September 2018

Arklow Wastewater Treatment Plant Project

Environmental Impact Assessment Report

Volume 2: Main text (Book 2 of 3)

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Glossary and Abbreviations

AA	Appropriate Assessment – An assessment of the potential adverse effects of a plan or project (in combination with other plans or projects) on the Natura 2000 network of European designated sites for biodiversity as defined by the Habitats Directive
AADT	Annual Average Daily Traffic – The total volume of vehicle traffic of a motorway or road for a year divided by 365 days.
ACM	Asbestos Containing Material
AHU	Air Handling Unit
The Alps	The vacant land (approximately 2.9ha) located to the west of River Walk at Upper Main Street, between Parade Ground to the south and Avoca River to the north. This area is as defined as the Alps Opportunity Site in the Arklow LAP.
AQS	Air Quality Standards
Aquatic ecology	The topic that deals with all aspects of ecology in the River Thames up to and including the flood defence walls. This includes fish, invertebrates, marine mammals and aquatic plants using the River Thames and its foreshore areas. Wintering birds which use the foreshore are not included in the aquatic ecology section (Refer to terrestrial ecology)
Archaeological Heritage	the term ‘archaeological heritage’ is applied to objects, monuments, buildings or landscapes of an (assumed) age typically older than AD 1700 (and recorded as archaeological sites within the Record of Monuments and Places)
Architectural Heritage	The term ‘architectural heritage’ is applied to structures, buildings, their contents and settings of an (assumed) age typically younger than AD 1700 For the purposed of this report the terms ‘architectural heritage’ and ‘built heritage’ have the same intended meaning and are used interchangeably.
Area of Archaeological Potential	An area with known potential for significant archaeological remains as identified in the Wicklow County Development Plan 2016 -2022
Arklow Bridge	The 19 arch bridge over the Avoca River in between Arklow town (to the south) and Ferrybank (to the north).
Arklow LAP	Arklow Local Area Plan 2018 - 2024
As	Arsenic
Assessment area	Study area considered in the environmental assessment for a given topic
Baseline	Refers to existing conditions as represented by latest available survey and other data

Benthic	A description for animals, plants and habitats associated with the river or seabed
BGL	Below Ground Level
Birds Directive	Council Directive 79/409/EEC as amended by Council Directive 2009/147/EC on the conservation of wild birds
BOD	Biological Oxygen Demand – The amount of dissolved oxygen needed by aerobic biological organisms to break down organic material present in a given water sample at certain temperature over a specific time period
BSI	British Standards Institution
Caisson	A foundation formed by constructing a shaft, often supported by precast concrete segments in rings, and then filled with concrete
CCTV	Closed-circuit television
Cd	Cadmium
CDWMP	Construction and Demolition Waste Management Plan
CEMP	Construction Environmental Management Plan
CIRIA	Construction Industry Research and Information Association
COD	Chemical Oxygen Demand – The amount of oxygen consumed by reactors in a measured solution (that can be used to quantify organics in water)
Cofferdam	A temporary watertight structure to enclose an area underwater that is pumped dry to allow construction work to be carried out
COMAH	Control of Major Accidents Hazards involving Dangerous Substances
CoRTN	Calculation of Road Traffic Noise
County Development Plan	Wicklow County Development Plan 2018 - 2024
CPO	Compulsory Purchase Order
Cultural Heritage	'Cultural Heritage' where used generically, is an over-arching term applied to describe any combination of archaeological, architectural and cultural heritage features. The term 'cultural heritage', where used specifically, is applied to other (often less tangible) aspects of the landscape such as historical event, folklore memories and cultural associations. This designation can also accompany an archaeological or architectural designation or describe features that have a more recent origin, but retain cultural heritage significance.
CSM	Conceptual Site Model
CSO	Central Statistics Office
Cu	Copper

Cumulative effect	Likely significant effects arising from a cumulation of effects associated with the proposed development and other projects in the local area of relevance
DaS	Dumping at Sea
DBO	Design Build and Operate – A form of contract where the contractor is responsible for the design and construction of a facility, and has a long term responsibility for operation
DCCAE	Department of Communications, Climate Action and Environment
DCHG	Department of Culture, Heritage and the Gaeltacht
Decibel (dB)	The ratio of sound pressures, which we can hear, is a ratio of 106 (one million: one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the ‘sound pressure level’ (Lp) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.
DIN	Dissolved inorganic nitrogen
DMRB	Design Manual for Roads and Bridges
DO	Dissolved oxygen
DoEHLG	Department of the Environment Heritage and Local Government
DSA	Detailed Site Assessment
DWF	Dry Weather Flow
ECJ	Court of Justice of the European Union
ED	Electoral Division
EIA	Environmental impact assessment
EIAR	Environmental Impact Assessment Report
The EIA Directive	Council Directive 2014/52/EU on the assessment of certain public and private projects on the environment
EIS	Environmental Impact Statement
ELV	Emission limit value
EPA	Environmental Protection Agency
ETS	Emissions Trading Scheme
EU	European Union
European designated site	The Natura 2000 site network, i.e. Special Areas of Conservation - (including candidate SACs) protected under the provisions of the Habitats Directive and Special Protection Area - (including proposed SPAs) protected under the provisions of the Birds Directive
FFT	Full flow to treatment
Fluvial	Relating to a river, i.e. fluvial flow is the flow of freshwater

Foreshore	The area of a shore that lies between the mean high water and mean low water mark
FOG	Fat, Oil and Grease (removal)
FSR	Flood Studies Report
GDA	Greater Dublin Area
GDSDS	Greater Dublin Strategic Drainage Study
GE	General Electric
GHG	Greenhouse Gas
GI	Ground Investigations
GNI	Gas Networks Ireland
GSI	Geological Survey of Ireland
ha	Hectare
Habitat	An area or natural environment formed of physical factors such as soil and moisture that reside in a defined topographical area in which organisms (fauna and flora) normally live.
Habitats Directive	Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
HGV	Heavy goods vehicle
HIA	Health Impact Assessment
HSE	Health Services Executive
HVAC	Heating, Ventilation and Air Conditioning
IAQM	Institute of Air Quality Management
ICE	Institute of Civil Engineers
ICPSS	Irish Coastal Protection Strategy Study
IE	Industrial Emissions Licence
IE	Intestinal enterococci
IED	Industrial Emissions Directive
IEMA	Institute of Environmental Management
IGI	Institute of Geologists Ireland
Interactive Effects	Likely significant effects arising from the interaction of different environmental factors that give rise to multiple effects on a single receptor
Intertidal	The area of shore that is exposed to the air at low tide and underwater at the high tide
IPPC	Integrated Pollution and Prevention Control

IROPI	Imperative Reasons for Overriding Public Interest
ISO	International Standards Organisation
$L_{Aeq\ T}$	The equivalent continuous sound level. It is an average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T).
$L_{Ar\ T}$	The rated noise level, equal to the L_{Aeq} during a specified time interval (T), plus specified adjustments for tonal character and/or impulsiveness of the sound.
Lg	Local sand and gravel aquifer
LI	Local Zones
Lidar	A remote sensing technology that measures distance by illuminating a target with a laser and analysing the reflected light
m	metres
mOD	metres Above Ordnance Datum
MAND	Major Accidents and Natural disasters
MBR	Membrane Bioreactors
MEICA	Mechanical, Electrical, Instrumentation, Controls and Automation
MHWS	Mean High Water Springs – The highest level that spring tides reach on the average over a period of time
Mitigation	This is defined as measures which avoid or reduce environmental effects which are not included in the design of the proposed development or otherwise included 'up front' in the scheme description (such as the CoCP)
MMO	Marine Management Observer
Mt	Million tonnes
NDP	National Development Plan
NHA	National Heritage Area – An area considered by the NPWS important for the habitats present or which holds species of plants and animals whose habitat needs protection
Ni	Nickel
NIAH	National Inventory of Architectural Heritage
NIS	Natura Impact Statement
NO_2	Nitrogen Dioxide
NTS	Non-technical summary
NPWS	National Parks and Wildlife Service
NPF	National Planning Framework
NRA	National Roads Authority
NSAI	National Standards Authority of Ireland

NSS	National Soil Survey
NVMP	Noise and Vibration Management Plan
NWSMP	National Wastewater Sludge Management Plan
OCU	Odour Control Unit
OD	Ordnance Datum
OPW	Office of Public Works
OHSAS	Occupational Health and Safety Assessment Series
OHSS	Occupational Hygiene and Safety Series
OS	Ordnance Survey
PCBs	Polychlorinated biphenyls
PCU	Passenger car units – One car is considered as a single passenger car unit (1 PCU), a motorcycle is considered as half a car unit (0.5 PCU). Buses and trucks (due to their large size) is considered equivalent to 3 cars (3 PCUs).
PE	Population Equivalent
PFRA	Preliminary Flood Risk Assessment
PID	Photo-ionisation detector
Pier	A column supporting the superstructure of a bridge
Planning boundary	The boundary for planning purposes of the project in question, i.e. the red line boundary as shown in Figure 1.1
PM	Particulate Matter
pNHA	Proposed Natural Heritage Area – An area identified by the NPWS on a non-statutory basis as sites of significance for wildlife and habitats
PO4	Orthophosphate
PPV	Peak particle velocity
Proposed development	The proposed Wastewater Treatment Plant and associated infrastructure including the interceptor sewer network, marine outfalls, upgrade to the revetment, Alps combined sewer overflow and stormwater storage tank.
Proposed Arklow Flood Relief Scheme	It is understood that Wicklow County Council funded by The Office of Public Works intends to undertake engineering works along the Avoca River to mitigate the risk of flooding in the Arklow and Ferrybank area in County Wicklow.
PSA	Preliminary Site Assessment
PSES	Public Sector Energy Efficiency Strategy
PV	Photovoltaics
RBC	Rotating Biological Contractors
RBMP	River Basin Management Plan
RDAS	Refurbishment / Demolition Asbestos Survey

Receptor	Something that could be adversely affected by the proposed development, such as people, an ecological system, property, water body or social infrastructure.
Rip-rap	Rock pieces 10-30 cm diameter used for scour protection of in-river works
RMP	Records of Monuments and Places
RPS	Records of Protected Structures
RQD	Rock Quality Description
RSES	Regional Assembly Spatial and Economic Strategy
SAC	Special Areas of Conservation - (including candidate SACs) protected under the provisions of the Habitats Directive
SBR	Sequencing Batch Reactor
Scour	Erosion of the riverbed due to water flows
SEA	Strategic Environmental Assessment
SI	Site investigation
SID	Strategic Infrastructure Development – Classified as such under the Seventh Schedule of the Planning and Development Act 2000, as amended including by the Planning and Development (Strategic Infrastructure) Act 2006.
Site	The entire area within the planning boundary for the proposed development
SMR	Sites and Monuments Record
Spring tide	The exceptionally high and low tides that occur at the time of the new moon or full moon when the sun, moon and earth are approximately aligned
SPA	Special Protection Area - (including proposed SPAs) protected under the provisions of the Birds Directive
SWO	Stormwater overflow – Relief valves within the network that allow excess combined storm water to be released to the storm water network, or directly to receiving waters (including rivers, lakes, estuarine or coastal waters).
T	Tonnes
TA	Total ammonia
TBM	Tunnel Boring Machine
TD	Téachta Dála – A TD is a member of Dáil Éireann, the lower house of the Oireachtas. It is the equivalent of terms such as ‘Member of Parliament’ or ‘Member of Congress’ used in other countries.
TDS	Total Dissolved Solids
TII	Transport Infrastructure Ireland
TSS	Total Suspended Solids

UMASW	Underwater Multichannel Analysis of Surface Waters
UPS	Uninterruptable power supply
UWWT Directive	Urban Wastewater Treatment Directive - Council Directive 91/271/EEC concerning urban waste-water treatment
WFD	Water Framework Directive – Council Directive 2000/60/EC establishing a framework for Community action in the field of water policy
WHO	World Health Organisation
WWDA	Wastewater Discharge Authorisation – Application made to and authorisation received from the EPA to discharge to aquatic environment as defined under Regulation 5 of the Waste Water Discharge Regulations 2007 (i.e. for an agglomeration with a population equivalent of more than 10,000 in the case of the proposed development)
WwTP	The proposed wastewater treatment plant that would be located at the Old Wallboard site, Ferrybank
WwTP site	The Old Wallboard site at Ferrybank where the proposed development would be constructed
WZ	Water-front Zone – Arklow’s Waterfront’ comprises the port, marinas, harbour, quays, north and south beaches and adjoining lands. The ‘Waterfront Zone’ is made of two district areas north and south of the river that have seen different development pressures and levels of activity over the year, but both sharing the common characteristics of water frontage onto the river and/or the sea and the presence of industrial lands / buildings, a large proportion of which is currently underutilised and vacant.

7 Traffic and Transportation

7.1 Introduction

This chapter describes the likely traffic and transportation impacts associated with the construction and operation of the proposed development. A detailed description of the proposed development in relation to traffic and transportation is provided in **Section 7.4**.

This transportation assessment has considered likely significant effects during both the construction and operation of the proposed development. However, it is envisaged that it is during the construction of the proposed development that the likely impact on the various transportation networks will be greatest.

This report will present the receiving transport environment including reporting on traffic counts carried out on the surrounding street network. The projected increase in traffic associated with the operation of the proposed development and its likely significant effects on the receiving transportation networks. The likely phasing and scheduling of the proposed construction works is presented and their likely significant effects on the receiving environment. Finally, any mitigation measures which will assist in reducing the significant effects of the proposed development on the surrounding transportation network is presented.

7.2 Assessment Methodology

The following section presents the assessment methodology used in this transportation assessment.

7.2.1 Study Area

The study area considered as part of this transportation assessment is illustrated in Figure 7.1 and includes the following primary streets/ roads;

- North Quay;
- South Quay;
- Arklow Bridge;
- Harbour Road;
- Abbey Street;
- Main Street; and
- Ferrybank.

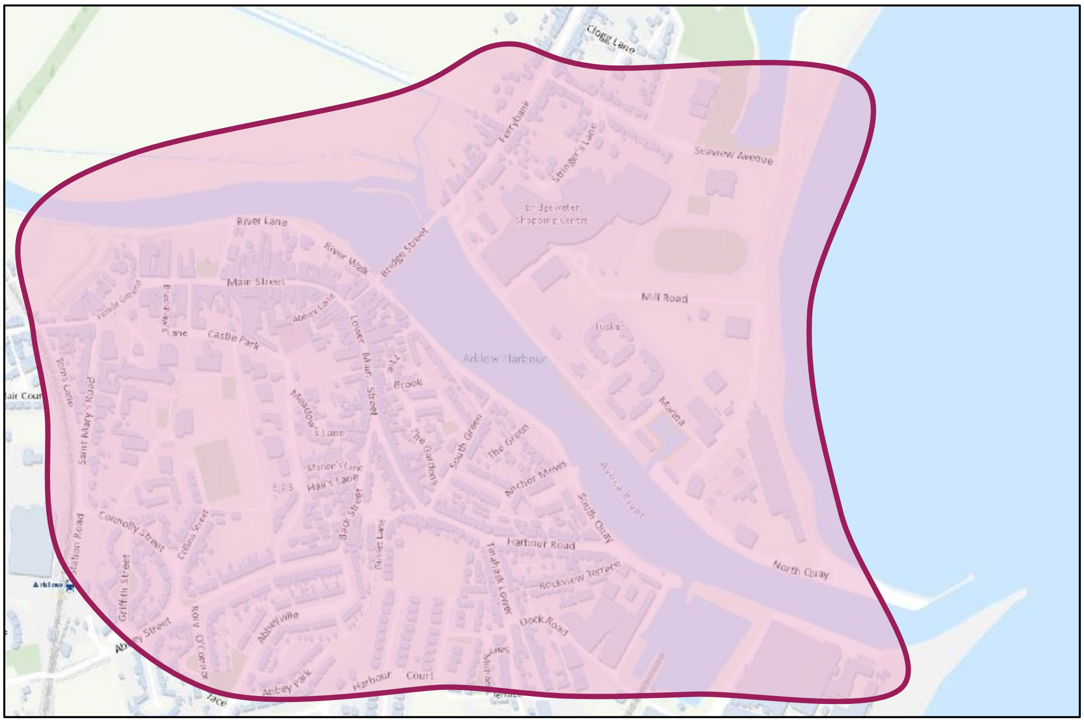

Figure 7.1: Study Area

The study area in Figure 7.1 is considered to be the primary zone of influence with respect to the management of traffic during the construction of the proposed development and is the area most likely to experience temporary changes in traffic flow during construction. As outlined in **Section 4.6 of Chapter 4**, the expected increase in traffic associated with the operation of the proposed development is expected to be very limited as the number of future employees is estimated at only 3-5 persons and regular deliveries/exports to the WwTP site will be minimal. This level of employment and the operational traffic associated with WwTP is expected to have little or no impact on the surrounding road network.

7.2.2 Traffic Count Data

Traffic counts were carried out in May 2017 and the traffic count locations are shown in Figure 7.2. The traffic counts were carried out to establish link flows only on an all day basis.

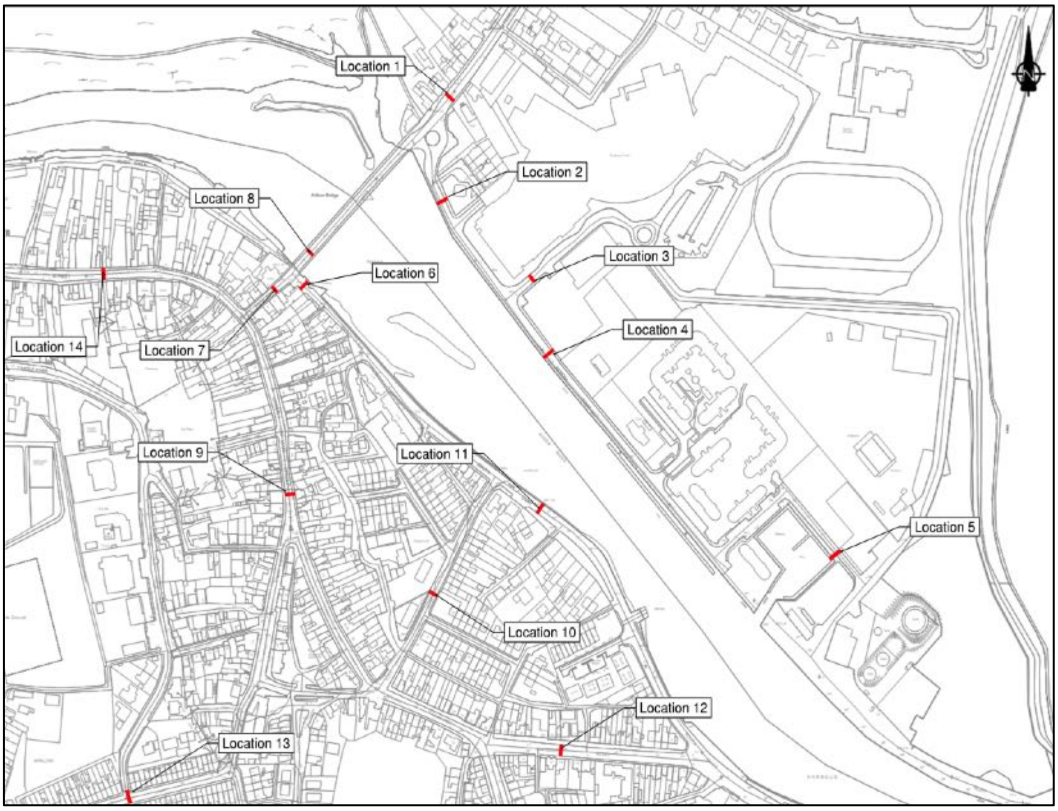

Figure 7.2: Traffic Count Locations

The first traffic survey was carried out from Thursday 4 May 2017 at 9:00 to Thursday 11 May 2017 at 14:00. Count information was obtained at the following locations.

- Location 1: R772-646 Ferrybank;
- Location 2: L6909-0 Bridgewater Road;
- Location 3: L6909-5 Off North Quay beside Aldi store;
- Location 4: L6909-10 North Quay; and
- Location 5: L6909-35 Marina.

The second traffic survey was carried out from Friday 12 May 2017 at 10:00 to Monday 22 May 2017 at 10:00. Count information was obtained at the following locations.

- Location 6: L6907 South Quay;
- Location 7: R775-656 Bridge Street;
- Location 8: R772-652 Arklow Bridge;
- Location 9: L2901-15 Lower Main Street; and
- Location 10: L6905-20 South Green.

The third traffic survey was carried out from Tuesday 23 May 2017 at 09:00 to Wednesday 31 May 2017 at 16:00. Count information was obtained at the following locations.

- Location 11: L6907-30 South Quay;
- Location 12: L6909-20 Harbour Road;
- Location 13: L2901-90 Abbey Street; and
- Location 14: R772-662 Main Street.

7.2.3 Future Year Traffic Growth Rates

Future traffic growth on the external road network is based on Transport Infrastructure Ireland's growth rates[1] for the Wexford Region. Based on Table 5.3.2. of the guidelines[1] (as presented in Figure 7.3) the recorded traffic flows have been increased by the central growth rates to establish Year 2020 base year traffic flows.

Year 2020 is expected to be the busiest year with respect to construction activity on the surrounding street/road network and thus has been used to present the likely significant effect of the construction of the proposed development. However, should the proposed development be delayed, there will be no change in the projected increase in traffic and resultant transport assessment as described herein.

Table 5.3.2: Link-Based Growth Rates: Annual Growth Factors

	Region	Low Sensitivity Growth				Central Growth				High Sensitivity Growth			
		2013 - 2030		2030 - 2050		2013 - 2030		2030 - 2050		2013 - 2030		2030 - 2050	
		LV	*HV*	*LV*	*HV*	*LV*	*HV*	*LV*	*HV*	*LV*	*HV*	*LV*	*HV*
1	**Dublin**	1.0089	1.0221	1.0004	1.0135	1.0134	1.0237	1.0038	1.0176	1.0149	1.0242	1.0054	1.0195
2	**Mid-East** *Kildare Meath Wicklow*	1.0109	1.0221	1.0018	1.0135	1.0140	1.0237	1.0048	1.0176	1.0154	1.0242	1.0054	1.0195
3	**Midland** *Laois Longford Offaly Westmeath*	1.0088	1.0221	0.9997	1.0135	1.0120	1.0237	1.0030	1.0176	1.0131	1.0242	1.0018	1.0195
4	**Border** *Cavan Donegal Monaghan Leitrim Louth Sligo*	1.0082	1.0221	0.9998	1.0135	1.0114	1.0237	1.0030	1.0176	1.0124	1.0242	1.0044	1.0195
5	**Mid-West** *Limerick Clare North Tipperary*	1.0066	1.0221	0.9962	1.0135	1.0099	1.0237	1.0000	1.0176	1.0110	1.0242	1.0018	1.0195
6	**West** *Galway City/County Mayo Roscommon*	1.0048	1.0221	0.9967	1.0135	1.0082	1.0237	1.0007	1.0176	1.0092	1.0242	1.0024	1.0195
7	**South-East** *Carlow Kilkenny Wexford South Tipperary Waterford City/County*	1.0076	1.0221	0.9996	1.0135	1.0106	1.0237	1.0022	1.0176	1.0118	1.0242	1.0038	1.0195
8	**South-West** *Cork City/County Kerry*	1.0070	1.0221	0.9983	1.0135	1.0102	1.0237	1.0012	1.0176	1.0112	1.0242	1.0031	1.0195

Figure 7.3: Future traffic growth (Source: Table 5.32 of the guidelines[1])

[1] Transport Infrastructure Ireland (2016) Project Appraisal Guidelines for National Roads Unit 5.3 - Travel Demand Projections – October 2016.

7.2.4 Traffic Generation

The projected change in traffic flows associated with the construction and operation of the proposed development are based on the following information:

- The volume of construction traffic activity is based on, the scale of the individual construction phases, the level of deliveries on site, the removal of soil/ waste from the site in addition to staff and ancillary traffic movements (i.e. servicing, visitors, etc..); and
- The volume of operational traffic activity is based on the number of staff employed and the volume of servicing/maintenance (i.e. sludge removal, etc.) trips associated with the proposed development.

7.2.5 Traffic Distribution

The distribution of generated traffic both operational and construction will reflect the existing distribution of traffic recorded by the traffic counts carried out on the local road network. In addition, the distribution of construction traffic is based on the following:

- All construction deliveries to the WwTP and the sewer network north of the Avoca River will access and egress the works area from Junction 20 on the M11 Motorway.
- All construction deliveries to the sewer network south of the Arklow Bridge will access the works area from Junction 21 on the M11 Motorway and egress via Junction 20 on the M11 Motorway.

7.2.6 Time Periods Assessed

The time periods assessed as part of this transportation assessment include the 08:00-09:00 period (i.e. during the morning peak period), the 17:00 - 18:00 period (i.e. during the evening peak period) and on an all-day basis (i.e. 24 hour period).

In terms of future assessment years it is proposed to assess the proposed development for Year 2020 as this is the expected busiest period during the construction. The operational assessment will be based on Year 2022 flows.

7.2.7 Site Visit

A site visit was undertaken on 11 July 2018 to develop an appreciation of the movement of traffic and pedestrians within the study area.

7.2.8 Consultation

Wicklow County Council was consulted in early March 2018 during the development of the traffic management plans to facilitate the construction of the proposed development. In principle, they are in agreement with the proposed traffic management plans, subject to the finalisation and submission of these plans on appointment of a contractor.

A further meeting was held with Wicklow County Council in mid-June 2018 to discuss the proposed diversion of traffic from North Quay to Seafield Avenue during the course of the construction of the proposed development.

7.2.9 Impact Assessment Methodology

The significance of effects has been assessed based on the criteria presented in Table 7.1 and has been based on the projected change in prevailing travel conditions which has regard to the EPA draft guidance[2] and with reference to professional judgement of the author who has more than 20 years' experience in undertaking traffic and transportation assessments.

Table 7.1: Assessment Criteria

Significance of Effects	Topic Specific Criteria
Imperceptible	No perceived impact on prevailing travel conditions
Not Significant	A small change in traffic flows without causing a real change in travel conditions
Slight Effects	A change in traffic flow resulting in a minor change in travel conditions
Moderate Effects	A change in traffic flows resulting in a modest change in travel conditions
Significant Effects	A marked change in travel conditions resulting in long delays to traffic
Very Significant Effects	A significant change in travel conditions resulting in very long delays to traffic
Profound Effects	A major change in travel conditions resulting in the breakdown in traffic flow and significant delays to traffic

7.3 Baseline Conditions

7.3.1 Site Location

The WwTP site is located to the north east of Arklow and is approximately 1.5km from the centre of the town. The site is located adjacent to the shore and is bounded by North Quay on both its western and southern boundaries.

The location of the WwTP site is presented in Figure 7.4.

[2] Environmental Protection Agency (2017) Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Draft August 2017)

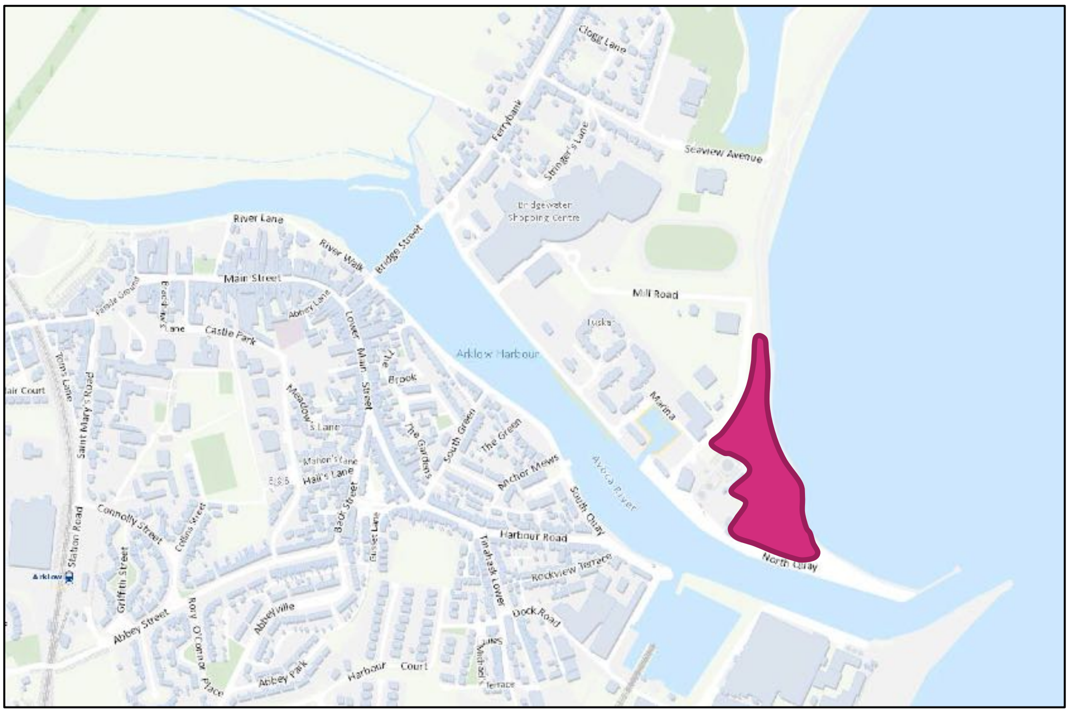

Figure 7.4: Location of proposed WwTP

7.3.2 Local Road Network

A brief description of the local road/street network in the vicinity of the proposed development is provided in **Sections 7.3.2.1 - 7.3.2.8**.

7.3.2.1 Ferrybank

Ferrybank is the primary route serving the northern side of Arklow and is the main road connecting Arklow to Junction 20 (Templerainey) on the M11. Ferrybank is a two-way roadway and directly serves adjacent residential properties. The roadway has good pedestrian facilities with footpaths located on both sides of the roadway and there is a pedestrian crossing outside Abercorn Masonic Hall on the two-way Ferrybank Road.

7.3.2.2 North Quay

North Quay is the primary access route serving the proposed WwTP. The junction of Ferrybank and North Quay is controlled via a roundabout and is a relatively busy intersection as North Quay also provides access to the Bridgewater Shopping Centre. The roadway is a single carriageway road with a footpath provided along one side of the roadway only. North Quay generally serves a combination of industrial and commercial properties.

7.3.2.3 South Quay

South Quay is a two-way roadway primarily serving residential properties. The roadway is generally narrow in width and has only intermittent footpath provision.

The northern end of South Quay operates one-way northbound and there are no footpaths provided along this section of roadway. The junction of Bridge Street and South Quay is a give-way junction but traffic is not permitted to access South Quay from Bridge Street.

7.3.2.4 Bridge Street

Bridge Street connects Main Street with Arklow Bridge. The street is two-way and supports on-street commercial and retail premises, no parking is permitted along Bridge Street. Bridge Street has footpaths located on both sides of the roadway and also has a pedestrian crossing provided close to its junction with Main Street.

The junction of Bridge Street/ Lower Main Street is non-standard with traffic travelling from Main Street having to give-way to traffic travelling between Bridge Street and Lower Main Street. This junction is a relatively busy location for both vehicular and pedestrian traffic.

7.3.2.5 Abbey Street

Abbey Street serves the south west districts of Arklow and also provides access to Junction 21 on the M11 Motorway. The street is two-way and supports mainly residential properties. The street has footpaths on both sides of the roadway and also supports some on-street parking.

7.3.2.6 South Green

South Green connects South Quay with Lower Main Street. The street is residential in nature, is two way and supports on street parking.

7.3.2.7 Harbour Road

Harbour Road connects Abbey Street to the southern end of South Quay. The street is two-way, however the connection to Abbey Street requires the utilisation of a system of one-way streets encompassing Lower Main Street/ Back Street and Old Chapel Street. The roadway is generally wide in nature, supports on-street parking and has footpaths provided on both sides of the roadway.

7.3.2.8 Main Street

Main Street connects Wexford Road with Bridge Street, via Upper Main Street. The street is two-way and supports on street commercial and retail premises. The street has footpaths on both sides of the roadway and supports on-street parking along one side of the roadway.

As noted previously traffic on Main Street has to yield to traffic on the Bridge Street- Lower Main Street route as part of the existing management of traffic.

7.3.3 Public Transport Network

Arklow is served by a rail service with Arklow train station located approximately 10 minutes' walk from the junction of Main Street/ Bridge Street. In addition, Arklow is served by regional bus services connecting it with the surrounding towns and cities including:

- Intercity Route 2: Wexford to Dublin also serving Gorey, Enniscorthy and Wexford; and
- Regional Route 133: Dublin to Arklow serving Rathnew, Wicklow, Bray.

The location of the train station and the primary bus route in Arklow is presented in Figure 7.5.

Figure 7.5: Public Transport Network

7.3.4 Existing Traffic Patterns

In order to assess the potential impact of the proposed development on the local road network an examination of the existing traffic flows was necessary. Traffic counts were carried out during May 2017 at the following locations as illustrated in Figure 7.6.

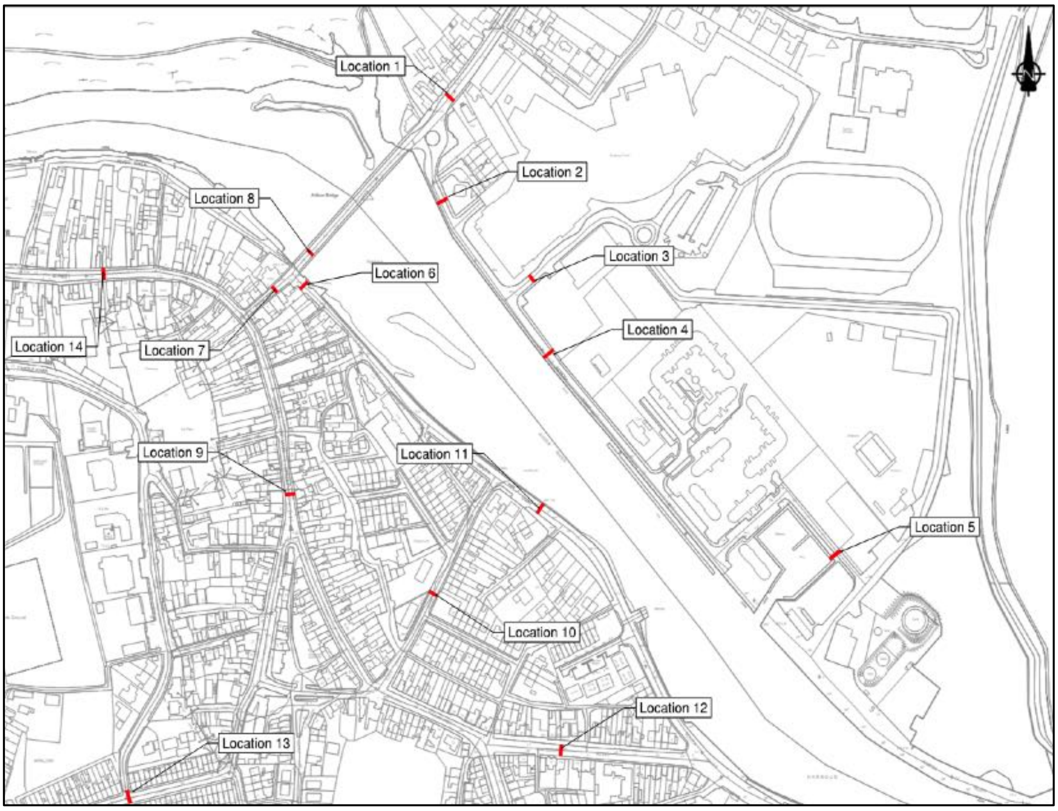

Figure 7.6: Traffic Count Locations

- **Location 1:** R772-646 Ferrybank;
- **Location 2:** L6909-0 Bridgewater Road;
- **Location 3:** L6909-5 Off North Quay beside Aldi store;
- **Location 4**: L6909-10 North Quay;
- **Location 5:** L6909-35 Marina;
- **Location 6:** L6907 South Quay;
- **Location 7:** R775-656 Bridge Street;
- **Location 8:** R772-652 Arklow Bridge;
- **Location 9:** L2901-15 Lower Main Street;
- **Location 10:** L6905-20 South Green;
- **Location 11:** L6907-30 South Quay;
- **Location 12:** L6909-20 Harbour Road;
- **Location 13:** L2901-90 Abbey Street; and
- **Location 14**: R772-662 Main Street.

Table 7.2 presents the morning peak (09:00-10:00), evening peak (17:00-18:00) and weekday daily traffic flows for the key streets in the vicinity of the proposed development.

Table 7.2: Existing Traffic Flow

Link	09:00 - 10:00	17:00 – 18:00	Daily
Ferrybank	1128 pcu	966 pcu	14726 pcu
North Quay	437 pcu	504 pcu	5779 pcu
South Quay – One Way Section	111 pcu	93 pcu	1369 pcu
South Quay – Two Way Section	66 pcu	70 pcu	1071 pcu
Arklow Bridge	1031 pcu	837 pcu	13498 pcu
Abbey Street	190 pcu	226 pcu	2540 pcu
South Green	204 pcu	122 pcu	2497 pcu
Harbour Road	48 pcu	55 pcu	693 pcu
Main Street	792 pcu	780 pcu	11677 pcu

Note: pcu = passenger car units

From the information in Table 7.2, it can be seen that the busiest routes include Ferrybank, Arklow Bridge and Main Street, with lower traffic flows using the remaining streets particularly on the south side of the Avoca River. The northern section of North Quay is relatively busy due to the presence of the Bridgewater Shopping Centre.

7.3.5 Committed Development

It is possible that the construction of the proposed development will be carried out at the same time as the proposed Arklow Flood Relief Scheme. The proposed Arklow Flood Relief Scheme includes works within the river itself, to the Arklow Bridge and works along both the North Quay and South Quay.

As noted previously the recorded baseline traffic flows have been increased by the suggested growth rates as presented by Transport Infrastructure Ireland[1] (Refer to Table 7.1). The inclusion of these growth rates reflects the potential increase in traffic on the surrounding road network from committed schemes in the general Arklow area.

7.4 Characteristics of the Proposed Development

7.4.1 Introduction

The following sections presents the proposed development and the likely changes to the existing transportation networks needed to accommodate the construction of the proposed development. In transportation terms, the construction of the proposed development can be divided into two primary phases, first the construction of the WwTP itself and the second the construction of the proposed interceptor sewer network and ancillary development to serve this new WwTP. The operation of the WwTP will be considered separately.

7.4.2 Wastewater Treatment Plant

The location of the WwTP is presented in Figure 7.7 along with the primary access route to the WwTP site, which will be via Mill Road. It is envisaged that this route will be used during both the operation and construction, however there may be some diversion of traffic along the North Quay during construction to facilitate the construction of the proposed interceptor sewer in this area. Further details of the proposed construction sequence associated with the sewers is presented in **Section 7.4.3**.

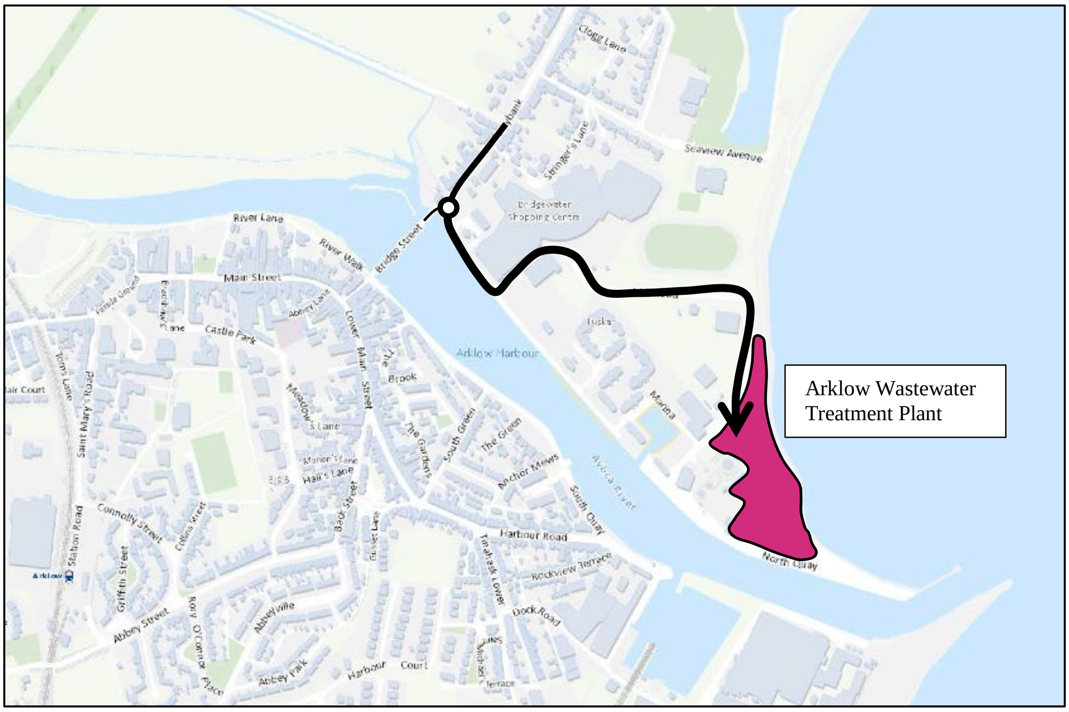

Figure 7.7: Primary Access Route – Arklow Wastewater Treatment Plant

7.4.2.1 Construction Phase

The construction of the WwTP at the Old Wallboard site at Ferrybank is expected to take approximately 42 months to complete and it is envisaged that the construction works will employ up to 120 persons during the peak construction period, which will last approximately 12 months.

There will only be limited parking provided at the WwTP site for site vehicles, management and occasional visitors with the remaining parking demand accommodated on either the surrounding road network or temporarily within an adjacent parking area secured by the contractor.

The WwTP will also include bicycle parking, changing rooms and showers to be provided for construction workers. Finally, an on-site canteen is proposed to minimise the movement of traffic between the site and the surrounding area during lunch and break times.

7.4.2.2 Traffic Generation

During the peak construction period, it is expected that the following volume of traffic will be generated by the proposed construction works based on the following key assumptions:

- 90% of construction staff traffic will arrive by car with a car occupancy of 1.2 persons.
- 50% of all construction staff traffic will arrive and leave during the traditional peak hour periods.
- The busiest construction period is likely to be during the revetment upgrade and the deep excavation required for the treatment plant. During this circa 3 month time period the estimated total volume of excavation and fill required is approximately 57,000m^3.
- The delivery of fill and excavation material from the site will be via rigid trucks (9m^3) and the calculation of truck movements is based on a 5 day operation with a 10 hour working day.
- The average delivery of fill and excavation material has been increased by 20% to represent some potential peaking in the arrival and departure of trucks to and from the site.
- All Heavy Goods Vehicles have been converted to passenger car units based on the following ratio: 1 HGV equals 2.3 passenger car units.

Table 7.3: Traffic Generation – Construction Phase

	Staff	**Deliveries**	**Service**
Daily	360 pcu	320 pcu	100 pcu
AM Peak	45 pcu	38 pcu	12 pcu
PM Peak	45 pcu	38 pcu	12 pcu

pcu = passenger car units.

7.4.2.3 Commissioning Works

As part of the commissioning of the WwTP some additional works will be required to the proposed interceptor sewer network to transfer flows from existing sewers to the proposed interceptor sewers. This will include the laying of short sections of spur pipelines from the new sewers and connecting these to the existing sewers. The sections of existing sewer to be abandoned will typically be pumped within concrete to form a plug at either end of the line.

The projected increase in traffic associated with the commissioning works will be less than that noted during the peak construction periods associated with the construction of the WwTP itself.

7.4.2.4 Operational Phase

On completion of the construction phase the WwTP is envisaged to employ 3-5 full time employees, some of whom would work in shifts as the facility would be operational 24 hours per day.

In terms of car parking a total of 20 spaces are proposed to cater both for the staff parking demand and potential visitor parking demands. In addition, there will be 4 bays for forklifts and 2 standby areas for trucks to collect and/ or deposit materials.

The WwTP will also generate service and maintenance trips with approximately 1 vehicle removing sludge expected on a daily basis.

7.4.3 Interceptor Sewer Network

It is envisaged that the construction of the proposed interceptor sewer network will be phased to both manage the overall construction programme and minimise effects on the receiving environment, particularly those associated with environmental conditions and local trader/resident requirements. For the purpose of this transportation assessment the following phased construction profile is presented in **Sections 7.4.3.1 - 7.4.3.13**, however it is noted that some modifications to this construction profile are possible reflecting the actual progress and potential impacts within the study area.

7.4.3.1 Stage A: River Walk (West)

Overview

Stage A includes the construction of the proposed sewer network and Alps SWO and stormwater storage along the south side of the Avoca River to the west of River Walk. The works are primarily along the route of the existing river side walkway and the extent of Stage A works is noted in Figure 7.8.

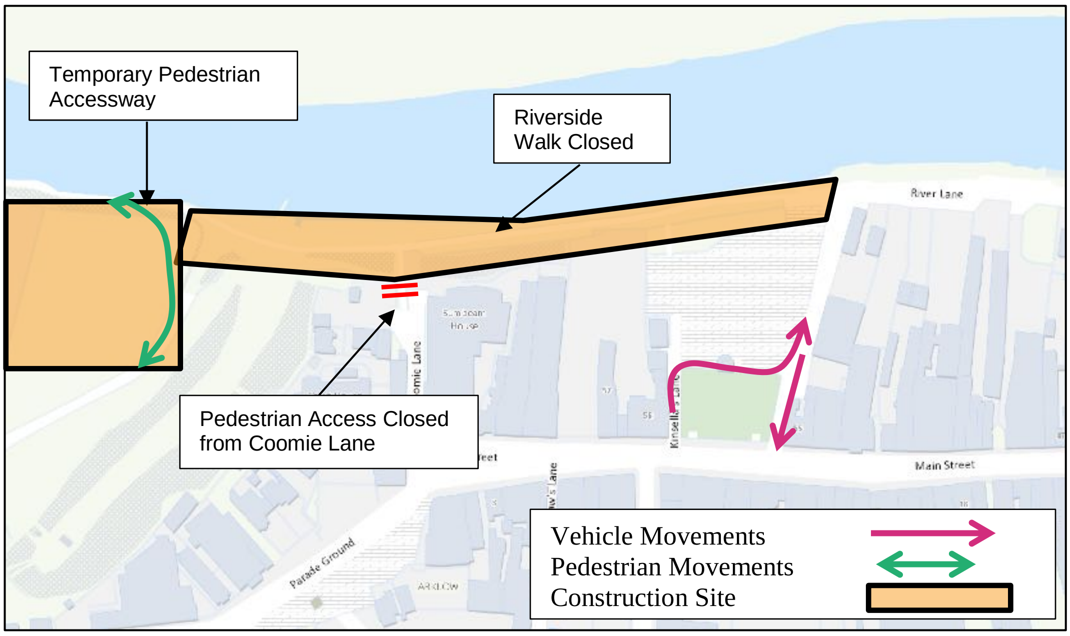

Figure 7.8: Proposed Sewer Network – Stage A

The primary characteristics of this phase of works include the following:

- Duration – Approximately 6 months.
- The riverside walk will be closed to all persons with the unaffected riverside only accessible from the pedestrian access over the rail line.
- Pedestrian access between the riverside walk and Coomie Lane will be closed.
- Construction and general public access will be via River Lane (West) and around Arklow Town car park.

Traffic Generation

Stage A does not include any significant diversion of traffic from the local street network and the primary impact during this stage will be associated with the physical works themselves.

The projected increase in traffic associated with Stage A is noted in Table 7.4 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor; and
- Approximately 15 construction staff will be employed at the working areas.

Table 7.4: Traffic Generation – Stage A: River Walk (West)

	Staff	Deliveries	Service
Daily	25 pcu	9 pcu	15 pcu
AM Peak	7 pcu	2 pcu	2 pcu
PM Peak	7 pcu	2 pcu	2 pcu

pcu = passenger car units

7.4.3.2 Stage B: River Walk (Central)

Overview

Stage B includes the construction of the proposed sewer network along the south side of the Avoca River along River Walk. The extent of Stage B works is noted in Figure 7.9.

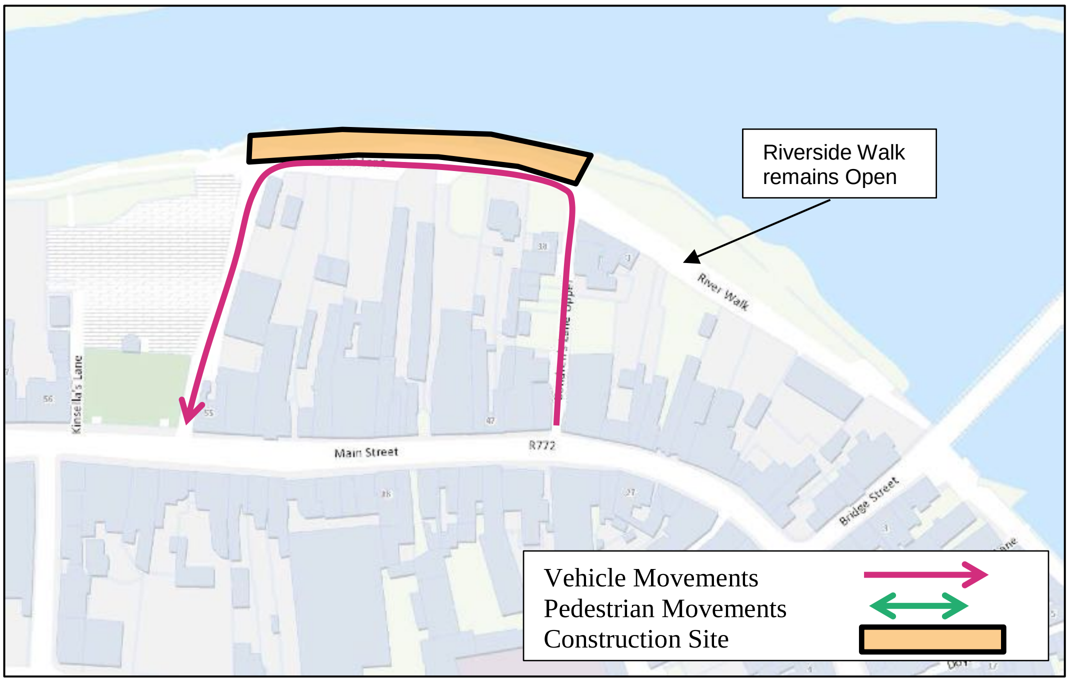

Figure 7.9: Proposed Sewer Network – Stage B

The primary characteristics of this phase of works include the following:

- Duration – Approximately 2 months.
- Riverside Walk east of the Stage B works remains open to two-way traffic at all times.
- Any required road closures will be either carried out at night and/or managed by a stop/go system to ensure access is maintained at all times.
- There will be some loss of parking during the construction of the works with between 5-10 spaces discontinued for the duration of the works.

- A safe pedestrian accessway will be secured along the southside of Riverside Walk for the duration of the construction works.
- Construction access will be via Condren's Lane Upper with traffic exiting via River Lane (West).

Traffic Generation

Stage B does not include any significant diversion of traffic from the local street network and the primary impact during this stage will be associated with the physical works themselves.

The projected increase in traffic associated with Stage B is noted in Table 7.5 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport; and
- Approximately 5 construction staff will be employed at the working areas.

Table 7.5: Traffic Generation – Stage B: River Walk (Central)

	Staff	Deliveries	Service
Daily	8 pcu	9 pcu	15 pcu
AM Peak	2 pcu	2 pcu	2 pcu
PM Peak	2 pcu	2 pcu	2 pcu

pcu = passenger car units.

7.4.3.3 Stage C: River Walk (East)

Overview

Stage C includes the construction of the proposed sewer network along the south side of the Avoca River along River Walk. The extent of Stage C works is noted in Figure 7.10.

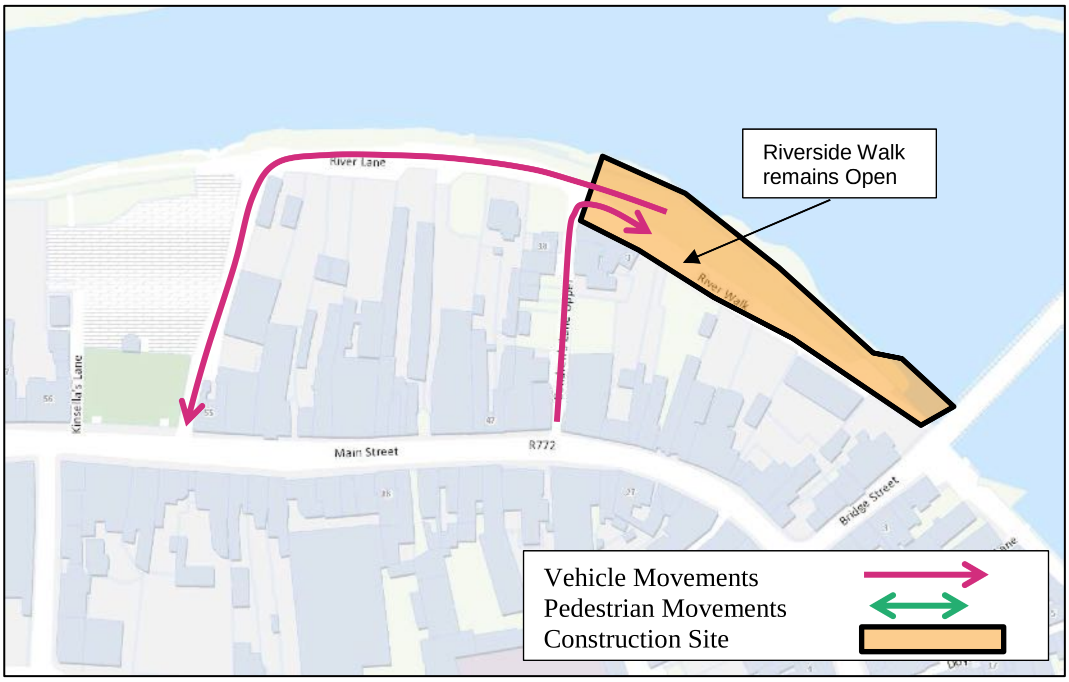

Figure 7.10: Proposed Sewer Network – Stage C

The primary characteristics of this phase of works include the following:

- Duration – Approximately 2 months.
- Riverside Walk east of Condren's Lane Upper will remain accessible for all traffic during the course of the construction works.
- Any required road closures will be either carried out at night and/or managed by a stop/go system to ensure access is maintained at all times.
- There will be some loss of parking during the construction of the works with between 10-15 spaces discontinued for the duration of the works.
- A safe pedestrian accessway will be secured along the southside of Riverside Walk for the duration of the construction works.
- Construction access will be via Condren's Lane Upper with traffic exiting via River Lane (West).

Traffic Generation

Stage C does not include any significant diversion of traffic from the local street network and the primary impact during this stage will be associated with the physical works themselves.

The projected increase in traffic associated with Stage C is noted in Table 7.6 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport; and
- Approximately 5 construction staff will be employed at the working areas.

Table 7.6: Traffic Generation – Stage C: River Walk (East)

	Staff	Deliveries	Service
Daily	8 pcu	11 pcu	15 pcu
AM Peak	2 pcu	3 pcu	2 pcu
PM Peak	2 pcu	3 pcu	2 pcu

pcu = passenger car units.

7.4.3.4 Stage D: Arklow Bridge

Overview

Stage D includes the extension of the quay walls into the Avoca River to facilitate the construction of the proposed sewer network along the south side of the Avoca River either side of the Arklow Bridge. The extent of Stage D works is noted in Figure 7.11.

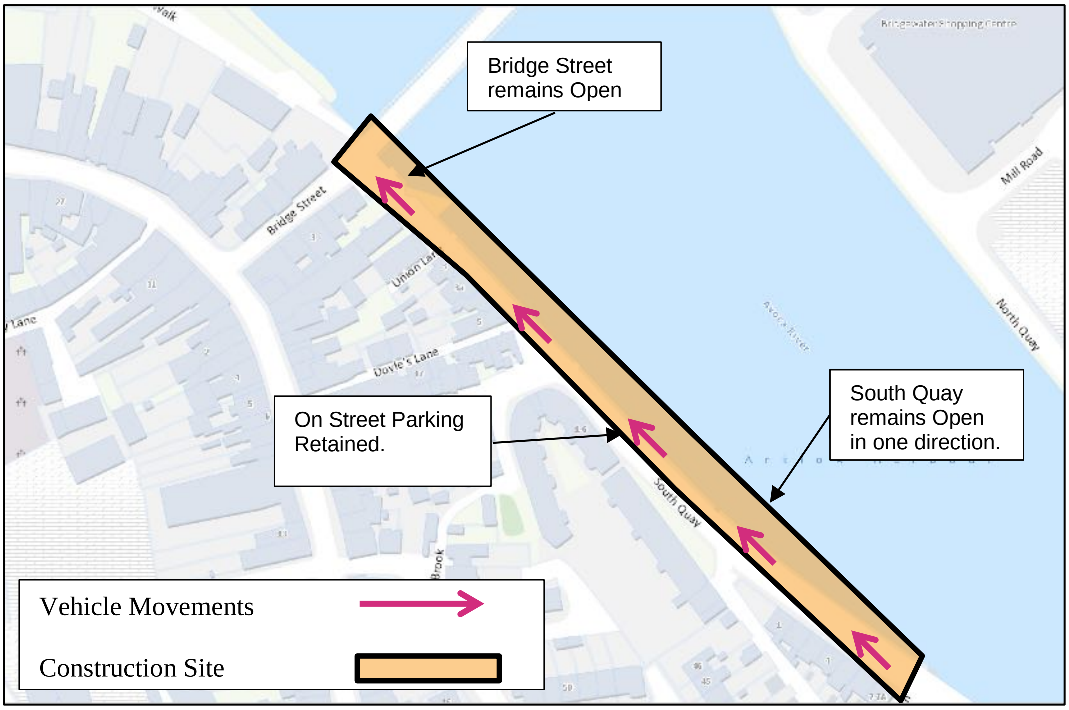

Figure 7.11: Proposed Sewer Network – Stage D

The primary characteristics of this phase of works include the following:

- Duration – Approximately 9 months.
- Riverside Walk remains open to two-way traffic at all times; Stage D works include the construction of a new quay wall and sewer under the existing Arklow Bridge.
- The underpinning of the Arklow Bridge which will require lane closures during the evening and night periods.

- The existing traffic management system will remain along South Quay with one-way traffic permitted between Doyle's Lane and the existing Arklow Bridge and two-way for the remainder of South Quay.
- Any works to the Arklow Bridge may require the temporary closure of one of the lanes.
- On-street parking is retained along South Quay, with the exception of the parking space opposite No. 1 South Quay.
- Construction access will be via South Green.

Traffic Generation

Stage D does not include any significant diversion of traffic along South Quay with access maintained northbound along the Quay and the primary impact during this stage will be associated with the physical works themselves.

The projected increase in traffic associated with Stage D is noted in Table 7.7 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor;
- Approximately 15 construction staff will be employed at the works area; and
- Approximately 16,400m^3 of extraction and fill required to construct the proposed haul road (3 month duration).

Table 7.7: Traffic Generation – Stage D: Arklow Bridge

	Staff	Deliveries	Service
Daily	25 pcu	46 pcu	15 pcu
AM Peak	7 pcu	6 pcu	2 pcu
PM Peak	7 pcu	6 pcu	2 pcu

pcu = passenger car units.

7.4.3.5 Stage E: South Quay/ South Green

Overview

Stage E includes the construction of two access chambers to the inceptor sewer on South Quay as well as the tunnelling of the sewer itself. The construction of the access chamber requires the complete closure of South Quay to the south of South Green. The extent of Stage E works is noted in Figure 7.12.

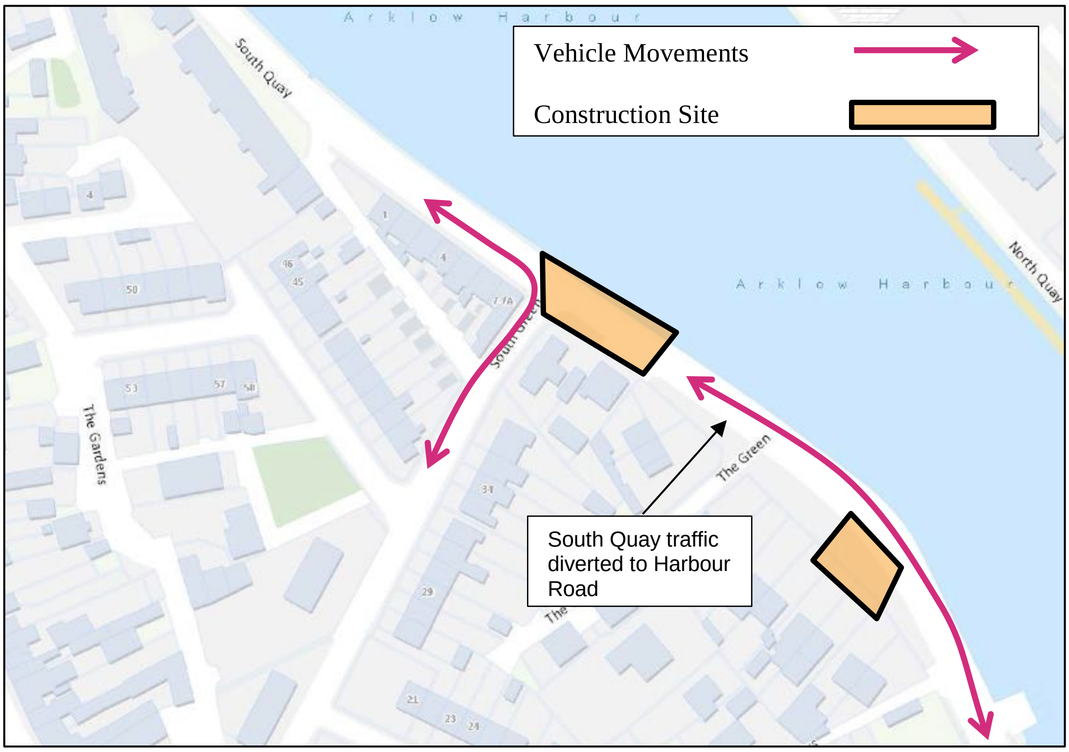

Figure 7.12: Proposed Sewer Network – Stage E

The primary characteristics of this phase of works include the following:

- Duration – Approximately 2 months.
- South Green closed to through traffic; all traffic on South Quay south of South Green diverted to Harbour Road.
- Pedestrian access retained along South Quay to ensure all properties retain access during the course of the works.
- Two temporary parking spaces provided to serve residential properties.
- Construction access to the access chamber construction sites will be via both South Green and Harbour Road.

Traffic Generation

Stage E does include some traffic diversion along South Quay with traffic having to divert from South Quay onto Harbour Road. The volume of traffic generated by the works themselves is expected to be relatively minimal.

The projected increase in traffic associated with Stage E is noted in Table 7.8 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor; and
- Approximately 6 construction staff will be employed at the working areas.

Table 7.8: Traffic Generation – Stage E: South Quay/ South Green

	Staff	Deliveries	Service
Daily	8 pcu	11 pcu	15 pcu
AM Peak	2 pcu	3 pcu	2 pcu
PM Peak	2 pcu	3 pcu	2 pcu

pcu = passenger car units.

7.4.3.6 Stage F: South Quay/ Harbour Road

Overview

Stage F includes the construction of an access chamber for the inceptor sewer on South Quay as well as the tunnelling section across the Avoca River. The construction of the access chamber requires the complete closure of South Quay to the north of Harbour Road. The extent of Stage F works is noted in Figure 7.13.

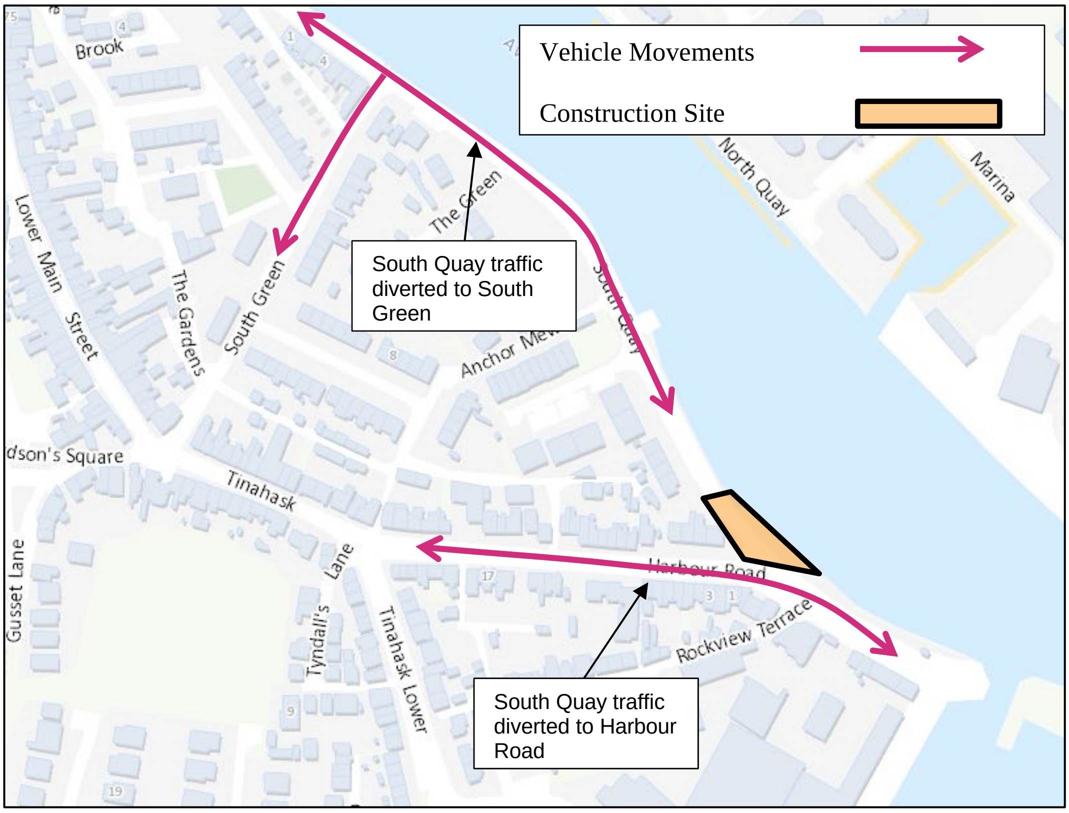

Figure 7.13: Proposed Sewer Network – Stage F

The primary characteristics of this phase of works include the following:

- Duration – Approximately 5 months.
- South Green closed to through traffic; all traffic on South Quay south of Harbour Road diverted to Harbour Road.

