe, C., & Lynn, D. , 2010. *A technical manual for monitoring white-clawed crayfish Austropotamobius pallipes in Irish lakes. ,* s.l.: s.n.

Ross, E. , 2006. *Initiation of a monitoring program for the freshwater pearl mussel, Margaritifera margaritifera (L.) in the Mountain River (Barrow). Unpublished report to National Parks and Wildlife Service.,* s.l.: s.n.

S.I. No. 140/2006, n.d. *Environmental Noise Regulations 2006.* s.l.:s.n.

Scott Wilson & Levitt-Therivel R., 2006. *Appropriate Assessment of Plans. Scott Wilson, Levett-Therivel Sustainability Consultants. ,* s.l.: s.n.

Skinner, A., Young, M., & Hastie, L. , 2003. *Ecology of the Freshwater Pearl Mussel. Conserving Natura 2000 Rivers.,* s.l.: s.n.

Smith, , G. F., O'Donoghue, P., O'Hora, K., & Delaney, E. , 2011. *Best Practice Guidance for Habitat Survey and Mapping. ,* s.l.: s.n.

Southern Regional Assembly, 2020. *Regional Spatial & Economic Strategy for the Southern Region 2020-2032. ,* s.l.: s.n.

Southgate Associates , 20025. *Conservation Strategy Report. Unpublished report.,* s.l.: s.n.

Southgate Associates , 2022. *Preliminary Building and Conservation Strategy Report. Draft unpublished report.,* s.l.: s.n.

Stalley, R. , 1987. *The Cistercian Monasteries of Ireland: An account of the history, art and architecture of the white monks in Ireland from 1142 to 1540. London and New Haven, CT: Yale University Press.,* s.l.: s.n.

Stoeckle, B. C., 2015. *Environmental DNA as a monitoring tool for the endangered freshwater pearl mussel (Margaritifera margaritifera L.): a substitute for classical monitoring approaches? Aquatic Conservation: Marine and Freshwater Ecosystems.,* s.l.: s.n.

Swayne, S. , 1988. *Duiske Abbey, Graignamanagh. Graignamanagh. Self-published.,* s.l.: s.n.

TA Luft, 2002. *Technical Instructions on Air Quality Control.* [Online] Available at: https://www.euromot.eu/wp-content/uploads/2017/03/GERMAN_TA_Luft_Technical_Instruction_on_Air_Quality_Control_2002-07-24.pdf

TerraDat , 2024. *Geophysical Survey Report (Licence 24R0041) Areas A-E. Unpublished Report.,* s.l.: s.n.

The Department of Environment, Housing and Local Government, 2010. *A Framework for Major Emergency Management, Guidance Document 1-A Guide to Risk Assessment in Major Emergency Management ,* s.l.: s.n.

The European Parliament and the Council of the European Union , 2007. *Directive 2007/60/EU of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks,* s.l.: s.n.

The European Parliament and the Council of the European Union, 2014. *Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 ammending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment.,* s.l.: s.n.

The Office of the Planning Regulator, 2021. *OPR, Practice Note PN01, Appropriate ASsessmetn Screening for Development Management,* s.l.: s.n.

The United Nations Economic Commission for Europe (UNECE), 1998. *UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention),* s.l.: s.n.

TII, 2001. *Guidelines for the Treatment of Noise and Vibration During the Planning and Construction of National Road Schemes.,* s.l.: s.n.

TII, 2004. *Guidelines for the Treatment of Noise and Vibration in National Road Schemes.* s.l.:s.n.

TII, 2011. *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes. ,* s.l.: s.n.

TII, 2014. *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes.* s.l.:s.n.

TII, 2019. *Project Appraisal Guidelines for National Roads Unit 5.3 - Travel Demand Projections,* s.l.: s.n.

TII, 2024. *Major Roads Projects Active List,* s.l.: s.n.

Triturus, 2021. *Graiguenamanagh-Tinnahinch Flood Relief Scheme freshwater pearl mussel (Margaritifera margaritifera) survey. ,* s.l.: s.n.

Triturus, 2021. *Graiguenamanagh-Tinnahinch Flood Relief Scheme white-clawed crayfish (Austropotamobius pallipes) survey. ,* s.l.: s.n.

UK Environment Agency, 2004. *UK Pollution Prevention Guidelines, (PPG) ,* s.l.: s.n.

Veon, 2025. *Graiguenamanagh Tinnahinch Flood Relief Scheme Bat Survey Report. ,* s.l.: s.n.

Wacker, S. L., 2019. *Host specificity drives genetic structure in a freshwater mussel. Scientific reports.,* s.l.: s.n.

WFD Application., 2018. *WFD Cycle 2: Catchment Barrow - Subcatchment Barrow_SC_130 Code 14_7,* s.l.: Environmental Protection Agency via catchments.ie..

WHO, 1999. *Guidelines for Community Noise.* s.l.:s.n.

WHO, 2005. *Air Quality Guidelines: Global Update 2005 : Particulate Matter, Ozone, Nitrogen Dioxide, and Sulfur Dioxide,* s.l.: s.n.

WHO, 2009. *Night Noise Guidelines for Europe.* s.l.:s.n.

WHO, 2018. *Environmental Noise Guidelines for the European Region 2018.* s.l.:s.n.

WHO, 2021. *Global Air Quality Guidelines - Particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide,* s.l.: s.n.

Wood, H. and Langman, A. (revised by Griffith, M) , 1956. *Calendar of the justiciary rolls, or proceedings in the court of the justiciar of Ireland preserved in the Public Record Office of Ireland. I to VII years of Edward II. Dublin. Public Record Office. ,* s.l.: s.n.