- Traffic generated north of Harbour Road along South Green diverted to South Green.
- Pedestrian access retained along South Quay to ensure all properties retain access during the course of the works.
- Any required road closures will be managed by a stop/go system to ensure access is maintained at all times.
- Construction access to and from the construction site via Harbour Road.

Traffic Generation

Stage F does include some diversion of traffic along South Quay with traffic having to divert from South Quay onto Harbour Road. The volume of traffic generated by the works themselves is expected to be relatively minimal.

The projected increase in traffic associated with Stage F is noted in Table 7.9 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor; and
- Approximately 6 construction staff will be employed at the working areas.

Table 7.9: Traffic Generation – Stage F: South Quay/ Harbour Road

	Staff	Deliveries	Service
Daily	8 pcu	11 pcu	15 pcu
AM Peak	2 pcu	3 pcu	2 pcu
PM Peak	2 pcu	3 pcu	2 pcu

pcu = passenger car units.

7.4.3.7 Stage G: North Quay (East of Bridgewater Shopping Centre)

Overview

Stage G includes the construction of the proposed sewer network on North Quay to the east of the entrance to the Bridgewater Shopping Centre and the construction of an access chamber on lands to the east of the existing Ferrybank Roundabout. The construction of the access chambers requires the complete closure of North Quay to the east of the Bridgewater Shopping Centre. Access to Bridgewater Shopping Centre will be via North Quay and the Ferrybank Roundabout while access to areas further east along North Quay will be provided via Mill Road. The extent of Stage G works is noted in Figure 7.14.

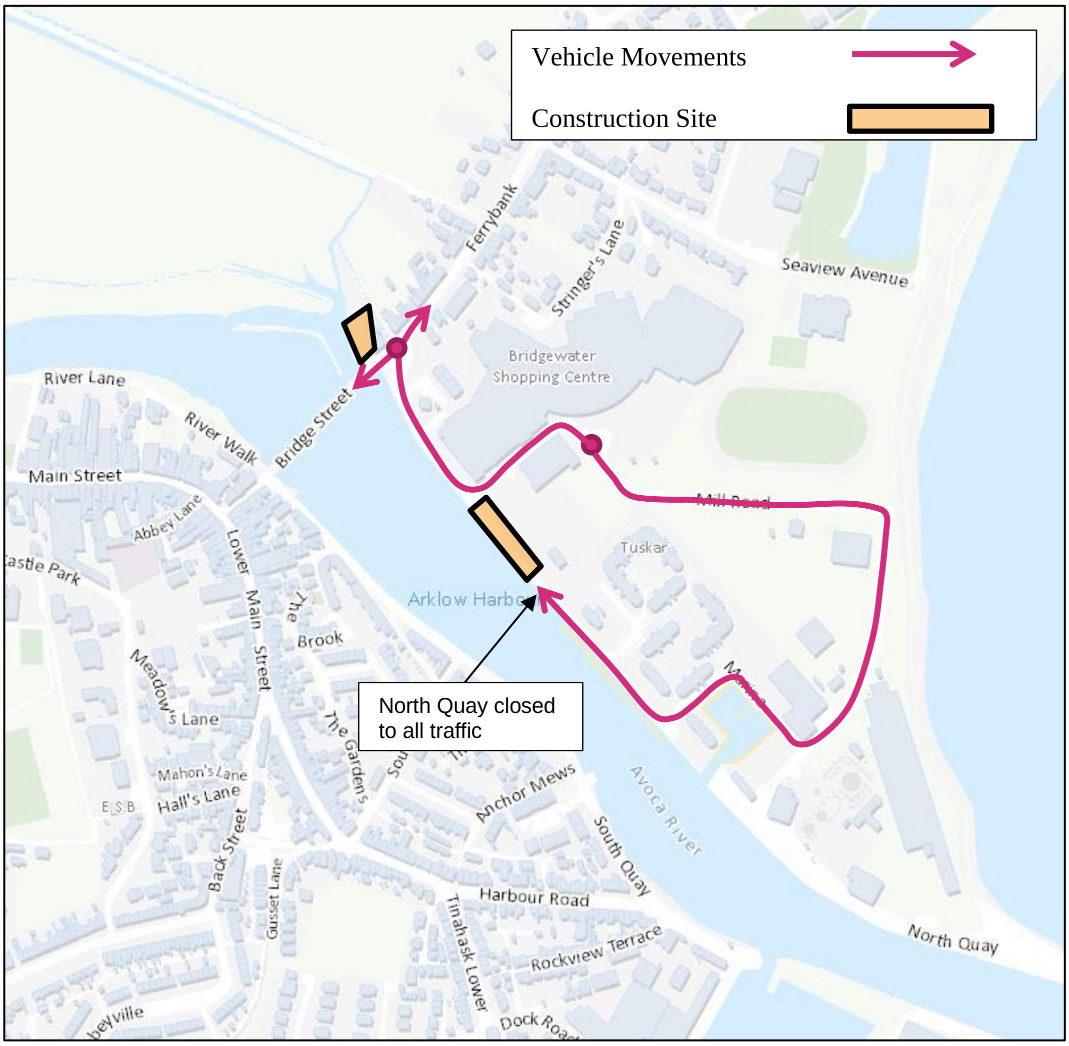

Figure 7.14: Proposed Sewer Network – Stage G

The primary characteristics of this phase of works include the following:

- Duration – Approximately 3 months.
- North Quay closed to all through traffic; all traffic diverted via the Bridgewater Shopping Centre.
- Access from the site west of the Ferrybank Roundabout will be directly from the Ferrybank Roundabout.
- Pedestrian access retained on North Quay.
- Construction traffic will need to be able to access from both sides of North Quay.

Traffic Generation

Stage G does include some diversion of traffic along North Quay with traffic east of the Bridgewater Shopping Centre having to divert from North Quay onto Mill Road. The volume of traffic generated by the works themselves is expected to be relatively minimal.

The projected increase in traffic associated with Stage G is noted in Table 7.10 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor;
- Approximately 6 construction staff will be employed at the two separate working areas; and
- Both sites will be active simultaneously.

Table 7.10: Traffic Generation – Stage G: North Quay (East of Bridgewater Shopping Centre)

	Staff	Deliveries	Service
Daily	16 pcu	22 pcu	30 pcu
AM Peak	4 pcu	6 pcu	4 pcu
PM Peak	4 pcu	6 pcu	4 pcu

pcu = passenger car units.

7.4.3.8 Stage H: North Quay (East of Ferrybank)

Overview

Stage H includes the construction of a single access chamber along North Quay between the Ferrybank Roundabout and the Bridgewater Shopping Centre. The construction of the access chamber requires the complete closure of North Quay to the south of the Ferrybank Roundabout and access to North Quay and the Bridgewater Shopping Centre will be provided via a new road from Seaview Avenue to the shopping centre and then onto North Quay. The extent of Stage H works is noted in Figure 7.15.

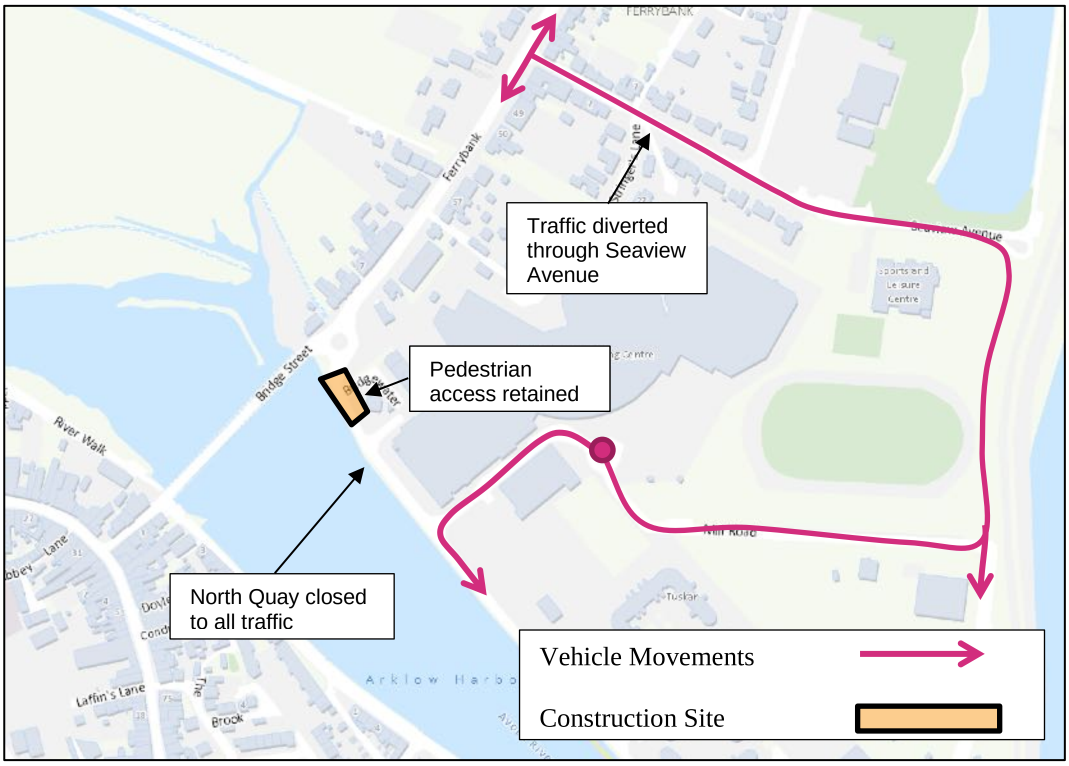

Figure 7.15: Proposed Sewer Network – Stage H

The primary characteristics of this phase of works include the following:

- Duration – Approximately 1 month.
- North Quay closed to all through traffic; all traffic diverted onto Seaview Avenue and Mill Road.
- Pedestrian access retained on North Quay.
- All local access maintained during the course of the construction works.
- Construction Access via the Ferrybank Roundabout and the North Quay via Mill Road and the Bridgewater Shopping Centre.

Traffic Generation

Stage H includes the diversion of traffic along North Quay with traffic west of the Bridgewater Shopping Centre having to divert from North Quay onto Seaview Avenue. The volume of traffic generated by the works themselves is expected to be relatively minimal and is presented in Table 7.11 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor;
- Approximately 3 construction staff will be employed at the working areas.

Table 7.11: Traffic Generation – Stage H: North Quay (East of Ferrybank)

	Staff	Deliveries	Service
Daily	4 pcu	11 pcu	15 pcu
AM Peak	1 pcu	3 pcu	2 pcu
PM Peak	1 pcu	3 pcu	2 pcu

pcu = passenger car units.

7.4.3.9 Stage I: North Quay (West of Ferrybank)

Overview

Stage I includes the construction of a single access chamber along North Quay between the Ferrybank Roundabout and the Bridgewater Shopping Centre. The construction of the access chamber requires the complete closure of North Quay to the south of the Ferrybank Roundabout and access to North Quay and the Bridgewater Shopping Centre will be provided via Seaview Avenue. The extent of Stage I works is noted in Figure 7.16.

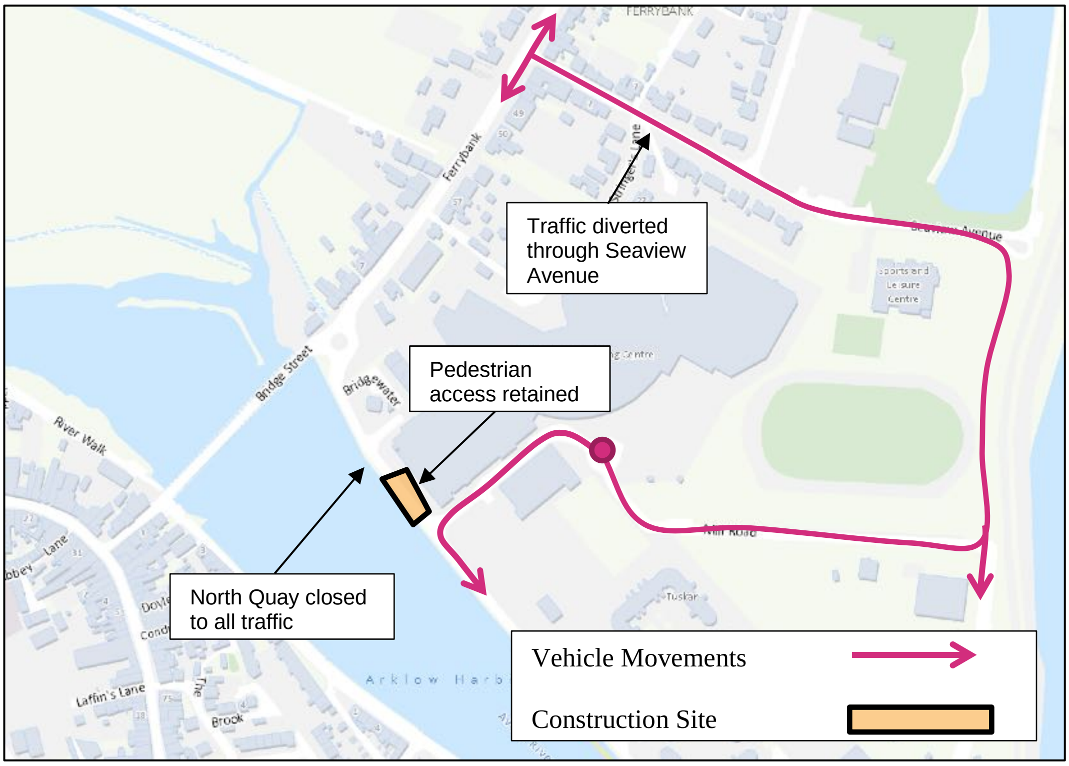

Figure 7.16: Proposed Sewer Network – Stage I

The primary characteristics of this phase of works include the following:

- Duration – Approximately 1 month.
- North Quay closed to all through traffic; all traffic diverted onto Seaview Avenue and Mill Road.

- Pedestrian access retained on North Quay.
- All local access maintained during the course of the construction works.
- Construction access via both the Ferrybank Roundabout and the North Quay via the Bridgewater Shopping Centre.

Traffic Generation

Stage I includes the diversion of traffic along North Quay with traffic west of the Bridgewater Shopping Centre having to divert from North Quay onto Seaview Avenue. The volume of traffic generated by the works themselves is expected to be relatively minimal and is presented in Table 7.12 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor; and
- Approximately 3 construction staff will be employed at the working areas.

Table 7.12: Traffic Generation – Stage I: North Quay (West of Ferrybank)

	Staff	Deliveries	Service
Daily	4 pcu	11 pcu	15 pcu
AM Peak	1 pcu	3 pcu	2 pcu
PM Peak	1 pcu	3 pcu	2 pcu

pcu = passenger car units.

7.4.3.10 Stage J: Marina Village

Stage J includes the construction of access chambers and sewers on North Quay and within the Marina Village. The construction of these access chambers requires the complete closure of North Quay to the east of Marina Village and the entrance to the residential development itself. The extent of Stage J works is noted in Figure 7.17.

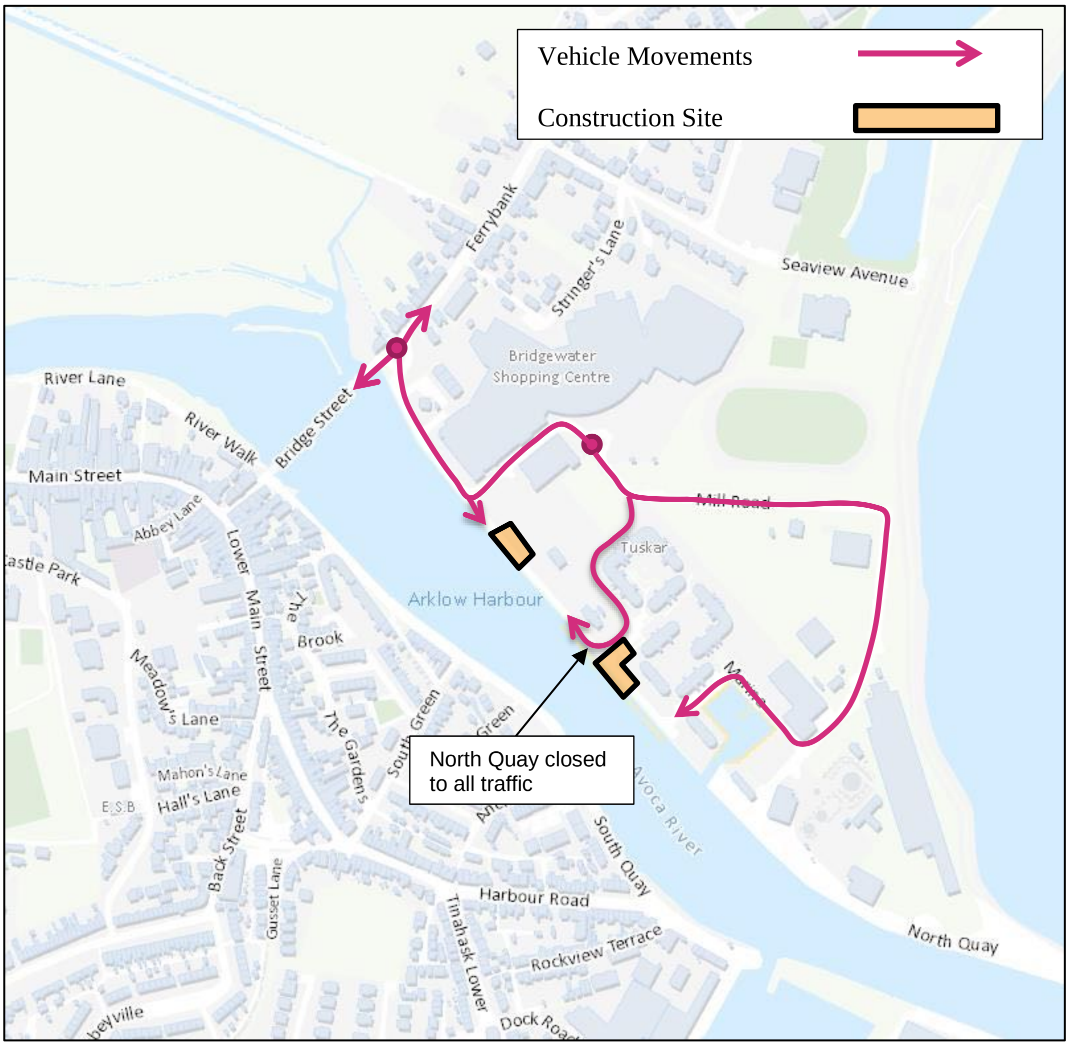

Figure 7.17: Proposed Sewer Network – Stage J

The primary characteristics of this phase of works include the following:

- Duration – Approximately 3 months.
- North Quay closed to all through traffic; all traffic diverted via the Bridgewater Shopping Centre and Mill Road.
- Pedestrian access retained on North Quay
- The temporary relocation of the access serving Marina Village from North Quay to Mill Road
- Temporary provision of 14 parking spaces.
- Construction access will be required from both directions along North Quay.
- No construction access will be permitted through Marina Village.

Traffic Generation

Stage J includes the diversion of traffic along North Quay with traffic west of the Bridgewater Shopping Centre having to divert from North Quay onto Mill Road.

The volume of traffic generated by the works themselves is expected to be relatively minimal and is presented in Table 7.13 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor; and
- Approximately 6 construction staff will be employed at the working areas.

Table 7.13: Traffic Generation – Stage J: Marina Village

	Staff	Deliveries	Service
Daily	8 pcu	11 pcu	15 pcu
AM Peak	2 pcu	3 pcu	2 pcu
PM Peak	2 pcu	3 pcu	2 pcu

pcu = passenger car units.

7.4.3.11 Stage K: Marina Village

Stage K includes the construction of an access chamber on North Quay to the east of Marina Village. The construction of this access chamber requires the complete closure of North Quay to the east of Marina Village. The extent of Stage K works is noted in Figure 7.18.

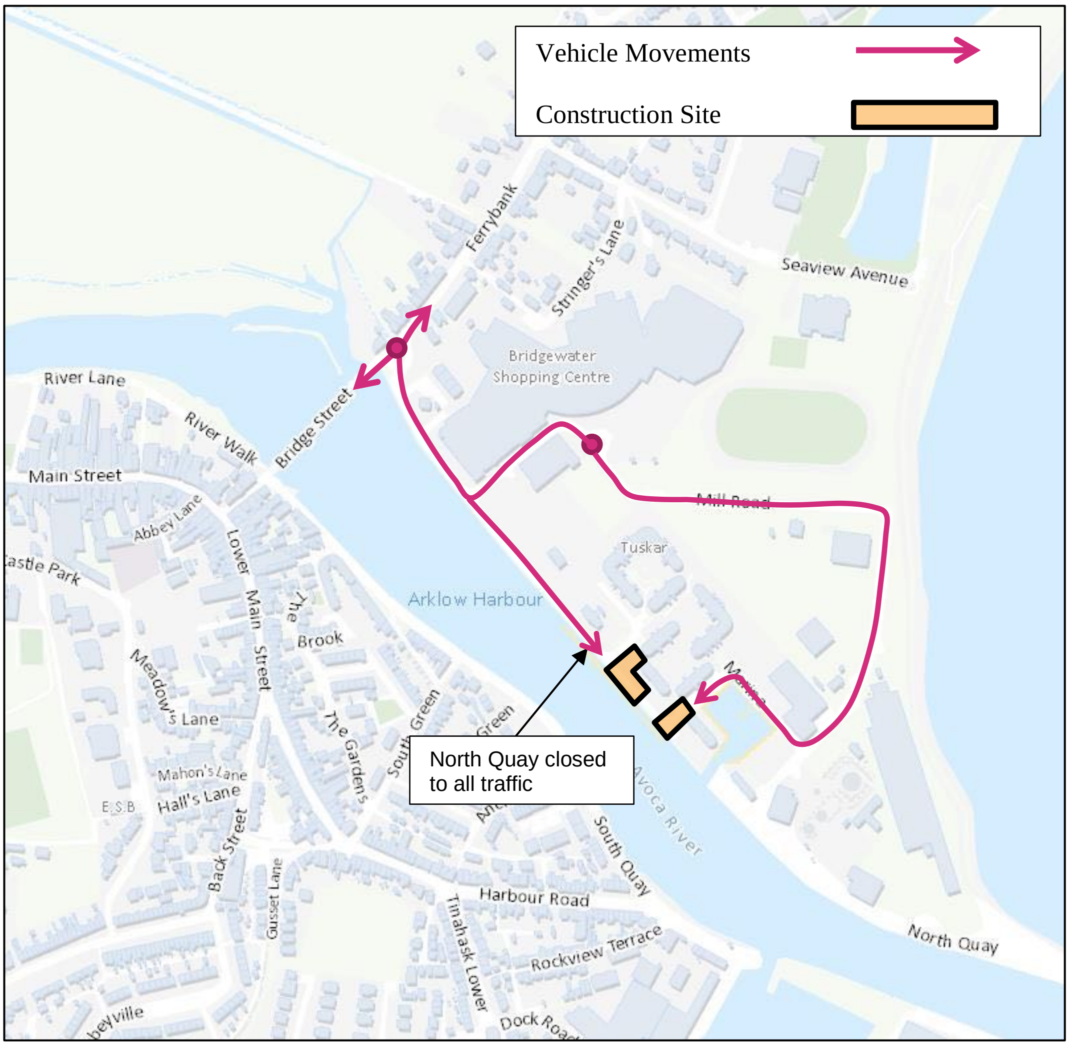

Figure 7.18: Proposed Sewer Network – Stage K

The primary characteristics of this phase of works include the following:

- Duration – Approximately 3 months.
- North Quay closed to all through traffic; all traffic diverted via the Bridgewater Shopping Centre and Mill Road.
- Pedestrian access retained on North Quay.
- Temporary access roads provided to serve the eastern most residential buildings within Marina Village.

Traffic Generation

Stage K includes the diversion of some traffic along North Quay with traffic west of the Bridgewater Shopping Centre having to divert from North Quay onto Mill Road. The volume of traffic generated by the works themselves is expected to be relatively minimal and is presented in Table 7.14 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor; and
- Approximately 6 construction staff will be employed at the working area.

Table 7.14: Traffic Generation – Stage K: Marina Village

	Staff	Deliveries	Service
Daily	8 pcu	11 pcu	15 pcu
AM Peak	2 pcu	3 pcu	2 pcu
PM Peak	2 pcu	3 pcu	2 pcu

pcu = passenger car units.

7.4.3.12 Stage L: Marina (North)

Overview

Stage L includes the construction of a number of access chambers along North Quay to the north of the existing Marina. The construction of these access chambers requires the complete closure of North Quay to the north of the Marina and the construction of a temporary access road to the north of the Marina. The extent of Stage L works is noted in Figure 7.19.

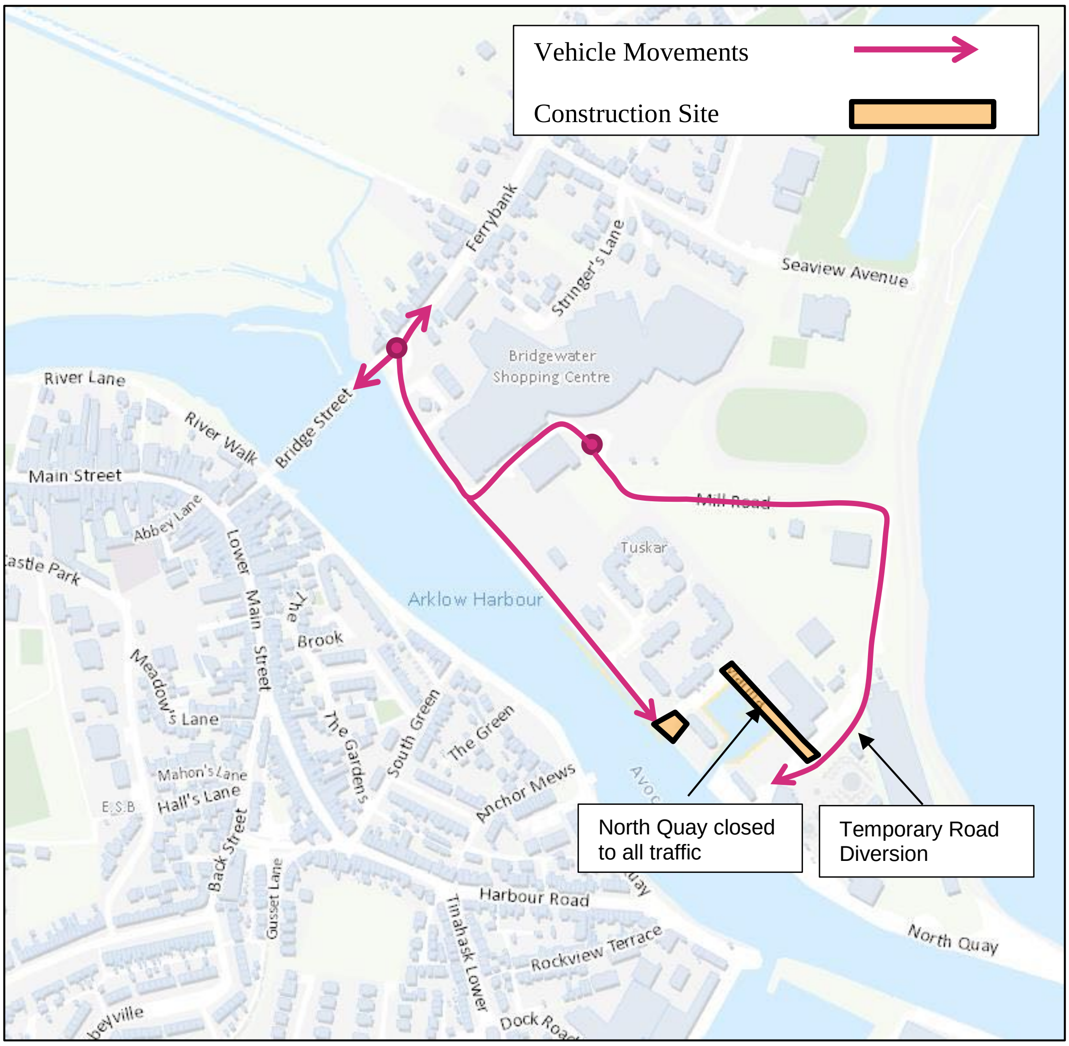

Figure 7.19: Proposed Sewer Network – Stage L

The primary characteristics of this phase of works include the following:

- Duration – Approximately 4 months.
- North Quay closed to all through traffic; all traffic diverted via the Bridgewater Shopping Centre and Mill Road.
- Pedestrian access retained on North Quay.
- Temporary access road provided to serve the eastern end of North Quay.

Traffic Generation

Stage L includes the diversion of some traffic along North Quay with traffic west of the Bridgewater Shopping Centre having to divert from North Quay onto Mill Road. The volume of traffic generated by the works themselves is expected to be relatively minimal and is presented in Table 7.15 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor; and

- Approximately 6 construction staff will be employed at the working areas.

Table 7.15: Traffic Generation – Stage L: Marina (North)

	Staff	Deliveries	Service
Daily	8 pcu	11 pcu	15 pcu
AM Peak	2 pcu	3 pcu	2 pcu
PM Peak	2 pcu	3 pcu	2 pcu

pcu = passenger car units.

7.4.3.13 Stage M: Marina (North)

Overview

Stage M includes the construction of an access chamber along North Quay to the northeast of the existing Marina. The construction of this access chamber (TSN8) requires the complete closure of the eastern end of North Quay and the construction of a temporary access road to the north of the Marina. The extent of Stage M works is noted in Figure 7.19.

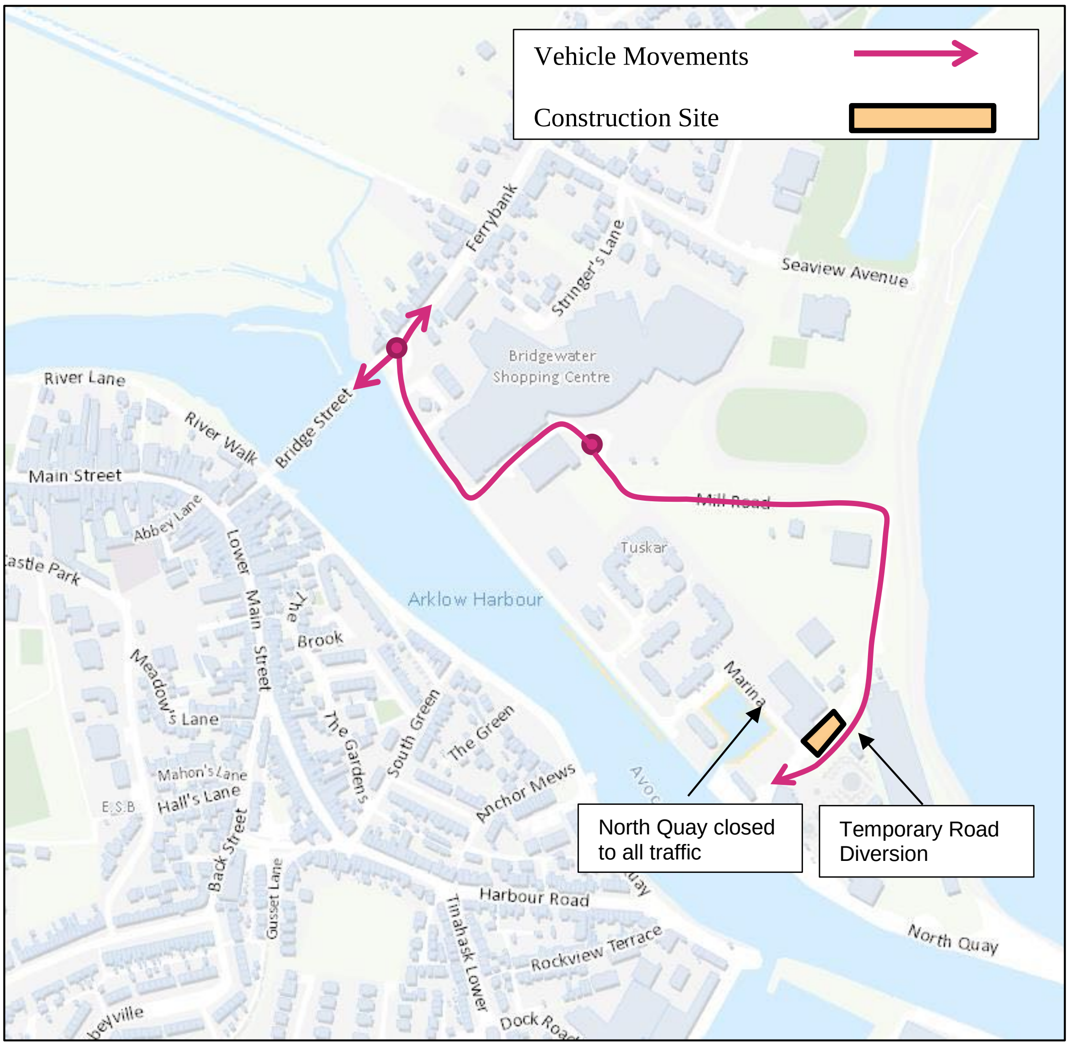

Figure 7.20: Proposed Sewer Network – Stage M

The primary characteristics of this phase of works include the following:

- Duration – Approximately 2 weeks.
- North Quay closed to all through traffic; all traffic diverted via the Bridgewater Shopping Centre and Mill Road.
- Pedestrian access retained on North Quay.
- Temporary access road provided to serve the eastern end of North Quay.
- Construction access will be via Mill Road.

Traffic Generation

Stage M includes the diversion of some traffic along North Quay with traffic west of the Bridgewater Shopping Centre having to divert from North Quay onto Mill Road. The volume of traffic generated by the works themselves is expected to be relatively minimal and is presented in Table 7.16 based on the following key assumptions:

- Limited parking will be provided for staff within the works area, with staff accessing the site from the site compounds by shared transport provided by the contractor; and
- Approximately 3 construction staff will be employed at the working areas.

Table 7.16: Traffic Generation – Stage M: Marina (North)

	Staff	Deliveries	Service
Daily	4 pcu	11 pcu	15 pcu
AM Peak	1 pcu	3 pcu	2 pcu
PM Peak	1 pcu	3 pcu	2 pcu

pcu = passenger car units.

7.5 Likely Significant Effects

The following sections presents the projected change in traffic flows on the surrounding road network based on the projected additional traffic associated with the construction works including both the WwTP and the interceptor sewer network and associated development. In addition, separate individual assessments will be presented for each of the Stages, presenting the projected change in traffic environment due to the introduction of temporary traffic management measures.

7.5.1 Do Nothing Scenario

Under a ‘Do Nothing Scenario’ no temporary increase in traffic is expected and traffic conditions on the surrounding road network will remain as current with some queues and delays evident along Ferrybank Road and approaching Main Street and Arklow Bridge in the town.

7.5.2 Assessment of Effects during Construction

7.5.2.1 Traffic Generation

It is envisaged that the construction of the WwTP will occur at the same time as the interceptor sewer network and associated works. In addition, it is likely that one of the construction stages associated with the northern interceptor sewer will be under construction at the same time as the southern interceptor sewer. For the purpose of this assessment it has been assumed that Stage D along the South Quays and Stage G along the North Quays are carried out at the same time, along with the peak construction works envisaged for the WwTP, to provide a robust assessment of the reasonable worst case likely significant effects.

Therefore, the maximum projected increase in traffic associated with this likely construction sequence will result in the following increase in traffic flows.

Table 7.17: Projected Peak Traffic Generation – Construction Phase

	Staff	Deliveries	Service	TOTAL
Daily	401 pcu	388 pcu	145 pcu	934 pcu
AM Peak	56 pcu	50 pcu	18 pcu	124 pcu
PM Peak	56 pcu	50 pcu	18 pcu	124 pcu

pcu = passenger car units.

7.5.2.2 Traffic Distribution

It is proposed to restrict the routing of construction deliveries to limit the effects of traffic within the study area. The following restriction will be put in place for the duration of the works:

- All construction deliveries to the WwTP and the sewer network north of the Avoca River will access and egress the works area from Junction 20 on the M11 Motorway.
- All construction deliveries to the sewer network and associated works south of the Arklow Bridge will access the works area from Junction 21 on the M11 Motorway and egress via Junction 20 on the M11 Motorway.

Construction staff will not be subject to the above restrictions and the following distribution of staff traffic has been applied.

Table 7.18: Project Staff Traffic Distribution

Link	Distribution
Ferrybank	45%
Abbey Street	15%
Main Street	40%

7.5.2.3 Traffic Assignment

Table 7.19 presents the projected increase in traffic associated with the construction of the proposed development taking into account the envisaged sequencing of construction stages. The projected traffic flows have been calculated for the Year 2020 as this is the time period where construction activity is expected to be at peak.

Table 7.19: Traffic Assignment

Link	09:00-10:00	17:00 – 18:00	Daily
Ferrybank	56 pcu	56 pcu	423 pcu
North Quay	76 pcu	76 pcu	588 pcu
South Quay – One Way Section	15 pcu	15 pcu	63 pcu
South Quay – Two Way Section	15 pcu	15 pcu	63 pcu
Bridge Street	31 pcu	31 pcu	211 pcu
Arklow Bridge	35 pcu	35 pcu	251 pcu
Abbey Street	12 pcu	12 pcu	91 pcu
South Green	4 pcu	4 pcu	30 pcu
Harbour Road	12 pcu	12 pcu	91 pcu
Main Street	22 pcu	22 pcu	160 pcu

7.5.2.4 Projected Traffic Increases

The following tables (Table 7.20, Table 7.21 and Table 7.22) present the projected future traffic flows during construction both with and without the proposed development as well as the projected percentage change in traffic flows.

Table 7.20: Projected Traffic Flows - 2020 Without Development

Link	09:00-10:00	17:00 – 18:00	Daily
Ferrybank	1237 pcu	1068 pcu	15840 pcu
North Quay	534 pcu	604 pcu	6639 pcu
South Quay – One Way Section	131 pcu	112 pcu	1496 pcu
South Quay – Two Way Section	84 pcu	87 pcu	1184 pcu
Bridge Street	673 pcu	745 pcu	8765 pcu
Arklow Bridge	1114 pcu	911 pcu	14382 pcu
Abbey Street	298 pcu	353 pcu	4414 pcu
South Green	218 pcu	132 pcu	2644 pcu
Harbour Road	63 pcu	70 pcu	816 pcu
Main Street	852 pcu	839 pcu	12385 pcu

Table 7.21: Projected Traffic Flows - 2020 With Development

Link	09:00-10:00	17:00 – 18:00	Daily
Ferrybank	1181 pcu	1011 pcu	15417 pcu
North Quay	458 pcu	528 pcu	6050 pcu
South Quay – One Way Section	116 pcu	97 pcu	1433 pcu
South Quay – Two Way Section	69 pcu	73 pcu	1121 pcu
Bridge Street	642 pcu	714 pcu	8545 pcu
Arklow Bridge	1079 pcu	876 pcu	14131 pcu
Abbey Street	286 pcu	340 pcu	4324 pcu
South Green	214 pcu	128 pcu	2614 pcu
Harbour Road	50 pcu	58 pcu	726 pcu
Main Street	829 pcu	817 pcu	12225 pcu

Table 7.22: Projected Percentage Change in Traffic Flows - 2020

Link	09:00-10:00	17:00 – 18:00	Daily
Ferrybank	4.8%	5.6%	2.7%
North Quay	16.6%	14.4%	9.7%
South Quay – One Way Section	13.1%	14.6%	4.4%
South Quay – Two Way Section	22.0%	19.4%	5.6%
Bridge Street	4.8%	4.3%	2.6%
Arklow Bridge	3.2%	4.0%	1.8%
Abbey Street	4.3%	3.6%	2.1%
South Green	2.0%	3.3%	1.2%
Harbour Road	24.7%	21.5%	12.5%
Main Street	2.7%	2.7%	1.3%

From the above, it can be seen that the construction of the proposed development is expected to increase traffic flows on the wider road network (i.e. Ferrybank, Abbey Street, Arklow Bridge) by less than 5% during the peak hour periods, and by less than 3% on an all day basis. The two quays (North Quay and South Quay) where the majority of the works are expected to take place are expected to have increases of approximately 15% -20% during the peak hour periods, and between 5% and 10% on an all day basis.

Based on the above it can be concluded that the proposed construction works at a wider network level will have a slight effect on traffic conditions in Arklow, as traffic increases on the primary road/street network (i.e. Ferrybank, Arklow Bridge and Main Street) are all 5% or less during the peak hour periods.

However, at the individual construction sites the effect will be more significant and the following sections describe the likely significant effects of these individual construction stages.

7.5.2.5 Likely Significant Effects (Per Stage)

Stage A: River Walk (West)

Stage A does not result in any diversion in traffic flows and the potential increase in traffic along River Walk and its approach streets (Condren's Lane Upper and River Lane (West)) will be low and the likely significant effects on traffic flows will be slight.

Stage B: River Walk (Central)

Stage B does not result in any diversion in traffic flows and the potential increase in traffic along River Walk and its approach streets will be low and the likely significant effects on traffic flows will be slight and primarily confined to River Walk where some temporary traffic management and loss of on-street parking will be required.

Stage C: River Walk (East)

Stage C does not result in any diversion in traffic flows and the potential increase in traffic along River Walk and its approach streets (Condren's Lane Upper and River Lane (West)) will be low and the likely significant effects on traffic flows will be moderate and primarily confined to River Walk where temporary traffic management and loss of on-street parking will be required.

Stage D: Arklow Bridge

Stage D includes only a limited diversion of traffic where southeast bound traffic on South Quay will have to exit the quay via Bridge Street. The projected increase in traffic is expected to have a moderate effect on the operation of South Quay where temporary traffic management measures will potentially restrict the free movement of traffic along the Quay.

Stage D also includes the underpinning of the Arklow Bridge which will require lane closures over the bridge with traffic flow operating on a shuttle basis. The required traffic management measures have the potential to result in significant traffic congestion and to manage the likely significant effects. The following measures are proposed:

- No scheduled lane closures should commence before 21:00 and all lane closures should be lifted by 07:00 in the morning.
- The length of lane closure and the required working area needs to be kept as small as possible to reduce the length of the shuttle system.

Stage E: South Quay/ South Green

Stage E includes a limited diversion of traffic where South Quay traffic will need to use Harbour Road to access the wider street network. This will result in the projected change in traffic flows on Harbour Road and South Green as outlined in Table 7.23.

Table 7.23: Projected Stage E Diversion Traffic Flows

Link	09:00-10:00		17:00 – 18:00		Daily	
	Without	With	Without	With	Without	With
South Green	214 pcu	283 pcu	128 pcu	201 pcu	2614 pcu	3,735 pcu
Harbour Road	50 pcu	119 pcu	58 pcu	131 pcu	726 pcu	1,847 pcu

The projected increase in traffic is expected to have a moderate effect on the traffic operations along South Quay, South Green and Harbour Road, particularly where traffic has to use longer routes due to the implementation of the temporary traffic diversions. Both South Green and Harbour Road will see an expected increase in traffic flows however these streets currently experience very low traffic flows and have sufficient capacity to accommodate the projected increase in traffic.

Stage F: South Quay/ Harbour Road

Stage F also includes for the diversion of traffic from South Quay to both Harbour Road and South Green to access the wider street network. This will result in a similar projected change in traffic flows on Harbour Road and South Green as noted in Table 7.23.

This projected increase in traffic is expected to have a moderate effect on traffic operations, particularly where traffic has to use longer routes due to the implementation of the temporary traffic diversions. In addition, both South Green and Harbour Road will see an increase in traffic flows.

Stage G: North Quay (East of Bridgewater Shopping Centre)

Stage G includes for the diversion of traffic from North Quay (East of Bridgewater Shopping Centre) to Mill Road. This diversion is expected to have a moderate effect on traffic operations, as traffic flows on this section of North Quay are relatively light with daily traffic flows noted at approximately 1,200 passenger car units (pcu) per day.

The primary effects associated with this stage of the works will be longer traffic journeys, traffic on North Quay will have to take, to access the wider street network, however no additional traffic congestion is expected during this stage due to the low level of traffic on Mill Road.

Stage H: North Quay (East of Ferrybank)

Stage H includes for a major diversion of traffic from North Quay (East of Ferrybank) to Seaview Avenue. The closure of North Quay will result in approximately 6,000 daily trips rerouting through Seaview Avenue and accessing the shopping centre and North Quay via a new road link.

This diversion of traffic is expected to be a significant negative effect on traffic operations, particularly at the junction of Ferrybank Road/ Seaview Avenue with the potential for long queues forming at the junction. To manage these potential likely significant effects and traffic restrictions, the following measures are suggested:

- The works should be carried out during a quiet period of the year, possibly late summer however impacts on tourist traffic will also need to be considered.
- The works should be carried out utilising a longer working day 16 - 24 hour basis, however the impact on adjacent residents would need to be considered to reduce the time North Quay needs to remain closed.
- The junction of Ferrybank/ Seaview Avenue would need to be manned during busy periods to ensure the junction operates efficiently and safely.
- Parking in and around the junction of Ferrybank and Seaview Avenue needs to managed and controlled.

Stage I: North Quay (West of Bridgewater Ferrybank)

Stage I also includes the diversion of traffic from North Quay (East of Ferrybank) to Seaview Avenue as noted under Stage H. The closure of North Quay is expected to have a significant effect on traffic operations, particularly at the junction of Ferrybank Road/ Seaview Avenue with the potential for long queues forming at the junction. The potential traffic management measures to mitigate this increase in traffic are as presented under Stage H.

Stage J: Marina Village

Stage J includes for the diversion of traffic from North Quay (East of Bridgewater Shopping Centre) to Mill Road. In addition, Marina Village will need to be temporarily accessed via Mill Road. This diversion is expected to have a moderate effect on traffic operations, as traffic flows on this section of North Quay are relatively light with daily traffic flows noted at approximately 1,200 passenger car units (pcu) per day.

The likely significant effects associated with this stage of the works will be longer journeys for traffic on North Quay and residents accessing Marina Village, however no additional traffic congestion is expected during this stage of the works due to the current low level of traffic using Mill Road.

Stage K: Marina Village

Stage K is expected to have very similar effects to that noted under Stage J, however the temporary access to Marina Village from Mill Road will no longer be required. The diversion of traffic is expected to have a slight effect on traffic operations due to longer distances travelled but no additional traffic congestion is expected during this stage of the works due to the current low level of traffic using Mill Road.

Stage L: Marina (North)

Stage L is expected to have a slight effect on traffic operations due to longer distances travelled but no additional traffic congestion is expected during this stage of the works.

Stage M: Marina (North)

Stage M is expected to have a slight effect on traffic operations as traffic accessing the WwTP site will need to use Mill Road and the new temporary construction road. However, due to the prevailing traffic conditions in the area no additional traffic congestion is expected during this stage of the works.

7.5.2.6 Cumulative

The construction works associated with the proposed Arklow Flood Relief Scheme have the potential to impact on the construction of the proposed development. There is the potential that should the projects be carried out simultaneously, co-ordinated traffic management plans will need to be prepared and agreed with Wicklow County Council.

As the proposed Arklow Flood Relief Scheme is still (at the time of writing) in its early design stage it is not possible to carry out a detailed combined assessment on traffic and transport. However the EIAR for the proposed Arklow Flood Relief Scheme will need to address the cumulative effects of it with the proposed development in due course.

At a wider level, the construction of both projects simultaneously will result in greater traffic flows, including Heavy Goods Vehicles on all the streets within Arklow and there is likely to be greater effects along both the North and South Quays where the works themselves will be concentrated.

7.5.3 Assessment of Effects during Operation

During the operation of the proposed development the projected increases in traffic flows will be very small, with between 10- 20 additional trips expected per day. This projected increase in traffic will have an imperceptible effect on prevailing traffic conditions.

7.6 Mitigation Measures and Monitoring

7.6.1 Mitigation

7.6.1.1 Mitigation During Construction

Construction Traffic Management Plan

The appointed contractor for the proposed development will prepare a detailed Construction Traffic Management Plan covering all stages of construction. This plan will need to take into account other potential construction works in the area including the proposed Arklow Flood Relief Scheme.

The Construction Traffic Management Plan will demonstrate how pedestrians, cyclists and motorised vehicles can pass through the working areas safely and that measures are in place which ensure traffic operates in as an efficient manner possible.

Consultation Plan

The Construction Traffic Management Plan will include a detailed Consultation Plan to deal with third party queries from both residents and retail/commercial operators. The Construction Traffic Management Plan will require agreement with both Wicklow County Council and An Garda Síochána.

The contractor will appoint a single point of contact to facilitate the communication of the various traffic management plans and the preparation of a project specific website to aid communications would also be beneficial.

Mobility Management Plan

As part of the Construction Traffic Management Plan a Mobility Management Plan will be prepared to ensure access to the site by sustainable travel modes is encouraged. The following measures will need to be considered within the Mobility Management Plan:

- The provision of showers/ changing rooms for construction staff;
- The provision of cycle parking for staff; and
- The promotion of car sharing among staff, including van pooling to travel between the different working areas.

Individual Traffic Management Plans

For Stage H and Stage I the following individual traffic management measures should be considered as part of the Construction Traffic Management Plan:

- The works should be carried out during a quiet period of the year, possibly late summer however impacts on tourist traffic will also need to be considered.
- The works should be carried out utilising a longer working day 16-24 hour basis, however the impact on adjacent residents would need to be considered to reduce the time North Quay needs to remain closed.
- The junction would need to be manned during busy periods to ensure the junction operates efficiently and safely.
- Parking in and around the junction of Ferrybank and Seaview Avenue needs to managed and controlled by appropriately trained personnel.

For any works to Arklow Bridge that require lane closures the following measures are suggested:

- No scheduled lane closures should commence before 21:00 and all lane closures should be lifted by 07:00 in the morning.
- The length of lane closure and the required working area needs to be kept as small as possible to reduce the length of the shuttle system.

7.6.1.2 Mitigation During Operation

No mitigation measures have been proposed with respect to effects from the operation of the proposed development as the projected increase in traffic will have no impact on prevailing traffic conditions.

7.6.2 Monitoring

7.6.2.1 Monitoring During Construction

For each construction stage the individual traffic management plans need to be continually monitored to ensure the impact on traffic flows on the surrounding street network are minimised and additional mitigation measures are introduced as required to assist the flow of traffic. The monitoring regime needs to consider all modes of traffic including pedestrians, cyclists and car parking provision.

7.6.2.2 Monitoring During Operation

No monitoring has been proposed with respect to effects from the operation of the proposed development as the projected increase in traffic will have no impact on prevailing traffic conditions.

7.7 Residual Effects

7.7.1 Residual Effects during Construction

The construction of the proposed development will result in additional traffic congestion particularly where construction works are taking place on Arklow Bridge and the section of North Quay between the Ferrybank Road and the Bridgewater Shopping Centre. These effects will be temporary in nature and following the completion of the construction works will have no residual effects.

During all construction stages the individual working areas will result in some restrictions and inconvenience to the movement of people and traffic. These restrictions will be temporary in nature and particularly localised to the working areas.

7.7.2 Residual Effects during Operation

No residual effects are anticipated during the operation of the proposed development.

7.8 References

Environmental Protection Agency (2017) *Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Draft August 2017)*

Transport Infrastructure Ireland (2016) *Project Appraisal Guidelines for National Roads Unit 5.3 - Travel Demand Projections – October 2016.*

8 Air Quality and Climate

8.1 Introduction

This chapter describes the likely significant effects of the proposed development on air quality and climate. Odour is addressed separately in **Chapter 9**.

Chapter 4 provides a full description of the proposed development and **Chapter 5** describes the Construction Strategy. The following aspects are particularly relevant to the air quality and climate assessment:

- Operation and Design: the use of energy efficient design throughout the scheme design reduces the annual CO_2 emissions of the proposed development. Key energy and resource efficiency measures are outlined in detail in **Section 8.5.1.2** including; WwTP location, gravity sewers, pump efficiencies, the use of PV panels and heat recovery at the WwTP.
- Operation: An emergency generator will be located at the WwTP for use during power outages.
- Construction: A generator will be used to power the TBM during the construction of the proposed development.

8.2 Assessment Methodology

8.2.1 General

Air quality assessments are concerned with the presence of airborne pollutants in the atmosphere. The likely significant effects of the proposed development on air quality have been assessed by considering the background concentration levels of pollutants in the atmosphere and the potential for likely significant effects during construction and operation of the proposed development. Predicted concentrations associated with the proposed development are then compared to the relevant limit values which are described in detail in **Section 8.2.2** to determine likely significant effects.

This assessment has also been undertaken with regard to the requirements of the Transport Infrastructure Ireland (TII), (formerly the National Roads Authority, guidelines[1]. These guidelines[1] provide a methodology for the assessment, management and mitigation of air quality at construction sites which can be adapted accordingly depending on the nature of the works.

The guidelines[1] state that increases in Annual Average Daily Traffic (AADT) flows of less than 5% and 10% during the operational and construction phases respectively are unlikely to result in significant air quality effects.

[1] TII (2011) Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes.

Likely significant effects on air quality are therefore assessed when the AADT flows increase above these thresholds during construction and operation of the proposed development.

Air dispersion modelling of pollutant emissions represents a widely accepted method of assessing potential risk of off-site impacts. To assess the likely significant effects of the construction phase of the proposed development on the ambient environment, dispersion modelling of odorous emissions was undertaken in accordance with the EPA guidance document[2]. The air dispersion modelling methodology is outlined in **Section 8.2.5.2**. There will be no operational air emissions.

The climate assessment for the construction and operational phase estimates the greenhouse gas (GHG) emission levels over the design life of the proposed development.

The results of the assessment have been compared against the EPA`s projected GHG emissions for both the non-Emission Trading Scheme (ETS) sector and total emissions for 2030[14].

An assessment of the potential risk of Asbestos Containing Materials (ACMs) being released to the environment has also been undertaken herein.

8.2.2 Guidance and Legislation

8.2.2.1 Limit Values

Limit values for a range of air pollutants have been set through European and national legislation. These limit values are set for the protection of human health and ecosystems.

On 12 April 2011, the Air Quality Standards (AQS) Regulations 2011 (S.I. No. 180 of 2011) came into force and transposed EU Directive 2008/50/EC on ambient air quality and cleaner air for Europe into Irish law. The purpose of the AQS Regulations is to:

- Establish limit values and alert thresholds for concentrations of certain pollutants;
- To provide for the assessment of certain pollutants using methods and criteria common to other European Member States;
- To ensure that adequate information on certain pollutant concentrations is obtained and made publicly available; and
- To provide for the maintenance and improvement of ambient air quality where necessary.

The limit values established under the AQS Regulations relevant to this assessment are included in Table 8.1.

[2] EPA (2010) Air Dispersion Modelling from Industrial Installations Guidance Note AG4

Table 8.1: Limit values in the AQS Regulations

Pollutant	Limit value for the protection of:	Averaging period	Limit value (µg/m^3)	Basis of application of limit value	Limit value attainment date
NO_2	Human Health	1-hour	200	≤ 18 exceedances p.a. (99.79%ile)	1 January 2010
		Calendar year	40	Annual mean	1 January 2010
NOx	Vegetation	Calendar year	30	Annual mean	1 January 2010
PM_{10}	Human Health	24-hours	50	≤ 35 exceedances p.a. (90%ile)	1 January 2005
		Calendar year	40	Annual mean	1 January 2005
$PM_{2.5}$	Human Health	Calendar year	20 Note 1	Annual mean	1 January 2020

Note 1: Limit value to be reviewed by the Commission in light of further information on health and environmental effects, technical feasibility and experience of the Target Value in Member States.

There are no statutory limits for dust at a European or national level. However, TA Luft[3] provides a guideline for the rate of dust deposition of 350mg/m^2/day averaged over one year. The EPA concurs[4] that this guideline may be applied, although the EPA typically applies the guideline limit as a 30-day average.

8.2.3 Study Area

The proposed development is located in Arklow, County Wicklow. The WwTP site is located on the eastern periphery of Arklow Town, approximately 20m from the coastline. The proposed development is contained within the planning boundary as shown in **Figure 1.1 in Volume 3**.

The closest sensitive receptors to the WwTP are located approximately 100m to the west of the site, approximately 185m to the north-west of the site and approximately 260m to the south of the site (the latter being across the Avoca River). In addition, the lands adjacent to the WwTP are zoned for Waterfront (WZ), which includes for a mix of residential, commercial, employment, leisure and tourism uses. These lands have been included as future sensitive receptors for the operational assessment.

[3] TA Luft (2002) *Technical Instructions on Air Quality.*
[4] EPA (2006) *Environmental Management in the Extractive Industry (Non-Scheduled Minerals).*

A number of sensitive receptors are also located along the route of the interceptor sewers, at River Walk, South Quay and North Quay (Refer to **Figure 8.1 in Volume 3)**.

The proposed development interacts with a number of different zoned areas, as outlined in the Arklow LAP and described in **Section 6.4.2 of Chapter 6**. Along North Quay, the proposed development crosses the Open Space (OS2) and Waterfront (WZ) zoned areas. The proposed development is also adjacent to Community & Education (CE) and Open Space (OSI) zoning objectives.

Along River Walk and South Quay, the proposed development crosses the Town Centre (TC), Open Space (OS1), Open Space (OS2) and Existing Residential (RE) zoning objectives. These have been considered in the assessment herein.

8.2.4 Categorisation of the Baseline Environment

A desk-based study of the baseline environment of the proposed development area was undertaken in order to inform this assessment. The EPA's Air Quality Reports[5] were used in order to determine the baseline air quality for the years 2014, 2015 and 2016 (refer to **Section 8.3** for further details).

Traffic modelling (as described in **Section 7.3 in Chapter 7**) was used for existing and projected traffic volumes within the study area.

8.2.5 Impact Assessment Methodology

8.2.5.1 Significance Criteria

Significance criteria have been adopted from the TII Guidelines and are presented in Table 8.2 through to Table 8.5. These criteria provide a basis for assessing the level of effects due to the additional traffic present during construction.

Table 8.2: Definition of magnitude for changes in ambient pollutant concentrations

Magnitude of Change	**Annual Mean NO_2/PM_{10}**	**No. days with PM_{10} greater than 50 ug/m^3**	**Annual Mean $PM_{2.5}$**
Large	Increase/decrease 4 ≥ µg/m^3	Increase/decrease >4 days	Increase/decrease ≥2.5 µg/m^3
Medium	Increase/decrease 2-<4µg/m^3	Increase/decrease 3 or 4 days	Increase/decrease 1.25 -<2.5µg/m^3
Small	Increase/decrease 0.4-<2µg/m^3	Increase/decrease 1 or 2 days	Increase/decrease 0.25-<1.25µg/m^3
Imperceptible	Increase/decrease <0.4µg/m^3	Increase/decrease <1 day	Increase/decrease <0.25µg/m^3

[5]EPA (2018) Annual Air Quality Reports, Available at: http://www.epa.ie/air/quality/

Table 8.3: Air quality effect descriptors for changes to annual mean nitrogen dioxide and PM_{10} and $PM_{2.5}$ concentrations at a receptor

Absolute Concentration in Relation to Objective/Limit Value	**Change in Concentration[6]**		
	Small	Medium	Large
Increase with Scheme			
Above Objective/Limit Value With Scheme (≥40µg/m^3 of NO_2 or PM_{10}) (≥25µg/m^3 of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme (36≤40µg/m^3 of NO_2 or PM_{10}) (22.5≤25µg/m^3 of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme (30≤36µg/m^3 of NO_2 or PM_{10}) (18.75≤22.5µg/m^3 of $PM_{2.5}$)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme (<30µg/m^3 of NO_2 or PM_{10}) (<18.75µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value Without Scheme (≥40µg/m^3 of NO_2 or PM_{10}) (≥25µg/m^3 of $PM_{2.5}$)	Sight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value Without Scheme (36-<40µg/m^3 of NO_2 or PM_{10}) (22.5-<25µg/m^3 of $PM_{2.5}$)	Sight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value Without Scheme (30-<36µg/m^3 of NO_2 or PM_{10}) (18.75-<22.5µg/m^3 of $PM_{2.5}$)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value Without Scheme (<30µg/m^3 of NO_2 or PM_{10}) (<18.75µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight Beneficial

[6] Where the magnitude is imperceptible, then the likely significant effect description is negligible.

Table 8.4: Air quality effect descriptors for changes to number of days with PM_{10} concentration greater than 50 µg/m^3 at a receptor

Absolute Concentration in Relation to Objective/Limit Value	**Changes in Concentration**		
	Small	**Medium**	**Large**
Increase with Scheme			
Above Objective/Limit Value With Scheme (≥35 days)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value With Scheme (32-<35 days)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value With Scheme (26-<32 days)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value With Scheme (<26 days)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value Without Scheme (≥35 days)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value Without Scheme (32-<35 days)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value Without Scheme (26-<32 days)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value Without Scheme (<26 days)	Negligible	Negligible	Slight Beneficial

Table 8.5: Assessment criteria for the effect of dust emissions from construction activities with standard mitigation in place

Source		**Potential distance for Significant Effects (Distance from Source)**		
Scale	**Description**	**Soiling**	**PM_{10}[7]**	**Vegetation Effects**
Major	Large construction sites, with high use of haul routes	100m	25m	25m
Moderate	Moderate sized construction sites, with moderate use of haul routes	50m	15m	15m
Minor	Minor construction sites, with limited use of haul routes	25m	10m	10m

[7] Significance based on the PM_{10} Limit Values specified in SI No. 180 of 2011, which allows 35 daily exceedances/year of 50 µg/m³

8.2.5.2 Construction Phase

Dust and Asbestos Assessment Methodology

The TII guidelines[1] state that dust emissions from construction sites can lead to soiling, elevated PM_{10} concentrations and can cause effects on vegetation such as reduction in light required for photosynthesis and an increase in leaf temperature due to changed surface optical properties.

The likely significant effects of dust emissions during construction are assessed by considering the proximity of sensitive receptors to the construction works. The likely significant effects of construction dust on sensitive habitats are also considered.

During the construction phase of the proposed development it is possible that disturbance of Asbestos Containing Materials (ACMs) on site could cause asbestos fibres to be released into the ambient environment. The likely significant effects of ACM disturbance during construction are therefore also assessed.

Air Dispersion Modelling

There is the potential for elevated ground level concentrations of Nitrogen Dioxide (NO_2) and Particulate Matter (PM) to be generated from the generator powering the Tunnel Boring Machine (TBM) during the construction phase of the proposed development. Detailed air dispersion modelling has been undertaken for the generator using the EPA approved Breeze AERMOD software package[8]. As outlined in **Section 8.2.1**, the air dispersion modelling has been undertaken in accordance with the EPA Guidance[2].

The model was used to predict ground level concentrations over a 1-hour averaging period for Nitrogen Dioxide and a 24-hour averaging period for Particulate Matter.

As the generator will be located within various work areas, the modelling assessment was undertaken to represent any working area by locating sensitive receptors between 15m and 200m from the generator at 10m grid intervals.

Meteorological data from Met Éireann's station at Dublin Airport was used for the years 2011 to 2015 inclusive. The meteorological data includes hourly values for wind speed, wind direction, atmospheric stability, ambient temperature and mixing height.

A CAT C32 100kVA diesel generator, or equivalent, will be used for powering the TBM. **Table 8.6** outlines the emission source data for this generator.

[8] Breeze AERMOD version 16216r, released January 2017.

Table 8.6: Emission source input data

Parameter	Unit	Generator
Stack Height	m	4.5
Stack Diameter	m	0.4
Flow Rate	m^3/s	3.2
Temperature	ºC	464
NO_x concentration	mg/Nm^3	2,928
NO_x emission rate	g/s	3.47
PM_{10} concentration	mg/Nm^3	11.9
PM_{10} emission rate	g/s	0.014

Traffic Assessment Methodology

The air quality assessment utilises traffic data outlined in **Chapter 7** to assess the likely significant effects of construction traffic on air quality.

As noted in **Section 8.2.1**, the TII guidelines[1] state that increases in AADT flows during the construction phase of less than 10% are unlikely to result in significant effects on air quality. As described in **Section 8.4.2.3**, there are four construction stages where construction traffic will result in a significant increase (>10%) in AADT flows due to traffic diversions and two locations where a significant increase will occur due to construction vehicles.

The UK Design Manual for Roads and Bridges (DMRB) Screening Method spreadsheet[9] is used in this assessment to assess the likely significant effects of construction traffic on sensitive receptors. This spreadsheet calculates annual average concentrations of NO_x, NO_2 and PM.

The DMRB spreadsheet method computes concentrations of pollutants based on factors including:

- Distance of receptors to the centreline of each road;
- Annual Average Daily Traffic (AADT) flows;
- Design speed of each road;
- Heavy Goods Vehicle (HGV) percentage;
- Road type; and
- Background pollutant concentrations.

Annual average concentrations for the traffic related pollutants NO_x, NO_2 and PM were modelled at each sensitive receptor identified in **Section 8.4.2.3**. The predicted concentrations of each pollutant are compared to the AQS limit values, as outlined in Table 8.1.

[9] DMRB (2007) Design Manual for Roads and Bridges (DMRB) Screening Method (Version 1.03c) spreadsheet.

Climate Assessment Methodology

In October 2014, the European Council reached political agreement on headline greenhouse gas emissions reduction targets in the context of the 2030 Climate and Energy Framework. An overall EU reduction of at least 40% in greenhouse gas emissions by 2030 compared to 1990 levels is to be delivered collectively by the EU.

EU greenhouse gas emission reduction targets and reduction obligations for Ireland are split into two broad categories. The first category covers the large energy and power (i.e. energy intensive) industry which have their emissions controlled under the EU Emissions Trading Scheme (ETS). The second category deals with the non-Emissions Trading Scheme (non-ETS) sectors such as agriculture, transport, residential, commercial, waste and non-energy intensive industry. The proposed development will operate within the non- ETS sector.

Ireland's 2030 target is to achieve a 30% reduction of non-Emissions Trading Scheme sector emissions on 2005 levels with annual binding limits set for each year over the period 2021-2030.

A climate impact assessment was carried out in order to determine the likely significant effects of greenhouse gas emissions (Mt CO_2 equivalent) predicted due to the construction phase of the proposed development, relative to Ireland's projected baseline for 2020, as reported by the EPA.

8.2.5.3 Operational Phase

Process Operations Assessment Methodology

Operational emissions to the atmosphere from the proposed development will be solely restricted to emissions from the Inlet Works Building and Process Building vent stacks. Detailed odour emission dispersion modelling has been carried out for the proposed development. Based on the level of detail involved, this assessment is described in detail in **Chapter 9**.

The WwTP will have an emergency power supply from a standby diesel generator located in the Process Building which will provide up to 24 hours' backup supply. The intention is that the generator would operate in the event of power outages. Preliminary estimates suggest a generator set of 1,250kVA will be used.

As this generator is the same size as the generator proposed to power the TBM (1,250kVA), in the event of power outages, the impact rating associated with its use is not considered significant. Refer to **Section 8.4.2.2** for details of the assessment of the TBM generator.

Traffic Assessment Methodology

As described in **Section 8.2.1**, and in accordance with TII guidance, likely significant effects on air quality are assessed where there is a significant (>5%) increase in AADT flows during the operation of the proposed development.

Climate Assessment Methodology

A climate assessment was carried out in order to determine the likely significant effects of greenhouse gas emissions (Mt CO_2 equivalent) predicted due to the operation of the proposed development, relative to Ireland's projected baseline for 2020, as reported by the EPA.

8.3 Baseline Conditions

8.3.1 Air Quality

As outlined in **Section 8.2.3**, the proposed development is located along the north and south quays of the Avoca river, with the WwTP site located on the eastern periphery of Arklow Town, adjacent to the coast. The AQS Regulations describe the air quality zoning adopted in Ireland as follows:

- Zone A (Dublin Conurbation);
- Zone B (Cork Conurbation);
- Zone C (16 Cities and Towns with population greater than 15,000); and
- Zone D (Rural Ireland: areas not in Zones A, B and C).

The proposed development falls within 'Rural Ireland' and is therefore located in Zone D.

The annual mean background concentration levels of NO_x, NO_2, $PM_{2.5}$ and PM_{10} from EPA monitoring undertaken during 2014 - 2016 are presented in Table 8.7. Concentrations of each pollutant recorded in Zone D are averaged to represent typical background levels. Average concentrations were obtained from all stations where data is captured for at least 90% of the time, in accordance with the AQS Regulations.

Table 8.7: Annual mean background pollutant concentrations for Zone D

Background Values	Annual Average NO_x (µg/m³)	Annual Average NO_2 (µg/m³)	Annual Average PM_{10} (µg/m³)	Annual Average $PM_{2.5}$ (µg/m³)
2014	7.5	5.5	10.5	5
2015	7.3	4	12	8
2016	10.0	6.3	13.1	9
Average	**8.3**	**5.3**	**11.9**	**7.3**
Limit	**30**	**40**	**40**	**20**

8.3.2 Climate

In November 2017, the EPA reported[10] that total national greenhouse gas emissions in 2016 were estimated to be 61.19 million tonnes carbon dioxide equivalent (Mt CO_{2eq}). This is 3.5% higher (2.06 Mt CO_{2eq}) than emissions in 2015 and returns greenhouse gas emissions to 2009 levels. Ireland's greenhouse gas emissions for non-ETS sectors were recorded to be 43.80 Mt $CO_{2\ eq}$ in 2016.

The EPA projects[10] total greenhouse gas emissions and non-ETS sector emissions (Mt CO_2 eq.) to 2035, refer to **Table 8.8.**

Table 8.8: Projected Emissions for the ETS Sector and Total Emissions (Source: EPA[10])

Projections (with existing measures)[11]	**Year**	**Non-ETS Sector Only (MT CO_2 eq.)**	**Total (Mt CO_2eq)**
	2020	45.64	61.56
	2025	47.74	65.39
	2030	47.14	66.49
	2035	47.31	69.21
Projections (with additional measures)[12]	2020	44.83	59.09
	2025	46.78	62.27
	2030	46.04	62.89
	2035	46.04	64.84

Current projections by the EPA indicate that Ireland will exceed its greenhouse gas emissions reduction targets.

8.4 Likely Significant Effects

8.4.1 Do-Nothing Scenario

In the scenario where the proposed development did not proceed as planned, none of the likely significant construction or operational effects as set out in this chapter would occur.

[10] EPA (2017) Ireland's Provisional Greenhouse Gas Emissions 1990-2016
[11] *With Existing Measures* scenario assumes that no additional policies and measures, beyond those already in place by the end of 2015, are implemented. (EPA, 2017)
[12] *With Additional Measures* scenario assumes further implementation of Government renewable and energy efficiency targets for 2020, as set out in the National Renewable Energy Action Plan (NREAP) and the National Energy Efficiency Action Plan (NEEAP). (EPA, 2017)

8.4.2 Assessment of effects during construction

8.4.2.1 Dust and Asbestos

Chapter 5 provides a description of the proposed strategy and methods of construction for the proposed development. Dust emissions are likely to arise from the following construction activities:

- Site excavation;
- Rock breaking;
- Tunnelling;
- Trenching;
- Crushing;
- Stockpiling of separated particles;
- Demolition;
- Handling of construction materials;
- Construction traffic movements; and
- Landscaping.

In general, any additional airborne concentrations of particulate matter arising from construction would be small and very local to the construction site (minimising human exposure). Particles generated by most construction activities tend to be larger than 10µm in diameter which are too large to enter the human lung.

The construction phase of the proposed development is considered to be of a moderate scale, based on the greatest level of construction along the proposed development, refer to **Table 8.5.** This has the potential to result in soiling effects within 50m and PM_{10} and vegetation effects within 15 m of the works with standard mitigation in place.

As shown in **Figure 8.1 of Volume 3**, a number of sensitive receptors are located along the route of the interceptor sewers, at the North and South Quays; the closest of which is located approximately 10m from the proposed construction works.

As the closest of these sensitive receptors is located approximately 10m away from the proposed interceptor sewer there is potential for soiling, PM_{10} and vegetation effects arising from construction activities along the North and South Quays. However, with the implementation of the standard mitigation measures outlined in **Section 8.5.1**, no significant negative effects are envisaged.

An Asbestos Demolition Survey Report has been undertaken for the proposed development, and known ACMs have been identified on site, largely in the form of asbestos cement. This survey has identified asbestos in the following areas on the site:

- The wall and roof cladding of the Old Wallboard building comprises asbestos cement sheets;
- The wall and roof cladding of the Stores building is asbestos sheet cladding;
- The ceiling of the stores building is asbestos sheet cladding;
- The roof cladding to the high section of the Wallboard building is asbestos cement sheets;
- The wall and roof cladding of the Masterglaze building is asbestos cement sheets;
- Rope seals to the lights in the Masterglaze building contain asbestos;
- Lino with asbestos paper backing is present in the electrical room of the Wallboard building;
- Vinyl floor tiles and bitumen containing asbestos are present in the locker room of the Wallboard building;
- Rain water goods in the buildings contain asbestos;
- The internal walls and ceiling of the prefab building contain asbestos;
- Asbestos cement debris is present around and within all of the buildings on the site; and
- Asbestos cement debris is present in the existing rock armour revetment on the seaward side of the site.

During the construction phase of the proposed development it is possible that disturbance of ACMs on site could cause asbestos fibres to be released into the ambient environment. However, with the implementation of the standard mitigation measures outlined in **Section 8.5.1**, no significant negative effects are envisaged.

8.4.2.2 Generator Emissions for Tunnelling

A CAT C32 1,250kVA diesel generator, or equivalent, will be used for powering the TBM. The location of the generator will vary throughout the works, whilst always remaining within a working area. An air dispersion modelling assessment was carried out to assess the short-term effects of the emissions associated with the operation of the generator.

Table 8.9 presents the results of the assessment.

Table 8.9: Predicted ground level concentrations of pollutants from construction generator

Parameter	Background Concentration (µg/m^3)	Predicted Concentration (µg/m^3)	Total Concentration (µg/m^3)	Limit Value (µg/m^3)	Distance of highest concentration from generator (m)
Nitrogen Dioxide (1 hour)	10.6[13]	175.3	185.9	200	50m
Particulate Matter (24-hour)	11.9	0.4	12.3	50	60m

The results in Table 8.9 show that compliance with the AQS Regulations can be achieved using the input data presented in Table 8.6. Additional measures, such as increasing the stack height or increasing the exit velocity can reduce the ground level concentrations of pollutants even further.

As the generator will only be operational during the construction phase of the proposed development and will be relocated throughout the working area as the tunnel progresses, the predicted air quality effects are not considered significant.

8.4.2.3 Traffic

The traffic assessment predicts pollutants where construction traffic increases by more than 10% and where significant traffic increase due to diversions are proposed.

Table 8.10 presents the locations where construction traffic will increase by more than 10%, as described in **Chapter 7**.

Table 8.10: Significant traffic increases from construction traffic.

Location	Traffic volume - existing	Traffic volume – due to construction vehicles
North Quay	6,050	6,639
Harbour Road	726	816

For locations where significant changes to traffic are predicted due to diversions, Table 8.11 outlines the stages, durations and predicted increases.

[13] Double the annual background concentration for 1-hr values, in accordance with EPA Guidance.

Table 8.11: Significant traffic increases due to diversions during construction.

Construction Stage	Duration	Traffic volume - existing	Traffic volume – due to rerouting	Road effected
Stage E South Quay / South Green	2 months	2,614	3,735	South Green Harbour Road
Stage F South Quay / Harbour Road	5 months	2,614	3,735	South Green Harbour Road
Stage H North Quay (East of Ferrybank)	2 weeks	Estimated at 3,000	9,000 (6,000 above baseline)	Seaview Avenue
Stage I North Quay (West of Bridgewater Ferrybank)	2 weeks	Estimated at 3,000	9,000 (6,000 above baseline)	Seaview Avenue

Table 8.12 presents the results for the predicted air quality increases from traffic during the construction phase due to construction vehicles and diversions.

Table 8.12: Predicted air quality increases during the construction phase

Road Location	Scenario	NO_2 (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_{10} (Days > 50 µg/m³)
	Limit Values	*40*	*40*	*25*	*35*
North Quay	Existing	7.0	12.3	8.6	<1
	From construction vehicles	7.1	12.3	8.6	<1
	Increase	0.1	0.1	0.1	0
	Impact Rating	Negligible	Negligible	Negligible	Negligible
Harbour Road	Existing	5.6	12.0	8.4	<1
	From construction vehicles	5.7	12.0	8.4	<1
	Increase	0.1	0.1	0	0
	Impact Rating	Negligible	Negligible	Negligible	Negligible
South Green	Existing	6.3	12.1	8.5	<1
	During diversions	6.7	12.2	8.5	<1
	Increase	0.4	0.1	0	0
	Impact Rating	Negligible	Negligible	Negligible	Negligible
Harbour Green	Existing	6.3	12.1	8.5	<1
	During diversions	6.7	12.2	8.5	<1
	Increase	0.4	0.1	0	0
	Impact Rating	Negligible	Negligible	Negligible	Negligible

Road Location	Scenario	NO_2 (µg/m³)	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_{10} (Days > 50 µg/m³)
	Limit Values	*40*	*40*	*25*	*35*
Seaview Avenue	Existing	6.5	12.1	8.5	<1
	During diversions	8.2	12.6	8.8	<1
	Increase	1.7	0.5	0.3	0
	Impact Rating	Negligible	Negligible	Negligible	Negligible

Negligible effects on air quality are predicted at all receptors as a result of the change in traffic emissions due to the proposed scheme.

8.4.2.4 Climate

The likely significant effects of the construction phase of the proposed development is outlined in **Section 8.5.2.3**.

8.4.3 Assessment of effects during operation

8.4.3.1 Process Operations

Normal operational impacts on air quality are solely generated from odour emissions from the vent stacks. This is assessed in **Chapter 9**.

As outlined in **Section 8.2.5.3**, the proposed generator for use in emergency situations at the WwTP is the same size (1,250kVA), as the generator proposed to power the TBM (1,250kVA). The likely significant effects associated with its use is considered as not significant. Refer to **Section 8.5.1.2** for details of the assessment of the TBM generator.

8.4.3.2 Traffic

As outlined in **Section 8.2.6**, emissions from operational vehicles are assessed where operational traffic results in a significant (>5%) increase in AADT (annual average daily traffic) flows near sensitive receptors.

Traffic levels during the operational phase will be light, as detailed in **Chapter 7**. As no increase in traffic >5% is likely to be generated during the operational phase of the proposed development, a negligible effect on air quality is predicted.

8.4.3.3 Climate

As outlined in **Section 8.3.2**, the EPA reported in 2017 that total national greenhouse gas emissions were estimated to be 61.19 Mt CO_2 eq. in 2016. Greenhouse gas emissions for non-ETS sectors were recorded to be 43.80 Mt CO_2 eq. in 2016.

Table 8.8 outlines a range of future projections for both total carbon emissions and ETS carbon emissions in Ireland (Mt CO_2 eq), as set out by the EPA[14].

The predicted annual CO_2 emissions from the proposed development, including the construction phase, as outlined in the Carbon Footprint Analysis carried out by the project design team is 3,968 tonnes CO_2 eq per annum (198,400 CO_2 eq over the 50-year design life of the proposed development).

The projected increase of CO_2 upon full implementation of the proposed development is 0.009% of Irelands Non-ETS Sector projections for 2020, and 0.006% of Ireland's total projections for 2020. Note that the projections 'with existing measures' (as defined in Table 8.8) are used as a worst-case scenario comparison assessment. This likely significant effect is considered to be an imperceptible on climate. This impact rating is based on EPA guidelines which defines an imperceptible impact as an effect capable of measurement but without significant consequences.

8.4.4 Cumulative

This section considers the potential for cumulative effect arising from the proposed development in association with other developments. Specifically, it considers a worst-case scenario, where both the proposed development and the proposed Arklow Flood Relief Scheme (or section thereof) are under construction at the same time.

The construction of the proposed Arklow Flood Relief Scheme is considered to be of a moderate scale based on the greatest level of construction as it is currently understood (Refer to **Table 8.5** for further detail). This has the potential to result in soiling effects within 50 m and PM_{10} and vegetation effects within 15m of the works with standard mitigation in place.

During the construction phase of the proposed Arklow Flood Relief Scheme, a temporary diesel generator may also be used to power equipment. As outlined in **Section 8.5.1.2**, the effects associated with its use are not considered significant.

In relation to construction traffic, the proposed Arklow Flood Relief Scheme is not considered to give rise to any additional effects over and above those stated in **Section 8.5.1.3** for the proposed development (Refer to **Chapter 7** for further detail).

The proposed development and the proposed Arklow Flood Relief Scheme is not likely to give rise to any significant effects during construction or operation phase once mitigation measures, as outlined in **Section 8.5**, are implemented.

[14] Ireland's Greenhouse Gas Emission Projections 2016-2035, EPA, 2017. Available at http://www.epa.ie/pubs/reports/air/airemissions/ghgprojections2016-2035/EPA_2017_GHG_Emission_Projections_Summary_Report.pdf

8.5 Mitigation Measures and Monitoring

8.5.1 Mitigation

8.5.1.1 Mitigation During Construction

The assessment of likely significant effects during construction (contained in **Section 8.4.2**) includes for the implementation of 'standard mitigation', as stated in the TII guidance[1]. This includes the following measures:

- Spraying of exposed earthwork activities and site haul roads during dry weather;
- Provision of wheel washes at exit points;
- Covering of stockpiles;
- Control of vehicle speeds, speed restrictions and vehicle access; and
- Sweeping of hard surface roads.

In addition, the following measures will be implemented for the proposed development:

- A c. 2.4m hoarding will be provided around the site works to minimise the dispersion of dust from the working areas;
- Generators will be located away from sensitive receptors in so far as practicable;
- Stockpiles will be located as far as possible from sensitive receptors and covered and/or dampened during dry weather.

Employee awareness is also an important way that dust may be controlled on any site. Staff training and the management of operations will ensure that all dust suppression methods are implemented and continuously inspected.

Where asbestos is uncovered on site during construction, the ACM will be double-bagged and removed from the site by a competent contractor and disposed of in accordance with the relevant procedures and legislation.

8.5.1.2 Mitigation During Operation

As there are no significant effects on air quality predicted during the operational of the proposed development, no mitigation measures are proposed.

In relation to climate, the use of energy efficient design throughout the WwTP reduces the annual CO_2 emissions of the proposed development. Key energy and resource efficiency measures incorporated include:

- The WwTP has been located as close as possible to the load centre in Arklow town; and adjacent to the Irish Sea (i.e. the target location for final discharge of effluent) and all treated effluent discharges will be conveyed to the long sea outfall via gravity flow to minimise pumping requirements (and thus associated energy use).

- All wastewater in the interceptor sewer network and the WwTP will be conveyed by gravity to the WwTP to minimise pumping requirements (and thus associated energy use).
- Soft start pumps/efficient pump selection will be utilised throughout;
- On-site renewable energy in the form of PV panels that use solar energy have been incorporated into the plant design to optimise the generation and use of renewable energy at the WwTP.
- The buildings on the WwTP site will be naturally ventilated where possible, with heating limited to mitigate the effects of frost and condensation in the Inlet Works and Process Building only. Occupied spaces would have heat recovery ventilation systems. The combination of these HVAC elements would minimise associated energy use in the building during operation.

8.5.2 Monitoring

8.5.2.1 Monitoring During Construction

Dust monitoring will be undertaken at a range of nearest sensitive receptors during the construction phase. The TA Luft dust deposition limit values of 350 $mg/m^2/day$ (averaged over one year) will be applied as a 30-day average.

8.5.2.2 Monitoring During Operation

As no significant effects are predicted to occur during the operation of the proposed development, therefore no monitoring measures are required.

8.6 Residual Effects

No significant residual effects are predicted on air quality and climate during the construction or operation of the proposed development with the implementation of the mitigation measures outlined herein.

8.7 References

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9 Odour

9.1 Introduction

This chapter describes the likely significant effects of the proposed development on odour. Air quality and climate are addressed separately in **Chapter 8**.

9.2 Assessment Methodology

9.2.1 General

The generation and dispersion of odorous emissions have been assessed due to the nature and scale of the proposed development. This assessment considers the potential for likely significant odour effects during the operation of the proposed development. There will be no significant odour emission sources during construction and therefore no construction assessment or mitigation is considered necessary.

Air dispersion modelling of odorous emissions represents a widely accepted method of assessing potential risk of off-site impacts[1]. In order to assess the likely significant effects of the proposed development on the ambient environment during operation, dispersion modelling of odorous emissions has been undertaken. The dispersion modelling methodology for the operational assessment is outlined in **Section 9.2.5.1**.

9.2.2 Limit Values

Currently, there is no general statutory odour standard in Ireland relating to industrial installations. Two reference documents have been cited herein and have been used to determine appropriate limit values. Table 9.1 outlines the odour limits used for this assessment based on the UK's Environment Agency Odour Management Guidance[2] and the Institute of Air Quality Management (IAQM) Guidance[3].

These guidance documents recommend that odour standards should be between 1.5 and 6.0 OU/m^3 as a 98th percentile of one-hour averaging periods at all receptors. This 98th percentile limit allows for exceedances for 176 1-hour values over a full year (8,760 hours).

[1] CIWEM (2016) *Policy Position Statement – Control of Odour*.
[2] Environment Agency (2011) *H4 Odour Management How to comply with your environmental permit*
[3] Institute of Air Quality Management (IAQM) (2018) *Guidance on the assessment of odour for planning*

The guidance allows limits to be set based on the offensiveness of the odour and allows adjustments for local factors such as proximity to sensitive receptors and population density. A summary of the indicative limit criteria for various industrial sectors is given in Table 9.1.

Table 9.1: Indicative odour criteria for various industrial sectors

Industrial Sectors	Relative Offensiveness of Odour	Indicative Criterion
Processes involving decaying animal or fish remains Processes involving septic effluent or sludge Biological landfill odours	Most Offensive	1.5 OU/m^3 as a 98th percentile of hourly averages at the worst-case sensitive receptor
Intensive livestock rearing Sugar beet processing Fat frying (food processing) Well aerated green waste composting	Moderately offensive	3.0 OU/m^3 as a 98th percentile of hourly averages at the worst-case sensitive receptor
Brewery, Confectionery, Coffee roasting, Bakery	Less offensive	6.0 OU/m^3 as a 98th percentile of hourly averages at the worst-case sensitive receptor

Considering the surrounding environment, proximity to sensitive receptors and the treatment of wastewater within the WwTP, an odour limit value of 3.0 OU/m^3 of the 98th percentile of 1-hour value at both the site boundary and the nearest sensitive receptor is proposed. As such, the proposed development is considered to generate moderately offensive odours.

In order to carry out a reasonable worst-case scenario assessment, the limit value of 3.0 OU/m^3 of the 98th percentile of 1-hour value has been applied herein.

9.2.3 Study Area

The proposed development is located in Arklow, County Wicklow and has been been described in detail in **Chapter 4**. The WwTP site is located on the eastern periphery of Arklow Town, adjacent to the Irish Sea. The existing site area layout is illustrated in **Figure 1.1 in Volume 3**. The interceptor sewers will be located along the north and south quays.

The closest existing sensitive receptors to the proposed WwTP site are the residential complex known as the Marina Village located approximately 100m to the west of the site and 185m to the north-west of the site. On South Quay, the closest residential receptor to the WwTP is approximately 260m to the south of the site.

A number of sensitive receptors are also located within 15m of the interceptor sewers, at River Walk, South Quay and North Quay, as outlined in **Section 2.6.5.1 in Chapter 2**.

In addition, the lands adjacent to the WwTP are zoned for Waterfront (WZ), which includes for a mix of residential, commercial, employment, leisure and tourism uses. These lands have been included as future sensitive receptors for the operational assessment. The proposed WwTP site boundary is therefore considered the most suitable location to apply the operational odour limits.

The proposed development interacts with a number of different zoned areas, as outlined in the Arklow LAP[4] and described in **Section 6.4.2**. Along North Quay, the proposed development crosses the Open Space (OS2) and Waterfront (WZ) zoned areas. The proposed development is also adjacent to Community & Education (CE) and Open Space (OSI) zoning objectives.

Along River Walk and South Quay, the proposed development crosses the Town Centre (TC), Open Space (OS1), Open Space (OS2) and Existing Residential (RE) zoning objectives. These have been considered in the assessment herein.

9.2.4 Categorisation of the Baseline Environment

A desk-based study has been undertaken in order to establish the baseline environment and inform this assessment. In addition, a site visit undertaken in April 2018 to ascertain if there are any prominent existing odour sources in the area. Baseline conditions are outlined in **Section 9.3**.

9.2.5 Impact Assessment Methodology

9.2.5.1 Air Dispersion Modelling

There is the potential for odour to be generated from the proposed development during operation due to discharge venting from the emission vent stacks along the interceptor sewers and from the vent stacks on the Inlet Works building and Process building. Detailed air dispersion modelling has been undertaken for the vent stacks using the industry standard Breeze AERMOD software package[5]. As outlined in **Section 9.2.1**, the air dispersion modelling has been undertaken in accordance with the EPA guidance[6].

AERMOD models the ground level concentration level of odours that are emitted from specified sources. In order to undertake the modelling, the following information is inputted:

- The location, size and scale of any on-site buildings;
- The location of the boundary line for sensitive receptors;
- Meteorological conditions in the study area; and
- The number, type and location of emission sources.

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[4] https://www.wicklow.ie/Living/Services/Planning/Development-Plans-Strategies/Local-Area-Town-Settlement-Plans/Arklow/Arklow-and-Environs-Local-Area-Plan-2018-2024
[5] Breeze AERMOD software package – version 1612r, released January 2017.
[6] EPA (2010) *Air Dispersion Modelling from Industrial Installations Guidance Note (AG4)*

The model was used to predict ground level odour concentrations over a 1-hour averaging period and relevant percentiles.

Meteorological Conditions

Meteorological data from Met Éireann's synoptic station at Dublin Airport was used for the years 2011 to 2015 inclusive. The meteorological data includes hourly values for wind speed, wind direction, atmospheric stability, ambient temperature and mixing height.

Location, Size and Scale of On-Site Buildings

The length, width and height of the Inlets Works Building and Process Building was included in modelling. AERMOD includes a software utility called Building Profile Input Program (BPIP) to calculate direction-specific building downwash factors using the relative positions and dimensions of sources and neighbouring buildings.

Location of Sensitive Receptors

Receptors are locations where AERMOD computes an odour concentration. As the distance from the subject site increases, the receptor grid density decreases. As such, three nested, Cartesian receptor grids were used for both modelling the Inlet Works Building and Process Building and the Interceptor Sewer Vents, centred on the emission source. The size of each grid is as follows;

- The largest grid has receptors covering a 10km by 10km area at 250m intervals;
- The medium sized grid has receptors covering a 1.5km by 1.5km area at 50m intervals; and
- The smallest grid has receptors covering a 2km by 2km area at 15m intervals.

For the Inlet Works Building and Process Building a dense receptor grid was placed around the development's site boundary to predict odour concentrations.

For the Interceptor Sewer Vents a dense receptor grid was placed around one of the vents, which is representative of the other vents, to predict odour concentrations.

By using this approach, a more dense receptor grid is placed closer to the source(s) where the highest concentrations are likely to be, and a less dense grid is used further from the source(s) to account for any high concentrations that may be located further away from the site.

Elevations were taken from Ordnance Survey mapping.

Emission Sources

As noted in **Chapter 4**, odour control measures have been incorporated as part of the design of the proposed development. The proposed development includes an odour treatment unit (OTU), as depicted in **Drawing No.247825-00-STE-001in Volume 3.**

Drawing No.'s 247825-00-MP-001 to 247825-00-MP-010 and Drawing No.'s 247825-00-C-IS-700 to 247825-00-C-IS-716 in Volume 3 show the locations of the vent stacks for the OTU Vent Stack, Process Building Vent Stack and the Interceptor Sewer Vents.

Table 9.2 outlines an indicative, reasonable worst case emission source data for the proposed OTU vent stack at the Inlet Works building, vent stack at the Process building and interceptor sewer vent stacks, as extracted from the design specification. It should be noted that during the detailed design stage, efficient design may result in further improvements in emissions at the Inlet Works Building and the Process Building. However, at a minimum, compliance with limit values outlined in **Section 9.2.2** will be achieved.

A centralised OTU has been designed for the WwTP, that would comprise biological and carbon filters and the treated air would discharge through a vent stack on the Inlet Works Building. The Process building will be sealed and mechanically ventilated and therefore odour treatment is not required. The Process building will be vented via a vent stack located on the building.

Table 9.2: Emission source input data

Parameter	**Unit**	**OTU Vent Stack**	**PB Vent Stack**	**Interceptor Sewer Vent(s)**
Stack Height	m	17.5	15.5	7.6
Stack Diameter	m	0.6	0.6	0.33
Flow Rate	m^3/s	8.7	1.43	1.28
Velocity	m/s	30.79	5.06	15.0
Temperature	ºC	15	15	15
Odour Concentration	OU/m^3	183	1,323	1,323
Odour Emission Rate	OU/s	1,592	1,890	1,696.5

9.3 Baseline Conditions

As outlined in **Section 9.2**, the proposed development is located in Arklow town. The proposed WwTP is located on the eastern periphery of Arklow town, approximately 20m from the coastline with the proposed interceptor sewers located primarily along the Avoca River at River Walk, North Quay and South Quay.

As outlined in **Section 2.3 of Chapter 2**, the existing wastewater network in Arklow town discharges untreated wastewater from homes and business to the Avoca River. It has been reported that this existing practise gives rise to a negative odour emanating from the Avoca River[7,8].The sailing, rowing clubs and the marina have each reported odour problems along the Avoca River.

[7]http://wicklownews.net/2017/05/not-all-sunshine-in-arklow/
[8] https://www.independent.ie/regionals/wicklowpeople/news/residents-fume-at-stinking-river-30470608.html

No other known existing odour sources were present in the area during a site visit on 12 April 2018.

9.4 Description of the Proposed Development

Chapter 4 provides a full description of the proposed development. The following aspects are particularly relevant to the odour assessment.

The main sources of odour at a WwTP are generally associated with either sludge or septic wastewater and hence, the priority for odour treatment is the inlet works, sumps and sludge tanks. The Process Building tanks, which form the secondary treatment, will not have the same potential sources of odour and therefore mechanical ventilation is considered appropriate for the Process building.

A centralised OTU has been designed for the WwTP, with an odour concentration of 183 odour units (OU)/m^3 and an emission rate of approximately 1,592 OU/sec. The OTU would comprise biological and carbon filters and the treated air would discharge through a 600mm diameter, 17.5 m high vent stack, in the Inlet Works Building (i.e. terminating 1m above the roof).

Air from the following areas would be treated in the OTU:

- Inlet pump sump;
- Stormwater holding tanks;
- Inlet works – screenings and grit disposal skips;
- Sludge holding tanks;
- Sludge thickeners;
- Sludge dewatering;
- Dewatered sludge skips; and
- Supernatant sump.

As the Process building will be sealed and mechanically ventilated, odour treatment is not required. The design odour concentration for the Process building is 1,323 OU/m^3 with an emission rate of 1,890 OU/sec. The Process building will be vented via a 600mm diameter vent stack at 15.5m height (i.e. terminating 1m above the roof).

12 vent stacks will be located along the interceptor sewer at each of the tunnel shafts. A reasonable worst-case odour concentration of 1,323 OU/m^3 has been assumed with an emission rate of 1,697 OU/sec. The vent stacks along the interceptor sewer network will be vented via a 330mm diameter vent stack at 7.6m height.

The odour control system for the WwTP has been designed to comply with an odour limit offsite of 3.0 OU/m^3.

9.5 Likely Significant Effects

9.5.1 Do-Nothing Scenario

In the scenario where the proposed development does not proceed as planned, none of the likely significant effects during operation, as set out in this chapter, would occur.

However, the current odours that are experienced across Arklow town, would continue, as described in **Section 9.3**.

9.5.2 Assessment of Effects during Construction

The proposed development will require excavation of soils and subsoils, to accommodate pipelines and structures, however, no significant negative effects on odour are predicted during construction of the proposed development. Furthermore, no significant effects are predicted during the excavation of any contaminated soil encountered during construction of the WwTP at the Old Wallboard site at Ferrybank.

9.5.3 Assessment of Effects during Operation

An odour modelling assessment has been undertaken in accordance with the methodology outlined in **Section 9.2**, and using emission data provided by the design team (Refer to Table 9.2). Predicted concentrations are compared to the limit value outlined in **Section 9.2.2**.

9.5.3.1 Inlet Works and Process Building

The highest predicted ground level concentrations of odour are presented in **Table 9.3** for the worst-case modelled results. **Figure 9.1 in Volume 3** shows an isopleth for the 98th percentile of 1-hour values for odour units.

Table 9.3: Modelling results for Inlet Works and Process Building Vents

Limit Value 98th percentile of 1-hour value (OU/m^3)	Highest Predicted Ground Level Concentration (g/m^3)	Distance from source to predicted highest ground concentration level (m)	Grid Reference (ITM)	
			Easting	Northing
3	0.48	98m	725339	673134

The result for the highest 98th percentile 1-hour values is predicted to be 0.51 OU/m^3 which is 16% of the limit value of 3.0 OU/m^3 and occurs at the site boundary of the proposed development. This is in good compliance with the limit value.

As stated in **Section 9.2.5.1**, during the detailed design stage, efficient design may result in further improvements in odorous emissions at the Inlet Works Building and the Process Building. This assessment shows that compliance with the limit value is capable of being achieved on the basis of the specimen design.

9.5.3.2 Interceptor Sewer Vents

The results for the highest predicted concentration of odour in proximity to an interceptor sewer vent are presented in **Table 9.4** for the worst-case modelled results. Meteorological data from 2011 was found to give rise to the highest predicted ground level concentration of odour.

Table 9.4: Modelling results for Interceptor Sewer Vents

Limit Value **98th percentile of 1-hour value (OU/m^3)**	**Highest Predicted Ground Level Concentration** **(g/m^3)**	**Distance from source to predicted highest ground concentration level (m)**
3	0.34	33

The result for the highest 98th percentile 1-hour values was predicted to be 0.34 OU/m^3 which is 11% of the limit value of 3.0 OU/m^3. This shows good compliance with the limit value.

As the results in Table 9.4 show, the highest predicted concentration of odour occurs at a distance of 33m from an interceptor sewer vent.

The 12 vent stacks will each be located at the tunnel shafts. The two closest shafts are TSS2A and TSS3, approximately 25m apart. In the unlikely worst-case scenario of the highest predicted ground level concentration values from both vents occurring at the same location, a cumulative value of 0.68g/m^3 is estimated. This value is 22% of the limit value and shows good compliance with the limit value.

Given the low predicted ground level concentration from each vent, as well as the distance between vents, any cumulative effects are not predicted to be significant and will still be well below the limit value of 3OU/m^3.

9.5.4 Cumulative

This section considers the potential for cumulative effects arising from the proposed development in association with other developments as described in **Section 2.6 in Chapter 2**.

The proposed development is not considered to give rise to significant odour effects during the construction phase, therefore cumulative odour effects will not occur during construction of the proposed development.

Gas Networks Ireland (GNI) have planning permission granted for a 3m high 'lamp post' style relief vent stack servicing the existing above ground district regulating installation located on North Quay adjacent to the planning boundary. This development, in combination with the proposed development will not give rise to any significant cumulative odour effects.

9.6 Mitigation Measures and Monitoring

9.6.1 Mitigation

9.6.1.1 Mitigation during Construction

No mitigation measures are considered necessary during the construction of the proposed development with regard to odour.

9.6.1.2 Mitigation during Operation

No mitigation measures other than those inherent design measures described in **Chapter 4** are required during the operation of the proposed development with regard to odour.

9.6.2 Monitoring

9.6.2.1 Monitoring during Construction

No monitoring measures are required during the construction of the proposed development with regard to odour.

9.6.2.2 Monitoring during Operation

The proposed development will be required to apply for a WWDA to the EPA prior to operation as outlined in **Section 4.5 of Chapter 4**. This licence will only apply to the wastewater discharged from the WwTP. All other environmental emissions, including odour, will be regulated by Wicklow County Council. Although the WwTP will not be formally regulated by the EPA, Irish Water will be operating the plant in accordance with EPA licensing standards. Monitoring of the OTU will be undertaken during commissioning and at predetermined frequencies over the life time of the proposed development.

Emissions from the WwTP and interceptor sewer vent stacks will be measured with continuous monitors to indicate the performance levels of the abatement measures. Furthermore, independent performance checks will be carried out by an ISO17025 accredited testing laboratory at quarterly intervals during the first two years of operation to verify the effectiveness of control measures and ongoing compliance with the odour limits.

9.7 Residual Effects

9.7.1 Residual Effects during Construction

No significant residual effects are anticipated during the construction of the proposed development with regard to odour.

9.7.2 Residual Effects during Operation

As outlined in **Section 9.5.3**, the odour levels are predicted to be in compliance with the limits presented in **Section 9.2.2**. No significant residual effects are therefore expected to occur at any of the receptor locations during the operation of the proposed development.

9.8 References

Chartered Institute of Water and Environmental Management (CIWEM), 2016. *Policy Position Statement – Control of Odour.*

Environmental Protection Agency (EPA), 2010. *Air Dispersion Modelling from Industrial Installations Guidance Note (AG4).* Co. Wexford, Ireland

Independent News, 2014. https://www.independent.ie/regionals/wicklowpeople/news/residents-fume-at-stinking-river-30470608.html

Institute of Air Quality Management (IAQM), 2018. *Guidance on the assessment of odour for planning*

UK Environmental Agency (UKEA), 2011 *H4 Odour Management, How to comply with your environmental permit.*

Wicklow News, 2017. http://wicklownews.net/2017/05/not-all-sunshine-in-arklow/

Wicklow County Council, 2018. *Local Area Plan 2018 - 2024.*

10 Noise and Vibration

10.1 Introduction

This chapter describes the likely significant noise and vibration effects resulting from the construction and operation of the proposed development. Where necessary, mitigation measures are identified to reduce effects and the likely residual construction and operational effects are described.

Chapter 4 provides a description of the proposed development and **Chapter 5** describes the Construction Strategy. The following aspects are particularly relevant to the noise and vibration assessment:

- Construction:
  - Noise and vibration associated with construction activities at the WwTP site;
  - Noise associated with the revetment construction;
  - Noise associated with the sea outfall construction;
  - Noise and vibration associated with construction activities at the interceptor sewer locations; and
  - Noise associated with construction traffic.
- Operation:
  - New sources of noise associated with the operation of the WwTP; and
  - Noise associated with operational traffic.

10.2 Assessment Methodology

10.2.1 General

This assessment considers the potential for generating significant noise and vibration impacts during the construction and operation of the proposed development and the likely significant effects of noise and vibration on sensitive receptors. Vibration has been considered during the construction phase only as there is not considered to be the potential for significant sources of vibration during the operation of the proposed development.

10.2.2 Guidance and Legislation

The noise and vibration assessment has been undertaken in accordance with the overarching EIA guidance identified in **Section 1.4.3 of Chapter 1** and in accordance with the following:

- EPA (2016) *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)*[1];
- Transport Infrastructure Ireland (TII, formerly NRA) (2014) *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes*[2];
- TII (2004) *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*[3]; and
- British Standards Institution (BSI) (2014) 5228-1 and 2:2009+A1:2014. *Code of practice for noise and vibration control on construction and open sites. Noise and Vibration*[4].

These guidance documents, have set out noise and vibration limits during construction which are generally applied by planning authorities to all construction projects in Ireland.

10.2.3 Categorisation of the Baseline Environment

10.2.3.1 Overview of the Surveys

The baseline noise environment was determined by conducting surveys on 12 and 13 April 2018 at sensitive receptors (residential properties) in the vicinity of the proposed development. The surveys were undertaken in accordance with ISO 1996-1:2016[5].

10.2.3.2 Survey Locations

Attended noise measurements were conducted in Arklow town at three locations in the vicinity of the WwTP site and at five locations in the vicinity of the proposed interceptor sewers. These eight locations are representative of the types of receptors encountered across the proposed development.

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[1] EPA (2016) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4). Available from: http://www.epa.ie/pubs/advice/noise/guidancenotefornoiseng4.html [Accessed 24 April 2018]
[2] TII (2014) *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes*. Available from: http://www.tii.ie/technical-services/environment/planning/Good_Practice_Guidance_for_the_Treatment_of_Noise_during_the_Planning_of_National_Road_Schemes.pdf [Accessed 24 April 2018]
[3] TII (2004) *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*.
[4] British Standards Institution (BSI) (2014) 5228-1 and 2:2009+A1:2014. Code of practice for noise and vibration control on construction and open sites. Noise and Vibration.
[5] ISO (2016) Acoustics – Description, measurement and assessment of environmental noise (Part 1 & Part 2).

The coordinates and descriptions of each of the survey locations are presented in **Table 10.1** and illustrated in **Figure 10.1 in Volume 3.**

Table 10.1: Description of baseline noise survey locations

Survey Location	**Description**	**Coordinates**	
		Easting	**Northing**
S01	Three storey residential apartment complex located on the North Quay, c. 150m west of the proposed WwTP site boundary.	325119	173280
S02	Three storey residential apartment complex located on the North Quay, c. 130m west of the proposed WwTP site boundary.	325116	173212
S03	Two storey residential dwelling located on the South Quay, c. 180m southwest of the proposed WwTP site boundary.	325114	172999
S04	Two storey residential dwelling located on the South Quay, c. 40m southwest of the nearby proposed interceptor sewer.	324922	173212
S05	Three storey residential dwelling located on the South Quay, c. 10m southwest of the proposed interceptor sewer.	324702	173445
S06	Two storey residential dwelling located adjacent to the roundabout to the northeast of Arklow bridge, c. 30m northeast of the proposed interceptor sewer.	324800	173628
S07	Three storey residential dwelling located on the South Quay, c. 25m south of the proposed interceptor sewer.	324560	173554
S08	Three storey residential dwelling located on the South Quay, c. 30m south of the nearby proposed interceptor sewer.	324293	173538

10.2.3.3 Instrumentation

A Brüel & Kjær 2250 Light Class 1 Sound Level Meter was used to carry out the baseline noise surveys. This meter complies with applicable industry standards[6]. The noise meter was calibrated before and after each measurement at each survey location using a Brüel & Kjær 4231 Acoustic Calibrator. A windshield was used to provide the microphone with effective wind protection to ensure that local meteorological conditions did not impact on the monitoring.

10.2.3.4 Meteorological Conditions

Meteorological conditions over the monitoring periods are set out in Table 10.2. Meteorological data has been taken from Johnstown Castle, Co. Wexford weather station data (the nearest weather station) for each day the surveys occurred.

Table 10.2: Meteorological conditions for survey periods

Date	**Rainfall (mm)**	**Max Temp (°C)**	**Min Temp (°C)**	**Mean Wind Speed (m/s)**
12 April 2018	0	9.9	7	3.0
13 April 2018	0	11.3	5.8	2.7

10.2.3.5 Measurement Parameters

The following parameters were recorded and reported as part of the baseline surveys:

- L_{Aeq} – this is the continuous steady sound level during the sample period and effectively represents an average value;
- L_{A10} – this is the sound level that is exceeded for 10% of the sample period. It is typically used as a descriptor for traffic noise; and
- L_{A90} – this is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.

The ‘A’ suffix denotes the fact that the sound levels are “A-weighted” in order to account for the non-linear nature of human hearing.

10.2.3.6 Survey Periods

Measurements were conducted at the survey locations during the following survey periods:

- Between 7am and 7pm on 12 April 2018 for daytime;
- Between 7pm and 11pm on 12 April 2018 for evening time; and
- Between 11pm on 12 April 2018 and 7am on 13 April 2018 for night-time.

[6] International Electro-Technical Commission (IEC) (2002) *Specification for Sound Level Meters*.

All surveys were carried out on a week day and during time periods that were selected in order to provide a typical snapshot of the existing baseline noise environment in the vicinity of the sensitive receptors.

The results were initially noted onto a survey record sheet immediately following each sample and were also saved to the instrument memory for later analysis where appropriate. Survey personnel also noted all primary noise sources contributing to the baseline noise environment.

10.2.4 Impact Assessment Methodology

10.2.4.1 Traffic Volumes (Construction and Operation)

The TII guidance[2] states that routes should be considered for assessment where the flow of traffic volumes is likely to increase or decrease by 25% or more during construction and/or operation.

As outlined in **Section 7.4 of Chapter 7**, the operation of the proposed development will not result in offsite traffic increases of greater than 25%, therefore a detailed assessment of noise and vibration associated with traffic is not required.

During construction, there will be increases in traffic volumes due to the presence of construction vehicles and traffic diversions. These diversions will be in place for periods of between two weeks to nine months. **Chapter 4** and **Chapter 7** outlines the full details of the traffic diversions during the construction of the proposed development. Table 10.3 outlines the classification of magnitude of noise impacts in the short term for traffic noise, as stated in DMRB guidance[7].

Table 10.3: Classification of magnitude of noise impacts in the short term

Noise change, $L_{A10,18h}$	Magnitude of Impact
0	No change
0.1 – 0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Moderate
5+	Major

[7] Design Manual for Roads and Bridges, Vol 11 Section 3 Part 7 HD 213/11 Noise and Vibration. Highways Agency.

For traffic noise predictions, the Calculation of Road Traffic Noise (CoRTN)[8] was used to calculate road traffic noise as receptors are located in close proximity to the road. The noise levels are calculated based on the following inputs;

- Traffic volumes;
- Vehicle speeds and road gradient;
- Angle of view of road (degrees);
- Location of receptors;
- Road surface; and
- Any obstacles, such as screens or barriers.

10.2.4.2 Construction Noise – Limits and Significance Criteria

Airborne Construction Noise

BS 5228[4] outlines guidance on construction noise criteria with reference to the existing noise environment, as well as prediction methodologies to estimate impacts. This guidance is considered the most appropriate to apply in this instance as they consider the existing baseline noise environment and include night-time limits. BS 5228[4] states that:

"*a potential significant effect is indicated if the $L_{Aeq,\,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.*"

Table 10.4 sets out the ABC method for establishing the impact criteria of construction noise as presented in BS5228.

Table 10.4: BS5228 (Part 1) ABC assessment categories and thresholds at dwellings [4]

Assessment Category and Threshold Value Period $L_{Aeq,\,1\,hour}$	**Threshold Value in Decibels (dB)**		
	A[A)]	**B[B)]**	**C[C)]**
Night (23:00-07:00hrs)	45	50	55
Evening and weekends [D)]	55	60	65
Day (07:00-19:00hrs) and Saturdays (08:00-14:00)	65	70	75

A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than category A values.

B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.

C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.

D) 19:00 – 23:00hrs weekdays, 14:00-23:00hrs Saturdays and 07:00-23:00hrs Sundays.

[8] Department of Transport UK, (1988) The Calculation of Road Traffic Noise (CoRTN)

The construction noise criteria outlined in Table 10.5 has been applied at the nearest sensitive receptor to the construction works based on the BS5228[4] criteria. Sensitive receptors are defined in BS5228[4] as any occupied premises outside a site used as a dwelling, place of worship, educational establishment, hospital or similar institution or any other property likely to be adversely affected by an increase in noise level.

Table 10.5: Noise limits to be applied based on BS5228 criteria

Assessment Category and Threshold Value Period L_{Aeq}	**Standard noise limits at sensitive receptors $L_{Aeq, 1\ hour}$**	**Noise limit at S05 $L_{Aeq, 1\ hour}$**
Night (23:00-07:00hrs) (L_{Aeq}, dB)	(Cat B)50	(Cat B)50
Evening (19:00-23:00hrs) (L_{Aeq}, dB)	(Cat A) 55	(Cat A) 55
Day (07:00-19:00hrs) (L_{Aeq}, dB)	(Cat A) 65	(Cat A) 70[9]

Where an exceedance of the construction noise criteria, as outlined in Table 10.5, is predicted, the impact associated with the noise increase is rated in accordance with Table 10.6.

Table 10.6: Likely impact associated with exceedance of construction noise criteria

Extent of Noise Impact (Exceedance of Assessment Criteria)	**Noise Impact Magnitude**	**Magnitude Rating**
Less than 3dB	No significant change/Imperceptible	Neutral to Slight Impact
Increase of 3-5dB	Slight increase	Slight to Moderate Impact
Increase of 6-10dB	Moderate Increase	Moderate to Major Impact
Increase of more than 10dB	Substantial Increase	Significant Impact

Table 10.7 outlines the duration and frequency of effect based on EPA guidance[10].

Table 10.7: Duration and frequency of effects

Effect Type	**Duration**
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

[9] Based on Table 10.4, a daytime noise limit of 70 dBL_{Aeq} can be applied at S05 as baseline noise levels at that location (when rounded to the nearest 5 dB), are the same as Category A values.
[10] EPA (2017) Guidelines on the information to be contained in Environmental Impact Assessment Reports.

Groundborne Construction Noise

Groundborne noise is generated as a result of propagation of vibration at various frequencies. Underground tunnelling has the potential to generate such frequencies and therefore an assessment for ground borne noise has been undertaken. BS 5228[4] provides the empirical formula to estimate groundborne noise for tunnelling works. $L_p = 127 - 54log_{10}r$

where;

L_p is the room sound pressure level, in decibels (dB) and r is the slope distance from the pile toe or tunnel crown, in metres (m).

This formula has been adapted to the formula below based on average ground conditions that are expected to be encountered across the proposed development[11].

$$L_p = 117 - 54log_{10}r$$

There are no relevant national or international standards setting criteria for groundborne noise. The impact criteria set out in Table 10.8 and Table 10.9 have been drawn from projects in the UK and Ireland that have required tunnelling works e.g. Crossrail, the Jubilee Line extension, DART Underground and High-Speed 2.

Absolute criteria, rather than noise change criteria, apply for groundborne noise as there is rarely any appreciable ambient groundborne noise at a receptor and the character and nature of groundborne noise differs from other ambient noise heard inside buildings.

Table 10.8: Groundborne noise impact criteria for residential receptors

Impact Classification	**Groundborne Noise Level (dB L_{Amax}) measured indoors, near the centre of any dwelling room on the ground floor[12]**	
Negligible	< 35	Not Significant
Low	35-39	
Medium	40-44	Significant Impact
High	45-49	
Very High	>49	

[11] The information for vibration prediction in BS5228-2 is based on the empirical data within Transport Research Laboratory paper 429 (Groundborne vibration caused by mechanised construction works), which contains vibration data for construction processes in a number of soil types. The updated formula is based on data for tunnelling through clay.
[12] The centre of any dwelling room on the ground floor has been assumed to be 2m from the façade of any building.

Table 10.9: Groundborne noise impact criteria for non-residential receptors

Building	**Significant Impact Threshold (dB L_{Amax})**
Theatres / Large Auditoria & Concert Halls	25
Sound Recording / Broadcast Studios	30
Places of meeting for Religious Worship / Courts / Lecture Theatres / Museums / Small Auditoria or Halls	35
Offices / Schools / Colleges / Hospitals / Hotels / Libraries	40
Factories / Warehouses	50

10.2.4.3 Construction Vibration – Limits and Significance Criteria

Sheet Piling

Sheet piling is proposed during two construction phases of the proposed development to enable the construction of the interceptor sewer via trench works (that require piling) and at the WwTP during the installation of the below ground structures and the cofferdam for the SWO. The piling works at the WwTP will not give rise to any significant vibration impacts at the nearest sensitive receptor as these receptors are located at over 100m from the works. In contrast, due to the close proximity of sensitive receptors during the interceptor sewer piling works, this construction activity has therefore been assessed as a reasonable worst case.

Sheet piling will be carried out along the southern banks of the Avoca River; from in the vicinity of Arklow Bridge to approximately the South Green – South Quay intersection. BS 5228-2[4] provides an empirical formula to estimate groundborne vibration for vibratory sheet piling, $v_{res} = k_v/x^{\delta;}$ where;

- v_{res} is the resultant PPV (peak particle velocity) in mm/s;
- k_v is a scaling factor (60 – 266 depending on probability of predicted values being exceeded. A value of 126 has been applied for screening);
- δ is an operations factor (assumed as 1.3, the average factor over both steady state and start up/rundown operations); and
- x is the distance measured along the ground surface in metres.

Tunnelling

Tunnelling will be carried out along the entire interceptor sewer route along North Quay and for approximately 350m of the interceptor sewer route on South Quay. BS 5228-2[4] provides an empirical formula to estimate groundborne vibration for tunnelling works, $v_{res} <= 180/x^{1.3}$ where;

v_{res} is the resultant PPV in mm/s and x is the distance measured along the ground surface in metres.

This formula has been adapted to the formula below based on average ground conditions that are expected to be encountered across the proposed development[13].

$$v_{res} <= 18/x^{1.3}$$

The main source of vibration during construction will be due to tunnelling and sheet piling. The TII guidance[2] recommends that in order to ensure that there is no potential for vibration damage during construction, vibration from construction activities should be limited to 8mm/s at frequencies of less than 10Hz, to 12.5mm/s for frequencies of 10 to 50Hz and to 20mm/s at frequencies of 50Hz and above.

Separately, Table 1 in BS 7385-2[14] and Table B.2 in BS5228-2[4] outline vibration limit values for transient vibration for cosmetic damage[15]. Both standards state that:

"where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 1 may need to be reduced by up to 50%."

As the BS 7385-2 limits are directly applicable to vibration in buildings, for continuous and transient vibration, and are also more onerous at lower frequencies compared to the TII limits, they have been carried through for assessment purposes.

Table 10.10 outlines the limits for transient vibration, applied in this assessment and recommend for the construction phase of the proposed development.

Table 10.10: Vibration limits at the nearest sensitive receptor

Type of building	**Peak component particle velocity in frequency range of predominant pulse**			
	Transient		***Continuous***	
	4 Hz to 15 Hz	**15 Hz and above**	**4 Hz to 15 Hz**	**15 Hz and above**
Reinforced or framed structures (Industrial and heavy commercial buildings)	50 mm/s		25 mm/s	
Unreinforced or light framed structures (Residential or light commercial type buildings)	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50mm/s at 40 Hz and above	7.5 mm/s at 4 Hz increasing to 10 mm/s at 15 Hz	10 mm/s at 15 Hz increasing to 25mm/s at 40 Hz and above

[13] Transport Research Laboratory paper 429: Groundborne vibration caused by mechanised construction works.
[14] BS 7385-2 (1993) Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from groundborne vibration
[15] 'Cosmetic' damage is defined in BS ISO 4866:2010 as *The formation of hairline cracks on drywall surfaces or the growth of existing cracks in plaster or drywall surfaces; in addition, the formation of hairline cracks in mortar joints of brick/concrete block construction.*

BS 5228-2[4] outlines guidance on the effects of vibration levels for humans. Vibration levels above 0.3mm/s PPV are likely to be perceptible but significantly higher values can be tolerated which will not cause annoyance. Table 10.11 outlines the likely human response to vibration levels.

Table 10.11: Human perception to vibration levels

Vibration level	Significance Level
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level

10.2.4.4 Operation – Limits and Significance Criteria

The effects of the proposed development during operation are assessed through the application of significance criteria based on predicted changes in noise level due to the proposed development. This was achieved by calculating the change in L_{Aeq} and applying a significance level as defined in Table 10.12.

Table 10.12: Significance criteria for changes in noise levels during operation [1,16,17]

Change in Sound Level (dB)	Subjective Reaction	Significance Level
None	No change	No change
<3	Inaudible	Imperceptible
4-5	Perceptible	Slight
6-10	Up to doubling of loudness	Moderate
11-15	Over a doubling of loudness	Significant
>16		Profound

[16] BSI (2014) 4142:2014. *Methods for rating and assessing industrial and commercial sound*.

[17] Department of Communications and Local Government (1994) *Planning Policy Guidance 24 (PPG24): Planning and Noise*.

The EPA guidance[1] sets out permissible levels for industrial facilities. Typical limit values (free field) for noise from industrial sites at sensitive receptors are:

- Daytime (07:00 to 19:00hrs) – 55dB $L_{Ar,T}$;
- Evening time (19:00 to 23:00hrs) – 50dB $L_{Ar,T}$; and
- Night-time (23:00 to 07:00hrs) – 45dB $L_{Aeq,T}$.

$L_{Ar,T}$ is the rated noise level, equal to the L_{Aeq} during a specified time interval (T), plus specified adjustments for tonal character and/or impulsiveness of the sound.

$L_{Aeq,T}$ is the equivalent continuous sound level. It is an average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T).

The proposed development will operate on a 24-hour basis. The limits above are applied to assess the effect of operational noise sources at the site boundary.

In addition, the lands adjacent to the WwTP are zoned for Waterfront (WZ), which includes for a mix of residential, commercial, employment, leisure and tourism uses (Refer to **Section 2.6.7 of Chapter 2** for further detail). These lands have therefore been included as future sensitive receptors for the operational assessment. The site boundary of the WwTP site is therefore considered the most suitable location to apply the operational noise limits.

10.3 Baseline Conditions

Table 10.13 presents the results of the baseline noise survey at each location. The results of the survey have indicated that baseline noise levels at all locations that have been assessed are dominated by passing traffic on the local road network. No sources of vibration were noted during the surveys.

Table 10.13: Baseline noise survey results

Survey Date and Time		Survey Location	L_{Aeq} (dB)	L_{Amax} (dB)	L_{A10} (dB)	L_{A90} (dB)	Qualitative Description
Day – 12 April 2018	18:19 – 18:49	S01	55	82	52	40	The dominant noise source at this location was local traffic on North Quay. Other sources of noise included industrial noise from Arklow marina, noise from pedestrians, noise from a nearby playing pitch and birdsong.
	17:48 – 18:18	S02	51	80	52	44	The dominant noise source at this location was local traffic on North Quay. Other sources of noise included industrial noise from Arklow marina, noise from pedestrians and birdsong.
	16:56 – 17:12	S03	56	76	57	49	The dominant noise source at this location was local traffic on South Quay. Other sources of noise included industrial noise from Arklow marina, noise from pedestrians and birdsong.
	17:28 – 17:43	S04	55	72	58	45	The dominant noise source at this location was local traffic on South Quay. Other sources of noise included distant industrial noise from Arklow marina, noise from pedestrians and birdsong.
	16:11 – 16:26	S05	63	81	65	60	The dominant noise source at this location was local traffic on South Quay. Other sources of noise included water flow under Arklow bridge, noise from pedestrians and birdsong.
	16:29 – 16:44	S06	61	83	63	56	The dominant noise source at this location was local traffic on the adjacent roundabout. Other sources of noise included water flow under Arklow bridge and noise from pedestrians.
	15:53 – 16:08	S07	51	65	53	48	The dominant noise source at this location was local traffic. Other sources of noise included distant traffic, noise from pedestrians and birdsong.
	15:28 – 15:43	S08	44	68	45	40	The dominant noise source at this location was birdsong. Other sources of noise included distant traffic and noise from pedestrians.
Evening – 12 April 2018	19:00 – 19:30	S01	52	86	48	39	The dominant noise source at this location was local traffic on North Quay. Other sources of noise included industrial noise from Arklow marina, noise from a nearby playing pitch and birdsong.

Survey Date and Time		Survey Location	L_{Aeq} (dB)	L_{Amax} (dB)	L_{A10} (dB)	L_{A90} (dB)	Qualitative Description
	19:32 – 20:02	S02	48	66	50	43	The dominant noise source at this location was local traffic on North Quay. Other sources of noise included industrial noise from Arklow marina, noise from pedestrians and birdsong.
	20:21 – 20:51	S03	53	72	54	44	The dominant noise source at this location was local traffic on South Quay. Other sources of noise included industrial noise from Arklow marina, noise from pedestrians and birdsong.
Night – 12 /13 April 2018	23:47 – 00:02	S01	45	65	46	43	Noise sources included occasional local traffic on North Quay, distant traffic noise and the movement of water in the Avoca River.
	23:30 – 23:45	S02	45	64	47	42	Noise sources included occasional local traffic on North Quay, distant traffic noise and the movement of water in the Avoca River.
	23:01 – 23:16	S03	47	68	47	44	Noise sources included occasional local traffic on South Quay, distant traffic noise and the movement of water in the Avoca River.
	23:19 – 23:24	S04	47	69	48	42	Noise sources included occasional local traffic on South Quay, distant traffic noise and the movement of water in the Avoca River.

10.4 Likely Significant Effects

10.4.1 Do-Nothing Scenario

In the scenario where the proposed development does not proceed as planned, none of the effects as set out in this chapter would occur. Under the 'do nothing' scenario, the noise and vibration baseline as presented in **Section 10.3** would persist and no significant effects would arise.

10.4.2 Assessment of Effects During Construction

10.4.2.1 Construction Phasing and Plant

The construction of the proposed development will involve construction activities within each of the working areas including WwTP site works, interceptor sewer trench construction works and tunnelling and construction of a sea outfall.

It is not possible at this stage to predict the exact equipment that will be chosen by the contractor(s) and predicted calculations are indicative only and used for the purposes of comparison with the adopted criteria. Based on the indicative construction programme (Refer to **Appendix 5.2**), a reasonable worst-case assessment has been undertaken. For the purposes of this assessment, the following construction phases are considered for the construction of the WwTP and the interceptor sewers:

- WwTP
  - Site preparation;
  - General site activities;
  - Building construction;
  - Revetment construction; and
  - Sea outfall construction.
- Interceptor Sewer
  - Open trench works (soil stripping, excavation, piling, rock breaking, pipe laying, backfilling, reinstatement);
  - Shaft construction;
  - Tunnelling; and
  - Sheet Piling.

The calculations assume that plant and equipment are operating simultaneously, as outlined in the following sections. Mitigation, in the form of a 2.4m hoarding, has been applied to each of the modelling scenarios. In practice, a reduction up to 10dB(A) can be achieved for hoarding of this height.

For the construction of the WwTP, open trench works and construction of the tunnelling shafts, a 10dB(A) reduction has been assumed on the basis that the noise sources are completely screened from sensitive receptors[4]. For the outfall and revetment upgrade works a 5dB(A) reduction has been assumed on the basis that the noise sources are partially screened from sensitive receptors[4].

The calculations also assume that all plant and equipment associated with the individual phases are operating simultaneously and at the distance specified in Table 10.14, Table 10.16, Table 10.18, Table 10.21, Table 10.22 and Table 10.23

Typically, construction will be from 7am to 7pm, Monday to Friday and 8am to 2pm on Saturday. However, during the construction of tunnel section of the interceptor sewer, the Tunnel Boring Machine (TBM) equipment (including generator) will operate continuously. Tunnelling will occur 24-hours a day, seven days per week and has been conservatively estimated to take 20-25 days per 100m section (including setup and removal), although this is dependent on the rate of progress of tunnelling. It is envisaged that a tunnelling rate of up to 10m per day can be achieved but for assessment purposes the conservative rate of progress has been assumed herein.

It is anticipated that the tunnelling works will take approximately one year and the construction of the subsurface and above ground structures, as well as the outfalls and the revetment for the WwTP will take approximately 22 months.

No additional works other than tunnelling are anticipated on Sundays and Bank Holidays. Notwithstanding the 24-hour use of the tunnelling equipment, it is anticipated that there may be times due to exceptional circumstances that construction activities may be necessary outside of the standard hours. This will be agreed in advance with Wicklow County Council and communicated to local residents with an estimation of the timing and duration.

10.4.2.2 WwTP

Table 10.14 outlines the number and type of plant and equipment assumed to be required during construction of the WwTP, along with the percentage time in operation, during the site preparation, general activities and building construction.

Table 10.14: Specification and number of equipment for each construction phase of the WwTP

Plant and equipment included in assessment	BS 5228 [4] reference	Number	Sound Power Level (L_w) dB	Percentage time in operation (%)
Site Preparation				
Tracked Excavator	C.1.12	3	110	66
Dump Truck	C.2.30	2	107	66
Crusher	C.1.14	1	110	66
Tower Crane	C.4.48	1	104	66
Breaker Mounted on Excavator	C.1.9	1	118	66
General Activities				
Piling	C.3.14	1	111	66
Tracked Excavator	C.1.12	2	110	66
Dump Truck	C.2.30	2	107	66
Angle Grinder	C.4.93	1	108	66
Tower Crane	C.4.48	1	104	66
Generator	C.4.84	2	102	66
Building Construction				
Cement Mixer Truck	C.4.18	2	103	66
Poker Vibrator	C.4.33	2	106	66
Tower Crane	C.4.48	1	104	66
Generator	C.4.84	1	102	66
Tracked Excavator	C.1.12	2	110	66
Circular Saw	C.4.72	1	107	66
Water Pump	C.2.46	2	93	66

Table 10.15 outlines the results for the site preparation, general site activities and construction phases at the three nearest sensitive receptors to the WwTP site (Refer to **Figure 10.2 in Volume 3**).

Table 10.15: Predicted sound pressure levels at the nearest sensitive receptors to the WwTP during daytime

Phase	Receptor ID (see Figure 10.2)	Baseline Noise Level daytime (dBA)	Predicted Noise Level ($L_{Aeq,\ 1\ hr}$) dB(A)	Total predicted noise level dB(A)	Impact Rating (refer to Table 10.6)
Site Preparation	R52	55	59	60	Moderate
	R51	51	57	58	Moderate
	R36	56	56	59	Slight
General Activates	R52	55	55	58	Slight
	R51	51	54	56	Slight
	R36	56	52	57	Imperceptible
Building Construction	R52	55	54	58	Slight
	R51	51	53	55	Slight
	R36	56	51	57	Imperceptible

The results of the assessment indicate that for the site preparation, general activities and construction of the WwTP, the daytime noise limit of 65 dB L_{Aeq} can be complied with at the nearest sensitive receptors to the WwTP site. The impact ratings associated with these works range from short term imperceptible negative impact to short term moderate negative impact.

The above calculations are indicative and are used for the purposes of comparison only with the adopted criteria.

10.4.2.3 Revetment

Table 10.16 outlines the number and type of plant and equipment assumed to required during construction of the revetment upgrade, along with the percentage time in operation, during the revetment upgrade works adjacent to the WwTP.

Table 10.16: Specification and number of equipment for revetment construction works

Plant and equipment included in assessment	BS 5228 [4] reference	Number	Sound Power Level (L_w) dB	Percentage time in operation (%)
Tracked Excavator	C.1.12	3	110	66
Dump Truck	C.2.30	2	107	66
Crusher	C.1.14	2	110	66
Tower Crane	C.4.48	2	104	66
Breaker Mounted on Excavator	C.1.9	1	118	66
Generator	C.4.84	2	102	66
Water Pump	C.2.46	2	93	66

Table 10.17 outlines the results for the revetment upgrade works at the three nearest sensitive receptors to the WwTP site (refer to **Figure 10.2 in Volume 3**).

Table 10.17: Predicted sound pressure levels at the nearest sensitive receptors to the WwTP for revetment works

Phase	Receptor ID (see Figure 10.2)	Baseline Noise Level (dBA)	Predicted Noise Level ($L_{Aeq,\ 1\ hr}$) dB(A)	Total predicted noise level dB(A)	Impact Rating (refer to Table 10.6)
Revetment Construction	R52	55	60	61	Slight
	R51	51	60	61	Significant
	R36	56	58	60	Slight
	R55	55	61	62	Moderate

The results of the assessment indicate that for the revetment upgrade works, the daytime noise limit of 65 dB L_{Aeq} can be complied with at the nearest sensitive receptors to the WwTP site. The impact ratings associated with these works range from short term slight negative impact to short term significant negative impacts.

The above calculations are indicative and are used for the purposes of comparison only with the adopted criteria.

10.4.2.4 Outfall

Construction of the long sea outfall will include works from both the land and sea. It is expected that several vessels may be required during the construction of the outfall and that diving support is likely to be required at times.

Section 5.6.5.1 of Chapter 5 outlines in detail the potential methods for the construction of the marine outfall. Based on current practice and site constraints/characteristics there are considered to be three potential construction methodologies:

- Horizontal directional drilling method;
- Flood and float method; and
- Bottom-pull method.

As the flood and float method and bottom pull method are deemed to generate more noise that the directional drilling option, these works have been assessed as a worst case.

Table 10.18 outlines the number and type of equipment assumed to be required for construction of the outfall, along with the percentage time in operation, during the sea outfall construction works adjacent to the WwTP site in the Irish Sea. Specification for the equipment and operational times have been taken from BS 5228-1[4]

Table 10.18: Specification and number of equipment for construction of the outfall

Plant and equipment included in assessment	BS 5228 [4] reference	Number	Sound Power Level (L_W) dB	Percentage time in operation (%)
Dredging	D.12.1	1	124	100
Loading dredged aggregates	D.12.4	1	112	100
Grab – hopper dredging ship	C.7.2	1	110	100

Table 10.19 outlines the results for the outfall construction works at the three nearest sensitive receptors to the WwTP site (refer to **Figure 10.2 in Volume 3**).

Table 10.19: Predicted sound pressure levels at the nearest sensitive receptors to the WwTP for construction of the outfall

Phase	Receptor ID (see Figure 10.2)	Baseline Noise Level (dBA)	Predicted Noise Level ($L_{Aeq, 1 hr}$) dB(A)	Total predicted noise level dB(A)	Impact Rating (refer to Table 10.6)
Outfall Construction	R52	55	62	59	Moderate
	R51	51	63	58	Significant
	R36	56	63	60	Moderate

The results of the assessment indicate that for the outfall construction works, the daytime noise limit of 65 dB L_{Aeq} can be complied with at the nearest sensitive receptors to the WwTP site. The impact ratings associated with these works range from short term moderate negative impact to short term significant negative effects.

The construction of the outfall has the potential for impacting marine mammals. Without mitigation, these impacts may have a short term significant impact on mammals, however, with the mitigation measures outlined in **Section 10.5.1.2**, the effects will not be significant.

10.4.2.5 Impact of WwTP, Sea Outfall and Revetment Construction

Table 10.20 outlines the results of the cumulative assessment for works ongoing at the WwTP, outfall and revetment simultaneously.

Table 10.20: Predicted sound pressure levels at the nearest sensitive receptors to the WwTP for works ongoing at the WwTP, outfall and revetment simultaneously

Phase	Receptor ID (see Figure 10.2)	Baseline Noise Level daytime (dBA)	Predicted Noise Level ($L_{Aeq, 1 hr}$) dB(A)	Total predicted noise level dB(A)	Impact Rating (refer to Table 10.6)
WwTP Site Preparation with Revetment and sea outfall construction	R52	55	65	65	Significant
	R51	51	65	65	Significant
	R36	56	65	65	Moderate
WwTP General Activities with Revetment and sea outfall construction	R52	55	65	65	Significant
	R51	51	65	65	Significant
	R36	56	64	64	Moderate
WwTP Building Construction with Revetment and sea outfall construction	R52	55	65	65	Significant
	R51	51	65	65	Significant
	R36	56	64	65	Moderate

The results of the assessment indicate that for the simultaneous WwTP works, the revetment works and outfall construction, the daytime noise limit of 65dB L_{Aeq} can be complied with at the nearest sensitive receptors to the WwTP site. The impact ratings associated with these works range from short term moderate negative impact to short term significant negative effects.

10.4.2.6 Interceptor Sewer Works (Airborne Noise)

Table 10.21 to Table 10.23 outlines the number and type of equipment assumed to be in operation, along with the percentage time in operation, during open trench works, construction of shafts and the operation of the tunnelling equipment.

Table 10.21: Specification and number of equipment in use for open trench works

Plant included in site preparation assessment	BS 5228 [4] reference	Number	Sound Power Level (L_w) dB	Percentage time in operation (%)
Open trench works (soil stripping)				
Tracked Excavator	C.2.18	1	103	50
Dozer	C.5.12	1	105	50
Open trench works (excavation)				
Tracked Excavator	C.2.18	1	103	50
Articulated Dump Truck	C.5.16	1	104	50
Open trench works (sheet piling)				
Mobile Crane	C.3.29	1	98	50
Sheet Piling	C.3.6	1	96	50
Open trench works (rock breaking)				
Tracked Excavator	C.2.18	1	103	50
Articulated Dump Truck	C.5.16	1	104	50
Hydraulic Rock Breaker	C.1.8	1	102	50
Open trench works (pipe laying)				
Mobile Crane	C.3.29	1	98	50
Lorry	C.2.34	1	108	30 [Note 1]
Open trench works (backfilling)				
Tracked Excavator	C.2.18	1	103	50
Articulated Dump Truck	C.5.16	1	104	50
Open trench works (reinstatement)				
Tracked Excavator	C.2.18	2	103	50
Dozer	C.5.12	1	105	50

Note 1 – limited operational time required during pipe laying

Table 10.22: Specification and number of equipment in use for shaft construction

Plant and equipment included in assessment	BS 5228 [4] reference	Number	Sound Power Level (L_w) dB	Percentage time in operation (%)
Shaft construction				
Piling Rig	C.3.17	1	104	50
Hydraulic Rock Breaker	C.1.8	1	102	50
Excavator	C.2.18	1	103	50
Dozer	C.5.12	1	105	50
Articulated Dump Truck	C.5.16	1	104	50
Water Pump	C.5.40	1	96	50
Mobile Crane	C.3.29	1	98	50

Table 10.23: Specification and number of equipment in use for tunnelling[18]

Plant and equipment included in assessment	Number	Sound Power Level (L_w) dB	Percentage daytime in operation (%)	Percentage evening time and night time in operation (%)
TBM				
Base Tanks and Pump	1	99	25	25
Screens	2	90	100	100
Desilter	1	92	100	100
Centrifuge	1	91	100	100
Cascade	1	92	100	100
Setting tanks and pumps	2	94	100	100
Compressor	1	100	100	100
Generator	1	87	100	100
Dump Truck	1	102	100	0
Excavator	1	99	25	0
Water Pump	1	93	100	100
Mobile Crane	2	95	20	5

Table 10.24 to Table 10.27 outline the results for the open trench works, launch and retrieval shaft construction and tunnelling construction phases at various distances from the proposed interceptor sewer locations.

[18] Dublin City Council (2012) Ringsend Wastewater Treatment Works Extension Environmental Impact Statement.

Banded distances have been selected to reflect the moving nature of the works with the closest sensitive receptor along the scheme approximately 10m from open trench works and 15m from shaft construction and tunnelling.

Table 10.24: Predicted sound pressure levels at banded distances for open trench works

Phase	**Predicted Noise Level ($L_{Aeq, 1 hr}$) at various distances**			
	10m	**20m**	**30m**	**40m**
Open Trench Works – Soil Stripping	66	60	57	54
Open Trench Works – Excavation	66	60	56	53
Open Trench Works – Piling	59	53	50	47
Open Trench Works – Rock Breaking	67	61	57	55
Open Trench Works – Pipe Laying	65	59	56	53
Open Trench Works – Backfilling	66	60	56	53
Open Trench Works – Reinstatement	66	60	57	54

The predicted results for the open trench works for the interceptor sewer, show slight exceedances of 1 to 2 dB for the daytime noise limit of 65 dB L_{Aeq} at 10m distance from the works.

Table 10.25: Predicted sound pressure levels at banded distances for open shaft construction

Phase	**Predicted Noise Level ($L_{Aeq, 1 hr}$) at various distances**			
	15m	**30m**	**45m**	**60m**
Shaft construction	67	61	57	54

The predicted results for shaft construction works for the interceptor sewer, show slight exceedances of 2dB for the daytime noise limit of 65 dB L_{Aeq} at 15m from the works.

As stated in **Section 10.5.1.1**, it is not possible at this stage to select the exact plant and equipment that will be chosen by the contractor(s) and so the above calculations are indicative and are used for the purposes of comparison only with the adopted criteria, using conservative estimates for plant, equipment and expected attenuation due to mitigation measures. It will be the responsibility of the contractor to minimise significant negative effects at nearby receptors for the duration of the construction works.

Table 10.26: Predicted sound pressure levels at banded distances for tunnelling – daytime

Phase	**Predicted Noise Level ($L_{Aeq, 1 hr}$) at various distances**			
	15m	**30m**	**45m**	**60m**
TBM tunnelling	65	59	55	53

Table 10.27: Predicted sound pressure levels at banded distances for tunnelling evening time and night-time

Phase	**Predicted Noise Level ($L_{Aeq, 1 hr}$) at various distances**			
	15m	**30m**	**45m**	**60m**
TBM tunnelling	63	57	54	51

The predicted results in Table 10.26 for airborne noise for tunnelling works during daytime for the interceptor sewer, show compliance with the daytime noise limit of 65 dB L_{Aeq}. Furthermore, as the tunnelling works progress away from the launch shaft noise levels will reduce further due to ground attenuation i.e. sound being contained and absorbed by the soil surrounding the TBM. Noise levels will likely reduce by up to 10dB during tunnelling works at distance from the launch shafts. The time predicted is based on a conservative tunnelling progress rate of 4m/day (25 days for 100m, as referred to in **Section 10.4.2.1**). It is envisaged that a tunnelling rate of up to 10m per day can be achieved.

The predicted results in Table 10.27 for airborne noise for tunnelling works during evening time and night-time for the interceptor sewer, show exceedances with the evening time and night-time noise limit of 55 dB L_{Aeq} and 50 dB L_{Aeq}, respectively. These exceedances are predicted to be short term significant negative impacts. Again, noise levels will likely reduce by up to 10dB during tunnelling works at distance from the launch shafts.

10.4.2.7 Impact Assessment for Residential receptors – Trench Works

Table 10.28 outlines the predicted sound pressure levels and impact ratings at each of the monitoring locations during trench works. Green shaded results indicate compliance.

The results of the assessment outlined in Table 10.28 indicate that at two of the three receptors assessed (S07 and S08), the predicted daytime noise at both receptors can comply with the daytime noise limit of 65 dB L_{Aeq}. Table 10.28 also indicates that at S05, predicted noise levels are compliant with the daytime noise limit of 70 dB L_{Aeq}.

The impact rating for these works show that two of the three receptors modelled (S07 and S08) may experience significant short term negative impacts.

Table 10.28: Predicted sound pressure levels and impact ratings at monitoring locations during trench works.

Receptor Number	Measured Daytime Noise Level (dBA_{LAeq})	Soil Stripping	Excavation	Piling	Rock Breaking	Pipe Laying	Backfilling	Reinstatement
Predicted noise level from works (dB(A))								
S05		68	67	61	69	67	67	68
S07		63	62	56	63	62	62	63
S08		60	60	53	61	59	60	60
Total noise level (dB(A))								
S05	63	69	68	65	70	68	68	69
S07	51	63	62	57	63	62	62	63
S08	44	60	60	54	61	59	60	60
Predicted increase in noise levels (dBA)								
S05	63	6	5	2	7	5	5	6
S07	51	12	11	6	12	11	11	12
S08	44	16	16	10	17	15	16	16
Impact rating (refer to **Table 10.6**)								
S05	63	Moderate	Moderate	Imperceptible	Moderate	Slight	Slight	Moderate
S07	51	Significant	Significant	Moderate	Significant	Significant	Significant	Significant
S08	44	Significant	Significant	Moderate	Significant	Significant	Significant	Significant

10.4.2.8 Impact Assessment for Residential Receptors – Shaft Construction and Tunnelling

Table 10.29 outlines the predicted sound pressure levels and impact ratings at each of the monitoring locations during shaft construction and tunnelling. Green shaded results indicate compliance while red shaded results indicate exceedances.

The results of the assessment outlined in Table 10.29 indicate that at each of the five receptors assessed, for shaft construction and tunnelling, the daytime noise limit of 65 dB L_{Aeq} can be complied with at three of the five receptors (S01, S02 and S03). Two receptors (S02 and S04) may potentially experience significant short term negative impacts during shaft construction.

During evening time works for tunnelling, one of the three receptors modelled (S02) may exceed the evening time noise limit of 55 dB L_{Aeq}. S02 may potentially experience significant short term negative impacts during tunnelling. Table 10.29 also indicates that at S03, predicted noise levels are compliant with the evening time noise limit of 55 dB L_{Aeq}.

During night time works for tunnelling, all four of the receptors modelled may exceed the night time noise limit of 50 dB L_{Aeq}. All four receptors will also experience a significant short term negative impacts during tunnelling.

Table 10.29: Predicted sound pressure levels and impact ratings at monitoring locations during shaft construction and TBM operation.

Time	Receptor Number	Baseline Noise Level (dBA)	Predicted Construction Noise Level (dBA)		Predicted Total Noise Level (dBA)		Predicted Increases in Noise Levels (dBA)		Impact Rating (refer to Table 10.6)	
			Shaft construction	TBM	Shaft construction	TBM	Shaft construction	TBM	Shaft construction	TBM
Day time	S01	55	60	57	61	59	6	4	Moderate	Slight
	S02	51	63	60	63	61	12	10	Significant	Moderate
	S03	56	58	55	60	59	4	3	Slight	Slight
	S04	55	67	64	67	65	12	10	Significant	Moderate
	S06	61	64	61	66	64	5	3	Slight	Slight
Evening Time	S01	52	No shaft construction during evening or night time	55		57		5		Slight
	S02	48		59		59		11		Significant
	S03	53		54		57		4		Slight
Night Time	S01	45		55		55		10		Significant
	S02	45		59		59		14		Significant
	S03	47		54		55		8		Significant
	S04	47		62		62		15		Significant

10.4.2.9 Interceptor Sewer (Groundborne Noise)

Table 10.30 presents the predicted results for the groundborne noise assessment at sensitive receptors and are compared to the values in Table 10.8 and Table 10.9.

Table 10.30: Predicted groundborne sound pressure levels for tunnelling

Nearest sensitive receptor to tunnelling works	Receptor type	Approximate slope distance to TBM (m)	Predicted Noise Level dBL_{Amax}	Impact Classification (refer to Table 10.6)
R01	Residential	40	30	Negligible
R02	Residential	56	22	Negligible
R03	Residential	25	42	Medium
R04	Residential	44	28	Negligible
R05	Residential	15	54	Very High
R06	Residential	19	48	High
R07	Residential	23	45	High
R08	Residential	25	42	Medium
R09	Residential	26	41	Medium
R10	Residential	59	21	Negligible
R11	Residential	27	40	Medium
R12	Residential	27	40	Medium
R13	Residential	57	22	Negligible
R14	Residential	26	41	Medium
R15	Residential	25	42	Medium
R16	Residential	21	46	High
R17	Residential	57	22	Negligible
R18	Residential	17	51	Very High
R19	Residential	31	36	Low
R20	Residential	18	50	Very High
R21	Residential	16	52	Very High
R22	Residential	17	51	Very High
R23	Residential	46	27	Negligible
R24	Residential	37	32	Negligible
R25	Residential	18	50	Very High
R26	Residential	16	52	Very High
R27	Residential	12	59	Very High
R28	Residential	42	29	Negligible
R29	Residential	39	31	Negligible
R30	Residential	36	33	Negligible

Nearest sensitive receptor to tunnelling works	Receptor type	Approximate slope distance to TBM (m)	Predicted Noise Level dBL_{Amax}	Impact Classification (refer to Table 10.6)
R31	Residential	34	35	Low
R32	Residential	30	38	Low
R33	Residential	26	41	Medium
R34	Commercial	12	58	Very High[19]
R35	Commercial	23	43	Negligible[19]
R36	Residential	42	29	Negligible
R37	Residential	47	27	Negligible
R38	Residential	40	30	Negligible
R39	Residential	33	35	Low
R40	Residential	28	39	Medium
R41	Church	55	23	Negligible[20]
R42	Residential	45	28	Negligible
R43	Doctor Surgery	18	50	High[21]
R44	Residential	51	25	Negligible
R45	Residential	20	47	High
R46	Commercial	25	42	Negligible[19]
R47	Sailing club	29	38	Negligible[19]
R48	Commercial	14	55	Medium[19]
R49	Residential	36	33	Low
R50	Residential	24	43	Medium
R51	Residential	14	54	Very High
R52	Residential	15	53	Very High
R53	Residential	34	34	Low
R54	Commercial	12	59	High[19]

The results in Table 10.30 have been summarised in Table 10.31 for assessment purposes.

[19] Using a significance threshold of 50dBL_{Amax} as outlined in Table 10.9, a factored rating is applied to this receptor.

[20] Using a significance threshold of 35dBL_{Amax} as outlined in Table 10.9, a factored rating is applied to this receptor.

[21] Using a significance threshold of 40dBL_{Amax} as outlined in Table 10.9, a factored rating is applied to this receptor.

Table 10.31: Summary of impact classifications for groundborne noise

Impact Classification (see Table 10.8)		Number of receptors	List of receptors
Not significant	Negligible	20	R1,2,4,10,13,17, 23,24,28,29,30,35,36,37,38,41,42,44,46,47.
	Low	6	R19,31,32,39,49,53
Significant	Medium	11	R3,8,9,11,12,14,15,33,40,48,50.
	High	6	R6, 7,16,43,45,54.
	Very High	11	R5,18,20,21,22,25,26,27,34,51,52.

The results presented in Table 10.31 show that of the 54 receptors assessed, the impact at 26 of these are considered not significant, 11 are considered of medium significance, 6 of high significance and 11 of very high significance. All impacts are considered short term negative, see Table 10.7.

Based on the results in Table 10.31, Table 10.32 predicts the length of time before the impact associated with groundborne noise at each receptor (identified in Table 10.31) is rated as not significant due to the movement of the TBM away from each the receptor. The time predicted is based on a conservative tunnelling progress rate of 4m/day (25 days for 100m, as referred to in **Section 10.4.2.1**). It is envisaged that a tunnelling rate of up to 10m per day can be achieved.

Table 10.32: Time required (in days) to reduce groundborne noise impact to not significant

Receptor	Receptor type	Approximate slope distance to TBM (m)	Approximate slope distance required before compliant with appropriate limit (m)	Time required for TBM to reach required slope distance from a receptor (days)
R05	Residential	14		<5
R06	Residential	18		<3
R07	Residential	21		<1
R16	Residential	20		<2
R18	Residential	16		<4
R20	Residential	17		<3
R22	Residential	16		<4
R25	Residential	17	23	<3
R26	Residential	15		<4
R27	Residential	11		<6
R34	Residential	12		<6

Receptor	**Receptor type**	**Approximate slope distance to TBM (m)**	**Approximate slope distance required before compliant with appropriate limit (m)**	**Time required for TBM to reach required slope distance from a receptor (days)**
R45	Residential	19		<2
R51	Residential	12		<5
R52	Residential	13		<4
R27	Residential	12		<6
R54	Commercial	12	18	<3
R43	Doctors	18	23	<3

In such circumstances, projects have considered using noise insulation or temporary re-housing as mitigation measures to prevent unacceptable levels of noise affecting receptors. In the case of groundborne noise, noise insulation will not mitigate against this type of noise, as the path of transmission is not through the windows, and so only temporary re-housing is an option in this case.

BS5228-1[4] provides an example of noise insulation and temporary rehousing policy, based on those adopted by several large infrastructure schemes in the UK. In addition to defining the threshold value of eligibility, this recommends a minimum number of days before a resident may be eligible. Where minimum durations of *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,* are predicted, BS 5228-1[4] recommends re-housing as an appropriate mitigation measure.

It is important to note that the predicted groundborne levels are an estimate based on the BS 5228[4] empirical formula, while in practice it is possible that the impact may be lower. The finalised construction details, plant and equipment for the proposed development are not known at present. The appointed contractor(s) will outline the specific construction methodologies and agree a schedule that minimises the impact on the effected receptors.

Any requirement for temporary re-housing will be confirmed by the contractor(s) in consultation with Irish Water and the affected stakeholder. The determination for such mitigation will be made after detailed construction methodologies, phasing and detailed equipment are known. This information will be presented in the Noise and Vibration Management Plan (NVMP), a template for which is included an appendix to the Outline CEMP (Refer to Appendix 5.1).

As outlined in **Section 10.6.2.1**, continuous noise monitoring will be undertaken at the three nearest receptors during the construction phase of the proposed development to measure compliance with the limit values presented in Table 10.5.

10.4.2.10 Interceptor Sewer (Vibration)

Table 10.33 presents the calculated groundborne vibration levels that may be experienced at the nearest sensitive receptor and compares these to the values in Table 10.10.

Table 10.33: Predicted vibration levels for tunnelling

Nearest sensitive receptor to tunnelling works	Receptor type	Distance measured along the ground surface (m)	PPV (mm/s)
R01	Residential	38	0.16
R02	Residential	54	0.10
R03	Residential	22	0.32
R04	Residential	42	0.14
R05	Residential	12	0.71
R06	Residential	16	0.49
R07	Residential	19	0.39
R08	Residential	22	0.32
R09	Residential	23	0.31
R10	Residential	57	0.09
R11	Residential	24	0.29
R12	Residential	24	0.29
R13	Residential	55	0.10
R14	Residential	23	0.31
R15	Residential	22	0.32
R16	Residential	18	0.42
R17	Residential	55	0.10
R18	Residential	14	0.58
R19	Residential	29	0.23
R20	Residential	15	0.53
R21	Residential	13	0.64
R22	Residential	14	0.58
R23	Residential	44	0.13
R24	Residential	35	0.18
R25	Residential	15	0.53
R26	Residential	13	0.64
R27	Residential	8	1.03
R28	Residential	40	0.15
R29	Residential	37	0.16
R30	Residential	33	0.19
R31	Residential	31	0.21

Nearest sensitive receptor to tunnelling works	Receptor type	Distance measured along the ground surface (m)	PPV (mm/s)
R32	Residential	27	0.25
R33	Residential	23	0.31
R34	Residential	10	0.90
R35	Residential	21	0.34
R36	Residential	40	0.15
R37	Residential	45	0.13
R38	Residential	38	0.16
R39	Residential	30	0.22
R40	Residential	25	0.27
R41	Church	53	0.10
R42	Residential	43	0.14
R43	Doctor Surgery	15	0.53
R44	Residential	49	0.11
R45	Residential & commercial	17	0.45
R46	Commercial	22	0.32
R47	Sailing club	26	0.26
R48	Commercial	11	0.80
R49	Residential	33	0.19
R50	Residential	21	0.34
R51	Residential	10	0.90
R52	Residential	11	0.80
R53	Residential	31	0.21
R54	Commercial	7	1.43

The result of the assessment show that at all receptors the predicted vibration levels will be in good compliance with the vibration limits as presented in Table 10.10. The potential impact is assessed as negligible in terms of potential for building damage. All impacts are considered short term, see Table 10.7.

Table 10.33 shows that the tunnelling works may exceed the level of 1mm/s at two receptors (R27 and R54). In general, it is recommended that prior notice be given to local residents before tunnelling commences. The proposed development will involve open trench works underneath Arklow Bridge. Based on the results for tunnelling, the impact of the trench works is not considered significant.

It should be noted that the predicted groundborne levels are an estimate based on the BS 5228 empirical formula, while in practice it is possible that the impact may be lower.

As stated in **Section 10.5.1.1**, it is not possible at this stage to select the exact plant and equipment that will be chosen by the contractor(s) and so the above calculations are indicative and used for the purposes of comparison only with the adopted criteria. It will be the responsibility of the contractor to minimise impacts at nearby receptors for the duration of construction.

10.4.2.11 Sheet Piling (Vibration)

Table 10.34 presents the calculated groundborne vibration levels that may be experienced at the nearest sensitive receptor and compares these to the values in **Table 10.10**.

Table 10.34: Predicted vibration levels for sheet wall piling

Nearest sensitive receptor to tunnelling works (see Figure 10.3)	Receptor type	Distance measured along the ground surface (m)	PPV (mm/s)
V01	Residential	11	5.9
V02	Commercial	12	5.0
V03	Commercial	13	4.7
V04	Residential	14	4.0
V05	Residential	12	5.3
V06	Residential	10	6.2
V07	Residential	14	4.2
V08	Residential	16	3.5
V09	Residential	16	3.5
V10	Residential	18	2.9
V11	Residential	23	2.2
V12	Residential	17	3.2
V13	Residential	17	3.2

The result of the assessment shows that at all residential and commercial receptors the predicted vibration levels are in compliance with the vibration limits as presented in Table 10.10 for transient vibration. All impacts are considered short term, see Table 10.7

Table 10.34 shows that the tunnelling works may exceed the level of 1mm/s at all receptors which may cause residential complaints. As outlined in Table 10.10, vibration above 10mm/s is likely to be intolerable for any more than a very brief exposure to this level. In general, it is recommended that prior notice be given to local residents before tunnelling commences.

It should be noted that the predicted groundborne levels are an estimate based on the BS 5228 empirical formula, while in practice it is possible that the impact may be lower.

10.4.2.12 Arklow Bridge Works

The proposed interceptor sewer will pass under the most southern arch of Arklow Bridge. At this point, the sewer will be approximately 3m-3.5m below ground level and approximately 1m below the existing river bed. **Chapter 5** outlines in details the various methodologies which may be used for the underpinning works including:

- Grouting and traditional underpinning;
- Mini piling; and
- Load bearing pile.

The underpinning and lowering of the floor of the bridge is likely to entail the following activities:

- Grouting each of the piers and the abutments of Arklow Bridge and the river bed to a depth of up to 2m below the piers and abutments, including drilling of holes to accommodate the grouting from the bridge deck, in order to stabilise the bridge and its formation during the underpinning works (Refer to **Figure 5.6 in Chapter 5**);
- Construction of a temporary causeway from the river bank to provide access to each of the piers and abutments;
- Creation of a bund around each pier or group of piers to allow works to be carried out in a dry environment;
- Removal of existing formation in a phased manner from the underside of each pier and abutment to a depth of approximately 1.6m below existing bed level and replacement with concrete (Refer to **Figure 5.7 in Chapter 5**); OR
- Construction of mini-piles around each pier to support the pier foundation (Refer to **Figure 5.8 in Chapter 5**); OR
- Construction of piles through the piers and abutments from the bridge deck to support the bridge during the underpinning works (Refer to **Figure 5.9 in Chapter 5**);
- Demolition of the existing concrete scour protection slabs and lowering of the floor of the bridge by approximately 1m on average (It should be noted that the floor of the second arch will be lowered by approximately 1.2m); and
- Construction of a new concrete scour protection slab between approximately 10m upstream to approximately 15m downstream of the bridge and beneath the arches of the bridge and the placement of riprap along the upstream and downstream edges of the concrete slab.

The proposed works have the potential to give rise to structural damage to Arklow Bridge. In terms of risks, it is considered that settlement, tilt and the torsional effects of the works are more likely to result in structural stress to the bridge than vibration.

The use of the empirical formula in order to estimate vibration levels is not deemed suitable as the distance x is less than 5m[4].

However, it has been conservativity assumed that there is potential for significant effects. At such close distances the most effective method of mitigation is through real-time vibration monitoring at the nearest piers along the bridge in compliance the limit values set out in Table 10.10. Vibration limits will be monitored on a continual basis during works at Arklow Bridge and in the event of vibration limits being exceeded, works will cease, be reassessed and where possible, alternative construction methods will be used. Monitoring locations will be specified in the Contractors NVMP.

10.4.2.13 Construction Traffic

No routes will experience increases of more than 25% in traffic volumes due to construction traffic, solely. For locations where significant changes to traffic are predicted due to diversions, Table 10.35 outlines the stages, durations and predicted increases.

Table 10.35: Significant traffic increases during construction phase.

Construction Stage	Duration	Traffic volume - existing	Traffic volume – due to rerouting	Road effected
Stage E South Quay / South Green	2 months	2,614	3,735	South Green Harbour Road
Stage F South Quay / Harbour Road	5 months	2,614	3,735	South Green Harbour Road
Stage H North Quay (East of Ferrybank)	2 weeks	Estimated at 3,000	9,000 (6,000 above baseline)	Seaview Avenue
Stage I North Quay (West of Bridgewater Ferrybank)	2 weeks	Estimated at 3,000	9,000 (6,000 above baseline)	Seaview Avenue

Table 10.36 presents the results for the predicted noise level increases from traffic during the construction phase.

Table 10.36: Predicted noise increases during construction phase.

Location	Distance to centre of road	Predicted existing noise level ($L_{A10,18hr}$)	Predicted construction noise level ($L_{A10,18hr}$)	Predicted increase (dB)	Impact Rating (refer to Table 10.3)
South Green	5m	63.0	64.8	1.8	Minor
Harbour Road	5m	63.0	64.8	1.8	Minor
Seaview Avenue	5m	63.8	68.6	4.8	Moderate

Receptors along South Green and Harbour Road may experience minor temporary negative impacts during traffic rerouting.

Receptors along Seaview Avenue may experience moderate temporary negative impacts during traffic rerouting.

10.4.3 Assessment of Effects During Operation

All equipment will be housed within buildings/chambers which will limit noise breakout to atmosphere. The acoustic performance data provided in Table 10.37 is based on predicted operational noise sources. The values quoted are for the highest noise emitters.

Table 10.37: Details of noise sources modelled

Location	Source	Number	Sound Power Level (dB) of Source	% of time in operation
Inlet Works Building	Fresh air fans	2	60	100%
	Pump	3	83	100%
	Fans	4	80	100%
Sludge Building	Pump	2	83	100%
	Fans	2	80	100%
Process Building	Fresh air fans	2	60	100%
	Pump	3	83	100%
	Transformer	1	85	100%
	Fans	4	80	100%
Admin Building	Air handling unit	1	60	25%
External	Generator [22]	1	100	100%[22]

The noise sources presented in Table 10.37 will be subject to noise attenuation that will reduce the overall noise levels at nearby receptors. This may be in the form of internal ducting, internal and external acoustic enclosures and cladding on external walls. The overall effect of these measures has been conservatively assumed to provide a Weighted Sound Reduction Index (R_w) of 15dB.

An assessment of the above noise sources was undertaken to predict noise levels at the proposed WwTP site boundary during night time, which is the most stringent noise limit. Assuming full-time operation, noise levels at the proposed WwTP site boundary are predicted at two locations and results presented in Table 10.38**.**

Changes in noise level have been given an impact rating.

[22] As the generator will only operate in emergency conditions, it has not been included in the operational noise assessment.

Table 10.38: Predicted operational noise levels at WwTP site boundary

Location (see Figure 10.1)	**Predicted operational noise levels (L_{Aeq}, dB)**	**Background noise level (night-time) (L_{Aeq})[23]**	**Total noise level (L_{Aeq})**	**Change in noise level**	**Impact rating**
L01	43.8	45	47.5	2.5	Imperceptible
L02	42.9	45	47.1	2.1	Imperceptible

Predicted noise levels are in compliance with the night time noise limit of 45dB at the proposed WwTP site boundary. The impact rating associated with the addition of the new noise sources is imperceptible over the long term, see Table 10.7. During the commissioning of the proposed WwTP noise monitoring will confirm compliance with the limit values.

10.4.3.1 Operational Traffic

No routes are predicted to experience increases of more than 25% in total traffic flows during the operational phase (refer to **Chapter 7**). Therefore, no detailed assessment is required, refer to **Section 10.3.1.1**.

10.4.4 Cumulative Assessment

This section considers the potential for in combination impacts arising from the proposed development in association with other developments. Specifically, it considers a worst-case scenario, where both the proposed development and the proposed Arklow Flood Relief Scheme (or section thereof) are under construction at the same time.

Based on the current level of understanding, construction of the Arklow Flood Relief Scheme (FRS) will consist of local river widening, construction of a flood containment embankment and flood wall and river dredging. While there may be physical and temporal cross over between the schemes, certain works will not be able to occur simultaneously e.g. the flood wall along the South Quay will be constructed after the sheet piling for the interceptor sewer. Table 10.39 outlines indicative equipment that may be used during the construction of the proposed Arklow Flood Relief Scheme. All the works outlined in Table 10.39 can occur at the edge of the Arklow River, therefore a minimum distance of 15m has been used for calculating the impacts.

[23] Background noise data has been taken from the nearest monitoring location.

Table 10.39: Estimated plant and equipment to be used during construction of proposed Arklow Flood Relief Scheme

Construction Phase for Arklow Flood Relief Scheme	Plant and Equipment	Location of Works	BS 5228 [4] reference	Number	Sound Power Level (L_w) dB	Percentage time in operation (%)
River Widening	Tracked Excavator	From R03 to R19 **(see Figure 10.2)**	C.2.18	1	103	50
	Articulated Dump Truck		C.5.16	1	104	50
Flood Wall Construction	Cement Mixer Truck	Along entire South Quay	C.4.18	1	103	50
	Water Pump		C.2.46	1	93	50
	Poker Vibrator		C.4.33	1	106	50
	Tracked Excavator		C.1.12	1	103	50
Flood Containment Embankment	Tracked Excavator	Western end of the proposed development north and south of the Arklow River	C.2.18	1	103	50
	Articulated Dump Truck		C.5.16	1	104	50
	Dozer		C.5.12	1	105	50
River Dredging	Digging out river bed	Along much of Arklow River.	D.12.2	1	112	50
	Tracked Excavator		C.2.18	1	103	50
	Articulated Dump Truck		C.5.16	1	104	50

Table 10.40 outlines the predicted construction noise levels from the proposed Arklow Flood Relief Scheme based on the data provided in Table 10.39**.**

Table 10.40: Predicted construction noise levels from the proposed Arklow Flood Relief Scheme

Phase	Predicted Noise Level ($L_{Aeq, 1 hr}$) at various distances			
	15m	30m	45m	60m
River Widening	62	56	52	50
Flood Wall Construction	65	59	55	53
Flood Containment Embankment	64	58	55	52
River Dredging	69	63	63	57

Table 10.40 outlines the predicted construction noise levels from the proposed Arklow Flood Relief Scheme.

As identified in Table 10.40, the activity that is predicted to cause the greatest impact from works associated with the proposed Arklow Flood Relief Scheme is the river dredging.

Should dredging occur simultaneously with the activity that causes the greatest impact during the proposed development (shaft construction, see Table 10.25), the overall predicted impact would be 71 dB ($L_{Aeq,\ 1\ hr}$), 6 dB above the proposed noise limit, and categorised as a temporary significant impact.

In relation to construction traffic, the impacts associated with the proposed Arklow Flood Relief Scheme will not add significantly to the overall impact from the proposed development which includes the diversion of approximately 1,000 vehicles along South Quay and 6,000 vehicles along Seaview Avenue.

10.5 Mitigation Measures and Monitoring

10.5.1 Mitigation

10.5.1.1 Management Plans & Method Statements

As outlined in **Section 10.4.2.9**, detailed construction methodologies, phasing and equipment, mitigation measures and method statements, will be set out in the Noise and Vibration Management Plan NVMP, as part of the Outline CEMP. An outline NVMP is appended to Appendix 5.1.

The NVMP will outline how the appointed contractor(s) will comply with the noise criteria set out in this section and will deal specifically with construction activities in a strategic manner to remove or reduce significant noise and vibration impacts associated with the construction of the proposed development. The NVMP will detail the provision and installation of localised acoustic screens, the best practice noise measures that the appointed contractor(s) will be required to adhere to for construction activities and the noise and vibration monitoring programme that the appointed contractor(s) will be required to undertake during the construction works.

In addition, the appointed contractor(s) will prepare detailed method statements addressing the likely groundborne noise and vibration levels that will be generated as a result of the construction activities once the specific details of the proposed plant, equipment and construction methodologies are known.

Where considered necessary, structural surveys will be undertaken at sensitive receptors in close proximity to the works to establish their condition and tolerance for vibration impacts.

10.5.1.2 Mitigation During Construction

General

The following section describes measures to minimise the potential for noise and vibration disturbance to the surrounding area which will be employed by the contractor to ensure the construction noise and vibration criteria outlined herein are not exceeded.

The contractor will take specific noise abatement measures and comply with the recommendations of BS 5228-1 and 2:2009+A1:2014[4] and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001[24].

The following specific measures will be implemented during the construction of the proposed development:

- A site representative shall be appointed to be responsible for matters relating to noise and vibration;
- Construction of temporary infrastructure (e.g. haul roads) will be with materials that minimise noise and vibration and design of haul roads will minimise reversing;
- Internal haul roads shall be well maintained;
- Unnecessary revving of engines should be avoided and equipment should be switched off when not required;
- Rubber linings shall be used in chutes and dumpers etc. to reduce noise;
- Drop heights of materials shall be minimised;
- Generators will be located away from sensitive receivers and will be enclosed;
- Careful selection of equipment, construction methods and programming with the objective of reducing noise and vibration where possible. Only equipment, including road vehicles, conforming to relevant national or international standards, directives and recommendations on noise and vibration emissions, will be used;
- Plant and vehicles shall be started sequentially rather than all together;
- Selecting electrically powered plant that is quieter than diesel or petrol-driven plant, if interchangeable;
- Fitting suitable anti-vibration mountings where practicable, to rotating and/or impacting equipment;
- Avoiding percussive piling, except where there is an overriding justification;
- Using noise-control equipment such as jackets, shrouds, hoods, and doors, and ensuring they are closed;
- Locating plant, as far as is reasonably practicable, away from receptors or as close as possible to noise barriers or hoardings where these are located between the source and receptor;
- Regular and effective maintenance by trained personnel shall be carried out to reduce noise and/or vibration from plant and machinery;
- Ensuring that all plant is maintained regularly to comply with relevant national or international standards and operation of plant and equipment that minimises noise emissions;

[24] European Communities (2001) *European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001*

- Ensuring that plant is shut down when not in use;
- Ensuring that air lines are maintained and checked regularly to prevent leaks;
- Designing all audible warning systems and alarms to minimise noise. Non-audible warning systems can be used in preference, i.e. cab-mounted CCTV or the use of banksmen.

  If required, ensure that audible warning systems are switched to the minimum setting required by the Health and Safety Authority and where practicable use 'white noise' reversing alarms in place of the usual 'siren' style reversing alert.
- A c. 2.4m hoarding of density of at least 7kg/m^2 shall be provided around construction works, including around the TBM launch site;
- Rotary drills and bursters actuated by hydraulic or electrical power will be used for excavating hard material. In some instances, chemical bursting can be used where nearby sensitive structures are particularly vulnerable to vibration from pneumatic breakers etc.;
- Handling all materials, particularly steelwork, in a manner that minimises noise. For example, storing materials as far as possible away from sensitive receptors and using resilient mats around steel handling areas;
- During construction, regular inspections will be undertaken to ensure that the noise and vibration minimising methods, plant and mitigation identified in the specimen design stage are adopted on site and are working effectively. If applicable, it is proposed that construction method inspections be integrated into any health and safety or quality surveillance regime;
- Typically, site activities shall be limited to 7am – 7pm, Monday to Friday; and 8am – 2pm, Saturday. However, during the interceptor sewer construction works, the TBM equipment (including generator) will operate on a 24-hour basis. No works are anticipated on Sundays and Bank Holidays (with the exception of tunnelling). Aside from the 24-hour use of the TBM equipment, it is anticipated that there will be times due to exceptional circumstances that construction work will be necessary outside of normal construction core working hours. Any such working hours outside the normal construction core working hours will be agreed with Wicklow County Council. The planning of such works will have regard to nearby sensitive receptors;
- A Communications Management Plan shall be prepared to provide for effective community liaison to help ensure the smooth running of construction activities and to address any issues that may arise;

Noise audits shall be carried out by a suitably qualified auditor, appointed by Irish Water in advance, at routine intervals to ensure that the mitigation measures are being correctly implemented.

Tunnelling

During tunnelling, the most effective pre-emptive measure that to reduce impacts is soil probing prior to tunnelling works. Probing prior to tunnelling will allow hard obstacles or rock to be identified.

If encountered pre- auguring will be undertaken at these locations where hard obstacles have been identified prior to tunnelling to minimise noise and vibration impacts. Where ground conditions may be unknown, this measure will be carried out prior to tunnelling.

Any requirement for temporary re-housing will be confirmed by the Contractor(s) in consultation with Irish Water and the affected stakeholder. The determination for such mitigation will be made after detailed construction methodologies, phasing and detailed equipment are known.

This information will be presented in the NVMP, as outlined in the **Appendix 5.1**. **Section 10.4.2.9** outlines the process in determining suitability for any temporary re-housing required, as per BS5228-1[4].

Sea Outfall Construction

During the construction of the long sea outfall, there is the potential for noise impacts on marine mammals. The Department of Arts, Heritage and the Gaeltacht have published guidance[25] on best practice construction mitigation measures that should be followed for construction in Irish waters.

The following summarised measures will be implemented during the construction of the marine outfall in Arklow Bay.

<u>Pre- Drilling</u>

A qualified and experienced marine mammal observer (MMO) shall be appointed to monitor for marine mammals and to log all relevant events using standardised data forms.

Drilling activity shall not commence if marine mammals are detected within a 500m radial distance of the drilling sound source, i.e., within the Monitored Zone.

<u>Pre- Start Monitoring</u>

Drilling activities shall only commence in daylight hours where effective visual monitoring, as performed and determined by the MMO, has been achieved. Where effective visual monitoring, as determined by the MMO, is not possible the sound-producing activities shall be postponed until effective visual monitoring is possible.

An agreed and clear on-site communication signal must be used between the MMO and the Works Superintendent as to whether the relevant activity may or may not proceed, or resume following a break (see below). It shall only proceed on positive confirmation with the MMO.

In waters up to 200m deep, the MMO shall conduct pre-start-up constant effort monitoring at least 30 minutes before the sound-producing activity is due to commence. Sound-producing activity shall not commence until at least 30 minutes have elapsed with no marine mammals detected within the Monitored Zone by the MMO.

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[25] Department of Arts, Heritage and the Gaeltacht (2014) *Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters* https://www.npws.ie/sites/default/files/general/Underwater%20sound%20guidance_Jan%202014.pdf.

This prescribed Pre-Start Monitoring shall subsequently be followed immediately by normal drilling operations. The delay between the end of Pre-Start Monitoring and the necessary full drilling output must be minimised.

Drilling

Once normal drilling operations commence, there is no requirement to halt or discontinue the activity at night-time, nor if weather or visibility conditions deteriorate nor if marine mammals occur within a 500m radial distance of the sound source, i.e., within the Monitored Zone.

Breaks in Sound Output

If there is a break in drilling sound output for a period greater than 30 minutes (e.g., due to equipment failure, shut-down or location change) then all Pre-Start Monitoring must be undertaken in accordance with the above conditions prior to the recommencement of drilling activity.

10.5.1.3 Mitigation During Operation

All equipment will be housed within buildings/chambers which will limit noise breakout to atmosphere. Therefore, a greater level of compliance than that presented in Table 10.38 would be expected and therefore no mitigation measures are considered necessary.

10.5.2 Monitoring

10.5.2.1 Monitoring During Construction

The contractor(s) shall be required to carry out continuous noise and vibration monitoring at the three closest sensitive receptors to the proposed WwTP and interceptor sewer works during the construction phase.

Vibration monitoring will be undertaken on the piers of the bridge and measured against the limits in Table 10.10. In the event of vibration limits being exceeded, works will cease and alternative construction methods will be used.

Noise and vibration levels will be compared to the limit values outlined in Table 10.5 and Table 10.10, respectively. If exceedances are recorded, the possibility of alternative construction methodologies will be examined to reduce impact at sensitive receptors.

10.5.2.2 Monitoring During Operation

Environmental emissions, including noise, will be regulated by Wicklow County Council. Although the WwTP will not be formally regulated by the EPA, Irish Water will be operating the plant in compliance with EPA licensing standards, as set out in **Section 10.2.4.4**. Monitoring at the site boundary will be undertaken during commissioning and at predetermined frequencies over the life time of the proposed development.

10.6 Residual Effects

10.6.1 Residual Effects During Construction

The noise assessment for the construction of the proposed development has shown that compliance with noise limit values in can be achieved at the nearest sensitive receptors to the WwTP site. However, noise limit values will be exceeded at the nearest sensitive receptor to the proposed interceptor sewer for some types of works.

The implementation of the mitigation measures outlined in **Section 10.6** will assist in reducing the impact on nearby sensitive receptors. Residual short-term, slight to significant negative impacts are predicted during the construction phase of the proposed development. Table 10.41 summaries the residual impacts during the construction phase.

Table 10.41: Summary of residual impacts during construction phase

Construction Phase	Summary of Impact Post Mitigation
WwTP construction.	Range from short term imperceptible negative impact to short term moderate negative impact
Revetment construction.	Range from short term slight negative impact to short term significant negative impacts
Sea Outfall construction. Impact of WwTP, Sea Outfall and Revetment construction.	Range from short term moderate negative impact to short term significant negative impacts
Impact assessment for residential receptors – trench works, shaft construction, tunnelling, ground borne noise and airborne noise	Short term significant negative impacts
Interceptor Sewer (Vibration) and Construction Traffic	Short term slight negative impacts
Sheet Piling (Vibration)	Short term moderate negative impacts
Arklow Bridge Works	Potential for short term significant effects

10.6.2 Residual Effects During Operation

It is predicted that the EPA limits will be complied with during the operational phase of the proposed development and that there will be no significant residual impacts.

10.7 References

British Standards Institution (BSI) 4142:2014, 2014. *Methods for rating and assessing industrial and commercial sound.*

British Standards Institution (BSI) (2014) 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 Part 2: Guide to damage levels from groundborne vibration*

Design Manual for Roads and Bridges (DMRB), *Vol 11 Section 3 Part 7 HD 213/11 Noise and Vibration*. Highways Agency.

Department of Communications and Local Government (1994) *Planning Policy Guidance 24 (PPG24): Planning and Noise.*

Department of Arts, Heritage and the Gaeltacht (2014) *Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters.*

Department of Transport UK, (1988) *The Calculation of Road Traffic Noise (CoRTN)*

Dublin City Council (2012) *Ringsend Wastewater Treatment Works Extension Environmental Impact Statement*

Environmental Protection Agency (EPA), 2017. *Guidelines on the Information to be contained in Environmental Impact Assessment Reports - Draft August 2017.*

EPA, 2015. *Revised Guidelines on the Information to be contained in Environmental Impact Statements - Draft September 2015.*

EPA, 2015. *Advice Notes for Preparing Environmental Impact Statements - Draft September 2015.*

EPA, 2016. *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)*, 2016.

European Communities (EC), 2001. *Noise Emission by Equipment for Use Outdoors Regulations, 2001*.

International Electro-Technical Commission (IEC), 2002, *IEC 61672-1 Electro-acoustics – Sound Level Meters – Part 1: Specifications*. IEC, Geneva, Switzerland.

ISO (2016) *Acoustics – Description, measurement and assessment of environmental noise (Part 1 & Part 2).*

Transport Research Laboratory paper 429 (2000) *Groundborne vibration caused by mechanised construction works.*

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 7385-2 (1993) *Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from groundborne vibrationsection*

11 Biodiversity

11.1 Introduction

This chapter describes the likely significant direct and indirect effects of the proposed development on biodiversity, including flora (plants), fauna (animals), and habitats in both the terrestrial and aquatic environment.

Chapter 4 provides a full description of the proposed development whilst **Chapter 5** describes the Construction Strategy. The following aspects are particularly relevant to the biodiversity assessment:

- Design:
  - The landscaping at the Alps and along River Walk, and at the WwTP site, will provide some opportunities for habitat creation and mitigation of direct and indirect effects on biodiversity including plants, animals and habitats in the terrestrial environment of Arklow town.
- Operation:
  - Discharge of untreated effluent to the Avoca River and Estuary will cease; and
  - Treated effluent will discharge to the Irish Sea via a 900m long sea outfall fitted with a diffuser. A separate storm water overflow (SWO) will discharge screened stormwater to inshore coastal waters.
- Construction:
  - Construction activities have the potential to impact on terrestrial biodiversity. Specifically, some of the working areas will require tree removal, vegetation clearance and works on structures that are currently used by bats to accommodate construction activities;
  - Construction activities occurring within the Avoca River channel and within the Irish Sea have the potential to impact on aquatic ecology; and
  - Construction activities will be undertaken in the vicinity of invasive plant species.

11.2 Assessment Methodology

11.2.1 General

The biodiversity assessment addresses the likely significant direct and indirect effects of the proposed development on terrestrial and aquatic (including marine) biodiversity, including flora, fauna and habitats in proximity to the site.

The assessment has been carried out in three stages:

1. Desktop assessment to determine existing information and records in relation to:
   - Sites, species and habitats protected under Council Directive 92/43/EEC (Habitats Directive), and sites and species protected under Council Directive 2009/147/EC (Birds Directive)[1], within 15km of the proposed development and more distant hydrologically linked sites; and
   - Biodiversity, habitats and species present in the vicinity of the proposed development.
2. Site visits and field surveys by the specialist aquatic and terrestrial ecologist teams (as described in detail below – Refer to **Appendix 1.2** for team competencies), to establish the existing ecological conditions within the footprint of the proposed development and within the vicinity of all of the proposed development elements. The site visits and field surveys include terrestrial, river, estuarine, and marine surveys.
3. Evaluation of the proposed development and determination of the scale and extent of likely direct and indirect significant effects on biodiversity (i.e. flora, fauna and habitats) and the provision of appropriate mitigation and monitoring.

The ecology team that carried out the biodiversity assessment is as follows:

- BEC Consultants carried out marine, estuarine, and freshwater aquatic ecological surveys;
- Brian Keeley Ecologist and bat licensed specialist carried out bat surveys and assessments; and
- Eleanor Mayes Ecological Consultant carried out terrestrial flora and habitat surveys and assessments, invasive plant surveys, and bird surveys and assessments, and is the lead ecologist for the proposed development.

11.2.2 Guidance and Legislation

The biodiversity assessment has been prepared with reference to the following legislation and guidance:

- Wildlife Acts 1976 to 2018;
- European Communities (EC) (Birds and Natural Habitats) Regulations 2011 – 2015;
- Council Directive 2009/147/EEC, i.e. Birds Directive;
- Council Directive 92/43/EEC (as amended), i.e. Habitats Directive;
- Flora (Protection) Order, S.I. No. 356 of 2015;

1 Natura 2000 sites, referred to as European sites in Part XAB of the Planning and Development Act 2000 (as amended); these terms are synonymous

- 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;
- DoEHLG, (2010). Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities – February 2010 edition;
- Department of Arts, Heritage and the Gaeltacht (2014)[2] Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters;
- EC (2002) Assessment of plans and projects significantly affecting Natura 2000 sites;
- EC (2007) Managing Natura 2000 Sites: Guidance document on Article 6(4) of the Habitats Directive 92/43/EEC;
- 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;
- CIEEM (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal;
- Inland Fisheries Ireland (2016) Guidelines on Protection of Fisheries during Construction Works in and adjacent to Waters
- EPA (2017) Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports; and
- EU (2017) Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU);

11.2.3 Study Area

11.2.3.1 Study area for Terrestrial Biodiversity and Bird Surveys

The study area for desk studies is detailed in **Section 11.2.6.1** and illustrated in **Figure 11.1 in Volume 3**.

The study area for terrestrial biodiversity surveys was defined to include all areas associated with the proposed development, including interceptor sewer route options considered during the development of the design, working areas and construction compounds.

2 issued as an official guideline and code of practice under Regulation 71 of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011)

Some adjoining lands, including lands around Arklow Pond, were included in the study area in order to provide context and baseline information on ecological corridors in the vicinity of the proposed development.

Waterbird surveys were carried out at Arklow Ponds as well as in the Avoca River and Estuary, because some waterbird species were observed to be moving between these areas. Marine inshore waters were also covered in bird surveys. These study areas are illustrated in **Figure 11. 3 in Volume 3**.

Bat surveys included some additional areas outside the main study area, in order to facilitate assessment of potential cumulative effects of the proposed development with the proposed Arklow Flood Relief Scheme: Brigg's Lane behind Ferrybank and along the eastern margin of Arklow Town Marsh pNHA, and along the Avoca River immediately downstream of the M11 flyover (Refer to **Figure 11.1 in Volume 3**).

11.2.3.2 Study Area for Aquatic Biodiversity Surveys

The study area for desk studies is detailed in **Section 11.2.6.1**. The study area for aquatic biodiversity surveys was within the Avoca River from just upstream of the M11 flyover down to its point of discharge into the Irish Sea (i.e. the harbour mouth), with benthic sampling extending out into the Irish Sea. The locations of the freshwater sample stations are illustrated in **Figure 11.2 in Volume 3**, while the estuarine and marine sample stations are illustrated in **Figure 11.3 in Volume 3**.

Marine mammals are vulnerable to man-made sound sources, thus the distribution of cetaceans (whales, dolphins and porpoises[3]) within Irish territorial waters, the Irish Sea, and in waters off Arklow are all potentially relevant to identifying the main areas of distribution of recorded species in the context of the proposed development. The catchment of the Avoca River is relevant to the consideration of migratory fish species, including Habitats Directive Annex II listed species, that move between marine and fresh waters through the Avoca Estuary.

3 All cetacean species are listed as species of community interest in need of strict protection in Annex IV of the Habitats Directive

11.2.4 Site Visits

Field survey dates for the different baseline biodiversity elements are given in Table 11.1.

Table 11.1: Biodiversity field survey dates

Biodiversity Survey Element	Survey dates
Flora and habitat and breeding bird surveys	27 June 2016, 10 August 2016, 26 April 2017, 22 August 2017, 12 April 2018, 16 May 2018
Invasive plant species surveys	10 August 2016, 26 April 2017, 22 August 2017, 12 April 2018, 16 May 2018
Waterbird surveys	16 September 2016, 25 October 2016, 24 November 2016, 8 December 2016, 28 January 2017, 24 February 2017, 29 November 2017, 13 February 2018
Bat survey WwTP site	27 June 2016, 22-23 August 2017
Bat survey River Walk, Arklow Castle, The Alps, Arklow Bridge, and the northern bank of the Avoca River at Ferrybank including Brigg's Lane	17 and 19 October 2016, 22 to 29 August 2017
Estuarine and marine benthic survey	24 April 2017
Estuarine walk over survey	25 April 2017
Freshwater macroinvertebrate survey	26 September 2017

11.2.5 Consultation

In its response to the Scoping Report, the EPA indicated that this biodiversity assessment should identify the direct and indirect significant effects of the proposed development on biodiversity, with particular attention to species and habitats protected under the Habitats Directive and the Birds Directive.

Consultation meetings were held with Inland Fisheries Ireland, on 16 March 2018, and with National Parks and Wildlife Service (NPWS) on 27 June 2018, in respect of the proposed development and the proposed Arklow Flood Relief Scheme. Issues discussed related to the Arklow Wastewater Treatment Plant Project included the following:

- An overview of the project was provided;
- Discussion on the design development and baseline biodiversity studies undertaken;
- Habitats Directive Annex II listed fish species that migrate through the Avoca Estuary, potential for River Lamprey adults and larvae to be present in works areas, protocols to remove/protect fish during construction, and seasonal restrictions of in-stream works;
- Water quality protection during construction;
- Habitats Directive Annex IV listed bat species, roost locations including Arklow Bridge, requirements for bat derogation licence and mitigation; and

- Relative proximity to coastal European sites, advice that coastal processes including longshore drift be studied and documented, to facilitate the assessment of potential ex situ effects on these sites to arise from the marine outfalls and revetment upgrade.

Inland Fisheries Ireland provided Avoca River Estuary fish data from monitoring carried out under the Water Framework Directive in 2015.

The NPWS provided information on bat roosts in Arklow, and data on the distribution of the protected plant species[4] *Equisetum x moorei* in the Arklow area outside the planning boundary of the proposed development.

11.2.6 Categorisation of the Baseline Environment

11.2.6.1 Desk Study

The desk studies carried out accessed information held by the following:

- NPWS metadata website, and NPWS protected plant species data;
- National Biodiversity Data Centre (NBDC) database;
- EPA;
- Inland Fisheries Ireland reports and data;
- Bat Conservation Ireland database;
- Wetland Surveys Ireland database; and
- I-WeBS data held by BirdWatch Ireland. The Irish Wetland Bird Survey (I-WeBS) is a joint scheme of BirdWatch Ireland and the National Parks and Wildlife Service (NPWS).

A literature review of published information on flora and fauna occurring on site and in the surrounding terrestrial, marine, estuarine and riverine environment was also carried out. The geographical extent of the biodiversity desk study varies with the species being considered as outlined in **Section 11.2.3**.

11.2.6.2 Terrestrial Flora and Habitat Survey

Walkover flora and habitat surveys were carried out to determine species composition and distribution in the study area (Refer to **Figure 11.1 in Volume 3**).

4 Flora (Protection) Order, S.I. No. 356 of 2015

Habitats present were classified in accordance with Fossitt[5], and also having regard to Heritage Council[6], in order to provide a basis for habitat evaluation. Plant species scientific nomenclature follows Parnell and Curtis[7], common names follow Scannell and Synnott[8] when common names are not given in Parnell and Curtis.

Habitats are small scale within the urban landscape of the proposed development, and have been subject to change during the course of the baseline studies, so they are described in the text provided, and illustrated by photographs rather than by habitat mapping.

Birds and mammals or mammal signs were also recorded during walk-over surveys.

11.2.6.3 Invasive non-native Plant Survey

Walk over surveys were carried out within the study area (Refer to **Figure 11.1 in Volume 3**), in order to check for the presence of invasive non-native plant species listed in Part 1 of the Third Schedule[9].

Additional species listed as invasive non-native plant species in the NRA Guidelines[10] were also recorded, together with non-native species encountered that can be spread through distribution of plant material.

A handheld mobile mapper was used during field survey to record the location and extent of any invasive species encountered, together with notes on the characteristics of each stand encountered and the associated plant species, as appropriate.

11.2.6.4 Bird Surveys

Breeding and non-breeding birds, including wintering waterbird surveys were carried out on the dates listed in Table 11.1. The following areas were surveyed:

- Avoca River upstream of Arklow Bridge
- Avoca Estuary east of Arklow Bridge, including the harbour on the South Quay
- Coastal waters within 1.5 km of the shoreline, and shorelines to the north and south of Arklow Harbour (**Figure 11.3 in Volume 3**)
- Arklow Pond, accessed from Seaview Avenue (**Figure 11.1 in Volume 3**)

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5 Fossitt, Julie A (2000). A Guide to Habitats in Ireland. The Heritage Council.

6 Best Practice Guidance for Habitat Survey and Mapping (Heritage Council, 2011)

7 Parnell, John, and Tom Curtis (2012). Webb's An Irish Flora. Cork University Press

8 Scannell, Mary J.P, and Donal M. Synnott (1987). Census catalogue of the Flora of Ireland. Stationery Office, Dublin.

9 Part 1 of the Third Schedule, European Communities (EC) (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011)

10 Transport Infrastructure Ireland (incorporating the National Roads Authority) Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Road Schemes (Revision 1, December 2010)

Counts were carried out using binoculars and a telescope fitted with a 32X wide angle lens or a 25-60X zoom lens, during a range of tidal conditions including spring tides and neap tides, at high and low water. Waterbirds and sea birds present were identified and counted, and their activity noted (feeding, roosting, bathing and preening).

All bird species observed during flora and habitat surveys (within the study area shown in **Figure 11.1 in Volume 3)** were recorded, together with bird activities indicative of possible, probable, or confirmed breeding.

11.2.6.5 Bat Surveys

There are a number of specific areas that were targeted for detailed examination, in addition to a general evaluation of bat activity and presence within the planning boundary and adjacent lands:

- WwTP site: the derelict wallboard factory buildings and site;
- Interceptor sewer working areas on the northern bank upstream of Arklow Bridge (that overlap with the proposed Arklow Flood Relief Scheme);
- The Alps area (below the ruined remains of Arklow Castle, confirmed by NPWS as a pipistrelle roost several years previously), and Avoca River corridor immediately upstream (that also overlap with the proposed Arklow Flood Relief Scheme);
- Trees and existing bat boxes on River Walk upstream of Arklow Bridge;
- Arklow Bridge (overlap with proposed the Arklow Flood Relief Scheme);
- The footprint of the embankment area at the eastern margin of Arklow Town Marsh pNHA included as part of the proposed Arklow Flood Relief Scheme; in order to facilitate assessment of cumulative effects of the proposed development with the proposed Arklow Flood Relief Scheme;
- Avoca River corridor immediately upstream of ‘the Alps’ site (included as part of the footprint for the proposed Arklow Flood Relief Scheme) in order to facilitate assessment of cumulative effects of the proposed development with the proposed Arklow Flood Relief Scheme;
- Avoca River corridor downstream of M11 flyover (included as part of the footprint for the proposed Arklow Flood Relief Scheme) in order to facilitate assessment of cumulative effects of the proposed development with the proposed Arklow Flood Relief Scheme

WwTP

The Old Wallboard site at Ferrybank was examined over two consecutive years in 2016 and 2017 for evidence of roosting bats. Surveys were undertaken in daylight for evidence of roosting bats and from prior to sunset for two hours. The site was visually inspected for the presence of bat roost evidence in the buildings on site prior to sunset with the aid of a high-powered beam.

The bat detector assessment commenced prior to dusk (21.30 hours with sunset at 21.53 hours in June 2016 and in 2017, sunset was at 20.33 hours on 23rd August).

Surveying continued for two hours before a pause in surveying and recommencement over one and a half hours before dawn (03.30 hours, sunrise 05.03 hours in 2016 and sunrise at 06.22 hours on 24th August in 2017).

A Song Meter 2 BAT+ (SM2 bat detector) was placed within the site along the edge of the main building for a period of two hours and was then moved at 23.44 hours to the second smaller building closer to the river from this time up to dawn in 2016. In 2017, the SM2 bat detector was again placed on the perimeter of the main building within the site and remained here throughout the survey period. An EM3 and Pettersson D240X were carried for the entire survey and bat activity and species present were noted throughout the site. Additionally, bat activity along the roadway leading to the site was observed and noted.

Interceptor sewer routes and other infrastructure

Bat activity at a number of points along and adjoining the proposed route of the interceptor sewers including Arklow Castle, the Alps, River Walk and the northern bank of the Avoca River close to the Ferrybank roundabout were all assessed in 2016. A further survey period was undertaken on 17 and 19 October 2016. This involved 2 post dusk assessments and 1 pre-dawn survey. On 17 October, there were two areas of assessment; a Cypress treeline at Ferrybank near the northern bank of the Avoca River upstream of Arklow Bridge (this treeline was subsequently felled to facilitate a separate development), and the ruins of Arklow Castle.

The 2016 survey involved the placing of a bat monitor at the side of the ruined castle within the grounds of the Courthouse prior to dusk and monitoring at this location until one hour after sunset (18.24 hours). The trees at Ferrybank were examined from sunset and for 1 hour and 20 minutes for any evidence of bat emergence from these trees. The trees were also examined in daylight for any potential roost cavities or crevices.

Prior to dawn, the area to the rear of Arklow Castle at the Alps was assessed as well as an evaluation of the trees at Ferrybank. During the night, the river was also examined for bat activity between the approach to Arklow Castle and the Cypress trees at Ferrybank.

Surveying was also undertaken in August 2017, a period of the year when many maternity roosts are still intact prior to the autumn disbandment of these gatherings and the formation of lesser mating assemblages and non-breeding groups or individual roosting behaviour. These sites were re-assessed on a number of dates in August including 21, 22, 23, 24 and 28 August up to dawn of 29 August 2017. In addition, the trees and timber bat boxes along River Walk between Arklow the Alps, and Arklow Bridge, were examined in daylight on 22 August 2017 for any evidence of bat activity. A bat detector evaluation of Arklow Bridge was carried out from 21 August to 22 August 2017 (sunset at 20.38 and sunrise at 06.18).

A Schwegler woodcrete bat box at the Arklow Ponds was superficially examined on 23 August 2017 for evidence of bat usage.

Surveying of Arklow Castle was also undertaken in August 2017 and any bat activity around the Castle was sought at dusk and prior to dawn. The family in residence to the rear of the Castle was questioned regarding bat roosts within the Castle and any observations of bats here in recent years.

Surveying included an examination of all areas through which the proposed development passes, from Arklow Castle and the Alps to the WwTP site.

Bat survey conditions and constraints

The survey in June 2016 was carried out on a mild dry night with no wind. There had been rain early in the day but there was no rain at any stage during the night. The Old Wallboard site at Ferrybank is coastal and there is a continuous breeze to the east of the buildings. The remainder of the buildings were sheltered from the breeze. These were ideal conditions for bat activity.

Surveying for bats in late June is a very suitable time to address the summer usage of a site for feeding and commuting and for assessing the use of trees as summer roosts.

The second survey period was a period of mild weather in October 2016 and there was a dry, calm spell that commenced with moderate temperatures and dropping two to three hours after sunset. Bat activity was relatively high especially on 17 October and this is a good representation of the bat fauna in autumn in the survey area. Sunset on 17 October was at 18.24 hours with a temperature of 13 degrees Celsius (˚C) and a moderate breeze and dry conditions. Sunset on 19 October 2016 was at 18.20 hours and the temperature at that time was 11 degrees Celsius and cloudy.

The survey in August 2017 was during mild dry weather and bat activity was noted at all periods of the survey. Pre-dawn conditions were cool and dry and bat activity was typically lower during this period. This was a representative survey of the site.

11.2.6.6 Aquatic Ecology Surveys

A desk study was carried out to gather existing information on the aquatic ecology of the study area. This desk study included a review of the NPWS online mapping tool, a review of reports and data held by the NPWS, and a general literature search including Inland Fisheries Ireland reports and publications as described in **Section 11.2.6.1**.

Freshwater macroinvertebrate survey

The macroinvertebrate community of the Avoca River was sampled at six locations on the main channel and at one location on the channel that runs in a south-easterly direction through Arklow Town Marsh (Refer to **Figure 11.2 in Volume 3**) on 26 September 2017. Sweep-samples were taken using a standard pond-net (25cm x 25cm, with 1 mm mesh bag), transferred to a labelled container and preserved in 70% Industrial Methylated Spirits for return to the laboratory for analysis. Basic physico-chemical parameters were recorded at each sample location:

- dissolved oxygen (mg/l and % saturation);
- pH;
- temperature (°C); and
- conductivity (mS/cm).

Also recorded at each sample location were details of the channel morphology and context:

- channel width (m);
- water depth (m);
- discharge;
- siltation;
- water clarity;
- shading;
- filamentous algae;
- slime;
- sewage fungus;
- surrounding land;
- bankside vegetation;
- instream vegetation;
- substratum; and
- other information.

Estuarine and marine benthic survey

Estuarine walkover survey

A walkover survey was carried out on 25 April 2017 in order to identify the intertidal habitats within the relevant sections of the study area. The survey was carried out at low water spring tide in order to be able to view the greatest expanse of intertidal habitat. The study area included the Avoca River estuary and the coast to the north of the river in the vicinity of the alignment of the proposed outfall (see **Figure 11.2 in Volume 3**).

Otter survey

The study area was walked and signs of Otter (*Lutra lutra*) activity noted. Such signs included spraints, slides, and footprints. Where notable otter signs were recorded, a location was recorded using a hand-held global positioning system (GPS) receiver to allow mapping.

Benthic survey

A benthic field survey was carried out on 24 April 2017 using a 0.1m^2 Day grab deployed from the boat M.V. Sharpshooter.

A total of 13 stations were sampled for macroinvertebrate and sediment analysis (granulometry and total organic carbon (TOC)). As outlined in **Figure 11.3 in Volume 3**, three sample stations were situated within the Avoca River Estuary, while the remaining ten were located outside the breakwaters of Arklow Port. Sample stations were located using the Sharpshooter's on-board GPS system, onto which pre-selected sample station locations were loaded.

The 0.1 m^2 Day grab was deployed from an A-frame on the survey boat. Sediment samples were taken as a core into the retrieved sediment, labelled and placed in a cooler box. These were subsequently frozen on return to shore. Macroinvertebrate samples were washed through a 1 mm mesh sieve. The residue was transferred to labelled sample containers and fixed with 10% Formalin before being transported back to the laboratory for processing.

Macroinvertebrate sample analysis

In the laboratory, macroinvertebrate samples were logged to track the processing. Each freshwater macroinvertebrate sample was washed through a 1mm sieve and the residue transferred to a white tray for sorting. Macroinvertebrates present were removed and separated by major group for identification and enumeration.

Rose Bengal was added to the marine and estuarine macroinvertebrate samples on arrival in the laboratory in order to aid sorting. After 72 hours, samples were transferred to 70% Industrial Methylated Spirits as preservative prior to sorting and identification. Samples were sorted in a white tray, with animals being transferred to labelled containers and preserved with 70% Industrial Methylated Spirits prior to identification.

The species lists produced were checked against the Pan-European Species directory Infrastructure[11]. Identification was carried out using stereoscopic and compound microscopes and appropriate keys.

Sediment sample analysis

Sediment analysis for granulometry and TOC was carried out by Nautilus, Dublin.

Data analysis

On completion of estuarine and marine macroinvertebrate and sediment sample analysis, the data were used to describe the benthic environment. R-Statistic was used to carry out data analysis on the macroinvertebrate and sediment data. The following statistical analyses were undertaken:

- **Univariate ecological indices**: On completion of sorting and identification, several ecological univariate ecological indices were calculated to characterise the invertebrate community within the study area. These included Species Richness (number of species), Shannon-Wiener diversity index and Pielou's evenness index.

11 PESI (2017) Pan-European Species directories Infrastructure. Accessed through www.eu-nomen.eu/portal on 2017-05-31.

- **Community structure**: Abundance data were fourth-root transformed to down-weigh the importance of the highly abundant species and to give rarer species more importance (Clarke, 1993[12]) and used to calculate a Bray-Curtis similarity matrix. The similarity matrix was then used in cluster analysis to find sample groupings, i.e. samples within a group that are more similar to each other, than they are similar to samples in different groups. Similarity profile routine (SIMPROF) was used to identify significant ($P < 0.05$) groupings and the results were represented graphically on a dendrogram.
- **Sediment**: Sediment data were fourth-root transformed and normalised to equalise variance and standardise contributory importance of each variable. Cluster analysis based on Euclidian distances was used to find sample groupings, i.e. samples within a group that are more similar to each other, than they are similar to samples in different groups. Similarity profile routine (SIMPROF) was used to identify significant ($P < 0.05$) groupings and the results were represented graphically on a dendrogram.

11.2.7 Impact Assessment Methodology

Likely significant direct and indirect effects are assessed during both the construction and operation of the proposed development.

Consideration has been given to the presence of European sites, habitats and species protected under the Habitats Directive, species listed in Annex IV of the Habitats Directive, and sites and species protected under the Birds Directive. The occurrence of mobile species listed as Qualifying Interests for European sites protected under the Habitats Directive ex situ in the zone of influence of the proposed development, has been considered. The sensitivity of individual species to individual construction and operational phase activities has been considered.

Individual assessments of direct and indirect effects on biodiversity, plants, animals, and habitats include reference to the qualitative and quantitative methodologies and guidance listed in **Section 11.2.2**. The description of likely significant effects follows Table 3.3 of the draft EPA guidance[13].

11.3 Baseline Conditions

11.3.1 Overview of the Area

The Avoca River drains a primarily upland catchment of some 650km^2, and enters the Irish Sea at Arklow via a short riverine estuary that is largely contained by existing sea and harbour walls. The Avoca River is formed by the joining of the Avonmore and Avonbeg rivers.

The Avonmore River flows from Lough Dan, just west of Roundwood, and flows in a generally south-easterly direction for approximately 30 km before meeting the Avonbeg River (which rises near Table Mountain at the top of Glenmalure valley), just north of the village of Avoca, and becomes the Avoca River.

12 Clarke, K.R. (1993) Non-parametric multivariate analyses of changes in community structure. Australian Journal of Ecology 18: 117-143.

13 EPA (2017) Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports

Closer to Arklow, the Aughrim River and the Avoca River flow through steeply sloping wooded valleys, and join at Woodenbridge.

The Avoca River flows through lower ground from Shelton Abbey towards Arklow, and forms a west - east corridor through the town. Tidal influence in the Avoca River extends upstream of Arklow Bridge and to the west of ‘the Alps’. Gravel banks in the Avoca River channel and estuary, both upstream and immediately downstream of Arklow Bridge, become exposed at low tide.

The largest area of exposure of gravel banks occurs during low water spring tides. Waterbirds use these areas, and are discussed further in **Section 11.3.4**.

There is a coastal north - south corridor of sand dunes habitats, interspersed with rocky headlands, along the coast of Wicklow and Wexford (Refer to **Figures 11.4 in Volume 3**). In the Arklow area, this coastal corridor is modified by recreational, commercial and industrial land uses on both sides of the Avoca estuary and Arklow Harbour. To the south of Arklow, there is a narrow strip of modified sand dune habitat, including a golf course, between Arklow Head and the south harbour wall. To the north of Arklow Harbour, part of an area of sandhills was reclaimed in the Ferrybank area during the 19th Century for commercial and industrial uses, while lands in the vicinity of Arklow Pond and to the north remain relatively natural although modified by residential, commercial and recreational land uses.

11.3.1.1 Protected areas: European Sites

The proposed development does not lie within or adjoining any European sites.

European sites located along the Wicklow and Wexford coasts within 15km of the proposed development, and more distant hydrologically linked European sites, are shown in **Figure 11.4 in Volume 3** and summarised in Table 11.2.

Screening for Appropriate Assessment has identified that part of the European site Buckroney – Brittas Dunes and Fen SAC (Site Code 000729) lies within the Zone of Influence of the proposed development. Since mitigation is provided under the precautionary principle to ensure that no adverse effects (slight, moderate or significant) arise to the European site Buckroney – Brittas Dunes and Fen SAC (Site Code 000729), A Natura Impact Statement (NIS) has been prepared in respect of the proposed development.

Table 11.2: Qualifying Interests of SACs and Special Conservation Interests of SPAs located within 15km, and more distant hydrologically linked sites

European site	Distance from proposed development	Qualifying Interests * indicates a priority habitat under the Habitats Directive
Buckroney – Brittas Dunes and Fen SAC (Site Code 000729)	Coastal site 4.5km to the north at its closest point	Annual vegetation of drift lines [1210]
		Perennial vegetation of stony banks [1220]
		Mediterranean salt meadows (Juncetalia maritimi) [1410]
		Embryonic shifting dunes [2110]
		Shifting dunes along the shoreline with Ammophila arenaria (white dunes) [2120]
		Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]*
		Atlantic decalcified fixed dunes (Calluno-Ulicetea) [2150]*
		Dunes with Salix repens ssp. argentea (Salicion arenariae) [2170]
		Humid dune slacks [2190]
		Alkaline fens [7230]
Kilpatrick Sandhills SAC (Site Code 001742)	Coastal site 6.5km to the south at its closest point	Annual vegetation of drift lines [1210]
		Embryonic shifting dunes [2110]
		Shifting dunes along the shoreline with Ammophila arenaria (white dunes) [2120]
		Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]*
		Atlantic decalcified fixed dunes (Calluno-Ulicetea) [2150]*
Magharabeg Dunes SAC (Site Code 001766)	Coastal site partly within 15km of the proposed development	Annual vegetation of drift lines [1210]
		Embryonic shifting dunes [2110]
		Shifting dunes along the shoreline with Ammophila arenaria (white dunes) [2120]
		Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]*
		Atlantic decalcified fixed dunes (Calluno-Ulicetea) [2150]*
		Petrifying springs with tufa formation (Cratoneurion) [7220]*
Wicklow Reef SAC (Site Code 002274)	Marine site located c. 20km to the north	Reefs [1170]
Blackwater Bank SAC (Site Code 002953)	Marine site located c. 30km to the south	Sandbanks which are slightly covered by sea water all the time [1110]

European site	Distance from proposed development	Qualifying Interests *** indicates a priority habitat under the Habitats Directive**
Wicklow Mountains SAC (Site Code 002122)	Upland site located some 25 to 30km upstream, including some of the headwaters of the Avoca River	Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae) [3110]
		Natural dystrophic lakes and ponds [3160]
		Northern Atlantic wet heaths with Erica tetralix [4010]
		European dry heaths [4030]
		Alpine and Boreal heaths [4060]
		Calaminarian grasslands of the Violetalia calaminariae [6130]
		Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) [6230]*
		Blanket bogs (* if active bog) [7130]
		Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsietalia ladani) [8110]
		Calcareous rocky slopes with chasmophytic vegetation [8210]
		Siliceous rocky slopes with chasmophytic vegetation [8220]
		Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0]
		Lutra lutra (Otter) [1355]
Vale of Clara (Rathdrum Wood) SAC (Site Code 000733)	Located 15km or more upstream of Arklow	Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0]
		Special Conservation Interest
Wicklow Mountains SPA (Site Code 004040)	Upland site located some 25 to 30km upstream	Merlin (Falco columbarius) [A098]
		Peregrine (Falco peregrinus) [A103]

11.3.1.2 Protected Areas: Proposed Natural Heritage Areas

Upstream of Arklow, the Aughrim River and the Avoca River flow through steeply sloping wooded valleys, and join at Woodenbridge. The valley sides, with both coniferous and deciduous woodlands, are included within Avoca River Valley pNHA (Site Code 001748). The best examples of deciduous woodland occur in the Shelton Abbey area, and are dominated by Oak *Quercus petraea*. Parts of the river corridors are included in the pNHA area (Refer to **Figure 11.5 in Volume 3**).

The proposed development does encroach on parts of Arklow Town Marsh pNHA (Site Code 001931), along the south and north banks of the Avoca River upstream of Arklow Bridge (Refer to **Figure 11.6 in Volume 3**). Arklow Town Marsh pNHA includes the Avoca River channel upstream of Arklow Bridge, and the wetland habitats that extend northwards from the bank of the river (Refer to **Figure 11.6 in Volume 3**). Arklow Town Marsh pNHA covers an area of approximately 0.84 km^2, including the adjoining river channel. Arklow Town Marsh was included in the Wicklow Wetlands Survey in 2012[14], and assigned the evaluation National Conservation Value.

Arklow Town Marsh has been surveyed more recently as part of the baseline studies for the proposed Arklow Flood Relief Scheme in June 2017 by the lead ecologist for that project (Richard Nairn - Natura Consultants). Habitats recorded in the two surveys referenced are as follows:

- Reed and large sedge swamp FS1;
- Tall herb swamp FS2;
- Marsh GM1;
- Depositing/lowland rivers FW2;
- Drainage Ditches FW4;
- Wet willow-alder-ash woodland WN6;
- Treelines WL1;
- Scrub WS1;
- Oak-Birch-Holly woodland WN1;
- Wet grassland GS4; and
- Dry meadow and grassy verges GS2.

The NPWS site synopses for Avoca River Valley and Arklow Town Marsh pNHAs are reproduced in **Appendix 11.1**. It should be noted that these site descriptions were drafted in 1995, at which time industrial air pollution was problematic in the Arklow area.

Arklow Sand Dunes pNHA (Site Code 001746) lies along the coast to the north of the proposed development (Refer to **Figure 11.5 in Volume 3**), the site synopsis is reproduced in **Appendix 11.1**. Arklow Rock-Askintinny pNHA (Site Code 001745) lies to the south of Arklow at Arklow Head.

11.3.1.3 Natural Heritage and Biodiversity Objectives

The proposed development lies within the boundary of the Arklow and Environs Local Area Plan 2018 – 2024 (Arklow LAP). The plan includes the following natural heritage objectives:

14 Wilson, F., Crushell, P. Curtis, T. & Foss, P.J. (2012). The County Wicklow Wetland Survey II. Report prepared for Wicklow County Council and The Heritage Council.

- HT1 - To maintain the favourable conservation status of all proposed and future Natural Heritage Areas (NHAs) in the plan area in particular the Arklow Marsh and to support environmentally sensitive measures to enhance the understanding and enjoyment of such natural areas; and
- HT9 - To maintain the conservation value of all proposed and future Natural Heritage Areas (NHAs) and to protect other designated ecological sites in Arklow and Environs.

Consideration should be given to separate Natural Heritage Objectives based on the County Development Plan objectives;

- NH3 – relating to protection of designated sites;
- NH5 – relating to maintain the conservation value of designated sites;
- NH6 – relating to the requirement for ecological impact assessment of proposed development likely to have a significant impact on rare or protected sites, habitats and species; and
- NH12 – in relation to protection and enhancement of biodiversity and ecological connectivity within the plan area in accordance with Article 10 of the Habitats Directive.

Further, the aim of Objective NH12 of Wicklow County Development Plan 2016-2022 is:

"To support the protection and enhancement of biodiversity and ecological connectivity within the plan area in accordance with Article 10 of the Habitats Directive, including linear landscape features like watercourses (rivers, streams, canals, ponds, drainage channels, etc.), woodlands, trees, hedgerows, road and railway margins, semi-natural grasslands, natural springs, wetlands, stonewalls, geological and geo-morphological systems, features which act as stepping stones, such as marshes and woodlands, other landscape features and associated wildlife where these form part of the ecological network and/or may be considered as ecological corridors or stepping stones that taken as a whole help to improve the coherence of the Natura 2000 network in Wicklow."

11.3.2 Terrestrial Flora and Habitats

Terrestrial and non-marine habitats recorded within the study area (**Figure 11.1 in Volume 3**) are summarised in Table 11.3. The extent of these habitats, and the dominant species present, has varied during the baseline survey period, arising from variations in land use and management, and natural succession, in the primarily urban environment of Arklow. The characteristics of the individual habitats recorded within and immediately adjoining the four areas are described in the following sections:

- **Section 11.3.2.1** - The Alps SWO and Stormwater Storage Tank;
- **Section 11.3.2.2** - River Walk and South Quay;
- **Section 11.3.2.3** - North Quay; and
- **Section 11.3.2.4** - WwTP site.

Habitats within the study area to the north of the WwTP site are summarised in **Section 11.3.2.5**.

Table 11.3: Terrestrial and non-marine habitats present in the planning boundary and the study area (i.e. outside the planning boundary of the proposed development)

Habitat (Fossitt classification)	The Alps SWO and Stormwater Storage Tank	River Walk and South Quay	North Quay	WwTP site	Habitats in the study area outside the planning boundary
Exposed siliceous rock ER1	✓				✓
Scrub WS1	✓		✓	✓	✓
Treelines WL2		✓	✓		✓
Riparian woodland WN5					✓
Buildings and artificial surfaces BL3	✓	✓	✓	✓	✓
Stone walls and other stonework BL1		✓	✓		✓
Spoil and bare ground ED2		✓	✓	✓	
Recolonising bare ground ED3		✓	✓	✓	
Amenity grassland GA2		✓	✓	✓	✓
Ornamental non-native shrub WS3	✓	✓	✓	✓	✓
Flower beds and borders BC4		✓			✓
Depositing lowland rivers FW2	✓	✓	✓		✓
Drainage ditches FW4			✓		
Tidal rivers CW2		✓	✓		✓
Wet grassland GS4					✓
Improved agricultural grassland GA1					✓
Reed and large sedge swamp FS1					✓
Dune scrub and woodland CD4					✓

11.3.2.1 The Alps SWO and Stormwater Storage Tank

Upstream to the west of the Alps SWO and Stormwater Storage Tank site, immediately outside the footprint of the proposed development, small areas of Gorse *Ulex europaeus* and Bramble *Rubus fruticosus* agg. dominated Scrub **WS1** and Exposed siliceous rock **ER1** occur, with mown grassland adjoining the footpaths. **S**loping ground north of the railway line includes extensive areas of Bramble and Gorse Scrub **WS1** with Elder *Sambucus nigra*, and overgrown hedgerows **WL1** of Hawthorn *Crataegus monogyna*, Elder and Holly *Ilex aquifolium*, Birch *Betula* spp., Blackthorn *Prunus spinosa*, and Sycamore *Acer pseudoplatanus* extending into Improved agricultural grassland **GA1**. Species poor Wet grassland **GS4** on low ground to the south of the riverside footpath appears to be liable to flooding from the Avoca River, Reed Canary-grass *Phalaris arundinacea* and Floating Sweet-Grass *Glyceria fluitans* occur here with Soft Rush *Juncus effusus*. Grey Willows *Salix cinerea* grow along the Avoca River bank on the northern side of the footpath.

Thin soils and outcropping rock in and adjoining the western part of the Alps SWO and Stormwater Storage Tank site are vegetated with Bramble and Gorse dominated Scrub **WS1**, with Ivy *Hedera helix* (Refer to Plate 11.1.2). Navelwort *Umbilicus rupestris*, Foxglove *Digitalis purpurea*, Field Wood-rush *Luzula campestris*, Wood Sage *Teucrium scorodonia*, Sweet Vernal Grass *Anthoxanthum odoratum*, Common Sorrel *Rumex acetosa*, and the fern Common Polypody *Polypodium vulgare* grow on outcropping rock and thin soil over rock (dark grey slate with minor pale sandstone, Refer to **Chapter 14**); this habitat corresponds to Exposed siliceous rock **ER1**, occurring in small areas in mosaic with Gorse and Bramble Scrub **WS1**.

The Alps SWO and Stormwater Storage Tank site is a small shaded valley, some 20m wide and 100m long, between rock outcrops in higher ground to the east, west, and to the south where the ruins of Arklow Castle are located. Soil depth varies within the SWO and Stormwater Storage Tank site.

Vegetation was cleared from relatively level ground in the main area of the site during the winter of 2012/13 and again in 2016/17 to facilitate site investigation works; the site was surveyed before and after clearance. The site area is dominated by species poor Bramble Scrub **WS1** with Nettle *Urtica dioica*, (Plate 11.1.1) and occasional Bittersweet *Solanum dulcamara*, and a ground flora including Cleavers *Galium aparine*, Creeping Buttercup *Ranunculus repens*, Rose-bay Willowherb *Epilobium angustifolium*, Common Sorrel, Broad-leaved Dock *Rumex obtusifolius*, Celandine *Ranunculus ficaria*, Lords-and-Ladies *Arum maculatum*, Cow Parsley *Anthriscus sylvestris*, and Ivy, with the grasses False Oat-grass *Arrhenatherum elatius*, Cock's-foot *Dactylis glomerata*, and Creeping Bent *Agrostis stolonifera*.

1. View into the Alps site from River Walk
2. River Walk immediately west of the Alps, showing rock outcrops on both sides of the footpath to Vale Road

3. View eastwards from River Walk opposite the Alps site
4. View westwards along River Walk towards the Alps site

Plate 11.1: Views of the Alps site and surrounding areas

Sloping ground in the eastern part of the SWO and stormwater storage tank site, below Coomie Lane, is vegetated with Bramble and Buddleia *Buddleja davidii* dominated Ornamental non-native Shrub **WS3**, with Sycamore and Cypress higher on the slope, and regrowth of some previously felled young trees of Ash *Fraxinus excelsior*, Sycamore and Elder on the lower slope. To the south east, tree and shrub cover on sloping ground includes Cypress, a mature Sycamore tree with ivy cover, and younger Sycamore, with mature Cherry Laurel *Prunus laurocerasus*, and Grey Willow, growing among Bramble and Buddleia. Cherry Laurel and Buddleia cast dense shade and there is little ground flora below them (see also **Section 11.3.3**). The ruins of Arklow Castle are partly overgrown with ivy, and are located on higher ground more than 20m south of the Alps SWO and Stormwater Storage Tank site boundary.

11.3.2.2 River Walk and South Quay

Access to the Alps SWO and Stormwater Storage Tank site is via the existing River Walk footpath **BL3** on the southern bank of the Avoca River.

1. Erosion along the south bank of the Avoca River

2. Small area of Bramble along the south bank of the Avoca River

3. Amenity grassland and young trees adjoining River Walk

4. Amenity grassland with Daffodils and trees at the car park at River Lane

Plate 11.2: Views vegetation and habitats along River Walk

Within the area of the proposed development, a semi-continuous Treeline **WL2** planted along the river bank from the Alps to Arklow Bridge includes Weeping Willow *Salix* hybrids (Plate 11.2, 3 and 4), Ash, Hawthorn, Silver Birch *Betula pendula*, and Alder *Alnus glutinosa*. Self-sown Grey Willow shrubs were cut back during the winter of 2017 - 2018.

Herbaceous vegetation along the river bank is mown and is grass dominated Amenity grassland **GA2** with Ryegrass *Lolium perenne*, Daisy *Bellis perennis*, Ribwort *Plantago lanceolata*, with occasional Alexanders *Smyrnium olusatrum*, Dock *Rumex spp.*, Cuckooflower *Cardamine pratensis*, Yarrow *Achillea millefolium*, and with occasional Cow Parsley and Soft Rush along the river bank. The river bank grassland is c. 7m wide at the Alps, reducing in width downstream, with evidence of river bank erosion, and occasional patches of Bramble. From near Condren's Lane Upper, the natural riverbank is replaced by retaining walls **BL1** and **BL3**, these continue along South Quay to the coast.

The ground on the southern side of River Walk rises steeply between The Alps and River Lane. There is mown amenity grassland slopes **GA2** and a retaining wall **BL3** between the car park at River Lane and River Walk, Daffodils are planted in the amenity grassland, and trees planted here include Lime, Sycamore, and ornamental Cherry (Plate 11.2.4). The adjoining slope at Sunbeam House has some mature Sycamore and Grey Willow trees, with developing Bramble and Grey Willow scrub **WS1** that is cut back periodically, and small areas of ornamental shrub planting **WS3**.

The Avoca River channel (**FW2, CW2**) upstream of Arklow Bridge is largely un-vegetated. Gravel banks in the centre and south of the channel expose during most of the tidal cycle and low river flows, and are not vegetated. Towards the northern side of the river channel, there is a linear gravel bank overlain with silt, and this supports a line of Grey Willow trees, corresponding to Riparian woodland **WN5**. Some areas of this woodland bank appear to have washed out during recent floods (Refer to Plate 11.3).

Avoca River viewed from Arklow Bridge, view of Riparian woodland on gravel and silt bank in the river channel near the north bank

Avoca River upstream of Arklow Bridge, gravel banks exposed at low tide

Plate 11.3: Gravel banks in the Avoca River upstream of Arklow Bridge

There is a small area of Ornamental/non-native shrub **WS3** on each side of the footpath leading from River Walk to Arklow Bridge.

Downstream of Arklow Bridge, the South Quay wall **BL1** and **BL3** is sparsely vegetated with plants that can colonise masonry and cement walls; Buddleia and Grey Willow seedlings, Red Valerian *Centranthus ruber*, Ivy-leaved Toadflax *Cymbalaria muralis*, Ribwort, Daisy and Dandelion, with Red Fescue and Cock’s-foot grass (Plate 11.4). There is a narrow strip of amenity grassland **GA2** above the Avoca Estuary retaining wall **BL3**, extending from South Green to Harbour Road. Trees planted within this grassland are mostly ornamental Acer cultivars, with some Lime, Rowan, Cherry Poplar, and a Hawthorn. A seating area on the South Quay opposite Harbour Road has ornamental planting **WS3** including *Escallonia*, *Cordyline*, *Viburnum davidii*, and *Montbretia*, with some Ground Elder *Aegopodium podagraria* occurring as a weed species.

1. View along South Quay towards Arklow Bridge

2. View along South Quay towards South Green

3. Amenity grassland and trees at South Green, looking west

4. Amenity grassland and trees at South Green, looking east

Plate 11.4: Vegetation and habitats from Arklow Bridge to Harbour Road

Amenity grassland **GA2** occurs along the southern side of South Green, adjoining residential properties (Plate 11.4.3 and 4). A **Treeline WL2** planted in this area includes a Horse Chestnut *Aesculus hippocastanum*, two mature *Acer* cultivars, two mature ornamental Cherry *Prunus* trees, and two recently planted Apple *Malus* trees.

A temporary construction compound (at working area S19) for the proposed development is located in a vacant site south of Arklow Harbour. This site includes concrete and gravel surfaces **BL3**, with spoil and bare ground **ED2** with a sparse vegetation of False Oat-grass *Arrhenatherum elatius*, Red Valerian, Bramble, and Bird's-foot Trefoil *Lotus corniculatus*, and with mounded areas of Recolonising bare ground **ED3** at the sides and back of the site, vegetated with Gorse, Grey Willow, grasses, and Alexanders.

The Third Schedule listed non-native plant species Sea-buckthorn *Hippophae rhamnoides* was recorded within a treeline of Whitebeam on the eastern side of the road linking the proposed Contractor's Compound with South Quay (see **Section 11.3.3**).

11.3.2.3 North Quay

Working Area TSN1 is located on the north bank of the Avoca River, on the western side of Arklow Bridge (Plate 11.5). This site was partially cleared in late 2016 in connection with a road upgrade project. A line of Cypress trees and adjoining Willow, Ash and Sycamore were felled at that time, and a hard core working area installed adjoining the road. When re-surveyed in May 2018, the hard core surface was classified as spoil and bare ground **ED2**, with a sparse colonising vegetation of Buddleia seedlings, Bramble, Common Ragwort *Senecio jacobaea*, Groundsel *S. vulgaris*, Smooth Sow-thistle *Sonchus oleraceus*, and Common Mouse-ear *Cerastium fontanum*.

1. Spoil and bare ground **ED2** and Scrub **WS1** in TSN1

2. Scrub **WS1** along the north bank of the Avoca River at TSN1

3. View west over overgrown amenity grassland towards Arklow Town Marsh pNHA

4 Scrub along the northern margin of overgrown amenity grassland

Plate 11.5: Habitat and vegetation cover in Working Area TSN1

The north bank of the Avoca River slopes steeply down into tidal silt and gravels at this site; the bank is vegetated with Willow, Sycamore, Birch and Ash that have been cut back previously and are re-growing as multi-stemmed trees, among a dense shrub layer of Bramble, Elder *Sambucus nigra*, and Gorse, with occasional shrubs of Broom *Cytisus scoparius* and Snowberry *Symphoricarpos albus*. This habitat developed along the margins of a former garden and is currently best described as Scrub **WS1**.

At the western end of Working Area TSN1, the vegetation is grass dominated, with Yorkshire Fog *Holcus lanatus* the dominant species, with Alexanders, and Soft Rush on lower ground adjoining a drainage channel **CW2** that forms the boundary with Arklow Town Marsh to the west. Adjoining ground to the north includes Buddleia and Bramble scrub, with Sycamore and Apple trees, Lilac and other ornamental shrubs of garden origin. This part of the TSN1 site is best described as overgrown amenity grassland **GA2**, that remains relatively species poor currently. An overgrown drainage ditch **FW4** adjoins this site.

Along the North Quay, vegetation is limited to the curtilage of some existing properties, and to a narrow strip c. 2m wide between the road and the quay wall. The road level is higher than the quay wall (Refer to Plate 11.6). This narrow strip includes occasionally cut amenity grassland opposite the Bridgewater Shopping Centre, and a crushed stone surface further east, planted mainly with a **Treeline WL2** ornamental Acer cultivars, and some Whitebeam *Sorbus aira* cultivars, Horse Chestnut, Lime, and Poplar cultivars throughout. Some Bramble and Gorse also occur in the quayside area, and there is some re-growth of Grey willow which was cut back previously. Grey Willow and Sycamore of self-sown origin occur along the quay wall near the marina on the North Quay.

There are some mounds of soil and stone within the Avoca River estuary immediately downstream of Arklow Bridge, adjoining North Quay (Plate 11.6). This small area supports colonising vegetation of Gorse, Grey Willow, Birch and Alder, with wetland species including Reed Canary-grass *Phalaris arundinacea* and Common Valerian *Valeriana officinalis* that occur upstream within Arklow Town Marsh pNHA (Wilson *et al*, 2012), and is classified as Spoil and bare ground **ED2**.

Plate 11.6: River bank habitat at the North Quay

The road around the marina at North Quay is not vegetated (**BL3**). Rough ground to the east of the marina has been colonised by Alder and Grey Willow, this early growth has been cut back recently and re-growth has commenced, among sparse grass and Bramble cover and the vetch species *Vicia hirsuta* and *V. sativa*. Access to the WwTP site from Mill Road is via a recently cleared area of Bramble dominated Scrub **WS1**.

Working area N14 has a concrete surface **BL3**, sparsely vegetated with Yellow Clover *Trifolium dubium*, Dandelion, Mugwort *Artemesia vulgaris*, and Biting Stonecrop *Sedum acre*. The boundaries of this area are vegetated with Bramble dominated Scrub **WS1**.

11.3.2.4 WwTP site

The Old Wallboard site at Ferrybank (i.e. WwTP site) is located on the northern side of Avoca River estuary, which is retained by the north quay of Arklow Harbour, the coastal revetment forms the eastern site boundary. The WwTP site includes a derelict wallboard factory and habitats present are listed in Table 11.3.

The WwTP site was originally occupied by sand hills, before Arklow Harbour walls were constructed and the site area reclaimed. Minor elements of the original coastal vegetation have persisted, or have re-colonised the site from the immediate locality; a small stand of Bracken *Pteridium aquilinum* and Bluebell *Hyacinthoides non-scripta* was recorded in April 2017 near the northern tip of the site, and a few plants of Autumn Gorse *Ulex gallii* occur near the southern site boundary, together with occasional plants of species of coastal grassland that have colonised hard core and tarmac surfaces, including Yellow-wort *Blackstonia perfoliata*, Wild Carrot *Daucus carota*, Sea Mayweed *Tripleurospermum maritimum*, Biting Stonecrop *Sedum acre*, Hare's-foot Clover *Trifolium arvense*, Kidney Vetch *Anthyllis vulneraria*, and Buck's-horn Plantain *Plantago coronopus*.

The WwTP site is largely occupied by derelict buildings and paved surfaces. Soil substrates are largely confined to the north-eastern part of the site adjoining the coastal rock armour. A treeline of Ornamental non-native shrub **WS3** of New Zealand Daisy Bush *Oleria macrodonta* of planted origin extends from the site entrance along the northern site boundary with the road. Red Fescue grass *Festuca rubra*, probably associated with previous Amenity grassland **GA2** landscaping extends along the eastern side of the main building and the base of the rock armoured revetment.

1. Bramble Scrub WS1 along the site boundary with working area N14, to the left

2. Recolonising bare ground ED3 and Gorse and Bramble Scrub WS1 between the two existing buildings on site

Plate 11.7: Existing vegetation and habitats on the WwTP site

Derelict buildings and tanks occupy c. 60% of the site area. Ivy *Hedera helix* is present on some existing cement walls, and gutters are overgrown with grasses. The derelict buildings are otherwise un-vegetated.

Most of the existing vegetation on the site has developed as sparse cover on hard-core and tarmac surfaces, extending into the site from the site boundaries, from seed in gravel or hard-core brought in during site development, from wind-blown seed and seed transported by birds. Silver Birch has colonised sheltered parts of the site near the western boundary, with occasional Alder and Elder. Grey Willow occurs in sheltered and more exposed parts of the site. Bramble and Gorse Scrub **WS1** extends into the site from the western site boundary (Plate 11.7).

Spoil and bare ground **ED2**, comprising paved and gravel surfaces, is vegetated with common colonising plant species. At the southern end of the site adjoining the quay wall of Arklow Harbour, a marine influence is evident and a sparse flora includes Buck's-horn Plantain, Biting Stonecrop, and Sea Mayweed.

Elsewhere within the parcel colonising plant species of Spoil and bare ground **ED2** include mosses, Creeping Bent-grass, Annual Meadow-grass *Poa annua*, Willowherb *Epilobium* species, Ribwort, Common Ragwort, White Clover *Trifolium repens*, Yellow Clover, Hairy bittercress *Cardamine hirsuta*, and Dandelion *Taraxacum officinale* agg.

Recolonising bare ground **ED3** is more densely vegetated with more than 50% plant cover, and includes the species listed above with additional grass species Red Fescue *Festuca rubra*, Cock's-foot grass *Dactylis glomerata*, and Yorkshire Fog *Holcus lanatus*.

The habitats present within the WwTP site have been disturbed by informal land uses, and by recent site investigation works carried out in respect of the proposed development.

11.3.2.5 Habitats in the Vicinity of the WwTP Site

Another currently derelict site is located on the opposite side of the road to the WwTP site, and supports similar colonising vegetation. To the north, Amenity grassland **GA2** includes recreational facilities and extends to Seaview Avenue; part of this area is included in the planning boundary (Refer to **Figure 11.1 in Volume 3**). Taller, occasionally mown, and more species rich grassland occurs on the revetment slope. Dominant grass species are Red Fescue, Cock's-foot, and False Oat-grass. Ribwort, Wild Carrot, and Common Knapweed *Centaurea nigra* occur on this slope, with occasional patches of Gorse and Bramble. Sea Beet *Beta vulgaris* occurs on the upper slopes of the revetment.

Arklow Pond (Refer to **Figure 11.1 in Volume 3**), within the area zoned as Open Space, was included in the Wicklow Wetlands Survey[15], and is described as an eroded and much modified dune system, still retaining typical dry and wet areas, one of which runs into a lagoonal lake at the south end[16]. The site evaluation for the Arklow Pond site by Wilson *et al* is C+; i.e. County Conservation Value.

The main area of open water at Arklow Pond is surrounded by Reed and large sedge swamp **FS1** dominated by Common reed *Phragmites australis*. The protected plant species[17] *Equisetum x moorei* occurs at a number of sites in the Ferrybank area (Curtis and Wilson[18]), including at the northern end of Arklow Pond. This area was surveyed in 2017, and *Equisetum x moorei* was confirmed to continue to be present at this location, c. 700m north of the proposed WwTP site. This species was not found at the WwTP site, or within the section of the revetment proposed to be upgraded.

An area of Dune scrub and woodland CD4 occurs to the north of the Reed and large sedge swamp FS1 at Arklow Pond. Scattered Oak, Sycamore, Grey Willow and Hawthorn trees grow over a shrub layer of Bramble, Burnet Rose Rosa pimpinellifolia, Gorse, and Bracken, with Bluebell. A number of footpaths traverse this area, connecting to Sea Road and Seaview Avenue.

11.3.2.6 Evaluation of Flora and Habitats

The planning boundary of the proposed development lies entirely within the Arklow LAP. In the context of the urban area of Arklow, the flora and habitats present within the planning boundary provide locally important biodiversity and ecological connectivity. Biodiversity along the Avoca River corridor is higher upstream of Arklow Bridge than it is downstream, because of the presence of natural (although modified by regular mowing of amenity grassland) river banks along most of River Walk. Mature trees along River Walk also provide feeding and commuting corridors for bats (see **Section 11.3.5.1**).

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15 Wilson, F., Crushell, P. Curtis, T. & Foss, P.J. (2011). The County Wicklow Wetland Survey I. Report prepared for Wicklow County Council and The Heritage Council.

16 Data from Arklow Pond: Wicklow County Council & The Heritage Council 2012, held by Wetland Surveys Ireland – map of Irish Wetlands, www.WetlandSurveysIreland.com , 20 May 2018)

17 Flora Protection Order, 2015)

18 Curtis, Dr. Tom & Faith Wilson (2008), Field Survey Of Rare, Threatened And Scarce Vascular Plants In County Wicklow. Data provided by NPWS

Biodiversity within the planning boundary of the proposed development is assessed as being of high local importance upstream of Arklow Bridge, and of low local importance downstream of Arklow Bridge along both the south and north quays.

The habitats present in the Alps SWO and Stormwater Storage Tank site, and its immediately adjoining temporary construction area, on the south side of the Avoca River are species poor, include the non-native invasive plant species Buddleia and Cherry Laurel (see **Section 11.3.3**), and are assessed as being of low local ecological importance.

The habitats within the WwTP site and the immediately adjoining working areas included within the planning boundary are assessed as being of low local ecological importance.

11.3.3 Invasive plant species

A total of five plant species listed in Part 1 of the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 – 2015 were recorded in the study area (Refer to **Figure 11.7 in Volume 3**):

- Japanese knotweed *Fallopia japonica*: High risk of impact[19]; a linear stand c. 10m long, located on the north bank of the Avoca River, within Arklow Town Marsh pNHA, and not expected to interact with the proposed development because of its location;
- Rhododendron *Rhododendron ponticum*: High risk of impact[19]; located at a number of areas within Arklow Town Marsh pNHA, and not expected to interact with the proposed development because of its location;
- Sea-buckthorn *Hippophae rhamnoides*: Medium risk of impact[19]: four mature shrubs of Sea buckthorn, of which one is spreading by suckers, in roadside planting at the Harbour on South Quay, there is a potential for the spread of seed or plant parts by machinery or other traffic movement between the Contractor’s Compound and works areas associated with the proposed development. A further stand of Sea buckthorn was recorded at the northern end of the study area, to the north of Arklow Pond;
- Spanish Bluebell *Hyacinthoides hispanica*: Low risk of impact[19]; located within Working Area TSN1, and occurring along a footpath linking to River Walk; and
- In addition, Himalayan Balsam *Impatiens glandulifera* was recorded at intervals along the northern bank of the Avoca River, upstream of the proposed development, during baseline studies for the proposed Arklow Flood Relief Scheme (by the project ecologist - Richard Nairn, Natura Consultants). This species is listed as High risk of impact[19], it is not expected to interact with the proposed development because of its location, although as a species that spreads by seed it may spread downstream into working areas.

19 National Biodiversity Centre (2018) Species Profile Browser. Available from: https://species.biodiversityireland.ie/ [Accessed 18 August 2018]

Two additional non-native invasive plant species, listed in the NRA guidelines[20] were recorded in the immediate vicinity of the proposed development:

- Buddleia / Butterfly Bush *Buddleja davidii*: Medium risk of impact[19]; present in many areas as a mature shrub and as seedlings, not mapped;
- Montbretia (*Crocosmia X crocosmiiflora*); a single stand recorded on the coastal revetment adjoining the WwTP site; and
- Laurel (Cherry Laurel) *Prunus laurocerasus* is listed by the National Biodiversity Data Centre as a non-native invasive species with a High risk of impact; this plant occurs in the vicinity of works associated with the proposed development at the Alps.

Management recommendations for non-native invasive plant species potentially interacting with the proposed development are included in **Appendix 11.2**.

11.3.4 Birds

11.3.4.1 Waterbirds

Peak numbers of waterbirds and seabirds recorded during baseline bird surveys, are given in Table 11.4 at each of the three survey areas. Data for the individual counts are given in **Appendix 11.3**.

Table 11.4: Peak numbers of waterbirds recorded during baseline surveys at Arklow

Species	**Birds Directive Annex 1 listed**	**BOCCI**[21]	**1% National level**[22]	**1% Inter-national level**[23]	**Shoreline and coastal waters**	**Avoca River estuary**	**Arklow Pond**
Red-throated Diver	yes	Amber (b)	20	3000	1		
Little Grebe		Amber (b/w)	20	4000			4
Cormorant		Amber (b/w)	120	1200	13	9	
Grey Heron			25	2700		3	
Mute Swan		Amber (b/w)	90	-		2	6
Greenland White-fronted Goose	yes	Amber (w)	110	240		1	1
Greylag Goose (feral)			-	-		43	29

20 Transport Infrastructure Ireland (incorporating the National Roads Authority) Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Road Schemes (Revision 1, December 2010)

21 Colhoun and Cummins, 2013. Birds of Conservation Concern in Ireland, 2014-2019. b= breeding, w= wintering. Irish Birds 9 (4): 523-544

22 Threshold level for national importance (1% of all-Ireland population of each species or sub-species/flyway) – data not available for gull species

23 Threshold level for International importance (1% of total population of each species or sub-species/flyway)

Species	Birds Directive Annex 1 listed	BOCCI [21]	1% National level[22]	1% Inter-national level[23]	Shoreline and coastal waters	Avoca River estuary	Arklow Pond
Teal		Amber (b/w)	340	5000			1
Mallard			290	20000		49	51
Moorhen				20000		4	5
Coot		Amber (b/w)	220	17500			1
Oystercatcher		Amber (b/w)	690	8200	3		
Ringed Plover			100	730	1		
Common Sandpiper		Amber (b)	-	-		1	
Turnstone			95	1400	12	12	
Kingfisher	yes	Amber (b)	-	-		1	
Mediterranean Gull		Amber (b)	-	770	3		
Black-headed Gull		Red (b)	-	20000	67	512	101
Common Gull		Amber (b)	-	16400	21	50	
Lesser Black-backed Gull		Amber (b)	-	5500	3	10	
Herring Gull		Red (b)	-	10200	150	390	2
Great Black-backed Gull		Amber (b)	-	4200	4	40	
Guillemot		Amber (b)	-		4		

Overall, 22 waterbird species were recorded, and a single seabird species (Guillemot). The numbers recorded were well below the threshold levels for national and international importance for waterbirds, where these have been determined (As outlined in Table 11.4).

Gulls were the most numerous group, and were recorded in all three survey areas. Five gull species were recorded in the Avoca River estuary. Black-headed Gulls were present during all counts, apart from April 2017 when they would be expected to be away at breeding colonies. Herring Gulls recorded in April 2017 were all immature third to third year birds.

Gulls feed in a range of habitats, including agricultural land and wetlands, and use a range of food sources opportunistically. Relatively little gull feeding behaviour was observed in the Avoca River estuary, although gulls were quick to respond to people arriving to feed birds, both on the river and estuary and at Arklow Pond. Herring Gulls scavenge among fish and bait boxes at the harbour on South Quay.

Most of the gull use of the Avoca River and estuary was by birds roosting, bathing and preening; gulls use the gravel banks upstream and downstream of Arklow Bridge to roost on, and bathe and preen in the fresh water of the river. The highest counts were recorded at low tide and river levels, when the largest areas of gravel are exposed. Downstream of Arklow Bridge, gulls also roosted on the pontoon opposite the Sailing Club, and in small numbers on the slipway and rock armour along the sea wall nearby at South Green. At Arklow Pond, Black-headed Gulls roosted on amenity grass near the pond, and on the pond, with regular flights out over coastal waters and to the Avoca River estuary.

Six gull species were recorded on coastal water surveyed; Common Gull, Lesser Black-backed Gull, Herring Gull, and Great Black-backed Gull numbers were highest on a day when fishing vessels were operating in the area, on 29 November 2017 (Refer to **Table 1 in Appendix 11.3**). Three Mediterranean Gulls were also observed on this date, the only record of this species during the baseline surveys. Black-headed Gulls and Herring Gulls were recorded on coastal waters during most surveys, the other species occurred less frequently. In coastal waters at Arklow, gulls were recorded feeding around the edges of the Avoca River freshwater plume as it enters marine waters, attending fishing vessels, and on one occasion (28 January 2017) mobbing a Harbour Seal that had caught a large fish.

The Greylag Geese that occur at Arklow are a resident feral population[24]. The origins of feral Greylag Geese in Ireland are uncertain, most flocks are thought to be descendants of released birds. Migratory Greylag Geese that breed in Iceland winter in Ireland and Britain, the closest flocks of Icelandic Greylags use sites in north Wicklow, at Poulaphouca and the North Wicklow Coastal Marshes[24]. The feral Greylag flock at Arklow use Arklow Pond and the Avoca River and adjoining habitats including amenity grassland, and were recorded feeding on amenity grassland at River Walk, South Green, and at Arklow Pond. They also take food that people bring to give them. A single Greylag gosling was recorded with two adults at Arklow Pond in April 2017. Feral Greylag geese are not of conservation interest.

A single Greenland White-fronted Goose was recorded at both the Avoca River and Arklow Pond, and was first recorded as a juvenile on 8 December 2016, associating with feral Greylag Geese.

This individual was still present, in adult plumage, in February 2018, but was not found in April 2018, and is assumed to have been a straggler from the Wexford flock of this Birds Directive Annex 1 listed sub-species that breeds in Greenland, and winters in Ireland and Scotland[25].

Mute swan, Mallard, and Moorhen were recorded on the Avoca River and at Arklow Ponds, with Mute Swan and Moorhen breeding at both sites. There were single records of Teal and Coot at Arklow Ponds. Little Grebe occur as a resident breeding species at Arklow Pond; two pairs were recorded during 2017 and 2018.

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24 Boland, H. and Crowe, O. 2012. Irish Wetland Bird Survey: Waterbird status and distribution 2001/02 – 2008/09. BirdWatch Ireland, Kilcoole, Co. Wicklow.

25 Fox, Tony, Ian Francis (Greenland White-fronted Goose Study), David Norriss, and Alyn Walsh (NPWS), 2017. Report of the 2016/2017 International Census of Greenland White-Fronted Geese.

Cormorant were recorded feeding in the Avoca River and estuary, and in coastal waters, with peak counts of 9 and 13 respectively. They also roosted within the river estuary, using fallen timber in the river channel, and built structures and mooring buoys in the estuary.

Grey Heron were recorded feeding and roosting in the Avoca River upstream of Arklow Bridge and at Arklow Pond.

Waders were recorded in small numbers. Turnstone occurred on the South Quay at the harbour, and on the harbour walls. Oystercatcher were recorded only on two occasions along the harbour walls. A single Common Sandpiper was recorded on gravel upstream of Arklow Bridge in April 2017, and was likely to be moving upstream to breeding areas in the upper Avoca catchment.

Single Kingfishers were recorded on three separate occasions, flying along the northern bank of the Avoca River upstream of Arklow Bridge and the drainage channel connecting into Arklow Town Marsh. It is considered likely that there is a Kingfisher breeding territory in this area.

There was a single observation of four Guillemot, feeding in coastal waters off Arklow.

Red-listed and Amber-listed Birds of Conservation Concern in Ireland are noted in Table 11.4.

11.3.4.2 Breeding birds

Passerine bird species recorded as breeding in the vicinity of the Alps were Blackbird, Robin, Blackcap, Chiffchaff, Chaffinch, and Wren. House Sparrow, Starling, Magpie and Wood Pigeon were recorded as present along River Walk and South Quay, and as breeding in the general area. Grey Wagtail and Pied Wagtail were consistently present along the Avoca River banks and feeding on exposed gravels, and were recorded flying south into the town carrying food; these species are likely to nest in buildings or other built structures.

Willow Warbler, Blackcap, Blackbird, Robin and Wren were recorded as breeding in the vicinity of 1 Ferrybank (i.e. the westernmost tunnel shaft and working area on North Quay [working area N1]) on the northern side of the Avoca River.

At the WwTP site, Hooded Crow, Wren, and Barn Swallow were confirmed as nesting in the main derelict building on site in 2017, Starling and feral Pigeon were recorded as possible breeders. Birds recorded in scrub habitat and as probable breeding species within the site were Great Tit, Blue Tit, Chaffinch, Goldfinch, House Sparrow, Wren, Robin, and Blackbird. Two Meadow Pipits were recorded in territorial display over recolonising bare ground in April 2017, one within the site, and another on an adjoining derelict site. Five Linnet were recorded within the site in August 2017, but were not recorded as a breeding species within the site.

Passerine bird species recorded as breeding in Reedswamp and Dune scrub and woodland habitats in the vicinity of Arklow Pond included Sedge Warbler, Willow Warbler, Reed Bunting, Chiffchaff, Bullfinch, Chaffinch, Robin, Wren, Blackbird, Blue Tit, Coal Tit, and Long-tailed Tit. Stonechat and Linnet were also recorded in the area, but breeding was not confirmed.

Meadow Pipit and Grey Wagtail are Red listed as breeding birds of Conservation Concern in Ireland, Barn Swallow, Robin, Stonechat, Starling, House Sparrow and Linnet are Amber listed (Colhoun and Cummins, 2013[26]).

11.3.5 Mammals

11.3.5.1 Bats

Introduction

Bats constitute a total of nine of the most widespread resident protected mammal species in Ireland. Eleven species of bat have been identified to date in Ireland, of which two were considered to be vagrant. Bats occur in the rural and the urban environment. They feed upon insect fauna at night and during the day, they occupy buildings and occasionally trees for short or long periods. Buildings are a vital element of the annual cycle of all Irish bat species and at no time more so than the period May to August, but many bats may also avail of buildings as hibernation sites. Changes to a site may reduce the lands available to bats as a feeding site and in some cases may even destroy their dwelling place through or during the partial or total demolition, restoration and renovation of buildings, bridges, clearance activities and the subsequent construction.

Bats are protected by Irish and EU[27] law and to prevent unlawful injury or death, it is essential that a full understanding of the site is available in advance to protect the resident bats from unintentional disturbance and to create a pathway by which a legal derogation and exemption may be designed in consultation with the NPWS.

Previous evaluations in the Arklow area including house visits, ad hoc observations and survey data recorded by Bat Conservation Ireland have determined the presence of common pipistrelles, soprano pipistrelles, Daubenton’s bats, Natterer’s bats, brown-longed eared bats and Leisler’s bats.

Other species in surrounding areas include one of the first records of Nathusius’ pipistrelles and a roost of this species in Wexford town 58km to the south-west. This species was first reported from this area on the Blessington Reservoir 20 years ago, 42 km to the north-west. Additionally, the only record of Brandt’s bat in Ireland was recorded in Glendalough approximately 27 km to the north-west. While these would appear considerable distances, these are two species that show high migratory habits in other European countries. Nathusius’ pipistrelle have been recorded in England, having been ringed in Latvia and Lithuania.

26 Colhoun, K. and S. Cummins, 2014. Birds of Conservation Concern in Ireland 2014-2019. Irish Birds 9 (4): 523-544

27 All species of Microchiroptera are listed as species of Community interest in need of strict protection in Annex IV of the Habitats Directive

Bat roosts

There is historic evidence of use of the ruins of Arklow Castle including information provided by the resident of the house adjacent to the Castle from childhood and up to recent years. The Castle has been confirmed to be used by roosting bats by the NPWS.

Common pipistrelle activity was the first noted at the ruins of Arklow Castle (19.08 hours) in the survey undertaken in October 2016 and this was followed 12 minutes later by soprano pipistrelle activity. Neither species was seen to return to Arklow Castle prior to dawn. However, on cold mornings, it is possible that bats have returned during the night and have not re-emerged to feed.

In August 2017, no bats emerged or returned to the Castle. A number of bats were noted returning towards the town from the Alps area prior to dawn but not to the Castle. Pipistrelle activity was noted heading to the south-west of the river. A Leisler's bat was noted flying to the south in the vicinity of the Castle (but clearly flying beyond the Castle).

The bat roost that was recorded previously by the NPWS as present within the Castle, would appear to be absent in August 2017 and October 2016. Given that the emergence area is more overgrown than when bats were present previously, it is probable that bats are either scarce or absent from the building.

None of the bat boxes in mature trees along both sides of River Walk along the riverbank had been occupied by bats in 2017. These bat boxes were in clutter and ivy was blocking a number of the box entrances.

Arklow Bridge was found to be the roost site of unidentified bat species, probably Daubenton's bat (*Myotis daubentonii*)**.** There is evidence that bats are availing of crevices in the upriver side of the bridge to roost. This was in the form of clusters and individual droppings below the crevices. These roosting or resting sites are predominantly towards the southern end of the bridge (on the west/upstream side). While the northern end would appear to offer very suitable roosting conditions, there was no evidence of bats within this section. Given the strong association of Daubenton's bats with bridges, it is considered most probable that these sites are used by this species.

Three other species are less commonly encountered in bridges (Natterer's bats, Brown long-eared bats and soprano pipistrelles) while in other European countries a much wider range of species avail of bridges (including species resident in Ireland).

Bats are using Arklow Bridge as a roost site (western side of the southern end of the bridge). This is likely to be individuals roosting rather than a maternity roost and it may be either a transitional roost or simply a night roost used by bats feeding around Arklow along the River Avoca.

Trees at the northern end of Arklow Bridge offer low roost potential, including a Cypress treeline inspected in October 2016 prior to felling. Trees within the hedgerows north of this point have higher roost potential.

No roosts were noted in any of the trees examined prior to dawn and it was considered most probable from pre-dawn activity that bats were heading towards the houses at Ferrybank or further afield.

No bat roosts were recorded in derelict buildings at the WwTP site.

The bat box at Arklow Pond was not checked from a ladder and from an inspection with a torch from ground level, no droppings or bat was visible. This box was reported to be occupied by residents in 2016 but this is unconfirmed.

Bat fauna feeding and commuting within and through the study area

Bat species recorded in the study area are as follows:

- Common pipistrelle *Pipistrellus pipistrellus*
- Soprano pipistrelle *Pipistrellus pygmaeus*
- Leisler's bat *Nyctalus leisleri*
- Daubenton's bat *Myotis daubentonii*

Areas of high bat activity are shown in **Figure 11.8 in Volume 3**. Further records are shown in **Appendix 11.4**.

Common pipistrelles were noted at all times throughout the survey period and throughout Arklow town. This is the most widespread species in Europe and is most often the most commonly encountered bat species. Common pipistrelles were widespread in Arklow in summer in 2016 and 2017. In October 2016, males of this species were noted calling along the riverbank south of the river. Common pipistrelles were also noted along the lands along the eastern boundary of Arklow Town Marsh. This species was heard within the fields adjacent to Brigg's Lane behind Ferrybank around a derelict house and along the disused railway line.

Closer to freshwater, soprano pipistrelles are often more numerous, and this species was certainly very evident along the Avoca River and in marshy areas close to the northern bank of the river. This was the first bat to be noted around the mature trees along the river and one individual was present along the disused railway line to the north of the river for several minutes as well as feeding and calling around the derelict house.

Soprano pipistrelles were seen and heard along the southern riverbank and were the only species noted prior to dawn on 18 October 2016. Similarly, in August 2017, soprano pipistrelles were the most commonly encountered bat species prior to dawn.

The SM2 bat detector was used north of the river on 19 October 2016 revealed the presence of three species of bat; Leisler's bat, common and soprano pipistrelle. Each bat only occurred on one occasion between 18.15 and 21.30.

Daubenton's bats were heard over several hours along the river and were also noted flying from the rear of the houses north of the Avoca River towards the river channel.

Daubenton's bats were present close to water in almost all encounters, with some Daubenton's bat activity in Arklow Town Marsh, and at Arklow Pond. Daubenton's bat activity was noted along the Avoca River from the Arklow Bridge to Arklow Castle and onwards to the M11 flyover.

Ireland is considered to be a stronghold for Leisler's bats and this species is encountered throughout Leinster and the east coast. Leisler's bats were very briefly present along the northern bank of the Avoca River on 19 October 2016 at 19:31 and otherwise there was very little activity. This species was present in August 2017 but was less in evidence than all other species. A Leisler's bat was seen and heard flying over the Main Road of Arklow close to the Castle ruins prior to dawn away from any areas within the study area. Leisler's bats were noted on occasion in the study area but were much less common than other species.

Bat fauna feeding and commuting within and through the WwTP site

The most commonly encountered bats within the proposed WwTP site were common pipistrelles (Refer to Figure 11.1). There were no greater than three common pipistrelles at any given time. Activity within the buildings was predominantly common pipistrelle with occasional soprano pipistrelle activity around and possibly within the main building.

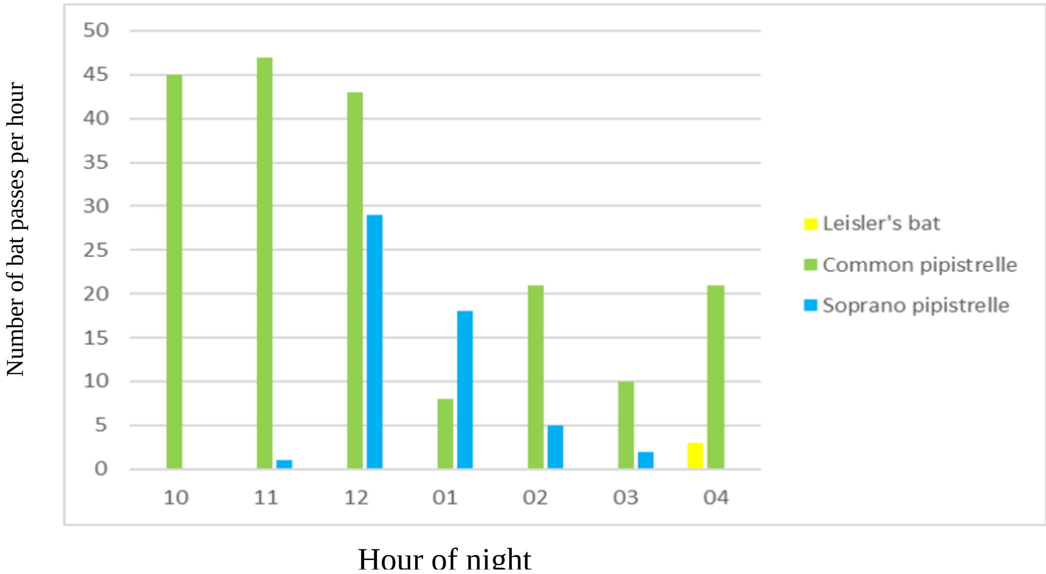


Figure 11.1: Bat activity recorded by the SM2 bat detector within the WwTP site in 2016

Ireland is considered to be a stronghold for Leisler's bats and this species is encountered throughout Leinster and the east coast. Leisler's bat fed over the proposed waste water treatment site while moving to and from a roost site that was not within the site itself in June 2016. The final bat observed prior to dawn was last noted flying towards the Avoca River in a south-westerly direction and it is probable that this individual was crossing towards the town over the river.

Bat fauna at Arklow Pond

Bat activity over the Arklow Ponds during an evaluation in 2017 was high (Refer to **Figure 11.8 in Volume 3**) and included Daubenton's bats, Leisler's bats, soprano and common pipistrelle. During consultation, the NPWS indicated that several bat boxes around the Ponds are known to be in use and noted that there is a pipistrelle roost in a building near Arklow Bay Hotel (west of Arklow Pond), and another bat roost in the Office of Public Works building in Arklow town.

11.3.5.2 Other terrestrial mammals

Otter *Lutra lutra* signs (spraints) were recorded along the banks of the Avoca River during aquatic ecology and terrestrial habitat surveys (Detailed description is given in **Section 11.3.6.3**). This species is listed in Annex II and in Annex IV of the Habitats Directive.

Fox *Vulpes vulpes* signs and scats were recorded at the Alps and at the WwTP site. Other terrestrial mammals likely to occur include Pygmy shrew *Sorex minutus* and the rodent species Wood Mouse *Apodemus sylvaticus*, House Mouse *Mus domesticus*, and Brown Rat *Rattus norvegicus* are likely to occur.

11.3.5.3 Marine Mammals

General information on marine mammal distribution in relation to Arklow

Marine mammals listed on Annex II of the Habitats Directive occur in coastal and marine waters off Arklow. The proposed outfalls lie within 10km square T27 (Refer to Figure 11.2).

Harbour Porpoise (Common Porpoise) *Phocoena phocoena* and Bottle-nosed Dolphin *Tursiops truncatus* have been recorded in 10km square T27. Records held by the National Biodiversity Data Centre include several databases compiled by the Irish Whale and Dolphin Group[28]: Records for coastal and offshore 10km squares to the north and south of Arklow T26, T27, T36, T37, T38, T39, T46, T47, T48 and T49 include the following additional cetacean species: Common Dolphin *Delphinus delphis*, Striped Dolphin *Stenella caeruleoalba*, Risso's Dolphin *Grampus griseus*, and Minke Whale *Balaenoptera acutorostrata* [29].

28 IWDG Cetacean Strandings Database, IWDG Casual Cetacean Sightings, and IWDG Ferry Survey sightings Data.

29 (Data from the Irish Whale and Dolphin Group held by the National Biodiversity Data Centre www.biodiversityireland.ie (downloaded from Biodiversity Maps on 26.04.2016 and 31 May 2018)

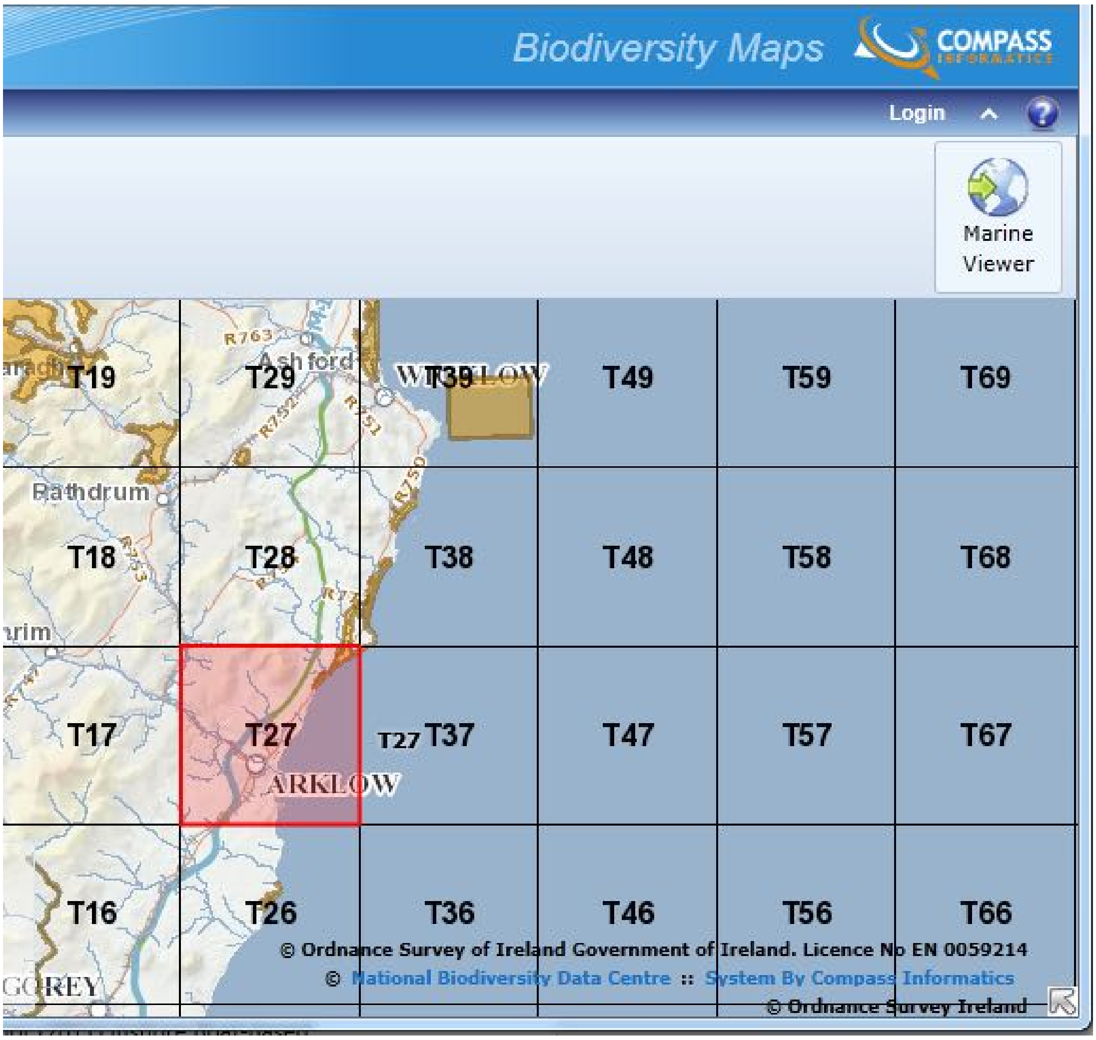


Figure 11.2: Coastal and offshore 10km grid squares in the Arklow area. SACs are also shown in orange

The Harbour Porpoise *Phocoena phocoena* is the smallest cetacean species that occurs in Irish waters, and is the most frequently reported and widespread cetacean species. It occurs throughout the year in continental shelf waters, and is frequently recorded in shallow bays, estuaries and tidal channels, in waters less than 20m deep. Line transect cetacean surveys in the Irish Sea in 2011 recorded a total of 57 sightings in Block A in the northern Irish Sea (Refer to Figure 11.3); 51 Harbour Porpoise sightings and six sightings of individual Minke Whales. In Block B in the southern Irish Sea (Refer to Figure 11.3), 14 cetacean sightings were recorded, all Harbour Porpoise sightings. This provided sighting rates of Harbour Porpoise of 0.29 sightings per km or 5.24 sightings per hour in Block A, and 0.10 Harbour Porpoise per km or 1.91 sightings per hour in Block B (Berrow *et al*, 2011[30]). There are three marine coastal areas where high numbers of Harbour Porpoise have been recorded (Refer to Figure 11.4), one off Co. Dublin on the east coast, and two off the south west coast of Ireland.

30 Berrow, Simon, Joanne O'Brien, Conor Ryan, Enda McKeogh and Ian O'Connor (2011) Inshore Boat-based Surveys for Cetaceans – Irish Sea. Report to the National Parks and Wildlife Service. Irish Whale and Dolphin Group. pp.24.

Three SACs include Harbour Porpoise as a Qualifying Interest: Rockabill to Dalkey Island SAC off the east coast (more than 50km to the north of Arklow), and Blasket Islands SAC and Roaringwater Bay and Islands SAC in the south west of Ireland.

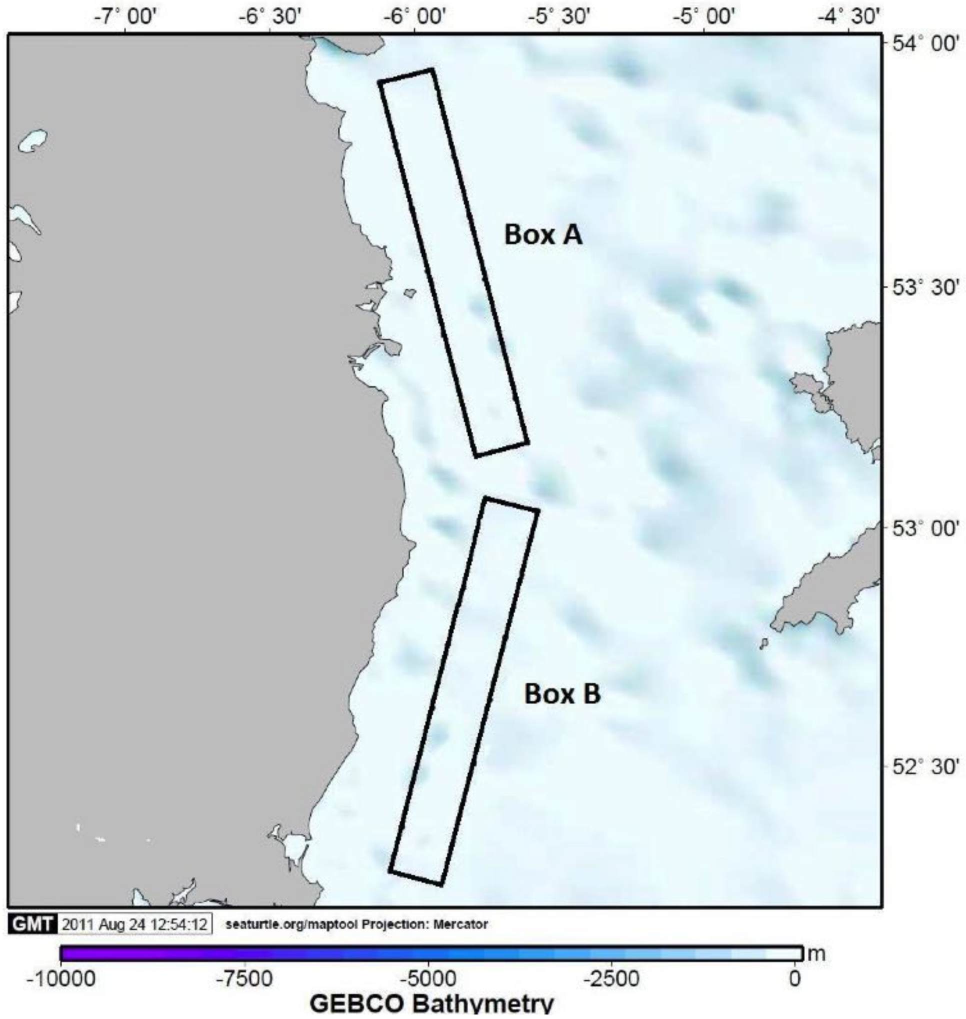


Figure 11.3: Map of Ireland showing the locations of survey blocks surveyed for cetaceans in 2011 (Reproduced from Berrow et al, 2011)

Bottle-nosed Dolphins have been seen in all Irish waters, particularly along the west coast, where three distinct populations are now recognised: the offshore, inshore and Shannon Estuary populations (Refer to Figure 11.4). One of the most important resident populations in Europe is the group of 120-140 Bottle-nosed Dolphins living year round in the Shannon; the species is included as a Qualifying Interest of the Lower River Shannon SAC. Bottle-nosed Dolphin is the Qualifying Interest of West Connacht Coast SAC, in Galway and Mayo. Since 2010, the Irish Whale and Dolphin Group (IWDG) has recorded an increase in sightings along the Irish east coast extending into the North Irish Sea and Ulster coast.

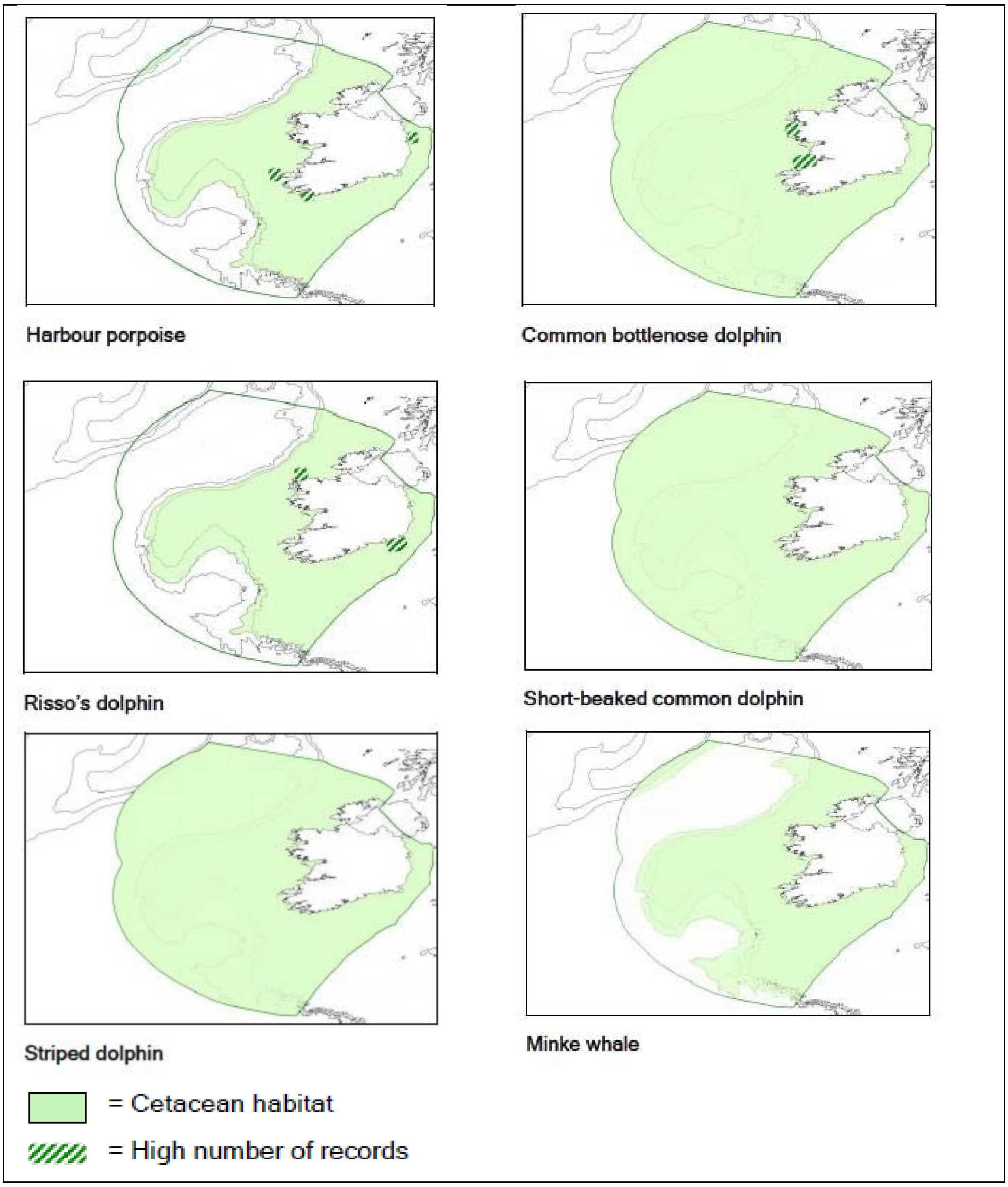


Figure 11.4: Generalised distribution of cetacean species that have been recorded in coastal waters in the Arklow area. (Reproduced from the Department of Arts, Heritage and the Gaeltacht[31])

Common Dolphins are the most frequently recorded dolphin species in Irish waters.

31 Department of Arts, Heritage and the Gaeltacht (2014) Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters – January 2014.

They are recorded in their largest concentrations over the continental shelf and in deeper waters, but are also frequently observed in shallow inshore waters off the south and southwest coasts of Ireland and around the Aran Islands, and in the southern Irish Sea[32,33].

Risso's Dolphins are fairly abundant with a world-wide distribution in tropical and temperate seas, but do not generally penetrate far into high latitudes. They are sighted regularly around the Irish coast, with sightings and strandings concentrated on the south-west and west coast of Ireland, with occasional sightings in the Irish Sea. Risso's Dolphins appear to prefer deep offshore waters but on occasion can be seen close inshore around the Irish coast (Irish Whale and Dolphin Group).

Striped Dolphins are not common in Irish waters, occurring mainly further south in warmer waters. They are recorded annually, mainly off the south west coast of Ireland[32]

Evidence from multi-annual surveillance programmes indicate that Minke Whales occur widely in Irish continental shelf and slope waters, and may do so throughout the year. They have also been recorded in the Celtic Sea and the Irish Sea[32,30].

Information on cetacean distribution, movements and seasonal occurrence in Irish and international waters is relatively recent, and currently concentrations of individual species have been identified in Irish waters only for Harbour Porpoise and Bottle-nosed Dolphin (Refer to Figure 11.4).

Grey Seal *Halichoerus grypus* and Harbour (Common) Seal *Phoca vitulina vitulina* have both been recorded in small numbers in inshore coastal waters in the Arklow area. Both species are listed in Annex II of the Habitats Directive. Important sites for these species are shown in Figure 11.5. Grey Seals are listed as a Qualifying Interest in ten SACs, of which two are on the east/south east coast: Lambay Island SAC, and Saltee Islands SAC. Harbour Seals are listed as a Qualifying Interest in thirteen SACs of which two are on the east/south east coast: Lambay Island SAC, and Slaney River Valley SAC. These SACs are located at distances in excess of 50km from Arklow.

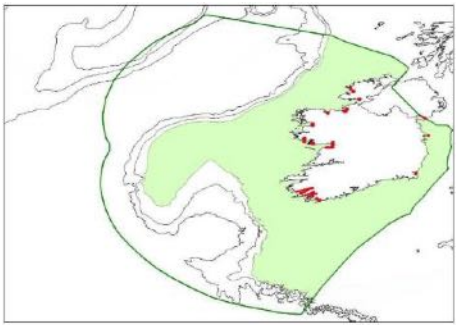
There is a small Grey Seal breeding site at Wicklow Head[34], with seals using small beaches and caves; there are no recent published census data for this colony.

32 NPWS (2013) The Status of EU Protected Habitats and Species in Ireland.

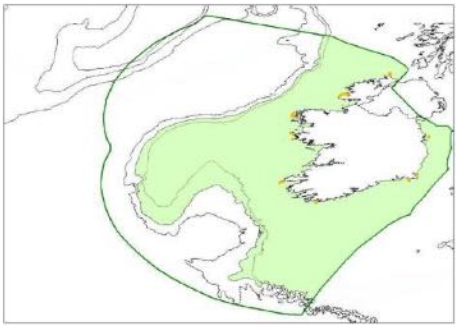
Species Assessments Volume 3, Version 1.0. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

33 Ryan, Conor, Simon Berrow, Alessandro Pierini, Joanne O'Brien, Ian O'Connor and David McGrath (2010) Inshore Boat-based Surveys for Cetaceans. Report to the National Parks and Wildlife Service. Irish Whale and Dolphin Group. pp.33.

34 Ó Cadhla, Oliver, Denis Strong, Ciarán O'Keeffe, Mary Coleman, Michelle Cronin, Callan Duck, Tony Murray, Pascal Dower, Richard Nairn, Paul Murphy, Pat Smiddy, Cyril Saich, David Lyons, Lex Hiby (2008). An assessment of the breeding population of grey seals in the Republic of Ireland, 2005. Irish Wildlife Manuals No. 34. National Parks & Wildlife Service



Harbour Seal; generalised distribution and key breeding and non-breeding haul-out locations



Grey Seal; generalised distribution and key breeding and non-breeding haul-out locations

Figure 11.5: Generalised distribution and key breeding and non-breeding haul-out locations for Harbour Seal (left) and Grey Seal (right). ((Reproduced from the Department of Arts, Heritage and the Gaeltacht[32])

Marine mammals recorded during baseline surveys

Site investigation works have been carried out in the Avoca River estuary and in Arklow Bay, to inform the proposed development (refer to **Chapter 14** for further detail) and a qualified Marine Mammal Observer (MMO) was appointed to monitor for marine mammals and to log all relevant events during those works. A total of 30 MMO watches were carried out during the 30 minutes prior to, and during site investigation works. No marine mammals were recorded. The MMO records are given in **Appendix 11.5**.

There were three sightings of seals during bird surveys of coastal waters in Arklow Bay as outlined in Table 11.5. A single Harbour Seal was recorded on 28 January 2017, approximately 500m offshore opposite the caravan park; it had caught a large fish and was being mobbed by two Lesser Black-backed Gulls, 15 Herring Gulls, and up to 30 Black-headed Gulls.

A single Grey Seal was recorded on 24 February 2017, feeding aproximately 80m offshore opposite the southern end of Arklow Pond. Five Grey Seals were recorded on 29 November 2017 at low tide, between 50 and 300m offshore opposite Arklow Pond; these animals appeared to be resting, their bodies including their heads held vertically in the water.

Table 11.5: Seal records in coastal waters in Arklow Bay during baseline bird surveys

Species/ count date	**24.11.16**	**8.12.16**	**28.01.17**	**24.02.17**	**29.11.17**	**13.02.18**
Harbour Seal			1			
Grey Seal				1	5	

11.3.6 Aquatic Ecology

11.3.6.1 General

The Avoca River is formed by the joining of the Avonmore and Avonbeg rivers. The Avonmore River flows from Lough Dan, just west of Roundwood, and flows in a generally south-eastern direction for approximately 30 km before meeting the Avonbeg River (which rises near Table Mountain at the top of Glenmalure valley), just north of the village of Avoca, and becoming the Avoca River. The Avoca River is located within Hydrometric Area 10 (HA10) along with the Vartry River and the Dargle River.

The Avoca River continues to be one of the most seriously polluted rivers in Ireland due to acid mine drainage at Avoca Mines, just upstream of the village of Avoca[35]. This pollution has had, and continues to have, serious impacts on the macroinvertebrate and fish populations of the river. These impacts are most severe closest to the Avoca Mines site and are having a lesser effect downstream; an effect that appears to be diminishing over time[36].

The effects of the acid mine drainage from the Avoca Mines extends all the way to the estuary of the Avoca River. The Avoca River Estuary is the only transitional or coastal waterbody in Ireland to fail for chemical status under the Water Framework Directive (WFD) assessment due to the levels of substances that are not ubiquitous in the water environment[35].

The rehabilitation of the Avoca Mines site is an on-going issue, with a feasibility study completed in 2008[37], and is under the authority of the Department of Communications, Climate Action and Environment.

In addition to the acid mine drainage impacting on the Avoca River for much of its length, the lack of a waste water treatment plant for Arklow and its environs has resulted in untreated wastewater being discharged into the Avoca River Estuary. This is impacting water and sediment quality within the estuary and is likely to be having an impact outside the mouth of the estuary also.

11.3.6.2 Fish

The Avoca River catchment is an important salmonid water with excellent populations of Salmon, Sea Trout and Brown Trout throughout.

35 Fanning, A. Craig, M., Webster, P., Bradley, C., Tierney, D., Wilkes, R., Mannix, A., Treacy, P., Kelly, F., Geoghegan, R., Kent, T. and Mageean, M. (2017) Water Quality in Ireland 2010-2015. Environmental Protection Agency, Johnstown Castle, Co. Wexford.

36 Gray, N.F. and Delaney, E. (2010) Measuring community response of benthic macroinvertebrates in an erosional river impacted by acid mine drainage by use of a simple model. Ecological Indicators 10: 668-675.

37 CDM (2008) Feasibility Study for Management and Remediation of the Avoca Mining Site. Investigative Reports: Volume 1. Report prepared by CDM for The Department of Communications, Energy and Natural Resources.

It is a large mainly upland catchment, with many varying habitats for fish, excellent species diversity and a good fishery potential. According to the Central Fisheries Boards[38], a total of 261 discrete migratory salmonid 'fishery systems' were identified nationally, of which 173 are recorded as 'salmon and sea trout' and 88 as sea trout only. The Avoca River system ranked 17th overall with regard to the fluvial habitat accessible to Salmon.

Despite the negative impacts on the Avoca River from the acid mine drainage and the release of untreated sewage, the river and estuary continue to support a diverse fish population. Surveys of the Avoca River Estuary carried out by Inland Fisheries Ireland[39,40,41] under the Water Framework Directive (WFD) recorded a total of 15 species across the two earlier sampling periods (2008 and 2010), and a total of 16 species recorded in 2015, with some variation in the species recorded during each of the surveys (Refer to Table 11.6).

The outcome of the above sampling was the Avoca River Estuary being classed as 'Moderate' status for the fish populations in both the 2008[39] and 2010[40] sampling periods. The Avoca River Estuary was classified as 'Good' status for fish populations in 2015[41]. The overall WFD status of the Avoca Estuary for the period 2010 to 2015 is moderate (Refer to **Chapter 15** for further detail - EPA data, Site Code IE_EA_150_0100).

In the course of the current survey, Minnow were recorded at stations S4-6, Three-spined stickleback at stations S4, S6 and S7, while two lamprey ammocoetes (larva) were recorded at S6.

A number of the species recorded in the WFD sampling are particularly notable, in that they are listed under Annex II of the Habitats Directive, namely Atlantic Salmon *Salmo salar* and River Lamprey *Lampetra fluviatilis*, while the European Eel is listed as Critically Endangered. Though not recorded in the course of the IFI surveys, Sea Lamprey (*Petromyzon marinus*) are also known from the Avoca River, and are also listed under Annex II of the Habitats Directive.

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38 McGinnity, P.,Gargan, P.,Roche, W., Mills, P. & McGarrigle, M. 2003. Quantification of the Freshwater Salmon Habitat Asset in Ireland using data interpreted in a GIS platform. Irish Freshwater Fisheries, Ecology and Management Series: Number 3, Central Fisheries Board, Dublin, Ireland.

39 Kelly, F., Harrison, A., Connor, L., Wightman, G., Matson, R., Morrissey, E., O'Callaghan, R., Feeney, R., Hanna, G., Lordan, M. and Rocks, K. (2009). Sampling Fish for the Water Framework Directive – Transitional Waters 2008. Avoca Estuary. The Central and Regional Fisheries Boards.

40 Kelly, F., Harrison, A., Connor, L., Matson, R., Morrissey, E., O'Callaghan, R., Feeney, R., Wögerbauer, C., Hanna, G., Gallagher, K. and Rocks, K. (2011). Sampling Fish for the Water Framework Directive – Transitional Waters 2010. Avoca Estuary. Inland Fisheries Ireland.

41 Ryan, Diarmuid, Roisín O'Callaghan, Will Corcoran, John Coyne & William Roche (2015). Water Framework Directive Fish Stock Survey of Transitional Waters in the Eastern River Basin District – Avoca Estuary 2015. Inland Fisheries Ireland

Table 11.6: Results of Inland Fisheries Ireland sampling carried out in 2008, 2010, and 2015 (Source: Kelly et al, 2009; 2011, Ryan et al, 2015), with Red List status (IUCN, 2018, King et al, 2011[42])

Scientific name	Common name	2008	2010	2015	Global status *	Irish status *
Chelon labrosus	Thick-lipped Grey Mullet	225	31	2	LC	-
Platichthys flesus	Flounder	36	97	152	LC	-
Anguilla anguilla	European Eel	20	9	12	CR	CR
Ciliata mustela	Five-bearded Rockling	6	-	11	LC	-
Lampetra fluviatilis	River Lamprey	5	9	1	LC	LC
Gasterosteus aculeatus	Three-spined Stickleback	5	2	3	LC	LC
Salmo trutta	Brown/Sea Trout	3	4	2	LC	LC
Melanogrammus aeglefinus	Haddock	2	1		VU	-
Merlangus merlangus	Whiting	2	-		LC	-
Pomatoschistus minutus	Sand Goby	1	21	258	LC	-
Sprattus sprattus	Sprat	1	-		DD	-
Salmo salar	Atlantic Salmon	1	-	16	LC	VU
Spinachia spinachia	Fifteen-spined Stickleback	-	2		LC	-
Gadus morhua	Cod	-	1	1	VU	-
Syngnathus acus	Greater Pipefish	-	1		LC	-
Ammodytes tobianus	Lesser sandeel	-	-	14	DD	-
Taurulus bubalis	Long-spined sea scorpion	-	-	1	LC	-
Pleuronectes platessa	Plaice	-	-	2	LC	-
Pollachius pollachius	Pollack	-	-	7	LC	-
Trisopterus minutus	Poor cod	-	-	1	LC	-
Atherina presbyter	Sand smelt	-	-	28	LC	-

Note: Results are not directly comparable between years owning to differences in the survey methodology employed – e.g. beam trawl used in 2010, but not 2008. CR = Critically Endangered, VU = Vulnerable, LC = Least Concern, and DD Data Deficient.

42 King, J.J., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., Fitzpatrick, Ú., Gargan, P.G., Kelly, F.L., O' Grady, M.F., Poole, R., Roche, W.K. and Cassidy, D. (2011) Ireland Red List No. 5: Amphibians, Reptiles and Freshwater Fish. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

The deep and slow flowing nature of the Avoca River within the surveyed study area does not provide suitable spawning habitat for salmon or lamprey species, which require shallower, faster flowing water over suitable spawning gravels. The presence of lamprey ammocoetes just upstream of the M11 flyover, suggests they may also be present downstream of the bridge. After hatching, ammocoetes inhabit silt beds for a number of years, feeding by filtering organic particles out of the water column, before transforming into an adult migrating to the river estuary or to sea[43]. Very slow-flowing or still areas of the Avoca River within the in-river working areas may support such habitat.

Salmon and trout require passage through the lower reaches of the Avoca River to reach spawning grounds further up the system and the area may also support smolts and adults for a period of time on their way to sea or upriver, respectively. The Avoca River supports a spring and summer salmon run, with adults returning from sea, passing through the estuary and moving upstream during this period. Sea trout adults return to the Avoca River in summer. Following hatching, salmon and trout develop through a number of stages over the course of a number of years before undergoing physiological change (smoltification) to become smolts and be ready to go to sea. There are a range of factors that determine the exact timing of the movement of smolts to sea, including water temperature and photoperiod[44,45] however, the seaward migration takes places over the spring to summer period.

Following metamorphosis to adults, River Lamprey migrate to estuaries and the sea, where they spend one to two years feeding.

In Ireland, migration of adults back upstream for spawning takes places over a protracted period from late summer to autumn[46], while downstream movement of newly metamorphosed adults peaks in March-April[47].

Sea Lamprey migrate into rivers for spawning in spring[43], while the seaward movement of newly metamorphosed adults takes place in autumn and into winter[46].

European Eels also require passage through the lower reaches of the Avoca River on their migration from spawning grounds at sea to rivers where they spend most of their lives.

43 Maitland, P.S. (2003) Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough.

44 McCormick, S.D., Hansen, L.P., Quinn, T.P. and Saunders, R.L (1998) Movement, migration, and smolting of Atlantic salmon (Salmo salar). Canadian Journal of Fisheries and Aquatic Sciences 55(suppl. 1): 77-92.

45 Byrne, C.J., Poole, R., Dillane, M., Rogan, G. and Whelan, K.F (2004) Temporal and environmental influences on the variation in sea trout (Salmo trutta L.) smolt migration in the Burrishoole system in the west of Ireland from 1971 to 2000. Fisheries Research 66(1): 85-94.

46 Kelly, F.L. and King, J.J. (2001) A review of the ecology and distribution of three lamprey species, Lampetra fluviatilis (L.), Lampetra planeri (Bloch) and Petromyzon marinus (L.): a context for conservation and biodiversity considerations in Ireland. Biology and Environment: Proceedings of the Royal Irish Academy 101B(3): 165 – 185.

47 Hardisty, M.W., Potter, I.C. and Sturge, R. (1970) A comparison of the metamorphosing and macroph-thalmia stages of the lampreys, Lampetra fluviatilis and Lampetra planeri. Journal of Zoology (London) 162: 383–400.

Adult European Eels move to sea in the autumn[48], while glass eels (young eels migrating from the spawning grounds to rivers) move upstream in spring[49].

Inland Fisheries Ireland[50] notes the following fish in coastal waters in the vicinity of Arklow: off-shore sandbanks dogfish, ray, codling, whiting and tope; shore angling bass, dabs, sole, flounder, plaice, Sea Trout and Mackerel further south off Clogga. Commercial fishing by boats based in Arklow Harbour is mainly for whelk.

11.3.6.3 Otter

Otters are listed under Annex II and Annex IV of the Habitats Directive and are protected under the Wildlife Acts 1976 to 2018.

Evidence of otter activity was noted within the study area in the course of the current survey. Otter spraint was recorded at two locations along the south bank of the Avoca River (Refer to Plate 1 in **Appendix 11.6**) between the M11 flyover and the start of the built-up banks in Arklow Town.

The area is prone to disturbance from human activity and dogs due to the path that runs along the river.

11.3.6.4 Freshwater Macroinvertebrates

The macroinvertebrate community of the Avoca River was sampled at six locations on the main channel and at one location on the channel that runs in a south-easterly direction through Arklow Town Marsh (Refer to **Figure 11.2 in Volume 3** and **Appendix 11.6**).

The most downstream sample station on the Avoca River (S1) shows the estuarine influence on the macroinvertebrate community with a high abundance of the shrimp *Gammarus chevreuxi*, while the high numbers of the worm *Lumbriculus variegatus* present at this site point towards issues of organic pollution. This site also had the lowest species richness, with eight species or higher taxa recorded.

Conversely, the most upstream site on the Avoca River (S6) had the highest species richness, with 21 species or higher taxa recorded.

This site supported high numbers of the cased caddisfly larva *Mystacides azurea*, with two other cased caddisfly species present (*Sericostoma personatum* and *Potamophylax latipennis*). Cased caddisfly larvae are considered ‘Less sensitive’ or Group B on the EPA scale of sensitivity to organic pollution that runs from ‘Sensitive’ (Group A) to ‘Most tolerant’ (Group E). The larvae of two damselfly species were also recorded (Beautiful demoiselle *Calopteryx virgo* and Large Red Damselfly *Pyrrhosoma nymphula*), which are also Group B.

48 Sandlund, O.T., Diserud, O.H., Poole, R., Bergesen, K., Dillane, M., Rogan, R., Durif, C., Thorstad, E.B., Asbjørn Vøllestad, L. (2017) Timing and pattern of annual silver eel migration in two European watersheds are determined by similar cues. Ecology and Evolution 7:5956–5966.

49 Anonymous (2008) National Report for Ireland on Eel Stock Recovery Plan Including River Basin District Eel Management Plans. Report prepared by the Inland Fisheries Division of The Department of Communications, Energy and Natural Resources, Dublin

50 Dunlop, Norman (2009). A Guide to Sea Angling in the Eastern Fisheries Region. Inland Fisheries Ireland

The sample station within the channel through Arklow Town Marsh (S7) was dominated by mollusc species including the Wandering Pond Snail (*Radix peregra*) and the Common Bladder Snail (*Physa fontinalis*). This reflects the very slow-flowing or still nature of the water at this site, which was dominated by aquatic plants including Branched Bur-reed (*Sparganium erectum*), Fool's-water-cress (*Apium nodiflorum*) and Reed Canary-grass (*Phalaris arundinacea*).

A full list of freshwater macroinvertebrate species and abundances recorded in the survey is presented in **Appendix 11.6** (Refer to Table A1, with field data in Table A2).

There are no records of the protected White-clawed Crayfish (*Austropotamobius pallipes*) from the Avoca River catchment, due to the low pH and alkalinity conditions created by the underlying geology[51].

Three Margaritifera Sensitive Areas lie upstream of the proposed development:

- Avoca - Aughrim; catchment of extant population;
- Avoca – Upper Avonmore; catchment of extant population; and
- Avoca – Lower Avonmore; catchments with previous records of Margaritifera, but current status unknown.

The Freshwater Pearl Mussel *Margaritifera margaritifera* is listed in Annex II of the Habitats Directive, and has been recorded in the Aughrim and Avonmore tributaries as noted above, but not in the Avoca River.

11.3.6.5 Intertidal Habitat

The intertidal habitats of the Avoca River Estuary are highly modified. The estuary banks comprise sheet piles, rock armour and concrete retaining walls (Refer to Plate 8 in **Appendix 11.6**). The intertidal habitat is limited to these surfaces and to a narrow strip of cobble, pebble and occasional sand, with abundant rubble on both sides of the estuary and the gravel banks in the river channel downstream of the bridge (Refer to Plate 9 and 10 in **Appendix 11.6**). Green algae (*Enteromorpha* spp.) and brown filmy algae coat the lower zone of the rock armour, with yellow and white lichens present in the upper zone (Refer to Plate 11 in **Appendix 11.6**). No marine invertebrate epifauna were noted within the estuary.

Evidence of pollution by sewage was present in the form of sewage fungus at a flap valve on the South Quay and an accumulation of toilet paper and sanitary towels nearby (Refer to Plate 12 and 13 in **Appendix 11.6**).

The location of the proposed outfall comprises a shore protected by rock armour at the revetment.

51 Lucey, J. and McGarrigle, M.L. (1987) The distribution of the crayfish Austropotamobius pallipes (Lereboullet) in Ireland. Irish Fisheries Investigations Series A (Freshwater). No. 29.

The lower section of the rock armour supports a limited biotope of green algae (often bleached white), below which occurs a zone of carrageen (*Chondrus crispus*), spiral wrack (*Fucus spiralis*), common limpet (*Patella vulgata*) and barnacles, above a zone supporting kelp (*Laminaria digitata*), sugar kelp (*Saccharina latissima*) and red algae (Refer to Plate 7 in in **Appendix 11.6**).

In summary, the intertidal habitat of the study area is highly modified by human activity and supports very few species, constituting habitats of low ecological value.

11.3.6.6 Estuarine and marine benthic macroinvertebrates

There is limited published information on the benthic ecology of the waters around Arklow; however, the habitats along the east coast of Ireland are similar along much of the coastline. A benthic survey was carried out as part of the EIA of the proposed Arklow Waste Water Treatment Works in the late 1990s[52].

This survey noted that an *Abra alba*-dominated community accounts for the majority of the sample stations surveyed, resembling similar communities recorded in the Irish Sea[53,54]. A number of other molluscs, polychaete worms and crustaceans were also recorded in the course of the survey. It was found that species richness and abundance were low close to the mouth of the Avoca River, with the presumed cause to be the high contamination content due to the Avoca Mines upstream. Metal contamination is known to be impacting the riverine fauna[55, 37] and so the effect is likely to extend into the estuary and surrounding waters.

The benthic survey carried out as part of the current study recorded a total of 1077 individuals represented by 49 species or higher taxa (Refer to **Figure 11.3 in Volume 3**, Table A3 and Table A4 in **Appendix 11.6**). Major invertebrate groups present included Annelida (23 taxa), Mollusca (8 taxa), Crustacea (8 taxa) and Echinodermata (4 taxa), with Nemertea, Ascidiacea, Hexacorallia and Insecta also present. The white furrow shell (*Abra alba*) was the most common species and was present in all but one of the samples taken outside the estuary.

Sample Station 7 was the most species rich of the stations sampled with 19 species, while Station 11 was the least species rich with 1 species as outlined in Table 11.7; Station 11 was located within the estuary. Station 9 scored the highest in terms of diversity and evenness (due to the fact that only a single specimen of each species was present). No diversity or evenness score could be calculated for Station 11 as only a single specimen of a single species was recorded. Stations with lower diversity and evenness scores tended to be those with a high proportion of a single taxon, such as *Abra alba* or Enchytraeidae.

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52 Anonymous (1999) Arklow Waste Water Treatment Works Environmental Impact Statement. Arklow Urban District Council/P.H. McCarthy & Partners. 90pp.

53 Anonymous (2015) Proposed Cruise Terminal, Dún Laoghaire, Co. Dublin. Environmental Impact Statement, prepared by Stephen Little & Associates on behalf of Dún Laoghaire Cruise Stakeholder Group.

54 Walker, A.J.M. and Rees, E.I.S. (1980) Benthic ecology of Dublin Bay in relation to sludge dumping. Irish Fisheries Investigation Series B 22:1-59.

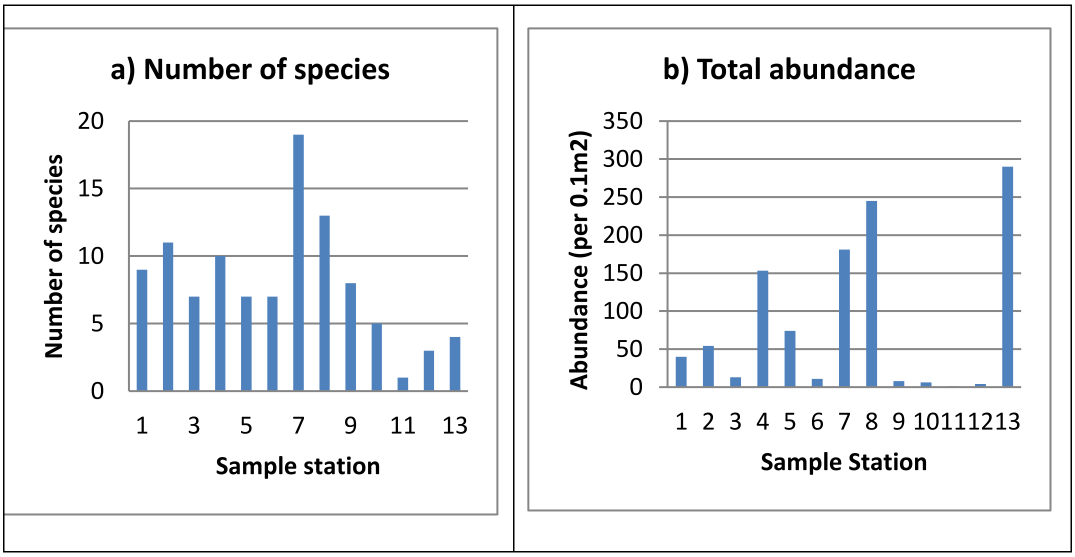
55 Gray, N.F. (1998) Acid mine drainage composition and the implications for its impact on lotic systems. Water Research 32(7): 2122-2134.

Table 11.7: Univariate ecological indices based on macroinvertebrate community.

Station	Number of species	Abundance (per sampling area)	Pielou's evenness	Shannon-Wiener diversity (natural logarithm base)
1	9	40	0.69	1.52
2	11	54	0.72	1.73
3	7	13	0.95	1.84
4	10	153	0.52	1.20
5	7	74	0.52	1.01
6	7	11	0.93	1.80
7	19	181	0.61	1.80
8	13	245	0.44	1.14
9	8	8	1.00	2.08
10	5	6	0.97	1.56
11	1	1	N/A*	N/A*
12	3	4	0.95	1.04
13	4	290	0.29	0.40

*No diversity or evenness score could be calculated for Station 11 as only a single specimen of a single species was recorded.

The univariate statistics scores are represented graphically in Figure 11.6. The three groups of sample stations, based on the statistical analysis of the macroinvertebrate species present, were stations 1-8, stations 9 and 10, and stations 11-13. Stations 1-8 represent the sand communities from outside the estuary, stations 9 and 10 represent the slightly gravelly sands outside the estuary, while stations 11-13 represent the sites within the estuary that are heavily influenced by the freshwater of the Avoca River (and the low species diversity caused by pollution from the mines upstream and the untreated wastewater from Arklow town).



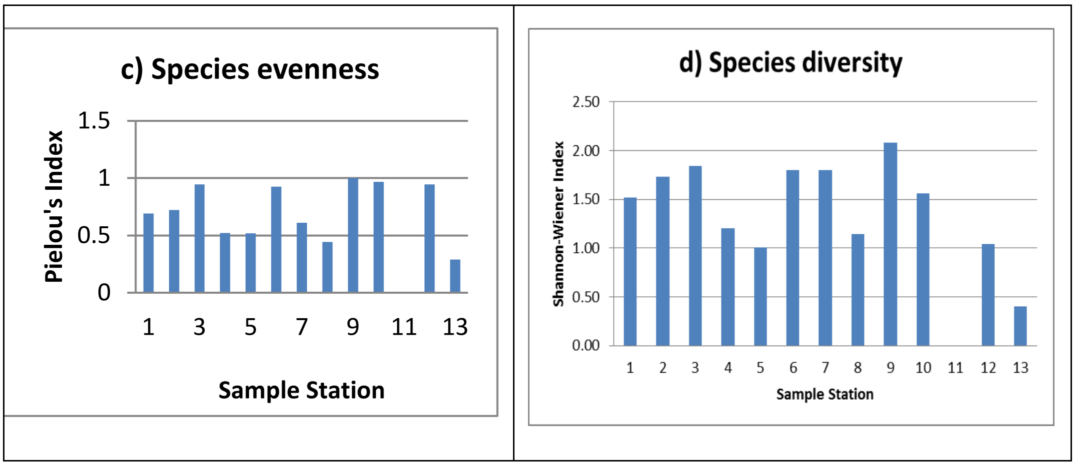


Figure 11.6: Univariate ecological indices based on macroinvertebrate community

The benthic macroinvertebrate community of Avoca River Estuary and the surrounding waters is largely dependent on the salinity and sediment type (Refer to Table A5 in **Appendix 11.6**). Within the estuary, where the salinity was low (≤1.3 PSU) and where the sediment was classed as mud (with leaf debris), the community is quite different from those outside the harbour where more sandy sediment is recorded. The sediment analysis revealed a pattern broadly similar to the macroinvertebrates, as would be expected, with four grouping: stations 11 and 12, stations 1, 4, 5, 7, and 8, stations 3 and 6, and stations 2, 9 and 10, with Station 13 very different from the others. Station 13, in the upstream part of the estuary, stands out from the rest of the samples on the basis of species and sediment as illustrated in Figure 11.7 and Figure 11.8.

The sediment was considerably more gravelly than any of the other samples, likely to be the result of higher current flows just downstream of Arklow Bridge. While stations 11 and 12 separated out together, this was on the basis of total organic carbon, as the sample at Station 12 was comprised entirely of tree leaves and the sample at Station 11 was comprised of mud and leaves. While stations outside the estuary were more sandy than those inside, silt & clays did still occur. This is due to localised variations in current flows due to bottom and/or coastal topographical variation.

The *Abra alba*-dominated community present at stations 1-8 is classified as ***Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (SS.SSa.CMuSa.AalbNuc)** (Connor *et al*., 2004). Stations 9 & 10 could not be defined further than **Infralittoral fine sand (SS.SSa.IFiSa)**, while stations 11-13, within the Avoca River Estuary are so heavily influenced by freshwater input and lacking in marine fauna, that no biotope was assigned.

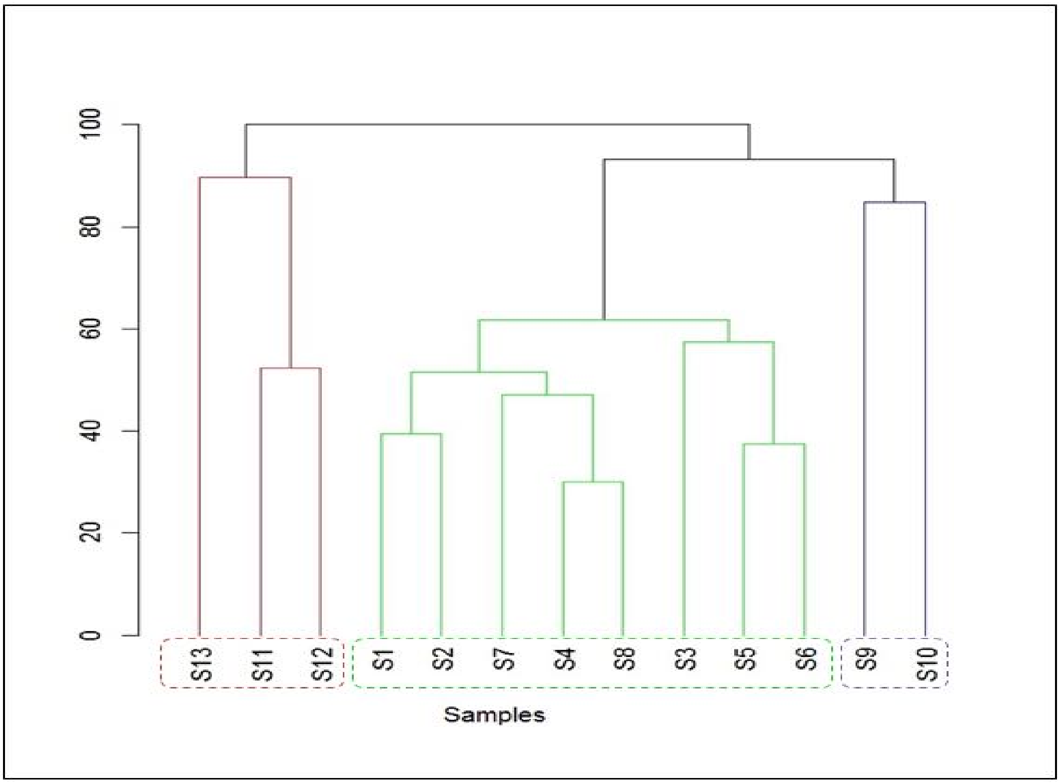


Figure 11.7: Cluster analysis showing significant (SIMPROF, $P < 0.05$) invertebrate community structure groupings among sampling sites (indicated with broken lines) based on Bray-Curtis similarities

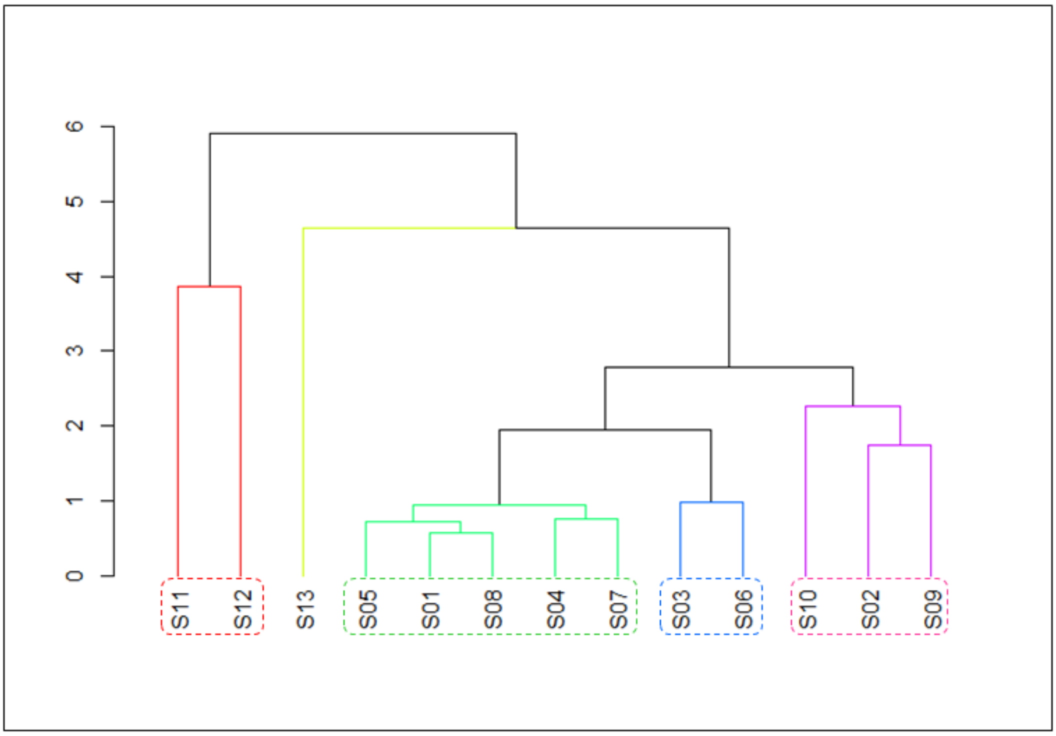


Figure 11.8: Cluster analysis showing significant (SIMPROF, $P < 0.05$) sediment characteristics groupings among sampling sites (indicated with broken lines) based on Euclidian distances**.**

11.3.6.7 Conclusion

The freshwater, estuarine and marine ecology in the vicinity of the proposed development has been described through field survey and desk study. The area is highly modified by human activity through the construction of retaining walls, breakwaters and stretches of rock armour, with the river impacted by acid mine drainage from the Avoca Mines upstream and the estuary also influenced by the input of untreated wastewater.

The species richness of the freshwater macroinvertebrate community is somewhat reduced at most of the sites as compared to what might be expected in a river such as the Avoca. This is due to the fact that the Avoca River is still recovering from the effects of acid mine drainage, which continues to have an influence on water quality. No rare or protected macroinvertebrate species were recorded in the course of the surveys or desk study.

Otters occur within the study area and are likely to make use of both banks of the river. The north bank is less prone to disturbance than the south bank and so is likely to provide better opportunities for otters in terms of resting up areas or the location of holts.

The three sample stations within the estuary (stations 11-13) lacked marine species and, with the exception of the oligochaete worms, the few animals recorded are likely to have washed down from upstream.

The low salinity of the estuary would likely play a factor in the low species richness and abundance, but the pollution caused by metals washed down from the Avoca mines upstream and the input of untreated wastewater into the estuary from Arklow town are likely to be combining to cause the depauperate benthic community of the Avoca River estuary, with the effect extending out into the Irish Sea.

The benthic community outside the Avoca Estuary has a depressed species richness compared to what might be expected from the habitat present. It is likely that the discharge of the Avoca River is having an influence in terms of contaminant load, as suggested in the previous benthic survey[52]. The area is dominated by a single biotope *Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment, which is present at stations 1-8 and tallies with the findings of the previous survey[52]. This biotope is common and widespread along the east coast of Ireland.

Sample stations 9 and 10 were assigned to the higher category Infralittoral fine sand due to the lack of defining species. The separation of these stations from the other marine stations is likely to be due to the sediment type and their more inshore location.

While the intertidal and estuarine habitats of the study area are of low ecological value, the estuary does continue to support a fish community and provides a corridor for fish that may successfully migrate through to cleaner waters upstream of the polluting influence of the mines[40,56].

11.4 Likely Significant Effects

11.4.1 Do-Nothing Scenario

If the proposed development were not carried out, significant adverse effects on aquatic ecology and biodiversity in the Avoca River and Estuary in Arklow, and in adjoining coastal waters arising from the discharge of untreated wastewater would continue to occur.

11.4.2 Assessment of Effects during Construction

11.4.2.1 Terrestrial Biodiversity Habitats and Flora

Southern side of the Avoca River

Alps and River Walk

Construction of the Alps SWO and stormwater storage tank will require the removal of existing vegetation, and rock breaking. This will impact on Gorse and Bramble dominated **Scrub WS1** and **Exposed Siliceous Rock ER1,** species poor Bramble and Buddleia dominated **Scrub WS1 and WS3**, and on Ash and Sycamore regrowth. There is a potential for ground disturbed in this area to re-vegetate with Buddleia, which would tend to develop a dominant tall scrub cover within which native plant species would be supressed, reducing biodiversity in the short, medium and long term with significant negative local effects (Refer to **Appendix 11.2**).

Temporary sheet piling at the southern end of this working area has the potential to cause root severance of a mature Sycamore tree, however this tree will be removed to facilitate construction.

The interceptor sewer will be constructed using open cut methods on the upstream, land based sections on River Walk (i.e. between MHS1-MHS8) and construction activities on River Walk (Working areas S8 – S10) will occur during October to March following consultation with Wicklow County Council. Interceptor sewer invert levels are between 2m - 4m below existing ground level in this section, therefore it is likely that the roots of mature trees growing in a semi-continuous **Treeline WL2** within a narrow strip (maximum width 7m) of mown amenity grassland along River Walk will be severed during these works. It is therefore assumed that in the reasonable worst case scenario almost all of the existing trees along the Avoca River bank within the planning boundary of the proposed development will be removed during construction.

56 Fahy, E. and Reynolds, J. (1987) The Avonmore Brown Trout Fishery at Rathdrum, Co. Wicklow. Fishery Leaflet No. 137. Department of the Marine, Dublin.

Three mature trees will be retained along River Walk near the Alps; two weeping willow and one mature Hawthorn (Refer to **Chapter 13** for further detail). Likely significant effects on trees during construction are assessed as negative locally significant.

Mown **Amenity grassland GA2** along the Avoca River bank is likely to be removed during construction in working areas S2 and S3. Working areas S7, S8 and S11 along River Walk extend marginally into the Avoca River channel and are required to facilitate traffic movements around the adjoining working areas on the landside of River Walk. A temporary trafficable surface will be installed as part of the enabling works requiring the removal of **Amenity grassland GA2,** young trees planted within the amenity grassland, and of two Silver birch trees growing on the edge of the river bank. Likely significant effects during construction are assessed as negative locally significant.

The interceptor sewer will be constructed within the existing tarmac surface **Buildings and artificial surfaces BL3** of River Walk.

Direct effects on terrestrial habitats and flora at the Alps SWO and stormwater tank site and along River Walk to Arklow Bridge are assessed as being of negative local significance during construction, because biodiversity along the Avoca River corridor is higher upstream of Arklow Bridge than it is downstream, and because mature trees supporting high levels of bat feeding activity, will be removed. The amenity value of this area is separately in **Chapters 13 and 17** (Refer to **Appendix 13.2** for the tree survey report).

South Quay

Downstream of Arklow Bridge, the construction of interceptor sewers within terrestrial habitats will impact on **Buildings and artificial surfaces BL3, Amenity grassland GA2,** and on young trees planted in a narrow strip of amenity grassland along the south quay wall; these will be removed. **Amenity grassland GA2** and some mature ornamental trees at South Green are likely to be removed during construction. Likely significant effects on these habitats are assessed as being of moderate negative local significance during construction, because biodiversity is lower downstream of Arklow Bridge, and most of the trees that would be removed are young. The amenity value of this area is discussed separately in **Chapters 13 and 17** (Refer to **Appendix 13.2** for the tree survey report).

Existing vegetation of **Spoil and bare ground ED2** and **Recolonising bare ground ED3** at the temporary construction area to the south of the Harbour at South Quay (working area S19) will be removed. This direct effect is assessed as being of moderate negative local significance during construction because biodiversity is lower downstream of Arklow Bridge and the area has been recently used as a compound for other developments.

Assessment of effects on aquatic habitats in this area during construction are discussed in **Section 11.4.2.6**.

Northern side of the Avoca River

The working area to the west of Arklow Bridge (Working area N1), includes **Scrub WS1** growing on steeply sloping ground along the north bank of the Avoca River, which will be used temporarily to support construction works located within an area vegetated with sparse colonising vegetation of **Spoil and bare ground ED2.** All vegetation will be cleared to facilitate construction. This direct effect is assessed as being of moderate negative local significance for terrestrial flora and habitats. Likely significant effects on aquatic ecology in this area during construction are discussed in **Section 11.4.2.6**.

To the east of Arklow Bridge, a **Treeline WL2**, mainly of young ornamental trees planted in a 2m wide strip of ground between the road and the quay wall will be removed, together with occasional patches of Bramble, Gorse, grass and herbaceous vegetation. This direct effect is assessed as being of slight negative local significance for terrestrial flora and habitats, since this vegetation is subject to existing disturbance arising from maintenance of the quay wall and is in poor condition.

Habitats and flora at the WwTP site and adjoining working areas

All of the existing vegetation on this site as described in **Section 11.3.2.4** will be removed. This direct effect is assessed as being of moderate negative local significance for terrestrial flora and habitats.

11.4.2.2 Invasive Plant Species

Two non-native plant species listed in Part 1 of the Third Schedule of the European Communities (Birds and Natural Habitats Regulations 2011-2015 were recorded within the planning boundary in working areas:

- Sea-buckthorn *Hippophae rhamnoides*, a medium risk of impact, non-native plant species listed in Part 1 of the Third Schedule of S.I No.477 of 2011 occur in roadside planting at the Harbour on the South Quay (see **Figure 11.7 in Volume 3**). There is a potential for this species to spread during construction if seeds or plant parts are transported from this area by construction machinery, in the absence of management measures given in **Appendix 11.2**, and
- Spanish bluebell, a low risk of impact, non-native plant species listed in Part 1 of the Third Schedule of S.I No.477 of 2011 (see **Figure 11.7 in Volume 3**).

Two additional non-native invasive plant species, listed in the Guidelines[10], were recorded in, and in the immediate vicinity of the proposed development:

- Buddleia / Butterfly Bush *Buddleja davidii*: Medium risk of impact; present in many areas as a mature shrub and as seedlings, not mapped; and
- Montbretia *Crocosmia X crocosmiiflora*; a single stand recorded on the revetment adjoining the WwTP site.

Management measures for these species are given in **Appendix 11.2**.

11.4.2.3 Birds

There is limited potential for disturbance, displacement, or habitat loss arising from the proposed development to affect the distribution of waterbirds recorded during baseline surveys, as construction activities will not extend to the main area of gravel banks within the Avoca River and Estuary used primarily by roosting, bathing and preening gull species. Waterbird numbers recorded were well below the threshold levels for national and international importance, where these have been determined. Gull species are not considered likely to be displaced from any of the areas in which they have been recorded during construction, either in estuarine or coastal waters. Likely effects during construction are assessed as not significant.

Amenity grassland along the south bank of the Avoca River at River Walk is used by Mallard and feral Greylag geese; this habitat will be largely removed during construction, and these waterbirds will be displaced to other areas in the vicinity including the Avoca River channel and estuary, and to Arklow Pond, which will not be affected by construction activities. Feral Greylag geese are not considered to be of conservation interest. Likely effects during construction are assessed as not significant.

Three species listed on Annex 1 of the Birds Directive were recorded during baseline surveys. A single Red-throated Diver was recorded on one occasion in coastal waters off Arklow. A single Greenland White-fronted Goose was recorded as a juvenile in December 2016, the presumed same bird remained in the area and was last recorded in February 2018. It is not expected that individual birds of either species will be affected by the proposed development, since their main areas of distribution are not located in the Arklow area. Single Kingfishers were recorded flying along the north bank of the River on three occasions during baseline surveys, and it is considered likely that there is a Kingfisher breeding territory in the area.

The river banks within the planning boundary are not suitable for Kingfisher nesting as Kingfishers prefer vertical or near vertical banks at least 1-2m high[57] and the river banks within the planning boundary are substantially lower than this. Potentially suitable banks were noted upstream along the Avoca River in the general vicinity of the M11 flyover. It is not expected that Kingfishers will be displaced from any breeding territory in the immediate area during construction of the proposed development. Likely effects on Annex 1 listed bird species during construction are assessed as not significant.

57 Cummins, Sinéad, Jennifer Fisher, Ruth Gaj McKeever, Laura McNaghten, and Olivia Crowe (2010). Assessment of the distribution and abundance of Kingfisher Alcedo atthis and other riparian birds on six SAC river systems in Ireland. A report commissioned by the National Parks and Wildlife Service and prepared by BirdWatch Ireland.

Loss of mature trees and scrub within the planning boundary and the demolition of existing buildings at the WwTP site, have the potential to result in the loss of active nests of passerine bird species, and mortality of eggs and nestlings, if felling and clearance works are carried out between 1 March and 31 August, however construction along River Walk will occur during October to March. Likely effects are assessed as significant negative during construction, in the absence of mitigation.

11.4.2.4 Bats

The modifications or features introduced by the proposed development that are relevant to bats are:

- Vegetation clearance;
- Bridge underpinning and grouting works;
- Lighting;
- Building demolition at the WwTP site; and
- New building and vegetation screening.

These modifications have the potential to affect bat roosts, and bat feeding and commuting. A Derogation Licence (No. DER/BAT 2018 – 73) has been issued for the proposed development (Refer to **Appendix 11.7**).

Bat roosts

There will be tree felling and some scrub removal along the river including at the Alps SWO and stormwater storage site to the south of the Avoca River. It is likely that some of the mature trees along River Walk between the Alps and Arklow Bridge will be removed during the construction of the interceptor sewer, thus there is also the removal of the existing bat boxes along the riverfront. These offer roosting opportunities specifically geared towards bats.

The tree felling at The Alps also creates the risk of roost loss and injury to bats if not examined prior to such operations. The removal of a mature Sycamore near the ruins of Arklow Castle may facilitate access by bats to this known roost site.

Underpinning and associated repairs to the southernmost two arches of Arklow Bridge will remove crevices used by bats as roost sites. In addition to roost loss, there is the possibility of death or injury to roosting bats if repair work were to be undertaken without an examination for bats in advance of repairs. Likely direct effects would be significant negative in the absence of mitigation.

On the north side of the Avoca River immediately upstream of Arklow Bridge, there will be some tree loss at working area N1 (i.e. TSN1 adjacent to 1 Ferrybank). The mature conifers with low roost surveyed in 2016 at this site have already been removed as part of a separate development, but there may be some further tree removal here to accommodate the proposed development. There is low roost potential considered for the remaining trees at this location.

The existing buildings at the Old Wallboard site at Ferrybank are within the WWTP site and will be demolished. These buildings offer some roost potential albeit that they have not been proven to be roost sites during the two surveys undertaken in 2016 and 2017. It is probable that at most this is a transitional roost for individual bats (most probable species common pipistrelle, followed by soprano pipistrelle and Leisler's bat). In addition to roost loss, there is the possibility of death or injury to roosting bats if buildings are removed without an examination for bats in advance of demolition.

Reduced feeding

There will be reduced feeding opportunities for bats around trees currently growing at The Alps, along River Walk, and in other areas of good tree and scrub cover close to the Avoca River that will be felled or otherwise removed during the construction (Refer to **Figure 11.8 in Volume 3**). Mature trees and scrub provide suitable sheltered sites for insects, and their removal consequently reduces the value of the area within the planning boundary for foraging bats, with long-term moderately negative effects upon bats during construction.

Disturbance from lighting

Lighting of the Avoca River corridor along River Walk will be increased by the loss of mature vegetation that assists in restricting illumination especially in summer. This may affect bat species, in particular, the light-intolerant bat species Daubenton's bat during foraging, and if directed at emergence points would affect all bat species, even those that will feed in illuminated areas.

Given the existing knowledge of the bat fauna, illumination will only affect commuting rather than roosting as there are no known tree roosts to date. Species such as common pipistrelle and Leisler's bat are less affected than all other Irish bat species (but are less common in lit sites than in dark sites of similar habitat) and this would not be a significant impact overall in the current situation. At worst, it would be a permanent slight negative effect during construction.

11.4.2.5 Protected Marine Mammals Risk Assessment

Marine mammal sensory systems are adapted to life in the water or, in the case of seals, both in water and on land. The sound receiving systems of marine mammals have become specialised to meet the physical demands of water and to diving to considerable depth, while retaining many of the characteristics of land mammals (e.g., ear canal, air-filled middle ear, spiral cochlea of the inner ear). Marine mammals rely on sound to navigate, to communicate with one another and to sense and interpret their surroundings.

Cetacean species may currently be distinguished by three groupings related to their known auditory ability and functional frequencies. Seal species that occur in Irish waters, and other pinniped species occurring elsewhere, demonstrate differing auditory ability in air and in water, so from a functional point of view they may be subdivided into two groups: (i) pinnipeds in water, and (ii) pinnipeds in air (Table 11.8). Further information on marine mammal noise exposure criteria for permanent injury and for disturbance/behavioural response is given in **Appendix 11.5**.

Table 11.8: Functional frequency ranges in Cetacean and Seal species (Reproduced from Department of Arts, Heritage and the Gaeltacht)

Cetaceans			**Pinnipeds**	**Pinnipeds**
Low Frequency 7 Hz-22 kHz	*Mid-frequency* 150 Hz-160 kHz	*High Frequency* 200 Hz – 180kHz	*in water* 75 Hz – 75 kHz	*in air* 75 Hz – 30 kHz
Baleen Whales	Most toothed whales, dolphins	Certain toothed whales, porpoises	All species	All species
Species – Ireland Humpback whale Blue whale Fin whale Sei whale Minke whale	*Species – Ireland* Sperm whale Killer whale Long-finned pilot whale Beaked whale species Dolphin species	*Species – Ireland* Pygmy sperm whale Harbour porpoise	*Species – Ireland* Grey seal Harbour seal	*Species – Ireland* Grey seal Harbour seal

Due to the concern regarding levels of anthropogenic sound associated with human activities in the marine environment, there is a growing body of literature and metrics describing the sound pressure level (SPL), sound exposure level (SEL) and other acoustic characteristics associated with specific machinery, vessels and operations, examples of which are given in **Appendix 11.5**.

With reference to the guidance[2], the proposed development construction activities of relevance to marine mammals include the following.

- Construction of the SWO at the WwTP, within a temporary cofferdam requiring the insertion and removal of sheet piles. A sheet piling method has not been specified, but can be expected to be carried out either by impact hammer or by vibrating head (including low vibration piling). These two piling methods have different sound generating characteristics, with impact hammer pile driving representing a worst case scenario. Pile driving strikes have generally been reported to produce low frequency pulse sounds of several tens of Hz to several thousand Hz (and up to approximately 20 kHz), with some technologies introducing underwater sound at comparatively high sound pressure levels exceeding 220 dB re: 1 μPa (Refer to Appendix 11.5 and Appendix C1 of the guidance[2]). This presents the possibility of permanent hearing injury (i.e., PTS), temporary hearing loss (i.e., TTS) or other injury for some marine mammals in close proximity to such operations (Refer to Appendix 11,5 and Appendix C2 of the guidance[2]).
- Construction of the long sea outfall will include works from both the land and sea and vessels and diving support is likely to be required at times. Three possible methodologies have been identified to construct the outfall as described in detail in **Chapter 5**:
- Horizontal directional drilling method;
- Flood and float method; and
- Bottom-pull method.

Of which the latter two methods require dredging of a trench within which the outfall will be laid. All three methods require works to attach the diffuser to the end of the outfall pipe, located approximately 900m offshore. Pile driving may be also required to construct a temporary cofferdam to facilitate this work. A sheet piling method has not been specified, but can be expected to be carried out either by impact hammer or by vibrating head (including low vibration piling). These two piling methods have different sound generating characteristics, with impact hammer pile driving representing a worst case scenario. Pile driving strikes have generally been reported to produce low frequency pulse sounds of several tens of Hz to several thousand Hz (and up to approximately 20 kHz), with some technologies introducing underwater sound at comparatively high sound pressure levels exceeding 220 dB re: 1 µPa (Refer to Appendix 11.5 and Appendix C1 of the guidance[2]). This presents the possibility of permanent hearing injury (i.e., PTS), temporary hearing loss (i.e., TTS) or other injury for some marine mammals in close proximity to such operations (Refer to Appendix 11.5 and Appendix C2 of the guidance[2]).

In addition to the sound from attendant vessels, dredging operations (required to construct the trench required as part of the flood and float and open cut methods) have been reported to produce low frequency omnidirectional sound of several tens of Hz to several thousand Hz (and up to approximately 20 kHz) at sound pressure levels of 135-186 dB re: 1 µPa. Some coastal dredging operations can therefore be detected at received levels (RL) exceeding ambient sound more than 10km from shore. While sound exposure levels from such operations are thought to be below that expected to cause injury to a marine mammal, they have the potential to cause lower level disturbance, masking or behavioural impacts, for example.

Drilling is generally acknowledged to produce moderate levels of continuous omnidirectional sound at low frequency (several tens of Hz to several thousand Hz and up to c.10 kHz). Source sound pressure levels have generally been reported to lie within the 145-190 dB re: 1 µPa range. While sound exposure levels from such operations are thought to be below that expected to cause injury to a marine mammal, they have the potential to cause lower level disturbance, masking or behavioural impacts, for example.

The revetment upgrade will require the removal of the existing rock revetment and its subsequent realignment and replacement of the rock armour. Construction of the revetment upgrade will be carried out from toe to crest by using suitable excavators located on the WwTP site. As a worst case scenario, noise levels are expected to be similar to those arising from dredging works.

In addition to the works in marine waters listed above, sheet piling is also likely to be required within the Avoca River estuary to construct the interceptor sewer in the river channel.

Occurrence of marine mammals in the vicinity of the proposed works

Harbour Porpoise, Bottle-nosed Dolphin, Harbour Seal and Grey Seal have been recorded occasionally in the vicinity of the proposed development, and in small numbers (see **Section 11.3.5.3**). This area is not known to hold important concentrations of these species.

Identified areas of importance for these species are located at a distance of at least 50km from the working areas. A total of 30 MMO watches, with a total duration of 268 hours of observations, were carried out during the 30 minutes prior to, and during site investigation works conducted in respect of the proposed development. No marine mammals were recorded.

The risk of cetaceans and seals being present in coastal waters during works is therefore assessed as low.

Additional marine mammal species recorded in coastal and offshore waters near Arklow are Common Dolphin, Striped Dolphin, Risso's Dolphin, and Minke Whale. This area is not known to hold important concentrations of these species.

Activities with the potential for cumulative effects include existing boat traffic entering and leaving Arklow Port, and existing activities at the quarry at Arklow Head. The proposed Arklow Flood Relief Scheme works will also include dredging works within the Avoca River both upstream and downstream of Arklow Bridge.

The lack of observations of marine mammals by the MMO during site investigation works indicates that risk is low, and arises with regard to the noise generating activities associated with particular construction activities in the Irish sea and Avoca River that are part of the proposed development. The Arklow area is not identified as a sensitive area for marine mammals, and the Arklow coastal area is not known to be used by important concentrations of marine mammals.

Notwithstanding that marine mammals do occur in the area, it is not possible to rule out a risk of injury or a disturbance/behavioural response to protected marine mammals; in the absence of mitigation there is a potential for direct significant adverse effects on individual marine mammals listed on Annex II of the Habitats Directive within their natural range.

11.4.2.6 Aquatic Ecology

Overview

While the intertidal and estuarine habitats of the study area are of low ecological value, the Avoca River estuary does continue to support a fish community and provides a corridor for fish that migrate through to cleaner waters upstream of the polluting influence of acid mine drainage (i.e. upstream of the proposed development). A number of the species recorded in the WFD sampling are particularly notable, in that they are listed under Annex II of the Habitats Directive, namely Atlantic Salmon *Salmo salar* and River Lamprey *Lampetra fluviatilis*. The planning boundary lies within transitional and coastal waters and River Lamprey adults have been recorded in transitional waters, and ammocoetes were recorded just upstream of the M11 flyover. Whilst not recorded in the course of the Inland Fisheries Ireland surveys[39],[40],[41], Sea Lamprey *Petromyzon marinus* are also known from the Avoca River, and are also listed under Annex II of the Habitats Directive.

None of these species are listed as Qualifying Interests in any of the SAC sites located upstream of the proposed development in the Avoca River catchment.

However, in the absence of mitigation, there is a potential for direct and indirect significant adverse effects on Atlantic Salmon *Salmo salar,* River Lamprey *Lampetra fluviatilis,* Sea Lamprey *Petromyzon marinus,* the Critically Endangered European Eel, and on other typical species within their natural range in the Avoca River catchment. The considerations potentially giving rise to these direct and indirect significant adverse effects are detailed below.

Temporary and permanent habit loss of aquatic habitat in the Avoca River and estuary

There will be a permanent loss of aquatic habitat arising from the southern interceptor sewer of which approximately 300m will be constructed in the Avoca River estuary from Arklow Bridge eastwards (River Working Area S1). An adjoining temporary causeway will be installed within the estuary (River Working Area S1) to facilitate these works. As described in detail in **Chapter 5**, the temporary causeway will be up to 10m wide and approximately 330m in length. The narrowest section of the estuary at South Green is approximately 96m wide. During construction, when the temporary haul road is in place, estuary width will reduce to 80m. 83% of the estuary width will therefore remain open to the passage of fish at this narrow point and no barrier to fish migration will arise during construction.

Working Areas S7, S8, S10 and S11 will be located on River Walk and extend marginally into the river channel. River Working Area S2 will be located in the river channel, in the vicinity of the proposed river crossing at tunnel shaft (TSS3) on South Quay. Working Area N1 will be located at No. 1 Ferrybank to support the construction of the interceptor sewer on North Quay. This working area includes a steeply sloping river bank and extends into tidal waters at the base of the bank.

The temporary working areas that directly overlap with the Avoca River required during construction of the proposed development will give rise to the direct and indirect effects described below.

Aquatic habitat alteration and degradation in the Avoca River and estuary

Construction activities including the construction and operation of temporary causeway and associated activities including transport of excavated materials and construction materials, will give rise to the potential for silt and soil to enter into the Avoca River and estuary. Increases in suspended sediment in a waterbody can cause stress and also affect the gills of fish, resulting in injury or mortality in a worst case scenario. Migratory fish movement through affected waters may also be adversely affected.

Construction works could potentially result in spillages and leakages entering the watercourse. Spills of construction materials may include concrete and cement, and leaks from construction equipment may include fuel, oils, lubricants and hydraulic fluids. These construction materials are toxic to aquatic fauna.

Disturbance of the existing Avoca River and estuary bed has a potential to mobilise existing contaminants including wastewater derived contaminants.

The resuspension of fine sediment can also remobilise heavy metals such as copper, zinc and lead that have settled in the river from the Avoca Mines and other sites upstream[58]. These metals could impact on freshwater and marine aquatic fauna.

Bentonite will be used during tunnelling of the sewers and during underpinning works at Arklow Bridge. This material is not toxic, but can have a smothering effect on vegetation and benthic fauna if released in quantity. Aquatic vegetation is not present at the Arklow Bridge, and the benthic macroinvertebrate community is species poor and of low ecological value. Bentonite would contribute to turbidity and an increase in suspended sediments if unintentionally released into water.

The temporary causeway within the estuary (River Working Area S1) will be contained on the river side to mitigate against silt and spill migration into the Avoca River (Refer to **Chapter 5** for further detail). The two most likely methods to achieve this containment would either be an additional row of sheet piles on the river side of the causeway or alternatively a row of stone gabions wrapped in a geotextile membrane. Either method would require that the containing material (i.e. the sheet piles or the gabion walls) are extended (i.e. to a height above the surface of the haul road) to be effective. Similar containment of all other temporary working areas extending into the Avoca River and estuary is detailed in **Section 5.6.3.3 of Chapter 5**. In the absence of this mitigation, there is a potential for direct and indirect significant adverse effects on Atlantic Salmon *Salmo salar,* River Lamprey *Lampetra fluviatilis,* Sea Lamprey *Petromyzon marinus,* the Critically Endangered European Eel, and on other typical species within their natural range in the Avoca River catchment during construction.

The insertion and removal of sheet piling or gabions can contribute to a temporary increase in sediment entering the waterbody, although it must be noted that the main function of these barriers is the separation of working areas from the waterbody and the reduction of risk of habitat alteration and degradation.

Effects associated with dewatering – contamination of surface waters in the Avoca River and estuary

Working areas may be liable to accumulate water through rainfall and also through infiltration of groundwater. Dewatering will be required to remove this water, which may potentially be includes traces of in-situ fresh concrete and cement products, fuels, oils, lubricants and hydraulic fluids, and by silts and soils and organic materials arising from excavations. In the absence of mitigation, there is a potential for these contaminants to reach the adjoining waterbody within the Avoca River and estuary, resulting in habitat alteration and degradation as described above. In the absence of mitigation, there is a potential for direct and indirect significant adverse effects on Atlantic Salmon *Salmo salar,* River Lamprey *Lampetra fluviatilis,* Sea Lamprey *Petromyzon marinus,* the Critically Endangered European Eel, and on other typical species within their natural range in the Avoca River catchment during construction.

58 Yau, H. and Gray, N.F. (2005) Riverine Sediment Metal Concentrations of the Avoca-Avonmore Catchment, South-East Ireland: A Baseline Assessment. Biology and Environment: Proceedings of the Royal Irish Academy 105B(2): 95-106.

Effects associated with dewatering– entrapment of fish in the Avoca River and estuary and in coastal waters

There is a potential for fish, including Annex II listed migratory species to become trapped in working areas in aquatic habitats when these are enclosed by sheet piles or geotextile wrapped gabions. This risk arises in the Avoca River and estuary, and also within the sheet piling to be provided to facilitate the construction of the SWO at South Quay.

In the absence of mitigation, there is a risk of injury and mortality to Atlantic Salmon *Salmo salar*, River Lamprey *Lampetra fluviatilis*, Sea Lamprey *Petromyzon marinus*, the Critically Endangered European Eel, and on other typical fish species within their natural range in the Avoca River catchment during excavation and dewatering activities.

Temporary and permanent benthic habitat alteration and loss in coastal and marine waters

The removal of the existing revetment during the revetment upgrade will result in the removal of a limited biotope of green macroalgae growing above a zone of Carrageen in the upper level to kelp species at depth. As described in **Section 11.3.6.5** and **Appendix 11.6**, this habitat is highly modified by human activity and has been assessed as being of low ecological value. Since a similar habitat is likely to colonise the revetment upgrade once in place, this likely significant effect is assessed as moderate negative, local, and of short to medium term in duration.

The construction of the SWO, terminating at the toe of the upgraded revetment, will not result in any additional loss of marine and marine benthic habitat, which would be excavated within a coffer dam to facilitate laying of the SWO. A concrete apron will also be placed around the outfall location, to protect against scour, but this will not result in the loss of any habitat as it will be within the footprint of the proposed upgraded revetment.

As described in detail in **Chapter 5**, the likely methods that can be undertaken to construct the long sea outfall, based on current practice and site restraints/characteristics, are:

- Horizontal directional drilling method;
- Flood and float method; and
- Bottom-pull method.

Construction of the outfall would include works from both the land and sea. It is expected that several vessels may be required during the construction of the outfall and that diving support is likely to be required at times.

Horizontal directional drilling

In the event of a blow-out during boring (required to enlarge the hole for the outfall as part of the horizontal directional drilling method), there is a potential for increased turbidity in marine waters with slight to moderate negative temporary effects on the existing depauperate benthic community and any fish that may be in the vicinity.

Benthic habitat loss will not arise from the horizontal directional drilling method of installing the outfall, because the construction and installation occurs at depth within the marine sediments, and no excavation is required within the surface of the sea bed, thus benthic communities would not be affected. No additional impacts on fauna arise.

Float and flood method and Bottom-pull method

The use of the float and flood method would require the formation of trenches and the placement of suitable material to support and protect the long sea outfall once it is in position. The use of the bottom-pull method would, in a similar manner to the flood and float method, require the formation of trenches and the placement of suitable bedding material to support and protect the positioned pipeline.

Trench excavation will impact directly on the existing benthic community in the habitat **Abra alba and Nucula nitidosa in circalittoral muddy sand or slightly mixed sediment**, and would be likely to result in some localised mortality to common species with slight negative temporary effects.

Diffuser assembly

Once the long sea outfall has been laid, by whichever construction method (HDD, float and flood or bottom-pull), the diffuser will be assembled on the seaward end of the outfall to construct the diffuser arrangement of up to 6 diffusers of approximately 0.16m diameter at a spacing of approximately 10m intervals.

The diffuser will be prefabricated on land and placed on the seabed by barge as one complete unit. The exact procedure and depths of backfill required will depend on the detailed design and equipment available from the contractor along with programme and cost considerations, however it is anticipated that this will likely require open excavation of the seabed, around the diffuser.

The diffuser structures will be likely to colonise with a different marine biotope over a period of time. Once operational, the diffuser will be subject to routine inspection and maintenance by Irish Water to ensure their proper functioning.

11.4.2.7 Potential Effects on Coastal Processes

Overview

The assessment on coastal processes is provided in detail in **Chapter 15** and **Appendix 15.5**. The following items are of relevance for the biodiversity assessment:

- The uniform units identified in the vicinity of the area of study of coastal processes are Kilmichael Point to Mizen Head and Mizen Head to Wicklow Head.
- Each uniform unit incorporates smaller sub-physiographic units, also defined by changes in coastline orientation and local headland features, which also have the effect of limiting sediment exchange between adjoining units.
- The direction of longshore drift along the Wexford and Wicklow coasts is from South to North, therefore uniform units and their constituent physiographic sub-units along sandy shores tend towards sediment starvation and erosion at their southern end, and towards sediment accretion at their northern end. This effect is noted in the Buckroney-Brittas Dunes and Fen SAC (site code: 000729) Conservation objectives supporting document - Coastal habitats (NPWS 2017[59]).
- A smaller sub-pysiographic unit is identified within the Kilmichael Point to Mizen Head uniform unit, in the stretch of coastline that is limited to the South by the breakwaters and piers which guard the entrance to Arklow Harbour, and to the North by the headland at Seabank, located at the North end of the Arklow North Beach. For clarity, this feature is referred to as the Arklow North sub-physiographic area of interest in this chapter.
- Three coastal SACs that are located at least 4km from the proposed development, are listed for Qualifying Interests with a potential to be affected by changes in coastal processes with regard to the single relevant attribute contributing to conservation status: Physical structure: functionality and sediment supply (Table 11.9). These European sites could be affected by ex situ activities that may impede longshore drift, and/or impede and alter sediment movement, to the extent of causing indirect effects on the Conservation Status of the Qualifying Interests listed in Table 11.8.

Table 11.8: Qualifying Interests of the European sites potentially affected by changes in coastal processes

European site	**Buckroney – Brittas Dunes and Fen SAC (Site Code 000729)**	**Kilpatrick Sandhills SAC (Site Code 001742)**	**Magharabeg Dunes SAC (Site Code 001766)**
Relevant Qualifying Interest * indicates a priority habitat under the Habitats Directive	Annual vegetation of drift lines [1210]	Annual vegetation of drift lines [1210]	Annual vegetation of drift lines [1210]
	Perennial vegetation of stony banks [1220]		
	Mediterranean salt meadows (Juncetalia maritimi) [1410]		
	Embryonic shifting dunes [2110]	Embryonic shifting dunes [2110]	Embryonic shifting dunes [2110]
	Shifting dunes along the shoreline with Ammophila arenaria (white dunes) [2120]	Shifting dunes along the shoreline with Ammophila arenaria (white dunes) [2120]	Shifting dunes along the shoreline with Ammophila arenaria (white dunes) [2120]

59 NPWS (2017) Buckroney-Brittas Dunes and Fen SAC (site code: 000729) Conservation objectives supporting document- Coastal habitats. Version 1 March 2017. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.

European site	Buckroney – Brittas Dunes and Fen SAC (Site Code 000729)	Kilpatrick Sandhills SAC (Site Code 001742)	Magharabeg Dunes SAC (Site Code 001766)
	Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]*	Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]*	Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]*
	Atlantic decalcified fixed dunes (Calluno-Ulicetea) [2150]*	Atlantic decalcified fixed dunes (Calluno-Ulicetea) [2150]*	Atlantic decalcified fixed dunes (Calluno-Ulicetea) [2150]*
	Dunes with Salix repens ssp. argentea (Salicion arenariae) [2170]		
	Humid dune slacks [2190]		

The Qualifying Interest habitats listed in Table 11.8 for Kilpatrick Sandhills SAC lie to the south of Kilmichael Point, and are outside the Kilmichael Point to Mizen Head uniform unit.

Part of Buckroney-Brittas Dunes and Fen SAC lies within the Kilmichael Point to Mizen Head uniform unit (Pennycomequick and Buckroney lie to the south of Mizen Head).

Magharabeg Dunes SAC lies within the Mizen Head to Wicklow Head uniform unit

Coastal processes potentially affected by the upgraded revetment

The extent of the proposed revetment upgrade is approximately 350m. Construction along the existing revetment will involve excavation in coastal waters along the toe of the existing revetment and removal of existing rock armour. The revetment upgrade may mobilise sand and silt.

As outlined in **Chapter 15** and **Appendix 15.3**, the only likely effect that the upgrade works could have on the existing coastal dynamics is the dispersion of material at the location of the revetment works during construction. The excavation of material from the seabed is limited at the toe of the proposed revetment and the volume of material is expected to be small.

Mobilised sand and silt is expected to be naturally deposited within the Arklow North sub-physiographic area of interest, and generally limited by both the harbour entrance at the south and the natural headland at the north at Seabank.

The likely indirect effects of the construction of the revetment upgrade on European sites (Kilpatrick Sandhills SAC -Site Code 001742; Buckroney – Brittas Dunes and Fen SAC - Site Code 000729, and Magharabeg Dunes SAC - Site Code 001766) are assessed as neutral (i.e. no effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error). No likely significant direct effects will arise during construction of the revetment upgrade.

Coastal processes potentially affected by the SWO

Mobilised sand and silt is expected to be naturally deposited within the Arklow North sub-physiographic area of interest, and generally limited by both the harbour entrance at the south and the natural headland at the north at Seabank. The likely effects of constructing the SWO on European sites (Kilpatrick Sandhills SAC -Site Code 001742; Buckroney – Brittas Dunes and Fen SAC - Site Code 000729, and Magharabeg Dunes SAC - Site Code 001766) are assessed as neutral. No likely significant direct or indirect effects will arise during construction of the SWO at the WwTP site.

Coastal processes potentially affected by the long sea outfall

Horizontal directional drilling method

Effects on coastal processes and sediment transport do not have a potential to arise with regard to the horizontal directional drilling method of installing the long sea outfall, because the construction and installation occurs at depth within the marine sediments, and no excavation is required at the surface of the sea bed.

The likely effect of the Horizontal directional drilling method of the long sea outfall during the construction phase on European sites (Kilpatrick Sandhills SAC -Site Code 001742; Buckroney – Brittas Dunes and Fen SAC - Site Code 000729, and Magharabeg Dunes SAC - Site Code 001766) is assessed as neutral. No likely significant direct or indirect effects would arise during construction of the outfall via the horizontal directional drilling method.

Flood and float and Bottom-pull methods

It is estimated that up to approximately 18,000 m^3 of seabed material may be excavated if the flood and float or bottom pull methods are used to construct the outfall in order to form a trench into which the outfall would be laid.

As described in detail in **Chapter 15** and **Appendix 15.5**, the marine environment is dynamic and there is a continuous process of sedimentation and deposition naturally occurring. In this context, the volumes of excavated material from the long sea outfall trench are considered to be relatively small and it is expected that up to around 50% of the excavated material will be reused to backfill the trench.

The likely effect of the float and flood method, and the bottom-pull method during is therefore assessed as neutral, with regard to the Conservation Objectives of Buckroney – Brittas Dunes and Fen SAC (site code: 000729).

Applying the precautionary principle, potential effects on the Conservation Objectives of Buckroney – Brittas Dunes and Fen SAC (site code: 000729) could be slight or moderate temporary adverse, because of the location of Pennycomequick dunes and Buckroney dunes within the Kilmichael Point to Mizen Head uniform unit, within which adverse effects on existing coastal processes could have a potential to occur during construction in the event of the construction phase of the long sea outfall interacting with a strong gale, storm or extreme weather event, in the absence of mitigation applied in accordance with the precautionary principle.

The likely indirect effect of the float and flood or bottom-pull methods of the long sea outfall during the construction phase on Kilpatrick Sandhills SAC (Site Code 001742) and Magharabeg Dunes SAC (Site Code 001766) are assessed as neutral. Direct effects on these European sites will not arise.

Diffuser assembly

Once the long sea outfall has been laid, by whichever method, the diffuser will be assembled at the seaward end of the outfall. The diffuser arrangement will include up to 6 diffusers of approximately 0.16m diameter at a spacing of approximately 10m intervals.

The diffuser will be prefabricated on land and placed on the seabed by barge as one complete unit. The exact procedure and depths of backfill required would depend on detailed design and the equipment available from the contractor along with programme and cost considerations, however it is anticipated that this will be undertaken from the barges and likely require open excavation of the seabed, around the diffusers.

The extent of excavation may be approximately 60m long and 6m wide, in a water depth of approximately 11m. The likely effects of the diffuser assembly during on European sites (Kilpatrick Sandhills SAC -Site Code 001742; Buckroney – Brittas Dunes and Fen SAC - Site Code 000729, and Magharabeg Dunes SAC - Site Code 001766) are assessed as neutral, because of the small scale of the works involved. Following the precautionary principle, mitigation is provided to ensure this outcome. No likely significant direct effects arise will arise during construction and assembly of the diffuser.

11.4.2.8 Cumulative

The proposed Arklow Flood Relief Scheme design is being developed currently and hydrological investigations are in progress to inform the final design.

The proposed Arklow Flood Relief Scheme which is still at design stage and in respect of which no planning application has yet been submitted would likely comprise the construction of direct flood defences, including flood defence walls, embankments and gates within Arklow town to improve resilience to flooding, as well as conveyance improvements in the Avoca River as described in **Section 2.6 of Chapter 2**.

As currently envisaged and understood given the information provided by the design team, dredging would take place as part f the proposed Arklow Flood Relief Scheme within the estuary (Transitional waterbody) in Arklow, both upstream and downstream of Arklow Bridge, and may extend into the Surface waters of the Avoca River also. Based on the current level of information available, the debris trap and gravel trap for the proposed Arklow Flood Relief Scheme are likely to be constructed in the Avoca River, subject to the final design details. Based on the current level of information available, it is not envisaged that the proposed Arklow Flood Relief Scheme would be occur in coastal waters.

On the basis of the information currently available, in respect of the proposed Arklow Flood Relief Scheme, which is still at design stage and in respect of which no planning application has yet been submitted, it is not considered likely that the proposed Arklow Flood Relief Scheme would interact with the proposed development as regards potential impacts on the European sites listed in Table 11.2 and outlined below:

- Buckroney – Brittas Dunes and Fen SAC (Site Code 000729);
- Kilpatrick Sandhills SAC (Site Code 001742);
- Magharabeg Dunes SAC (Site Code 001766);
- Wicklow Reef SAC (Site Code 002274);
- Blackwater Bank SAC (Site Code 002953);
- Wicklow Mountains SAC (Site Code 002122);
- Wicklow Mountains SAC (Site Code 002122);
- Vale of Clara (Rathdrum Wood) SAC (Site Code 000733); and
- Wicklow Mountains SPA (Site Code 004040).

Because Buckroney – Brittas Dunes and Fen SAC (site code: 000729) is the only European site that has been identified for the provision of mitigation, following the precautionary principle, to ensure neutral effects during construction of the proposed development, and because it is not envisaged that any works for the proposed Arklow Flood Relief Scheme would occur in coastal waters, potential cumulative effects of the two developments on European sites are assessed as neutral.

Since the proposed development and the proposed Arklow Flood Relief Scheme overlap within the Avoca River and Estuary, the same baseline Annex II listed species occur in the footprint for both schemes. With reference to Table 11.2, Otter *Lutra lutra* is listed as a Qualifying Interest for Wicklow Mountains SAC (Site Code 002122).

Otters will utilise freshwater habitats from estuary to headwaters. No aquatic habitat severance will arise to Otters moving between the upper Avoca River catchment and coastal waters, since water will continue to flow through the river and estuary during construction works undertaken for both the proposed development and the proposed Arklow Flood Relief Scheme.

The operation of plant and machinery, and the presence of workers on the site, will result in some level of disturbance to Otters using the area. Otters are predominantly nocturnal and therefore would not overlap greatly with construction activities. Further, Otters are also quite tolerant of human disturbance and are often recorded in urban areas, so this impact is unlikely to be significant. Disturbance arising from cumulative construction works may have some potential to result in brief displacement of Otters to unaffected areas of the river channel and banks in the Arklow area, but since works are not anticipated to continue throughout 24 hours each day, cumulative effects are assessed as slight negative and restricted to the Arklow area. Ex situ cumulative effects on Otter in Wicklow Mountains SAC are assessed as neutral.

Fish species listed on Annex II of the Habitats Directive i.e. Atlantic Salmon and River Lamprey, occur in the Avoca River catchment and estuary, while Sea Lamprey are known to occur but have not been recorded in recent surveys of the estuary. The estuary area has been highly modified by human activity through the construction of estuarine retaining walls, harbour breakwaters, and a stretch of coastal rock armour revetment, with the river impacted by acid mine drainage from the Avoca Mines upstream and the estuary also influenced by the input of untreated wastewater.

While the estuarine habitats of the study area are of depressed species richness and low ecological value, the estuary does continue to support a fish community and provides a corridor for fish including Habitats Directive Annex II listed species. Since these species are not listed as Qualifying Interests for any upstream Natura 2000 sites, no cumulative ex situ effects arise. However, potential cumulative direct and indirect effects arise on Habitats Directive Annex II listed Atlantic Salmon *Salmo salar,* River Lamprey *Lampetra fluviatilis,* and Sea Lamprey *Petromyzon marinus,* the Critically Endangered European Eel and on other typical species within their natural range in the Avoca River catchment, in the absence of mitigation should the construction of the proposed development and proposed Arklow Flood Relief Scheme occur simultaneously.

Aquatic ecology

Dredging in the river channel as part of the proposed Arklow Flood Relief Scheme has the potential to impact on the aquatic environment in a number of ways. These impacts may include habitat loss, habitat alteration, impacts on species populations, increased suspended solids, and the risk of hydrocarbon pollution. This can impact on fish species by clogging gills, reducing visibility when foraging, and clogging spawning gravels (though it should be noted that there is no evidence of salmonid or lamprey spawning within the proposed dredge area).

The resuspension of fine sediment can also remobilise heavy metals such as copper, zinc and lead that have settled in the river from the Avoca Mines and other sites upstream[60]. These metals could impact on freshwater and marine aquatic fauna.

60 Yau, H. and Gray, N.F. (2005) Riverine Sediment Metal Concentrations of the Avoca-Avonmore Catchment, South-East Ireland: A Baseline Assessment. Biology and Environment: Proceedings of the Royal Irish Academy 105B(2): 95-106.

Bats

Four Habitats Directive Annex IV listed bat species have been recorded within the proposed development and proposed FRS combined works areas:

- Common pipistrelle - *Pipistrellus pipistrellus*
- Soprano pipistrelle - *Pipistrellus pygmaeus*
- Leisler's bat - *Nyctalus leisleri*
- Daubenton's bat - *Myotis daubentonii*

Individual Bat Derogation Licences will be required for each project in respect of works at Arklow Bridge. A Derogation Licence (No. DER/BAT 2018 – 73) has been issued in respect of the proposed development (Refer to Appendix 11.7) and it is anticipated that the proposed Arklow Flood Relief Scheme would also obtain their own derogation license in due course.

Likely potential effects of the proposed Arklow Flood Relief Scheme on bats are outlined below:

- There will be the removal of suitable crevices from Arklow Bridge during underpinning works. In addition to potential roost loss, there is the possibility of death or injury to roosting bats if works were to be undertaken without an appropriate examination for bats in advance of works.
- Tree felling behind Brigg's Lane may be required to allow the construction of the flood protection berms which also creates the risk of roost loss and injury to bats if not examined prior to such operations.
- There will be reduced feeding as mature trees are felled and suitable sheltered sites for insects are removed that consequently reduces the value of the site for foraging bats. The feeding opportunities within the footprint of the proposed Arklow Flood Relief Scheme provided by the trees to the rear of Brigg's Lane and Ferrybank.

In the absence of mitigation, this creates a long-term moderately negative impact upon bats.

Generally, the changes within Arklow, if following current trends, would see a loss in green space, increase in lighting and increase in modern buildings with an associated removal of old buildings for some developments associated with those developments identified in Chapter 2. These would all create a permanent moderate negative effect if not appropriately mitigated in each project.

11.4.3 Assessment of Effects during Operation

11.4.3.1 Terrestrial Biodiversity, Habitats, Flora, and Fauna

In the absence of mitigation, the effects of the proposed development will be similar to those described in **Sections 11.4.2.1 to 11.4.1.4**, with the following exceptions:

- loss of bird's nests and mortality or injury to nestlings would not arise; and
- mortality or injury to Annex IV listed bat species would not arise.

11.4.3.2 Bats

External lighting will be installed around the WwTP for the safety and security of staff on the site during for operational reasons. The lighting will be kept close to the buildings and only operate when there is movement. Operational lighting will be designed in accordance with the relevant street light standards. LED flood lighting with glass lenses will be provided on the WwTP site, located within some parts of the louvered building façade, and would be switched rather than motion activated. This may lead to the disturbance of light intolerant or shy species while the more urban-adapted species will be affected only over a short-term period. Of the species noted on and around the WwTP site, no bats would be considered light-intolerant as they will generally avoid direct illumination but are not usually fully excluded by the presence of light.

Pipistrelles, the main species within the WwTP site, are negatively affected by lighting but to a lesser extent than most Irish species. Leisler's bats are the most tolerant of light of the three species noted. This species will feed around lighting in car parks as the night progresses. There are no roosts directly illuminated by changes to the site as there were no roosts noted within the site in June 2016 or in August 2017.

Once constructed, the proposed WwTP buildings may have a positive impact as they may have future roost potential for bats.

The planting of vegetation within the WwTP site provides feeding and commuting potential for bats.

11.4.3.3 Marine Mammals

During operation, it is not envisaged that noise generating activities associated with the proposed development would have a potential to affect cetacean species listed in Annex IV of the Habitats Directive and/or Harbour Seal and Grey Seal listed in Annex II of the Habitats Directive.

11.4.3.4 Aquatic Ecology

The commissioning of a WwTP at Arklow will have positive impact on aquatic ecology. Currently, untreated wastewater is entering the river, as evidenced by the accumulation of toilet paper and sanitary towels in parts of the estuary.

The input of untreated wastewater affects water quality can result in elevated nutrient levels, increased turbidity, changes to pH and reduced oxygen levels; all of which can impact on aquatic ecology. In addition, the Avoca Estuary is being impacted by the acid mine drainage from upstream and so the two pollution sources may be acting cumulatively or synergistically, resulting in serious impacts on the aquatic environment.

Freshwater, estuarine and marine macroinvertebrate communities are sensitive to nutrient and dissolved oxygen levels, as well as other chemicals and metals, and so the elimination, in so far as possible of untreated wastewater discharges will result in a change to a more natural community structure, indicative of cleaner waters. This will benefit the aquatic environment and biodiversity generally and have a positive impact on the status of the river, estuary and coastal waters from the perspective of the Water Framework Directive. The negative impact wastewater is currently having on the macroinvertebrate community is evidenced by the dominance of the worm *Lumbriculus variegatus* downstream of the Arklow Bridge (Refer to Table A1 in **Appendix 11.6**).

Many fish species are also sensitive to reduced water quality, and serious pollution incidents involving substances that reduce dissolved oxygen (such as untreated wastewater) can result in fish kills, while chronic exposure to sub-lethal levels of pollutants can impact on overall health and reproduction. The Avoca Estuary provides habitat for adult and juvenile marine species and is also an important pathway for important migratory species, such as the Habitats Directive Annex II listed Atlantic Salmon, River Lamprey, and Sea Lamprey, the critically endangered European Eel, and on other typical fish species within their natural range in the Avoca River catchment, and in the Estuary. Physiological changes required to move between freshwater and seawater mean that certain migratory species have to spend some time in the estuarine environment before moving on, which, in the case of the Avoca Estuary, exposes them to elevated pollution levels associated with raw wastewater. The improvement in estuarine water quality that will result from the proposed development will positively impact on the fish species that use the estuary for short or long periods of time.

The proposed development does not have a potential to affect marine mammals during the operational phase, therefore likely significant effects are imperceptible.

11.4.3.5 Coastal Processes

The scour protection concrete mattress over the long sea outfall may create a 900m long linear artificial reef habitat, which would be likely to colonise with a different marine biotope over a period of time.

Assuming a base width of approximately 6m, the scour protection, if exposed above the sea bed level, would cover an area of approximately 0.54ha of sea bed, where the existing habitat is classified as **Abra alba and Nucula nitidosa in circalittoral muddy sand or slightly mixed sediment**. This biotope is common and widespread along the east coast of Ireland. It would be replaced by c.0.54ha of scour protection, effectively creating a 900m long linear artificial reef habitat, which would be likely to colonise with a different marine biotope over a period of time.

Colonisation of the scour protection would be by a range of subtidal marine algae and sessile animals, such as kelps and other seaweeds, molluscs such as mussels, crustaceans such as barnacles, bryozoa and sponges, as well as mobile invertebrates. The colonisation would begin as soon as the scour protection is in place, with a succession of species taking advantage of the unoccupied surface until it reaches an equilibrium over a number of years. The scour protection and the associated sessile species would also provide cover and foraging for larger mobile species such as fish, crabs and lobsters. This effect is assessed as slight positive, because species diversity will increase.

Otherwise, the long sea outfall during the operation of the proposed development is assessed as neutral on the Conservation Objectives of Buckroney – Brittas Dunes and Fen SAC (site code: 000729), with regard to the relevant attribute Physical structure: functionality and sediment supply, for which the target is to maintain the natural circulation of sediment and organic matter throughout the entire dune system, without any physical obstructions. Direct effects on European sites will not arise from the proposed development.

Further north, within the Mizen Head to Wicklow Head uniform unit, the effects of the outfall during operation is assessed as neutral on the Conservation Objectives of Magharabeg Dunes SAC (Site Code 001766), because of distance from the proposed development and location to the North of Mizen Head and another headland at Ballynacarrig. Direct effects on this European site will not arise from the proposed development.

11.4.3.6 Cumulative

It is noted that a Public Realm Plan would be developed as part of the proposed Arklow Flood Relief Scheme and that this will include tree planting along River Walk, along the South Quay and adjacent to the Town Marsh pNHA in Arklow. Planting of mature trees may therefore be implemented as part of the proposed Arklow Flood Relief Scheme along the southern banks of the Avoca River and Estuary. This is considered a positive effect on biodiversity during operation of the proposed development and the proposed Arklow Flood Relief Scheme.

11.5 Mitigation Measures and Monitoring

11.5.1 Mitigation

11.5.1.1 Mitigation During Construction

Terrestrial biodiversity, habitats, and flora

Overview

The mitigation measures for habitats and flora aim to implement Objective NH12 of County Development Plan (Refer to **Section 11.3.1.3**), in the context of the ecological baseline conditions recorded within the planning boundary of the proposed development.

Chapter 5 provides for top-soiling and seeding of existing areas of Amenity grassland **GA2** within the planning boundary of the proposed development, where these are removed or damaged during the construction phase. The species listed in Table 11.9 are suitable for seeding in these areas, and managed as short meadow. **Section 13.5 of Chapter 13** makes recommendations in relation to the planting of replacement trees in these locations.

Table 11.9: Native grasses and wild flowers to be included in short and long meadow habitat

Common name	Scientific name	Habitat / management notes
Grasses		
Red Fescue	*Festuca rubra*	Dominant grass species on existing site. Common widespread species, also salt tolerant. Suitable for use in in short and long meadow habitat
Common Bent/Brown Top	*Agrostis capillaris*	Component species of wild flower seed mix
Flowering herbaceous plants for inclusion in wild flower mix. All these native species occur on site or in the Arklow coastal area, are pollinated by insects and will enhance biodiversity and habitat for bats and birds		
	Apiaceae	
Wild Carrot	*Daucus carota*	Biennial. Tolerates coastal conditions, calcareous substrate, suitable for use in long meadow habitat
	Asteraceae	
Common knapweed	*Centaurea nigra*	Perennial. Suitable for use in long meadow habitat
Hawkbit	*Leontodon spp.*	Suitable for use in short and long meadow habitat
Sea Mayweed	*Tripleurospermum maritimum*	Biennial or perennial of coastal rock, shingle and waste ground. Suitable for use in small gravel or reinforced surface with light use, or in meadow
Yarrow	*Achillea millefolium*	Perennial, suitable for use in short and long meadow habitat
Legumes; Clovers and Vetches	**Fabaceae**	
Bird’s foot trefoil	*Lotus corniculatus*	Perennial. Suitable for use in short meadow habitat
Common vetch	*Vicia cracca*	Perennial. Suitable for use in long meadow habitat
Hare’s-foot Clover	*Trifolium arvense*	Annual of coastal habitats. Suitable for use in small gravel or reinforced surface and in meadow

Common name	Scientific name	Habitat / management notes
Kidney vetch	*Anthyllis vulneraria*	Perennial, coastal habitats. Suitable for use in short and long meadow habitat
Meadow vetchling	*Lathyrus pratensis*	Suitable for use in long meadow habitat
White clover	*Trifolium repens*	Suitable for use in reinforced grass surface and in short meadow habitat
Red clover	*Trifolium pratense*	Suitable for use in reinforced grass surface and in short and long meadow
Black medick	*Medicago lupulina*	Suitable for use in short and long meadow
	Lamiaceae	
Selfheal	*Prunella vulgaris*	Perennial, suitable for use in short and long meadow
	Rubiaceae	
Lady's bedstraw	*Galium verum*	Perennial of dry sandy and coastal areas, suitable for use in short and long meadow

Wildflower grassland management

Initially, sown areas will need to be monitored for germination and establishment, and any unwanted species removed manually. Subject to monitoring, mowing may not be required during the first year after seeding. After the meadow is established, the following regime is recommended:

Short meadow will generally be mown five times per year, with cut material removed:

- First cut after the 15 April
- Second cut at end of May
- Third cut in mid-late July (maximises growth of Clovers and other wildflowers)
- Fourth cut at the end August
- Fifth cut after mid-October.

Long meadow will be mown once a year, in late September or October, with cut material removed.

For both short and long meadow, a high cut setting of >8-10cm is recommended during mowing or strimming.

At the Alps SWO and storm water storage tank site, Honeysuckle will be planted at 2m centres along the western and eastern sides of the perimeter fence. This measure will provide shelter and habitat for insects and feeding habitat for bats at a small site where tree and shrub planting would be inappropriate.

The grass and wildflower seed mix listed in Table 11.9 will be seeded within and adjoining the temporary construction site as part of completion works and managed initially as short meadow, to implement measures to control Buddleia are required in this area as identified in **Appendix 11.2**.

Landscaping around the four buildings at the WwTP site will follow a basic grid, derived from the primary geometries of the site. This grid will include hard landscaping between the buildings in addition to soft landscaping that will be planted around the site perimeter. This landscaping will be provided as part of the completion works, as illustrated in **Drawing No. 247825-00-L002 in Volume 3**.

Planting of trees, shrubs and climbers, and seeding with the bespoke mix of native grasses and wild flowers listed in Table 11.9 to be managed as short and long meadow, will be carried out in areas agreed with the project architect Clancy Moore within the WwTP site, and also along the site road frontage where a 5m setback to be provided will allow space for planting of groups of trees and short meadow, with Honeysuckle provided at intervals along the WwTP site boundary fence. Irish native species are proposed throughout, as specified in Table 11.9 and Table 11.10, with the exception of Scot’s pine for which a cultivar is likely to be more suitable for this coastal location.

Table 11.10: Trees, shrubs and climbers to be included in planting at the WwTP site

Common name	**Scientific name**	**Habitat / management notes**
Colonising / established trees and shrubs recommended for planting		
Silver Birch	*Betula pendula*	Requires some shelter. Birch provides light shade, suitable for under-planting with Bluebell *Hyacinthoides non-scripta*. Bluebell leaves will emerge in autumn, flowers in April and May, leaves will die back in June. Wildflower meadow species from adjoining planting will colonise. Any maintenance of herbaceous ground flora required in areas planted with Silver birch should be carried out in July and August.
Autumn Gorse	*Ulex gallii*	Tolerates exposure. Mature plants up to 0.8m tall, little management required. Not suitable for under-planting with grasses or wild flowers
Honeysuckle	*Lonicera periclymenum*	Climber, suitable for planting at intervals along the site boundary fence, may need some support until established. Little management required
Scot’s pine	*Pinus sylvestris*	A cultivar, Pinus sylvestris Glauca Nana that appears to do well in coastal windy locations is recommended, it will grow to 12m in height after 20-50 years

Birds

Tree felling, removal of scrub and other tall vegetation will be carried out between 1 September and 28 February, to avoid any risk to breeding birds and their habitats.

At the WwTP site, depending on the schedule of demolition of existing buildings, the sequence of demolition works may require to be modified to take account of a small number of breeding birds that may be present within structures, in the event of works occurring from 1 March to 31 August.

Nesting boxes for the Red-listed species Grey Wagtail, and for Pied Wagtail will be provided in alternate arches of Arklow Bridge, on ledges above high-water level in the existing concrete structure on the upstream side of the Arklow Bridge (because existing ledges are not secure from predation), in order to provide nesting habitat for these species that feed extensively along the river channel.

Bats

A Derogation Licence (No. DER/BAT 2018 – 73) has been issued for the proposed development (Refer to **Appendix 11.7**).

As all bat species recorded within the planning boundary of the proposed development are protected under Annex IV of the Habitats Directive, the works to be carried out to the two southernmost arches of Arklow Bridge and their associated piers require the aforementioned derogation license from the NPWS to allow works that would create a risk to bats and would remove existing roosting options. The following measures were proposed as part of the application for the derogation licenses and will be implemented during construction to meet the requirements for protecting the bats availing of Arklow Bridge:

- Examination of the bridge prior to works by the licensed bat specialist for evidence of bats.
- Exclusion of bats if necessary with one-way valves devised by the bat specialist.
- Capture of any bats that are still present prior to works and retention until the risk of injury or re-entry to the bridge has been removed.
- Provision of 4 x 2FR Schwegler woodcrete bat tubes for each modified arch (i.e. 12 x 2FR bat tubes). These bat boxes must be attached to the bridge in an unlit area above high-water mark.
- The boxes should be attached upright unless there is insufficient clearance above the river and the lower section would be immersed. Two boxes should be attached together to form a large cavity suitable for a large population of bats.

Examination of all mature trees, and bat boxes along River Walk with roost potential prior to removal

All mature trees at the Alps, along River Walk, and along the south and North quays in Arklow shall be examined for bats prior to felling.

This may be achieved through a bat detector assessment if undertaken in the active season (prior to November and after March) or alternatively may require supervision at the time of felling. Any mature trees will require survey prior to felling.

All buildings within the WwTP site shall be examined for bats prior to removal. This may be achieved through a bat detector assessment if undertaken in the active season (prior to November and after March) or alternatively may require supervision at the time of removal.

Lighting at the WwTP site

External lighting will be installed around the WwTP for the safety and security of staff on the site. The specimen lighting required during construction has been designed in consultation with the licenced bat expert. The detailed lighting required will be designed in consultation with the licenced bat expert, using emerging lighting technologies and having regard to best practice.

Mitigation for bats proposed as part of the application for the derogation licenses and required to be implemented during construction includes the following additional lighting considerations:

- Floodlighting is required for two of the external yards, and will be located within the building facade, and screened from broader light spillage by the louvered elements of the facade. Floodlights will be LED, as these have glass lenses which can be used to direct the light to the working area and reduce light spillage;
- Floodlights for working areas will make use of multiple lights to produce a more uniform light output and to lower the individual output from a single source – these will however still be quite high output;
- The site lighting incorporates the use of street lights to light the roadway around the building. The street lights will be selected to minimize upward lighting spill, hoods, louvres, shields or cowls would be fitted on the lights to reduce light spillage, and will incorporate the use of presence detection;
- Perimeter fence lighting will also incorporate presence detection, and will be off by default until motion is detected;
- Low level (~ 1m high) bollard lighting is being used in selected areas (refer to architect’s landscape plans);
- Lights should be of low intensity. It is better to use several low intensity lights than one strong light spilling light across the entire area. The source of light should be Light Emitting Diodes (LEDs) as this is a narrow beam highly directional highly energy efficient light source. The lighting should allow for a light level of 3 lux at ground level. This low lighting is thus easier to control both the direction but also the actual light level because it is so close to the target area (if using bollard lighting);
- Narrow spectrum lighting should be used with a low UV component. Glass also helps reduce the UV component emitted by lights.

In the event of security lighting being required, it is recommended that infra-red lighting and infra-red cameras are employed to record anti-social activity to assist in crime solving and prevention. This will not raise the visible light levels that would affect mammals and birds to a much greater extent.

Additional habitat creation measures for bats

It is envisaged that the façade of the new buildings at the WwTP will provide roosting opportunities for bats. As part of the detailed design of the proposed development, the appointed bat specialist shall review the buildings and advise on an appropriate location for of a purpose-built bat box such as the Improved Roost-Maternity Bat Box; likely to be located on the southern facade of both Process and Inlet works Buildings at about 4.5m off the ground. These locations will not be directly illuminated.

Planting of trees, shrubs, climbers, and species rich grassland within the planning boundary of the proposed development is detailed in the flora and habitats mitigation **Section 11.5.1.1**.

Marine mammals

The Standard Management Conditions for the contractor will include a requirement to consider alternative construction methodologies during the development of the detailed design, including confirmation of the sound generation characteristics (in air and in water) of all methodologies and all the equipment intended to be used in coastal and marine environments (i.e. in all areas east of Arklow Harbour at South Quay). The contractor will also be required to apply the appropriate risk minimisation measures outlined in the guidance[2]. These risk minimisation measures include the following as a minimum[2]:

- A6.1 - Minimise the duration over which the sound-producing activity is intended to take place;
- A6.2 - Minimise the individual and cumulative sound pressure and exposure levels delivered into the environment by the activity. If necessary the use of alternative, lower impact equipment and methods could be explored (e.g., vibratory hammer, gravity base piles).
- A6.3 - Incorporate the use of clear "ramp-up" (i.e., "soft-start") procedures, whereby sound energy input to the marine environment is gradually or incrementally increased from levels unlikely to cause significant behavioural impact on marine mammals to the full output necessary for completion of the activity.
- A6.4 - Incorporate the use of fully enclosing or confined bubble curtains, encircling absorptive barriers (e.g., isolation casings, cofferdams) or other demonstrably effective noise reduction methods at the immediate works site, in order to reduce underwater sound propagation from on-site operations. Studies have shown that such methods can provide a significant reduction in sound input to the wider aquatic environment in the order of 10-30 dB.

- A6.5 - Use trained and experienced marine mammal observers (MMOs) to provide effective means of detecting marine mammals in the vicinity of coastal and marine plans or projects. Associated operational considerations must also be taken into account (see Section 4.2 of the guidance[2]).

Implementation of these measures during construction will ensure that no risks of injury to, or of a disturbance/behavioural response by marine mammals from man-made sound will arise during construction.

Aquatic ecology

The contractor will submit a detailed programme of work to the client and to Inland Fisheries Ireland showing the order of procedure and the method by which it is proposed to carry out the authorised works, together with a timetable for completion of such work, in compliance with the guidance[61].

The seasonal restriction contained in the guidance[61] has been modified in consultation with Inland Fisheries Ireland, in respect of the proposed development, to take account of the presence and seasonal passage on migration of Habitats Directive Annex II listed fish species Atlantic Salmon, River Lamprey, and potentially also Sea Lamprey in the Avoca River and Estuary. All instream works including the installation and removal of sheet piling or geotextile wrapped gabions required to provide barriers between the in-river working areas (including the temporary causeway) and aquatic habitats will be carried out during the July to September inclusive.

The following mitigation measures will apply:

- Four weeks' notice shall be given in writing to the Employer's Representative and Inland Fisheries Ireland before the authorised works commence;
- A suitably qualified Environmental Clerk of Works shall be appointed to oversee and monitor all measures taken to protect the aquatic environment;
- The contractor shall pay all statutory fees associated with the works;
- The contractor will be responsible for maintaining flows in the river at all times. The contractor will be permitted to construct temporary causeway, however the flow must be maintained throughout this period to enable free passage of fish. The details of the all temporary works in and immediately adjoining the Avoca River shall be subject to approval by the Employer's Representative and by Inland Fisheries Ireland;
- The contractor shall take all practicable measures to prevent the deposition of silt or other material in, and the pollution or damage to the Avoca River;
- Any construction equipment and vehicle which in the opinion of the Employer's Representative presents a risk of affecting the Avoca River shall be removed from site;

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- Instream machine works shall be minimised, and any machines working in the watercourse must be protected against leakage or spillage of fuels, oils, greases and hydraulic fuels;
- Instream earthworks must be executed so as to minimise the suspension of solids. Construction activities, especially ones involving the pouring of concrete, must be conducted in the dry;
- Dewatering of any in-stream or marine sheet piled areas will be via a screened water intake pipe, to avoid injury or mortality to any fish that may be present;
- Search for and safe removal to safe waters of any fish trapped in enclosed working areas in the aquatic environment will be carried out by suitably qualified and licenced personnel, using methodologies to be agreed with Inland Fisheries Ireland;
- Discharge from the dewatering process will be passed to a suitably sized settlement pond or a propriety silt removal system, before discharge to the Avoca River or the local sewer network. Back-up equipment will be required to be maintained ready for use at all working areas. Any discharge to either sewer or watercourse will be subject to a discharge licence;
- In order to minimise the volumes of water required to be removed from contained working areas in which in-situ cement works and/or excavation are required, working areas will be covered overnight and when works are not in progress therein, in order to minimise infiltration of rainfall;
- To minimise the risk of spills and/or leaks, standard good practice will be followed with regard to pollution prevention as part of the detailed CEMP(s);
- All in-situ cement works will be monitored by the appointed Environmental Manager to ensure that spill prevention and remediation measures are in place, to minimise the risk and extent of spills and to rapidly deploy clean up equipment;
- Machinery maintenance work, re-fuelling of construction equipment and the addition of hydraulic oil or lubricants to vehicles/equipment will take place in designated bunded areas within the construction compounds. All waste oil, empty oil containers and other hazardous wastes will be disposed of in compliance with the requirements of the Waste Management Acts 1996, as amended. All of the construction machinery operating near any watercourse will be systematically checked in order to avoid leaks of oils, hydraulic fluids and fuels; and
- Spill-kits and hydrocarbon absorbent packs will be stored in the cabin of each vehicle and operators will be fully trained in the use of this equipment.

Coastal processes

Relevant mitigation measures for coastal processes are described in **Section 15.5.1 of Chapter 15** and in **Appendix 15.5**.

11.5.1.2 Mitigation during Operation

Subject to the implementation of the monitoring provided in **Section 11.5.2 in Chapter 15** and **Appendix 15.2**, no further mitigation will be required with respect to biodiversity effects during the operation of the proposed development.

11.5.2 Monitoring

11.5.2.1 Monitoring during Construction

The following monitoring would be carried out during construction:

- Monitoring of new seeding and planting provided as habitat and flora mitigation will be carried out during implementation of these measures;
- Monitoring of the effectiveness of implementation of bat mitigation measures, including occupancy of bat roost boxes and bat responses to WwTP site lighting, will be carried out during the construction of the proposed development; and
- Monitoring and reporting of marine mammals will be provided by MMO as referred to in **Section 11.5.1.1**.

11.5.2.2 Monitoring during Operation

The following monitoring would be carried out during operation of the proposed development:

- Monitoring of new seeding and planting provided as habitat and flora mitigation will be carried out during the first two years of operation.
- Monitoring of the effectiveness of implementation of bat mitigation measures, including occupancy of bat roost boxes, and bat responses to WwTP site lighting, will be carried out during the first two years of operation.

11.6 Residual Effects

11.6.1 Residual Effects during Construction

With the implementation of mitigation measures included, following **in Section 11.5.1.1**, residual indirect effects on the European site Buckroney – Brittas Dunes and Fen SAC (site code: 000729), in respect of the Qualifying Interests listed in Table 11.8, are assessed as neutral. No likely significant direct residual effects arise.

With the implementation of the mitigation measures specified in **Section 11.5.1.1**, residual effects on the Habitats Directive Annex II listed fish species Atlantic Salmon, River Lamprey and Sea Lamprey during construction are assessed as neutral.

With the full implementation of the mitigation measures specified in **Section 11.5.1.1**, residual effects on Habitats Directive Annex IV listed bat species (Common pipistrelle, Soprano pipistrelle, Leisler's bat and Daubenton's bat) are assessed as neutral.

With the full implementation of the mitigation measures specified in **Section 11.5.1.1**, residual effects on Habitats Directive Annex IV listed cetacean species, and Habitats Directive Annex II listed Harbour Seal and Grey Seal, are assessed as neutral.

With the implementation of seasonal mitigation measures specified in **Section 11.5.1.1**, residual effects on breeding birds and their nests, eggs and nestlings, are assessed as neutral.

Local effects on terrestrial flora and habitats within the planning boundary, (providing locally important biodiversity and ecological connectivity through the urban environment of Arklow), are assessed as short term, slight, and reversible, in the context of the urban area of Arklow.

11.6.2 Residual Effects during Operation

With the implementation of mitigation measures included in **Section 11.5.1.2**, residual indirect effects on the European site Buckroney – Brittas Dunes and Fen SAC (site code: 000729), in respect of the Qualifying Interests listed in Table 11.8, are assessed as neutral. No likely significant direct residual effects arise during operation.

With the implementation of the mitigation measures specified in **Section 11.5.1.2,** and from the considerations given in **Section 11.4.3.4**, residual effects on the Habitats Directive Annex II listed fish species Atlantic Salmon, River Lamprey and Sea Lamprey are expected to be positive during operation.

With the implementation of the mitigation measures specified in **Section 11.5.1.2**, local residual effects on terrestrial flora and habitats within the planning boundary, providing locally important biodiversity and ecological connectivity through the urban environment of Arklow, and residual effects on species including Habitats Directive Annex IV listed bat species (Common pipistrelle, Soprano pipistrelle, Leisler's bat and Daubenton's bat), are assessed as not significant during operation.

With the implementation of the mitigation measures specified in **Section 11.5.1.2**, residual effects on Habitats Directive Annex IV listed cetacean species, and Annex II listed Harbour Seal and Grey Seal, are assessed as neutral during operation.

Arising from the implementation of seasonal mitigation measures specified in **Section 11.5.1.2**, residual effects on breeding birds and their nests, eggs and nestlings, are assessed as neutral. The provision of nesting boxes for Grey Wagtail and Pied Wagtail at Arklow Bridge is assessed as slight positive during operation.

As detailed in **Section 11.4.3.4**, the proposed development will have positive effect on aquatic ecology.

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12 Archaeology, Architectural and Cultural Heritage

12.1 Introduction

This chapter describes the likely significant effects of the proposed development on archaeology, architectural and cultural heritage.

Chapter 4 provides a full description of the proposed development whilst **Chapter 5** describes the Construction Strategy. The following aspects are particularly relevant to the archaeology, architectural and cultural heritage assessment:

- Design:
  - Likely significant effects of the proposed development on architectural heritage and setting; and
  - Likelihood of encountering archaeological remains associated with the footprint of the proposed development.
- Operation:
  - Likely significant effects of the proposed development on architectural heritage and setting during operation.
- Construction:
  - Likelihood of encountering archaeological remains during intrusive works including subsurface construction and open cut construction of the outfalls and interceptor sewers; and
  - Underpinning works to Arklow Bridge.

It should be noted that this assessment has had regard to the ongoing data gathering and assessment of the archaeology, architectural and cultural heritage as part of the proposed Arklow Flood Relief Scheme. This work is currently being carried out by Courtney Deery and ADCO on behalf of the Office of Public Works and Wicklow County Council. As such, references to this ongoing assessment are made, where relevant, within this assessment chapter.

12.2 Assessment Methodology

12.2.1 General

This assessment determines, as far as reasonably possible from existing records, the nature of the cultural heritage resource within the footprint and a defined vicinity of the proposed development using appropriate methods of study.

As outlined by the Chartered Institute for Archaeologists[1], desk-based assessment is a programme of study of the historic environment within a specified area or site on land, the inter-tidal zone or underwater that addresses agreed research and/or conservation objectives. It consists of an analysis of existing written, graphic, photographic and electronic information in order to identify the likely heritage assets, their interests and significance and the character of the study area, including appropriate consideration of the settings of heritage assets.

Desk based assessment leads to the following:

- Determining the presence of known archaeological and built heritage sites that may be affected by the proposed WwTP development;
- Assessment of the likelihood of finding previously unrecorded archaeological remains during the construction programme;
- Determining the impact (direct/ indirect) upon the known cultural heritage sites in the surrounding area (receiving environment); and
- Identifying mitigation measures based upon the results of the above research; and
- Describing the residual impact on the archaeological, architectural and cultural heritage resource.

Research for this assessment has been undertaken in a number of phases. The first phase comprised a paper survey of publicly available archaeological, architectural, historical and cartographic sources. The second phase involved a field inspection of the proposed development site. Phases one and two were carried out in early 2018 and the third phase included full marine archaeological investigations, including a marine geophysical survey (in April 2017), dive inspections and an inter-tidal survey (April 2018).

12.2.2 Guidance and Legislation

This assessment has been undertaken having regard to general EIA guidance as described in **Section 1.4.3 of Chapter 1** and the following legislation and guidelines were also consulted as part of the assessment.

- National Monuments Act 1930 to 2014;
- The Planning and Development Acts 2000 to 2018;
- Heritage Act, 1995, as amended;
- Heritage Act 2018;
- Frameworks and Principles for the Protection of the Archaeological Heritage, 1999, (formerly) Department of Arts, Heritage, Gaeltacht and Islands; and
- Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act, 1999 and the Local Government (Planning and Development) Acts 2000-2018.

[1] Chartered Institute for Archaeologists 2017 Standards & Guidance for Desktop Assessments

12.2.3 Study Area

The archaeological and cultural heritage receiving environment is defined as an area measuring 200m from the planning boundary for the proposed development. The architectural heritage receiving environment is defined as an area measuring 150m from the edge of the planning boundary for the proposed development.

Measurements have been taken from the proposed development boundary to the upstanding remains of a site or structure. Where there are no upstanding remains, the measurement is taken to the centre of the site as indicated within Figure 12.1.

12.2.4 Consultation

Following the initial research, a number of statutory and voluntary bodies were consulted to gain further insight into the cultural background of the receiving environment and study area, as follows:

- Two meetings were held with the Department of Culture, Heritage and the Gaeltacht (DCHG) on 16 January 2018 and 19 June 2018.

The following were also informally consulted to gain baseline data for the study area:

- Units in the DCHG including the Heritage Service, National Monuments and Historic Properties Section which include a number of datasets: Record of Monuments and Places; Sites and Monuments Record; Monuments in State Care Database; Preservation Orders; Register of Historic Monuments; Architectural Advisory Unit and Underwater Archaeology Unit;
- National Museum of Ireland, Irish Antiquities Division: topographical files of Ireland;
- National Inventory of Architectural Heritage: County Wicklow; and
- Wicklow County Council: Planning Section.

In undertaking this assessment, consultation has also taken place with the archaeological and cultural heritage specialists (Courtney Deery and ADCO), undertaking the archaeological, architectural and cultural heritage assessment for the proposed Arklow Flood Relief Scheme.

12.2.5 Paper Survey

A paper survey is a document search undertaken as part of the desktop study of the baseline data. The following sources were examined and a list of areas of archaeological, architectural and cultural heritage potential was compiled:

- Record of Monuments and Places for County Wicklow;
- Sites and Monuments Record for County Wicklow;
- Monuments in State Care Database;
- Preservation Orders;

- Register of Historic Monuments;
- The Shipwreck Inventory of Ireland;
- Topographical files of the National Museum of Ireland;
- Cartographic and written sources relating to the study area;
- Wicklow County Development Plan 2016 - 2022 (County Development Plan);
- Arklow and Environs Local Area Plan 2018 - 2024 (Arklow LAP);
- National Inventory of Architectural Heritage County Wicklow (Architectural & Garden Survey);
- Aerial photographs; and
- Excavations Bulletin (1970 – 2017).

Further information is provided below on the key data sources:

Record of Monuments and Places (RMP)

Section 12(1) of the National Monuments (Amendment) Act 1994 provides that the Minister for Arts, Heritage, Gaeltacht and the Islands (now the Minister for Culture, Heritage and the Gaeltacht) shall establish and maintain a record of monuments and places where they believe there are monuments. The record comprises of a list of monuments and relevant places and mapping showing each monument and relevant place in respect of each county in the State. Sites recorded on the RMP all receive statutory protection under the National Monuments Act. All recorded monuments are referred to as Archaeological Heritage (AH sites) within this appraisal.

Sites and Monuments Record (SMR)

The SMR holds documentary evidence and records of field inspections of all known archaeological sites and monuments. Some information is also held about archaeological sites and monuments whose precise location is not known e.g. only a site type and townland are recorded. These are known to the National Monuments Section as 'un-located sites' and cannot be afforded legal protection. As a result these are omitted from the RMP. SMR sites are also listed on a website[2] maintained by the DCHG

National Monuments in the State Care Database

This is a list of all the National Monuments in the State guardianship or ownership. Each is assigned a National Monument number whether in guardianship or ownership and has a brief description of each monument.

A National Monument receives statutory protection and is described as 'a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto' (National Monuments Act, 1930, Section 2).

[2] www.archaeology.ie

The Minister for the Department of Environment, Heritage and Local Government (now the Minister for Culture, Heritage and the Gaeltacht) may acquire National Monuments by agreement or by compulsory order. The State or Local Authority may assume guardianship of any National Monument (other than dwellings). The owners of National Monuments (other than dwellings) may also appoint the Minister or the Local Authority as guardian of that monument if the State or Local Authority agrees. Once the site is in ownership or guardianship of the State, it may not be interfered with without the written consent of the Minister.

Preservation Orders List

Preservation Orders and/or Temporary Preservation Orders, can be assigned to a site or sites that are deemed to be in danger of injury or destruction. Orders are allocated under the National Monuments Act, 1930. Preservation Orders make any interference with the site illegal. Temporary Preservation Orders can be attached under the National Monuments Act, 1954. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the Minister (DCHG).

Register of Historic Monuments

This register was established under Section 5 of the National Monuments (Amendment) Act 1987 and requires the Minister to establish and maintain such a record. Historic monuments and archaeological areas included in the register are afforded statutory protection pursuant to the regime under the National Monuments Acts 1930 to 2014. The register also includes sites under Preservation Orders and Temporary Preservation Orders. All registered monuments are included in the RMP.

The Shipwreck Inventory of Ireland

This inventory includes all known wrecks for the years up to and including 1945 and approximately 12,000 records have been compiled and integrated into the shipwreck database thus far. An inventory of wrecks covering the coastal waters off counties Louth, Meath, Dublin and Wicklow was published in 2008. Wrecks over 100 years old and archaeological objects found underwater are protected under the National Monuments Acts 1930 to 2014. Significant wrecks less than 100 years old can be designated by Underwater Heritage Order on account of their historical, archaeological or artistic importance.

Topographical files of the National Museum of Ireland

This is the national archive of all known finds recorded by the National Museum of Ireland. This archive relates primarily to artefacts but also includes references to monuments and unique records of previous excavations. The find spots of artefacts are important sources of information on the discovery of sites of archaeological significance.

Cartographic sources

These are important in tracing land use development within the receiving environment of the proposed development as well as providing important topographical information on areas of archaeological potential and the construction of buildings. Cartographic analysis of all relevant maps has been made to identify any topographical anomalies or structures that no longer remain within the landscape.

The cartographic sources consulted include:

- Down Survey Barony Map of Wicklow (1655-8); and
- Ordnance Survey 6" and 25" maps of Co. Wicklow (1841, 1895-1900, 1928-29).

Documentary sources

Documentary sources (as identified above) were consulted to compile background information on the archaeological, architectural and cultural heritage receiving environment of the proposed development.

Development Plans

Development Plans contain a catalogue of all the Protected Structures, archaeological sites and Architectural Conservation Areas within every county. The development plans of relevance that were examined as part of this assessment include the County Development Plan and Arklow LAP.

The National Inventory of Architectural Heritage (NIAH)

The NIAH is a government based organisation tasked with making a nationwide record of locally, regionally, nationally and internationally significant structures, which in turn provides county councils with a guide as to what structures to list within the Record of Protected Structures. The NIAH have also carried out a nationwide desk based survey of historic gardens, including demesnes that surround large houses.

Aerial photographic coverage

This is an important source of information regarding the precise location of sites and their extent. It also provides information on the terrain and its likely potential for archaeology. Ordnance Survey aerial photographs (1995, 2000, 2005), Google Earth coverage (2003 - 2012) and Bing Maps were examined for this assessment.

Excavations Bulletin

This is a summary publication that has been produced every year since 1970. This summarises every archaeological excavation that has taken place in Ireland during that year up until 2010 and since 1987 has been edited by Isabel Bennett. This information is also available online[3] from 1970 - 2017.

[3] www.excavations.ie

Information from this resource is vital when examining the archaeological content of any area, which may not have been recorded under the SMR and RMP files.

12.2.6 Field Inspection

Terrestrial

Field inspection is necessary to determine the extent and nature of archaeological and architectural remains and can also lead to the identification of previously unrecorded or suspected sites and portable finds through topographical observation and local information. The archaeological and architectural field inspection was carried out during June 2018 and entailed:

- Noting and recording the terrain type and land usage;
- Noting and recording the presence of known and previously unknown features of archaeological, architectural or cultural heritage significance;
- Verifying the extent and condition of recorded sites and structures (RMPs/ RPS/ NIAH); and
- Visually investigating any suspect landscape anomalies to determine the possibility of their being anthropogenic in origin and of archaeological, architectural or cultural heritage significance

Aquatic

Marine archaeological investigations were required in order to inform the baseline conditions in the vicinity of the long sea outfall, along with the impact assessment. In April 2017 ADCO carried out a marine geophysical survey of a 20ha area around the proposed footprint of the outfall alignment. This was undertaken under licence 16R0219. A summary of the report is included within the baseline conditions and the report itself is available in **Appendix 12.1**.

Following the initial survey, an archaeological dive inspection of potential archaeological anomalies was carried out by ADCO in April 2018. This was carried out under licences 17D0078 and 17R0197. The works included a survey of the intertidal area along the eastern edge of the proposed development. A summary of the report is included within the baseline conditions and the report itself is available in **Appendix 12.2**.

ADCO have also completed an underwater survey of the Avoca River over a length of approximately 1km, including Arklow Bridge, as part of the proposed Arklow Flood Relief Scheme. The results of this survey were reviewed as part of this assessment. A summary of this work is given in **Appendix 12.2**.

12.2.7 Impact Assessment Methodology

In order to assess, distil and present the findings of this study, the following definitions apply.

- ‘Cultural Heritage’ where used generically, is an over-arching term applied to describe any combination of archaeological, architectural and cultural heritage features, where –
- The term ‘archaeological heritage’ is applied to objects, monuments, buildings or landscapes of an (assumed) age typically older than AD 1700 (and recorded as archaeological sites within the Record of Monuments and Places);
- The term ‘architectural heritage’ is applied to structures, buildings, their contents and settings of an (assumed) age typically younger than AD 1700;
- The term ‘cultural heritage’, where used specifically, is applied to other (often less tangible) aspects of the landscape such as historical events, folklore memories and cultural associations. This designation can also accompany an archaeological or architectural designation or describe features that have a more recent origin, but retain cultural heritage significance.
- For the purposes of this report the terms ‘architectural heritage’ and ‘built heritage’ have the same intended meaning and are used interchangeably.

12.3 Baseline Conditions

12.3.1.1 Archaeological and Historical Background

Arklow town is located in County Wicklow, on the east coast of Ireland. It is situated at the mouth of the River Avoca and is accessible via the N11 road or the Dublin/Rosslare railway line.

Prehistoric Period

There is some evidence to indicate that Wicklow was inhabited from the late Mesolithic period (5500-4000 BC). During this period people hunted, foraged and gathered food and appear to have had a primarily (but not exclusively) mobile lifestyle. The archaeological record is characterised mainly by discarded flint tools and the debris from their manufacture. Flint scatters are recorded from Ardanairy, near Brittas Bay and on Corporation Lands to the south of Wicklow town (Grogan and Kilfeather 1997, 1).

Considerable evidence has been identified that dates to the Neolithic period (4000-2400 BC) in County Wicklow. During this period communities became less mobile and their economy became based on the rearing of stock and cereal cultivation. This transition was accompanied by major social change. Agriculture demanded an altering of the physical landscape, forests were rapidly cleared and field boundaries constructed. There was a greater concern for territory, which saw the construction of large communal ritual monuments called megalithic tombs, which are characteristic of the period.

The while most of the main prehistoric tomb types have been identified in County Wicklow, passage tombs appear to have been of particular importance during the Neolithic period. A number of these tombs were built across the Wicklow Mountains, which commanded great views across the Plain of Dublin, Dublin Bay and Wicklow.

The Bronze Age (2400-800 BC) in Wicklow is largely represented by burial monuments, including wedge tombs, barrows and urn burials. A number of these burial and ritual monuments survive in the Ashford area of Wicklow. Standing stones, stone alignments and stone circles are generally associated with this period and are often thought to have a ritual significance. The townlands of Ballybetagh, Hollywood and Castleruddery contain stone circles dating from this era. Hillforts at Rathgall, Baltinglass Hill and Spinnans Hill provide evidence for late Bronze Age settlement in Wicklow. As with most parts of the country, *fulachta fiadh* or burnt mounds have been identified throughout the county. These are generally considered to be Bronze Age in date and may have been cooking and/or feasting sites. They are normally found close to a water source and are characterised by a horseshoe shaped mound. These mounds are formed by up-cast charcoal rich burnt stones, which often cover a pit, or trough. These troughs may be wood lined, and often survive intact within the damp conditions that *fulachta fiadh* are often found in.

There is not a large amount of archaeological evidence for prehistoric occupation within the town of Arklow; however, the SMR file does make reference to the 19th-century discovery of a possible bronze age burial mound. Although the exact site was never located it was reported to have been located to the north of the bridge over the River Avoca within the townland of Ferrybank. Pottery and burnt bones were found there by workmen.

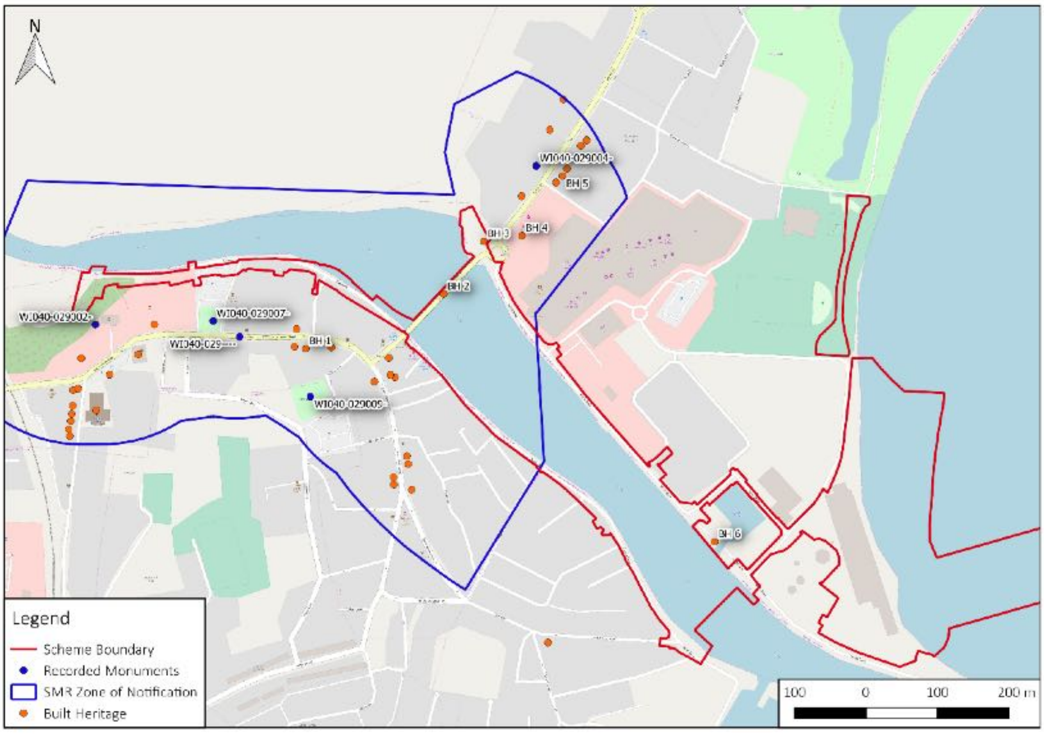

Figure 12.1: Extract from the RMP map showing recorded monuments and structures and the proposed development boundary

Early Medieval Period

During the early medieval period Ireland was not a united country but rather a patchwork of minor monarchies all scrambling for dominance, with their borders ever changing as alliances were formed and battles fought. Kingdoms were a conglomerate of clannish principalities with the basic territorial unit known as a *túath*. Byrne (1973) estimates that there were probably at least 150 kings in Ireland at any given time during this period, each ruling over his own *túath*. These kings were distributed strategically throughout the region and ruled over many tribal units.

The most common indicator of settlement during the early medieval period is the ringfort. Ringforts, (also known as *rath, lios, caiseal, cathair* and *dún*) are a type of defended homestead comprising of a central site enclosed by a number of circular banks and ditches. The number of ditches can vary from one (univallate) to two or three (bivallate or tri-vallate) and is thought to reflect the status and affluence of the inhabitants. Another morphological variation consists of the platform or raised ringfort – the former resulting from the construction of the ringfort on a naturally raised area. Ringforts are most commonly located at sites with commanding views of the surrounding environs which provided an element of security. While ringforts, for the most part, avoid the extreme low and uplands, they also show a preference for the most productive soils (Stout 1997, 107). One of the most recent studies of the ringfort (Stout, 1997) suggested that there are a total of 45,119 potential ringforts or enclosure sites throughout the island of Ireland. This figure has since been revised upwards to ‘over 47,000 ringforts’, while O’Sullivan et al suggest that there are ‘at least 60,000 early medieval settlement enclosures on the island’ (O’Sullivan et al., 2014).

Whilst there are no known early medieval sites in and within the town of Arklow, it is likely that the area was settled at this time due to the presence of the coastal resource and the River Avoca. During the latter part of this period, the Vikings named the settlement *Arnkell*, a Norse name meaning a low-lying meadow near a river. It is this name that the modern name of Arklow is derived from.

Medieval Period

Both Arklow and Wicklow became important medieval towns in the Anglo-Norman period. This is reflected by the presence of a zone of archaeological potential that surrounds the heart of the town (RMP WI040-029), which can be seen in Figure 12.1. In 1185 the manor of Arklow was granted to Theobald Fitzwalter by King John. Land was also granted for the Cistercians, but it seems that they never erected an abbey church in the area. A large amount of the land surrounding Arklow was parcelled up and given to the supporters of the English king. In 1264, Thomas, son of Theobald, granted land to the Dominicans, who established a friary within the southern portion of the town (WI040-029001). It is probable that this is the land outlined by the townland of Abbeylands. This area is also denoted within the Down Survey Barony map of Arklow.

During the early part of the 19th century, human remains were identified to the north-northeast of the Arklow Bridge. These were found within lintelled graves, or ‘long-cists’ and may represent the site of the Cistercian Monastery, which were usually established well outside of established settlements (WI040-029008).

The Fitzwalters held the position of chief Butler to the Monarch and because of this title, the Fitzwalters slowly adopted the name Butler as a surname. The denuded remains of Arklow Castle, thought to date to the 13th century and associated with the Fitzwalters, is located to the south of the proposed scheme (near the ‘Alps’ site) (WI040-029002). The Butler’s had other estates in different parts of Ireland and in the 14th century they decided to move their centre of operations to Kilkenny, with Kilkenny Castle becoming their main home. Caretakers were appointed to look after affairs in Arklow, including the castle, which may have replaced an earlier defensive structure

By the 14th century the Anglo-Normans had secured an area around Dublin, which they called the Pale, outside of which they had little influence or control. It varied in size as the fortunes of war dictated. Arklow was sometimes on the very southern tip and sometimes isolated from the rest of it, depending on how successful the attacks of the O' Byrnes and the O' Tooles were at any given time.

Post Medieval Period

During the Civil War against King Charles I, the leader of the Royalists in Ireland was James Butler, Earl of Ormonde. However, he was not successful against Cromwell, whom after capturing Drogheda, arrived in Arklow on 29 September 1649, on his way to Wexford. His Army camped across the river at Sheepwalk and prepared to attack. A message was sent calling on the garrison to surrender. If they agreed, everyone could go free, if they resisted everyone would be killed. The town surrendered to Cromwell and he held court within the castle, which he all but demolished on his departure. All that remained was a circular tower and part of the curtain wall, which are present today (WI040-029002).

Forty years later, England was engaged in another Civil War, which had less of an impact on Arklow. This time the forces of James II and William of Orange were fighting over the right to the Kingship. After his defeat at the Battle of the Boyne, James left his Irish supporters to the mercy of the Williamites. He headed for Waterford to take a ship to France, passing through Arklow on the way, where he stayed at Shelton Abbey. Tradition has it that whilst there James suffered from a nose bleed, which were a common ailment of his. The wood in the porch of the Abbey was stained by his blood, but cut out and kept as a souvenir. The wood remained at the Abbey until 1860, when a careless servant threw it out onto a rubbish fire.

The next major event was the Battle of Arklow on 9 June 1798. It is considered to be one of the most important events in the whole campaign for independence that took place at the end of the 18th century. While exact figures are not known it is generally agreed that there were approximately 3,000 garrison troops and between 10,000 and 12,000 fighting insurgents. The battle lasted roughly four hours and was fought on two main fronts. The first was around Coolgreany Road and Upper Main Street, the second was the Old Chapel Ground/Fair Green/Back Street/Lower Main Street area. The main prize was the bridge (see below), which had been built 40 years earlier and controlled access to Dublin. The garrison, though very much smaller than the insurgent force, were well trained, well-armed and had the use of artillery and barricade cover.

They won on both fronts, but their ammunition had run so low by late evening that had the rebels known, another charge might well have won the day. There are stories that during the erection of the quays to the east of Arklow Bridge (during the 19th century) that enormous heaps of bones were found, which are presumed to be the ‘fallen’ from a battle in 1798. Whilst this is cited in a local history website (countywicklowheritage.org), no other evidence for the identification of human remains during the erection of the quays has been found.

Arklow Bridge is a protected structure (RPS A26) and is included within the NIAH survey as being of regional significance (NIAH Ref.: 16322046). The structure is one of the longest post medieval bridges in Ireland and originally consisted of 19 arches. It was constructed by Andrew Noble who committed suicide in 1759 and is buried at ‘Ennercilly’. The eastern elevation is rubble masonry with roughly dressed voussoirs and cut waters. Originally constructed in 1746, bridge was widened to its western side during 1959. O’Keeffe and Simington (2016, 58) note that works on the bridge during the 1970s identified the remains of wickerwork mats under some of the bridge piers during underpinning works, which may be associated with an earlier structure. However, it is possible that an earlier bridge (as indicated on Moll’s maps of 1714 and 1728) may have been a timber structure, as there is a wide fortification pier at the centre of the present bridge (ibid). It remains possible that the river crossings depicted within Moll’s maps may represent fording points rather than an earlier bridge and that the presence of wickerwork mats does not necessarily mean the presence of an earlier structure.

During the later part of the 19th century, Arklow became more industrialised and docks were established along the banks of the Avoca River, between the bridge and the piers that defined entrance into the sea.

Prior to this the area was characterised by estuarine sands and channels. A chemical works was established at the mouth of the Avoca, which by 1895 had been purchased by a company called Kynoch and was producing cordite. Part of the factory site forms part of the proposed WwTP site today (Figure 12.2). The factory initially employed 260 people but expanded at the beginning of the 1900s after receiving large orders to supply troops during the Boer War in South Africa. Large orders followed, with the outbreak of the World War 1 and numerous new buildings were constructed to the north of the main factory. The number of employees increased to 5000 and special trains were put on in order to get the work force to the station from the surrounding countryside. Despite a large work force, the dangerous nature of what was being produced, meant that injuries were common. During the war, injuries were so common that a hospital was opened on site. This treated 900 injuries during the time it was active, 135 of which were defined as serious. In September 1917, a large explosion took place at the plant, where 27 men died and six were seriously injured. Although there were rumours of a German submarine attack, the explosion was deemed to have been accidental. The announcement of the closure of the factory came five months after the accident and after 1919 the site was dismantled and many of the buildings demolished (Cannon 2006). However, as the site had been purchased by a Mr David Frame for £90,000, he intended to recoup his investment and everything from the site was sold. Recycled bricks from the plant were used to the Ormonde Dance Hall and the old club house at Arklow lawn tennis club (Fitzgerald 2017).

Today nothing of the original 19th or early 20th century factory remains within the WwTP or its immediate surroundings. The site was developed during the 1980s and now contains the remains of a derelict plasterboard factory. A number of Kynoch bunkers do survive in a ruined condition approximately 900m to the north of the proposed WwTP, but many of the storage magazines have been reclaimed by the sea. Refer to **Section 14.3.8 of Chapter 14** for further detail on the industrial history of the WwTP site.

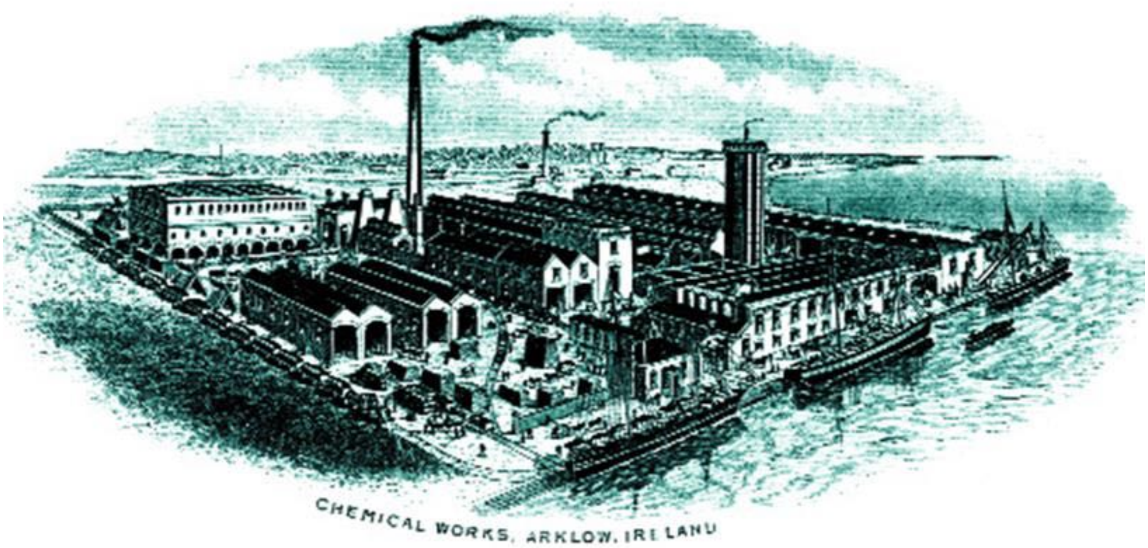

Figure 12.2: View northeast of the Arklow Explosive Factory (1895)

12.3.1.2 Summary of Previous Archaeological Investigations within the Receiving Environment

A review of the Excavations Bulletins (1970 – 2017) has shown that numerous excavations have been undertaken in the general vicinity of the proposed development, including several within and immediately adjacent to the proposed development.

Full monitoring of the Wicklow County Water Conservation Programme works in Arklow town was undertaken in 2014. These works took place in various locations around the town (Licence No.: 14E0054, C534, E4542, R356). Nothing of archaeological significance was noted in any of the works areas at that time.

Archaeological assessment took place at a residential development at South Quay, Arklow, Co. Wicklow (Licence No.: 98E0187), immediately to the south of the proposed development. This investigation produced pottery of 19th century date and redbrick rubble sitting directly on top of the natural subsoil.

Monitoring of construction works relating to the laying of a gas pipeline along Main Street identified large areas of post-medieval deposits confirming that the current streetscape has remained relatively unchanged (Licence No.: 00E0891).

Further works under this same licence were carried out along South Quay, within a portion of the works areas, although nothing of archaeological significance was encountered.

Development of a new retail/office building at 4 River Walk was monitored in 2006 (Licence No.: 05E1375). The site was located to the immediate south of the proposed development area. Works uncovered several layers of modern made-up ground sitting directly on top of sterile riverine gravels.

Additional testing was taken on Main Street (Licence No.: 07E0315), c.165m southwest of the works areas in the vicinity of the old cinema, however all materials found were post medieval in date and not deemed to have been of archaeological significance.

On the northern bank of the Avoca archaeological monitoring was undertaken at Ferrybank, in the immediate vicinity of the WwTP site, in advance of the laying of electricity cables. It was found that the ground consisted of reclaimed salt marsh. No finds of archaeological significance were noted.

Further along North Quay, approximately 15m from the interceptor sewer, archaeological monitoring was carried out at the site of the Bridgewater Shopping Centre. A large area was stripped during these works, however nothing of archaeological significance was encountered. North Quay was also subject to an archaeological dive survey (Licence Nos.: 06D059), as part of earlier investigations for the flood relief scheme. Another underwater survey was undertaken in the same area in 2012 as part of earlier iteration of Arklow Main Drainage Scheme (12D008). While no materials predating the 19th century quay construction was identified during either survey, it was noted that there was still the possibility of archaeological material surviving within the riverbed.

In 2007 a total of 21 test trenches were excavated in plots fronting onto Main Street Upper and the Parade Ground, 150m to the west of the proposed scheme as part of a request for further information from Arklow Town Council (Licence No.: 07E0315). The only feature of interest was noted as a probable 17th century cobble stone surface.

In 2005, archaeological monitoring and testing was also undertaken along River Walk without any archaeological discoveries (Licence No.: 05E1375).

In 2018 site investigations associated with the proposed development were subject to archaeological monitoring within the WwTP site. A total of 27 trial holes were monitored and these excavations revealed that the site is formed by reclamation material in the form of sand, stones and gravel. Some denuded structural remains were noted that may be directly associated with the former explosives factory. Nothing of archaeological significance was identified, with the exception of an ex-situ piece of worked flint.

12.3.1.3 Summary of Marine Geophysical Survey

In April 2017 ADCO carried out a marine geophysical survey within a 20ha area around the proposed footprint of the outfall alignment. This was undertaken under licence 16R0219. The full technical report itself is available in **Appendix 12.1**.

While there are more than 173 recorded wrecking events associated with Arklow, the Avoca River and the Arklow Coast, there are no known or recorded wrecksites within the area that was subject to survey. The closest site to the long sea outfall lies 3.1km southeast of the proposed outfall terminus.

The requirements for archaeologically-led marine geophysical survey in Ireland are set by the National Monuments Service and these are presented in the technical report in **Appendix 12.1**.

A series of 15 anomalies appeared in the side-scan sonar data. The majority of results were interpreted as rocks and were small-scale anomalies (approximately 1m in length). Six non-natural anomalies were identified (anomalies ss4, ss5, ss7, ss8, ss11, ss13), but none appeared to be obvious shipwreck remains.

The magnetometry data acquired across the survey areas reflected a series of localised variations that were, for the most part, small-scale variations and not sharply defined. A series of 16 variations occur within the survey area. A number of the anomalies possessed a strong magnetic signature, suggesting that they may contain metal content and be man-made in nature.

The survey concluded that whilst a number of anomalies had been detected, there was no clear indication of archaeologically significant remains, either within the planning boundary or on the seabed adjoining these areas that were surveyed. The survey recommended that five of the anomalies, (located within the alignment of the long sea outfall), be subject to further inspection in the form of a dive survey.

12.3.1.4 Summary of Aquatic Dive Inspections

In April 2018, ADCO carried out a dive inspection of the anomalies described above under licences 17D0078 and 17R0197. This included a survey of the intertidal area along the eastern edge of the WwTP site (Refer to **Appendix 12.2**).

The dive survey revealed that none of the five anomalies (identified during the geophysical survey) were deemed to be archaeological in nature. In addition, no archaeological features or deposits were evident along the intertidal area that was surveyed.

In tandem with the marine survey, additional archaeological survey was carried out within the river channel. This added to previous investigative work, which looked at the river channel adjoining the existing quaysides and certain alternative locations for the proposed river crossings for the interceptor sewer.

From the archaeological dive survey undertaken, two observations of relevance were noted:

- A ship's block constructed of wood was noted within the channel at a location upstream of the harbour, at ING 325056E 173125N; and
- A section of ship or boat wreckage was located a little upstream at ING 324977E 173248N, next to an existing foul outfall.

Arklow Bridge was surveyed in detail and a comprehensive record of its elements was prepared. A laser-scan image of the bridge's downstream elevation at its southernmost arches has been carried out.

In addition, the structural levels under the waterline were recorded using a Total Station to provide a comprehensive and metrically accurate record of the standing structure (Refer to **Appendix 12.2**).

12.3.1.5 Cartographic Analysis

Down Survey Map of the Barony of Arklow, 1656-58

Arklow Castle and several houses are portrayed on this map, but are representations of buildings rather than an accurate guide. The townland of Abbeyland is also marked further to the south of the town, but no buildings are marked within it.

First Edition Ordnance Survey Map, 1839, scale 1:10560

This is the first detailed depiction of the landscape containing the planning boundary (Refer to Figure 12.3). To the south of the river, the town is mainly constructed along one curvilinear street that is aligned west>east>southeast. Arklow Castle (WI040-029002) is located in the west of the town and is marked as being in ruins. There may have been a market square located to the southeast of the castle prior to the post medieval construction of a police station and post office.

There is no road indicated along the southern quays of the town. This area consists of garden plots that are associated with houses that front on to the main street, to the west of the bridge (RPS A26) and an open area to the east of the bridge. No roads have been established on the northern bank of the river, which is shown as an estuarine area characterised by sand dunes and river channels. The WwTP site is located within this area.

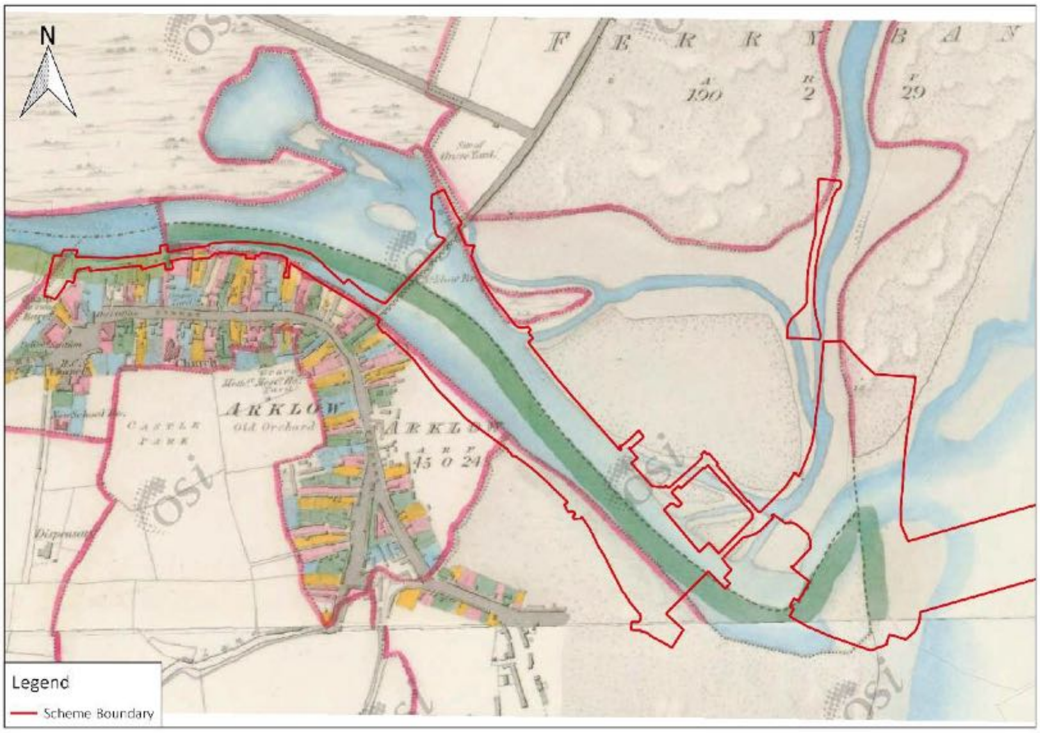

Figure 12.3: Extract from the first edition OS map, showing the planning boundary

Second Edition Ordnance Survey Map, 1886, scale 1:10560

By the time of releasing the second edition map in 1886, the town has grown a considerable amount, both to the south and north of the bridge (RPS A26). The northern quay to the east of the bridge has been established and a swivel bridge is marked along the quay to provide entrance to an estuarine channel to the northeast. A small structure marked as a Salvage Store is located adjacent to the bridge. This structure is extant today but is located outside of the site planning boundary.

At the WwTP site, structures are present that are annotated as the Arklow Chemical Works. The southern quay has yet to be established, although it appears that some earthworks are marked as present and the immediate area is annotated as being liable to floods. To the west of Arklow Bridge, the route of the proposed sewers is still shown as running through gardens associated with houses fronting onto the Main Street. The ruins of the castle are marked at the western end of the scheme (WI040-029002).

Ordnance Survey Map, 1910, scale 1:2500

This map shows the gradual development of the northern and southern quays to the east of Arklow Bridge (Refer to Figure 12.4). To the north of the northern quay the former estuarine area is marked as marsh and is gradually being reclaimed. A bridge is still marked into a small inlet along the north quay, although this is now much smaller than the channel shown on the previous map.

The Salvage Store remains present and annotated. The site of the Chemical Works is shown in detail (Refer to Figure 12.5). Multiple structures are marked, along with chimneys, tanks and a hydraulic press. A railway is marked running from the quay adjacent to the site, through the plant and continuing north. The railway provides access to a number of magazine bunkers marked along the coast. This coastal area has now been reclaimed by the sea.

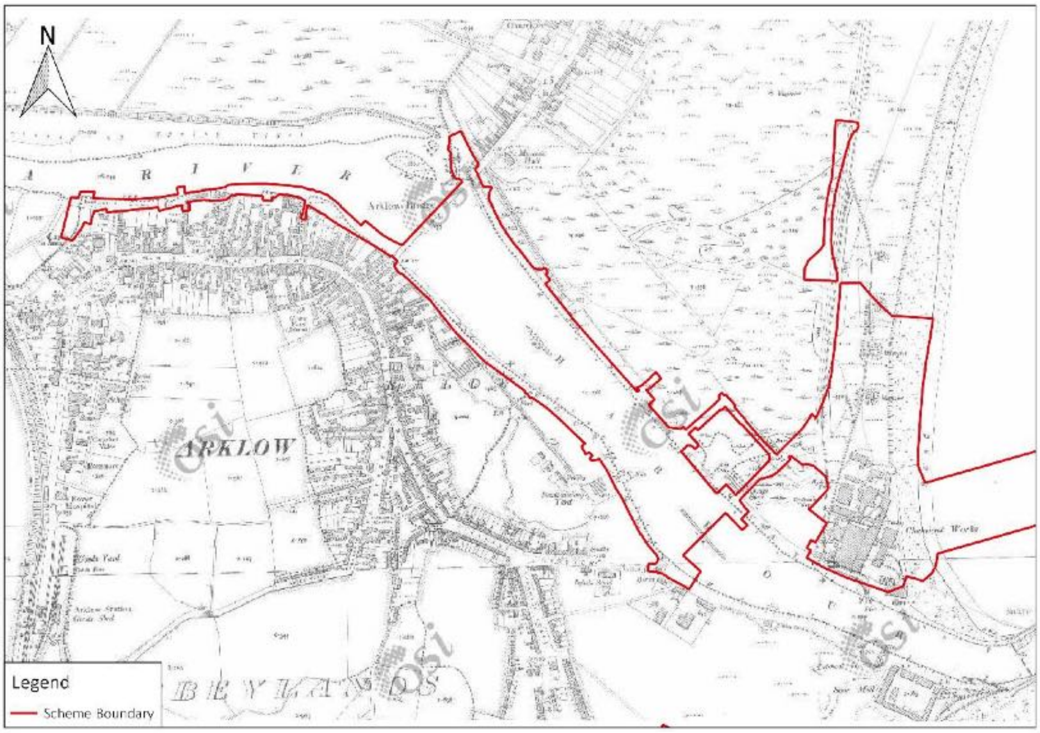

Figure 12.4: Extract from the 1910 OS map, showing the planning boundary

The southern quay is also marked, along with a number of structures, including a Saw Mill, Boat Building Yard and Smithy. To the west of the Bridge, the south bank of the river remains as being shown as garden plots associated with structures to the south. Arklow Castle remains marked as being in ruins. A small stream is shown running through the approximate location of the proposed combined sewer overflow upgrade before joining the Avoca River.

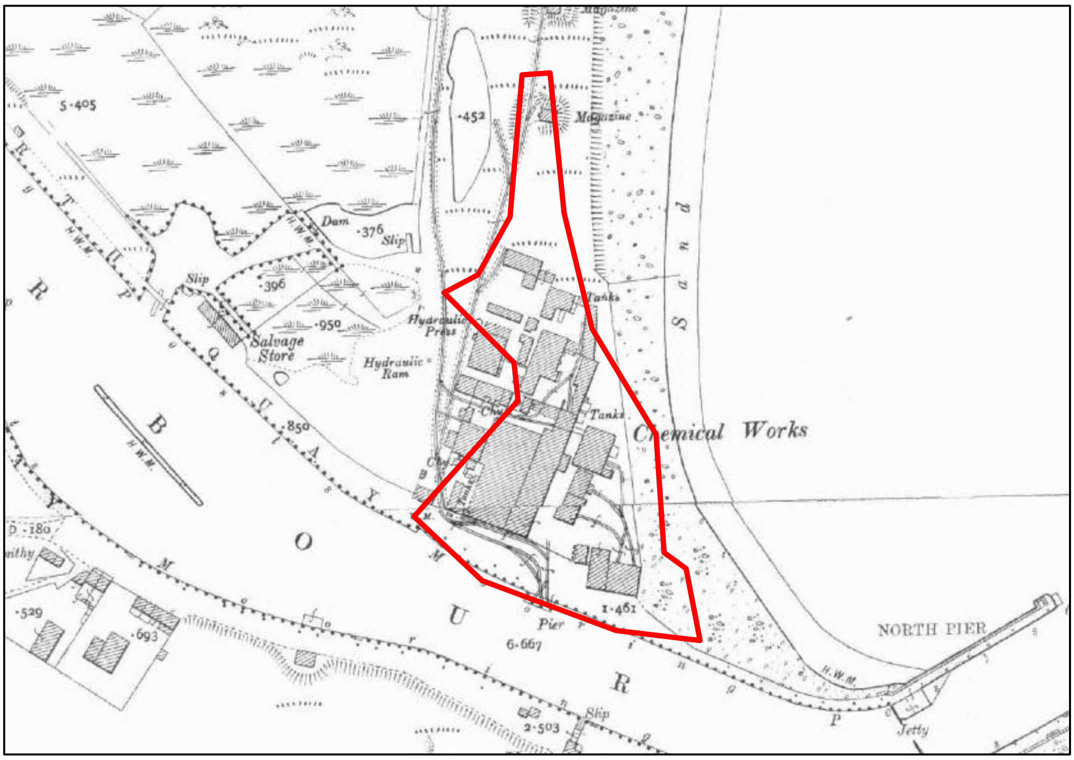

Figure 12.5: Extract from the 1910 OS map, showing detail of the WwTP site

12.3.1.6 County Development Plan

Archaeological Heritage

The County Development Plan recognises the statutory protection afforded to recorded monuments as does the Arklow LAP. Recorded Monuments within the receiving environment of the proposed development are detailed in **Appendix 12.3**, whereas aims and objectives relating to the archaeological resource are included in **Appendix 12.6**.

There are a total of eight monuments are recorded within the receiving environment of the proposed development (Refer to Table 12.1). The western section of the interceptor sewer is located within the zone of notification for the historic settlement of Arklow (WI040-029). The site of the ruined castle is located approximately 50m south of the proposed Alps SWO and stormwater tank.

Table 12.1: Recorded Monuments located within the receiving environment

RMP No.:	Classification:	Approximate distance from the planning boundary:	Statutory protection:
WI040-029-	Historic Town	0m	RMP
WI040-029001-	Religious house - Dominican friars	c.140m to the southwest	RMP
WI040-029002-	Castle - Anglo-Norman masonry castle	c.50m to the south	RMP
WI040-029003-	Church	c.70m to the south	RMP
WI040-029004-	Religious house - Cistercian monks	c.115m to the northeast	RMP
WI040-029007-	Graveyard	c.60m to the south	RMP
WI040-029008-	Graveyard	c.140m to the southwest	RMP
WI040-029009-	Graveyard	c.115m to the northeast	RMP

None of the sites are listed as National Monuments or are subject to Preservation Orders.

Built Heritage

The County Development Plan recognises the statutory protection afforded to protected structures, as does the Arklow LAP. Protected structures within the receiving environment of the proposed development are detailed in **Appendix 12.5**, whereas aims and objectives relating to the architectural resource are included in **Appendix 12.7**.

There are 16 protected structures located within the receiving environment of the proposed scheme (Refer to Table 12.2). The closest is Arklow Bridge (BH 1, RPS A26) as the interceptor sewer will pass beneath the southern-most arch of the bridge, within the river bed (**Figure 12.1**). The closest protected structure to the WwTP site is BH 4 (A29), which is located approximately 500m to the northwest.

Table 12.2: Protected Structures located within the receiving environment

BH No.	RPS No.	Townland	Classification	Description	Approximate distance from the planning boundary
BH 1	A05-A10, A22, A23, A24, A25, A27, A37, A38	Arklow	Arklow town (south)	The urban area to the south of the proposed development contains 13 protected structures. These primarily consist of residential or commercial buildings and one church.	35 - 150m south
BH 2	A26	Arklow/ Ferrybank	Bridge	Arklow Bridge, built c. 1755	0m
BH 4	A29	Ferrybank	Masonic Lodge	Lodge built c. 1900	50m northeast
BH 5	A30	Ferry Bank	House	19th century house	130m northeast

There are no Architectural Conservation Areas (ACAs) located within the receiving environment of the proposed development.

12.3.1.7 National Inventory of Architectural Heritage structures (BH sites) within the Receiving Environment

A review of the National Inventory of Architectural Heritage (NIAH) has shown that there are 27 NIAH structures located within the receiving environment of the proposed WwTP development. Of these 27 sites, 15 are also listed on the Record of Protected Structures. One of the structures (NIAH Ref.: 16322077), has been demolished since the survey was undertaken.

Inclusion within the NIAH does not confer statutory protection. However, as some of the buildings are listed within the Record of Protected Structures, these buildings are subject to statutory protection under the Planning and Development Acts 2000-2018.

Table 12.3: NIAH sites located within the receiving environment

BH No.	NIAH No.	Townland	Classification	Description	Approximate distance from the planning boundary
BH 1	16322017-20,	Arklow	Three houses	Three 19th century houses (all in the RPS)	150m south
BH 1	16322016	Arklow	Cinema	Early 20th century cinema	80m south

BH No.	NIAH No.	Townland	Classification	Description	Approximate distance from the planning boundary
BH 1	16322015	Arklow	Monument	Late 19th century monument	130m south
BH 1	16322013	Arklow	Shop	Late 19th century shop	40m south
BH 1	16322012	Arklow	Bank	Late 19th century bank (also in the RPS)	90m south
BH 1	16322034-35, 47, 48	Arklow	Shops/ Bank	Late 18th and 19th century shops. Early 20th century bank (also in the RPS).	55-75m southwest
BH 1	16322036, 37, 44, 35	Arklow	Shops/ House	Early to late 19th century houses/ shops (three also in the RPS).	35-70m southwest
BH 1	16322038-42	Arklow	Shops/ Houses	Early to late 19th century shops and houses.	110-130m southwest
BH 2	16322046	Arklow	Bridge	Mid-18th century bridge (also in the RPS)	0m
BH 3	16322077	Ferrybank	House	Demolished	N/a
BH 4	16322058	Ferrybank	Masonic Lodge	Early 20th century lodge (also in the RPS)	50m northeast
BH 5	16322076, 59-61	Ferrybank	Shop/ houses	Late 19th century shop and houses (one included in the RPS)	90-175m northeast
BH 6	16322030	Ferrybank	Beacon	Early 20th century shipping beacon	60m northwest

12.3.1.8 Results of Field Inspection

The field inspection sought to assess the proposed development, its previous and current land use, the topography and any additional information relevant to the report. During the course of the field inspection the proposed development and its immediate surrounding environs were inspected. The field inspection was carried out in June 2018 in dry, clear conditions.

The field inspection commenced at the western end of the proposed development at the site of the proposed Alps SWO and stormwater tank. The section of the site is located approximately 50m north of the ruins of Arklow Castle (WI029-029002) in an overgrown area that is bordered to the northwest and southeast by overgrown slopes (Refer to Figure 12.6). The historic mapping shows a stream running through this area, although it is no longer extant today.

Although the area is very overgrown, the tower of the castle is just visible through the trees to the south.

Figure 12.6: The Alps site, facing southwest

The proposed interceptor sewer runs in an easterly direction along the southern bank of the River Avoca. The first section is characterised by a modern footpath (Refer to Figure 12.7), which then joins River Lane and River Walk (Refer to Figure 12.8). This area represents made ground established to the north of the property boundaries to the south, which front onto Main Street. Although this section, the proposed development is located within the zone of archaeological potential for Arklow town and is in immediate proximity to the river, previous archaeological monitoring in this area failed to identify any features or deposits of archaeological potential.

Figure 12.7: Route of proposed interceptor sewer adjacent to the Avoca River, facing west (upstream)

Figure 12.8: Route of proposed interceptor sewer along River Lane, facing southeast

As the proposed interceptor sewer reaches Arklow Bridge (RPS A26), it enters the existing river channel to pass underneath the southernmost arch. The arch is obscured from the west by the 1960s widening works (Figure 12.9). However, it is clearly visible from the east (Figure 12.10). A rubble wall, with a rendered cement coping abuts the eastern elevation of the bridge, to the immediate south of the arch (Figure 12.11).

It is possible that the wall represents the denuded remains of a wall associated with the southern quay, but a large amount of alterations have been carried out in this area. It is clear from the historic mapping that both the North and South Quays post-date the construction of the bridge.

Figure 12.9: Arklow Bridge (RPS A26), facing east-southeast

Figure 12.10: Southernmost arch of Arklow Bridge (RPS A26), facing northwest

Figure 12.11: Wall abutting the south-eastern side of Arklow Bridge, facing northwest

The proposed interceptor sewer follows the path of South Quay as it re-joins the road from the river channel. This section of the roadway is bounded to the southwest by a mixture of modern and vernacular properties (**Figure 12.12**).

Figure 12.12: South Quay, facing southeast

The quay wall, although present in sections, has been subject to alteration and large sections have been rendered with cement (**Figure 12.13**). Just to the northwest of the harbour, the pipeline will be tunnelled across the river to the North Quay from South Quay.

Figure 12.13: South Quay wall, facing south-southeast

The proposed sewer will be tunnelled along the North Quay along existing modern roads. Sections of the North Quay wall is apparent bounding this stretch of the river. It is formed by roughly worked masonry blocks (**Figure 12.14**).

Figure 12.14: Section of the rubble North Quay wall, facing northeast

The surrounding development is modern in nature. The only structures of heritage merit is the early 20th century shipping beacon (NIAH Ref.: 16322030) (**Figure 12.15**), located 60m to the northwest and the former Salvage Store, which is a structure that fronts onto North Quay and dates to the early 19th century. The Salvage Store building is single storey, of roughly coursed masonry construction. Larger windows have been inserted at a later date into the fabric with red brick reveals (**Figure 12.16**).

The original vehicular entrance in the eastern gable end has been blocked up and a pedestrian entrance inserted. The Salvage Store is located outside of the planning boundary.

Figure 12.15: Early 20th century shipping beacon (NIAH Ref.: 16322030), facing northwest

Figure 12.16: Early 19th century Salvage Store, facing north

The WwTP site is currently occupied by a late 20th century factory associated with its former use as a plaster board production site (Figure 12.17). The factory is very derelict and includes a tall metal chimney stack.

Figure 12.17: Existing factory structure within the WwTP site, facing northeast

There are a number of ruined modern structures within the site, but nothing remains that relates for the former explosives factory. The site is bounded to the east by modern rock armour sea defences (Figure 12.18).

Figure 12.18: WwTP site with coastal rock armour, facing south

No previously unrecorded sites of archaeological potential were noted during the course of the field inspection. It is clear that there has been a large amount of modern development within the receiving environment, including the site of the proposed WwTP.

However, the proximity of the riverine and coastal resource does increase the archaeological potential that can be attributed to the landscape.

No previously unrecorded sites of architectural heritage merit were noted during the course of the field inspection, with the exception of the now altered, early 19th century former Salvage Store, located adjacent to the proposed scheme on the North Quay.

12.4 Likely Significant Effects

12.4.1 Assessment of effects during construction

12.4.1.1 Terrestrial Archaeology

Whilst it is clear that modern development within Arklow town and environs is likely to have impacted upon the potential archaeological resource, it remains possible that excavations associated with the laying of the interceptor sewers may have a negative effect on previously unrecorded archaeological remains. Negative effects have the potential to be permanent and range from significant to profound during construction.

The WwTP site is located within a reclaimed estuary and it is clear that modern construction has disturbed the site. No features of archaeological potential were noted during the excavation of site investigation pits on the WwTP site. It remains possible that excavations associated with the construction of the proposed development may have a negative effect on previously unrecorded archaeological remains. Negative effects have the potential to be permanent and range from significant to profound.

12.4.1.2 Aquatic Archaeology

The interceptor sewer will be constructed beneath the southernmost arch of Arklow Bridge (RPS A26). In order to carry out these works and to mitigate against potential flood risk, two arches will require underpinning. It is possible that any excavations to undertake these works may have a negative effect on previously unrecorded archaeological features or deposits that remain buried within the river bed. Negative effects on the archaeological resource have the potential to be permanent and range from significant to profound during construction.

During marine archaeological investigations to date, no features of archaeological potential have been identified within the alignment of the marine outfalls. The method of construction for the marine outfalls considered to have the potential for most impact are open cut methods (i.e. flood and float or bottom pull) where excavation of a trench is required to allow installation of the pipeline.

The seabed material will need to be removed to achieve the required depth and slope of the trench and trenching may be carried out through the use of dredging barges that would be either be anchored to the sea bed or jacked up using steel piles.

Despite the results of the investigative works undertaken to date, it remains possible that disturbances to the seabed will have a negative effect of archaeological deposits that are buried at a greater depth than the areas analysed by the geophysical and dive surveys. Negative effects on underwater archaeology have the potential to be permanent and range from significant to profound during construction.

It is possible that ground disturbances to the intertidal area during the revetment upgrade may have a negative effect on previously unrecorded archaeological deposits that survive beneath the current seabed level. Negative effects have the potential to be permanent and range from significant to profound.

12.4.1.3 Architectural Heritage

The interceptor sewer will be constructed beneath the southernmost arch of Arklow Bridge (RPS A26). In order to carry out these works and to mitigate against potential flood risk two arches will require underpinning and the fabric of the structure will also require grouting.

It is possible that the proposed techniques may have a negative effect on the fabric of the bridge structure during the course of the underpinning works. Effects on architectural heritage during construction have the potential to range from Slight to Profound, may be temporary or permanent and may result from the following:

- Movement of loose masonry if grouting is over-pressurised;
- Risk of structural damage/settlement if underpinning is not carried out correctly; and
- Risk of structural damage due to associated vibration during piling technique.

12.4.1.4 Cumulative

A number of residential developments are proposed in Arklow town as discussed in **Section 2.6.6 of Chapter 2**. None of these proposals, in combination with the proposed development, are considered to represent a negative cumulative effect on the archaeological, architectural or cultural heritage resource.

Full consideration has been given to the proposed Arklow Flood Relief Scheme during this assessment. It is possible that the effects associated with the proposed underpinning of the Arklow Bridge (which will be carried out within two arches as part of the proposed development and the remaining arches as part of the Flood Relief Scheme) may be exacerbated as a result of the in combination construction of both schemes as a greater number of arches in the bridge would be underpinned. Impacts may range from Slight to Profound and may be temporary or permanent.

12.4.2 Assessment of effects during operation

12.4.2.1 Terrestrial Archaeology

No likely significant effects on terrestrial archaeology are anticipated during the operation of the proposed development.

12.4.2.2 Aquatic Archaeology

No likely significant effects on aquatic archaeology are anticipated during the operation of the proposed development.

12.4.2.3 Architectural Heritage

No likely significant effects on the architectural heritage are anticipated during the operation of the proposed development.

12.4.3 Do-nothing Scenario

If the proposed development were not to proceed there would be no negative impact on the archaeological, architectural or cultural heritage resource.

12.5 Mitigation Measures and Monitoring

12.5.1 Mitigation During Construction

12.5.1.1 Terrestrial Archaeology

- All ground excavations associated with the proposed development will be monitored by a suitably qualified archaeologist. This will enable the identification of any previously unrecorded features/ deposits of archaeological significance. Full provision will be made available to ensure the preservation by record of any such features, should that be deemed the most appropriate manner in which to proceed, following consultation with the DoCHG.
- All archaeological works will be carried out under the supervision of a project archaeologist, appointed on behalf of Irish Water, to ensure all mitigation measures are implemented.

12.5.1.2 Aquatic Archaeology

- All excavations associated with the outfalls and revetment upgrade, will be monitored by a suitably qualified underwater archaeologist. Works will be carried out under licence to the DCHG and full provision will be made to ensure the preservation by record of any features that may be identified, should that be deemed the most appropriate manner in which to proceed, following consultation with the DCHG.

- All excavations associated with interceptor sewer within the river channel (and any associated underpinning works) will be monitored by a suitably qualified underwater archaeologist. Works will be carried out under licence to the DCHG and full provision will be made available to ensure the preservation by record of any features that may be identified, should that be deemed the most appropriate manner in which to proceed, following consultation with the DCHG.
- All archaeological works will be carried out under the supervision of a project archaeologist, appointed on behalf of Irish Water, to ensure all mitigation measures are implemented.

12.5.1.3 Architectural Heritage

- All works to Arklow Bridge will be carried out under the supervision of a conservation engineer and/or registered conservation architect. A full assessment of potential effects will be undertaken once the preferred methodology has been selected for the underpinning works. This will lead to the production of a construction method statement that will ensure the historic fabric of Arklow Bridge is maintained throughout construction.

12.5.2 Mitigation During Operation

No likely significant effects to archaeology, architecture and cultural heritage during the operation of the proposed development have been identified. Therefore, no mitigation measures have been proposed with respect to effects from operation of the proposed development.

12.5.3 Monitoring

12.5.3.1 Monitoring During Construction

The mitigation measures recommended above, including the monitoring of works by qualified archaeologists and a conservation engineer, would support effective monitoring during construction to allow the further assessment of the scale of the predicted impacts and the effectiveness of the recommended mitigation measures.

12.5.3.2 Monitoring During Operation

No monitoring has been proposed with respect to effects from operation of the proposed development.

12.6 Residual Effects

12.6.1 Residual Effects during Construction

With the implementation of the mitigation measures detailed above no significant residual effects are predicted upon archaeological, architectural and cultural heritage resources.

12.6.2 Residual Effects during Operation

No significant residual effects are predicted upon archaeological, architectural and cultural heritage resources.

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ELECTRONIC SOURCES

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www.excavations.ie – Summary of archaeological excavation from 1970-2016

www.osiemaps.ie – Ordnance Survey aerial photographs dating to 1995, 2000 & 2005 and 6-inch/25-inch OS maps.

www.googleearth.com – Aerial photographs of the proposed development area

www.bingmaps.com – Aerial photographs of the proposed development area

www.buildingsofireland.ie – NIAH survey results for County Wicklow

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13 Landscape and Visual

13.1 Introduction

This chapter describes the likely significant effects of the proposed development on landscape and visual aspects of the receiving environment.

Chapter 4 provides a full description of the proposed development whilst **Chapter 5** describes the Construction Strategy. This chapter is accompanied by a set of Photomontages of the proposed development which are included in **Appendix 13.1 and in Volume 3**.

The following aspects are particularly relevant to the landscape and visual assessment:

- Design:
  - Form and massing of the WwTP;
  - Façade on all above ground structures; and
  - Cognisance of how design elements impact on Views of the proposed development and any effects on the receiving environment, including landscape character.
- Operation:
  - Views of the proposed development and any effects on the receiving environment, including landscape character.
- Construction:
  - Views of the proposed development and any effects on the receiving environment, including landscape character; and
  - Loss or change of existing structures that contribute to the receiving environment.

13.2 Assessment Methodology

13.2.1 General

The landscape assessment has considered the likely significant effects of the proposed development on the landscape as an environmental resource and the visual assessment has considered the effect of visual change on receptors. Landscape and visual effects have been considered for the construction and operation of the proposed development.

Further, to support the assessment, a series of photomontages, illustrating the physical and visual appearance of the proposed development, has been prepared from a range of publicly accessible locations that are representative of the more open views in the surrounding environment. The photomontage views that have been prepared are included within **Appendix 13.1 and Volume 3**.

13.2.2 Guidance and Legislation

This assessment has been undertaken having regard to general EIA guidance as described in **Section 1.4.3 of Chapter 1** and the Landscape Institute guidelines[1].

13.2.3 Consultation

Consultations relevant to landscape and visual aspects include those relating to site selection and WwTP design as described in **Chapter 3**, and also iterative project design coordination between the design and client teams of the proposed development and the proposed Arklow Flood Relief Scheme.

The proposed development has extensive physical overlap along the south side of the Avoca River with the proposed Arklow Flood Relief Scheme. It was important to ensure that any works carried out as part of the proposed development would be compatible with the likely design of the subsequent proposed Arklow Flood Relief Scheme. The benefits of design coordination include:

- Optimising investment in structural and civil works to suit the proposed development and the proposed Arklow Flood Relief Scheme;
- Minimising future potential environmental effects that might arise from the proposed Arklow Flood Relief Scheme; and
- Minimising further future disruption to the local community.

Design coordination between the proposed development and the proposed Arklow Flood Relief Scheme involved iterative consultation and workshops, between November 2017 and July 2018, and involving the design and client teams for both projects, and also Wicklow County Council as party to both projects.

The specific areas of design coordination included:

- Detailed consideration of the realignment of sections of quay walls required as part of the proposed development to enclose the proposed interceptor sewers, so as to readily accommodate the provision of a parapet along the quay wall in the future as part of the proposed Arklow Flood Relief Scheme;
- The interface of proposed and planned infrastructure with the Arklow Bridge, a protected structure, to ensure the protection and enhancement of the visual integrity and setting of the Arklow Bridge following the implementation of the proposed quay wall realignment and proposed interceptor sewer, and also of the future parapet along the quay wall as part of the proposed Arklow Flood Relief Scheme (Refer to **Chapter 12** for further details on the Arklow Bridge); and,
- Consideration of design objectives and known details of public realm improvements anticipated as part of the completion of the proposed Arklow Flood Relief Scheme.

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[1] UK Landscape Institute and IEMA (2013) Guidelines for Landscape and Visual Impact Assessment; 3rd Edition;

The coordination of the design of the proposed development and the proposed Arklow Flood Relief Scheme were presented as part of the wider consultation with the Department of Culture, Heritage and the Gaeltacht during two meetings (on 16 January 2018 and 19 June 2018).

13.2.4 Categorisation of the Baseline Environment

The landscape and visual assessment involved visits to Arklow town, initially in March 2012, and more recently in March, April, May and June of 2018, to review the nature and scale of existing development both on and surrounding the site, to identify landscape features, local character and land uses, to identify key views to and from the proposed development, and to note receptor sensitivity.

This site based assessment was augmented by reviewing aerial photography, publications and reports and information on the proposed development included within the application for consent and in this EIAR.

13.2.5 Impact Assessment Methodology

The landscape and visual impact assessment for the proposed development takes account of the character and nature of the existing site and its surrounds, the location of sensitive landscapes and visual receptors, the sensitivity and significance of the site, and its vulnerability to change.

The classification of significance of effects as set out in Table 13.1 has been derived from guidance from the EPA[2] and the UK Landscape Institute[1] and from the professional experience of the author in carrying out landscape and visual assessments for over 25 years.

Table 13.1: Categorisation of likely significant effects (derived from the guidance[2])

		EXISTING ENVIRONMENT Significance / Sensitivity			
		High	**Medium**	**Low**	**Negligible**
DESCRIPTION OF IMPACTS Character/Magnitude/ Duration /Probability/ Consequences	**High**	Profound	Very Significant	Significant / Moderate	Moderate / Slight
	Medium	Very Significant / Significant	Significant / Moderate	Moderate	Slight / Not Significant
	Low	Significant / Moderate	Moderate / Slight	Slight / Not Significant	Not Significant / Imperceptible
	Negligible	Slight / Not Significant	Not Significant	Not Significant / Imperceptible	Imperceptible

The significance of effects, which in nature may be positive, neutral or negative/adverse, are therefore described as follows:

[2] Environmental Protection Agency (2017) Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Draft August 2017)

- **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:** An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
- **Moderate:** An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
- **Significant:** 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 the majority of a sensitive aspect of the environment.
- **Profound:** An effect which obliterates sensitive characteristics.

In terms of duration, effects are considered as follows:

- **Momentary**: lasting seconds to minutes.
- **Brief**: lasting up to one day.
- **Temporary**: lasting up to one year.
- **Short-term**: lasting one to seven years.
- **Medium-term**: lasting seven to fifteen years.
- **Long-term**: lasting fifteen to sixty years.
- **Permanent**: lasting over sixty years.

Further aspects of effects including their **magnitude** (*i.e.* extent, frequency, and context); **probability** (*i.e.* likely, indeterminable, 'worse-case'); and **type** (*i.e.* cumulative, interaction (synergistic), residual, indirect, *etc*.) are also considered in the assessment, where appropriate in accordance with those descriptions outlined in the EPA guidance[2].

13.3 Baseline Conditions

13.3.1 Site Context and Description

The proposed development extends to terrestrial, riverine and marine lands as illustrated in Figure 13.1 and **Figure 1.1 of Volume 3**. A tree survey has been undertaken for this assessment and is available in **Appendix 13.2** and is described herein.

The site extends along the Avoca River immediately north of the town centre, and includes vacant lands at a site known as The Alps; the River Walk upstream of Arklow Bridge; South Quay and North Quay downstream of Arklow Bridge; the Old Wallboard site at Ferrybank on the seaward side of the North Quay at Arklow Harbour; and the revetment along the shore. The project also includes a long sea outfall extending northeast from the proposed WwTP and storm water overflow (SWO) north of the long sea outfall, both discharging to the Irish Sea.

Figure 13.1: Arklow town with project footprint overlaid (Source: Bing Maps)

Arklow town has its origins on the southern side of the Avoca River, and essentially comprised a single street running parallel to the river with buildings on both sides, and those on the northern side of the street with their backs to the river. The river opened out on the seaward side of the town to extensive mudflats and sand hills at Ferrybank and Tinahask Lower to the north and south respectively.

The town has a long association with the sea, and as a port, and the evolution of the town as a port has strongly shaped its growth. The Arklow Bridge (Protected Structure, RPS A26), is a 19 arch stone bridge spanning 150m that was constructed in the middle of the 18th century, and provided a connection between Arklow Main Street and Ferrybank on the northern side of the river. Over time, the mudflats and sand hills were reclaimed and extended the harbour area on both sides of the river to where the north and south piers are now located.

Today, the original Main Street remains the centre of the town, and the settlement extends for 1 - 1.5km to the south, east and west, with the ground rising gently to the south from the river. North of the river, the Ferrybank area extends for a similar distance, and in more recent times, there has seen significant development and regeneration along the North Quay with the Bridgewater Shopping Centre and the Marina Village apartments.

The Avoca River, the Arklow Bridge and the coastal setting are the key defining natural and built features of the urban and port setting of Arklow town.

Figure 13.2: Aerial view showing Arklow town south of the Avoca River; Arklow Bridge connecting to the Ferrybank and North Quay area; and the wider setting of the southern Wicklow Mountains in the distance

Within the planning boundary, there are a number of distinct landscape character areas, including the following (which are discussed in detail in **Sections 13.3.1.1 - 13.3.1.7**).

- The Alps;
- River Walk;
- Arklow Bridge;
- South Quay;
- North Quay;
- The Old Wallboard site; and
- The Revetment.

13.3.1.1 The Alps SWO and Stormwater Storage

The Alps is an area of vacant land to the west of River Walk behind the properties on Upper Main Street (Refer to Figure 13.3), and adjoins the ruins of Arklow Castle (RMP No. WI040-029002). Part of the lands includes a deep escarpment that runs immediately to behind the buildings on the more elevated terrain of Upper Main Street. The base of the escarpment is typically at the same level as the river bank, beyond which the ground slopes up steeply again to meet the more elevated levels of the town. The escarpment area is heavily vegetated and overgrown with scrub, and includes a number of trees.

A pathway leads up along the sloped ground to a pedestrian bridge over the railway line and connecting to Vale Road. River Walk extends across the mouth of the escarpment and continues further upstream.

Figure 13.3: The Alps escarpment, from elevated and ground level, looking south towards the rear of the buildings on Upper Main Street

13.3.1.2 River Walk

River Walk extends from The Alps along the south bank of the Avoca River to the Arklow Bridge. The Avoca River and part of its riverbanks lies within a proposed Natural Heritage Area (pNHA, Site Code 001931). River Walk comprises riverbank footpaths, the town carpark, and River Walk local access road serving the rear of the properties along Main Street and incorporating on street parking and areas of open space. A number of laneways and paths including New Coomie Lane, Coomie Lane, River Lane and Condren’s Lane connect River Walk to the Main Street and to Vale Road.

Upstream of the carpark, River Walk is an attractive riverfront amenity walkway, comprising a grass riverbank with occasional mature trees and shrubs affording open views of the river and the more strongly wooded northern riverbank as illustrated in Figure 13.4. Trees are generally in fair to good physical condition, typically fair structural condition, and provide moderate to good amenity value.

Figure 13.4: River Walk upstream of carpark, looking downstream

Downstream of the carpark, River Walk provides convenient pedestrian connection and local vehicular access. The walkway along the riverbank is formed in concrete, and a low concrete wall separates the walkway from the roadway and on-street parking as illustrated in Figure 13.5.

The walkway affords open views across the river to the mostly wooded edge of the Arklow Marshlands on the northern side of the river. The Arklow Bridge is also prominent from this location, however, the upstream side of the bridge incorporates extensive concrete piers and cappings that support substantial pipework and a concrete parapet that detracts from the appearance of the stone arched bridge. Trees in this area are typically smaller and younger, in fair physical condition, with fair to poor structural condition, and provide moderate amenity value.

Figure 13.5: River Walk upstream of Arklow Bridge, looking upstream

The built side of River Walk downstream of the carpark (Refer to Figure 13.6) includes occasional units that provide active frontage onto the walk, including at the carpark, Condren's Lane and approaching the Arklow Bridge, but the balance comprises rear walls of property boundaries and gates that present a piecemeal and haphazard elevation to the walk.

Figure 13.6: River Walk upstream of Arklow Bridge, looking downstream

13.3.1.3 Arklow Bridge

Arklow Bridge is one of the most impressive and defining built elements of Arklow town. Built in the middle of the 18th century, and comprising nineteen stone arches, it is the longest stone bridge in Ireland spanning approximately 150m (Refer to Figure 13.7).

As detailed in **Chapter 12**, Arklow Bridge is a protected structure (RPS A26; NIAH No. 16322046) and is a defining asset of the built environment of Arklow town as well as being an important piece of architectural and industrial heritage.

Figure 13.7: Arklow Bridge seen from South Quay

Arklow Bridge is best appreciated from the downstream side, as the stonework on the upstream side is substantially obscured with concrete piles and cappings that support extensive pipework and a concrete parapet. The nineteenth arch on the northern end of the bridge however has previously been compromised by the installation of a range of utilities pipework as illustrated in Figure 13.8. The proposed interceptor sewer will pass through the first arch on the southern side of the bridge, and will be appropriately integrated.

Figure 13.8: Downstream view of the first (southern) and nineteenth (northern) arch of the Arklow Bridge

13.3.1.4 South Quay

South Quay is notably different in character to River Walk in that the buildings along South Quay were built to front onto the river, and South Quay also faces the buildings along North Quay as opposed to the wooded riverbank at Arklow Town Marsh that lies opposite River Walk. From Doyle’s Lane, there is a notable change in the scale, use and intensity of buildings, where almost all buildings as far downstream as the harbour area are residential and are clearly more contemporary and a later extension of the town centre.

The roadway along South Quay varies considerably to include one-way single carriageway and wider two-way sections. There are minimal footpaths on one side only between Doyle’s Lane and South Green (refer to Figure 13.9), beyond which there are frequently no footpaths on either side of the road. Depending on the width of the roadway, parking is generally defined on either one or both sides of the road. Further downstream, there is space for parking but it is not generally defined. South Quay is mostly used for residential access, however, a substantial number of heavy goods vehicles also use South Quay for access to and from the harbour area and the quarry at Arklow Rock to the south.

Figure 13.9: South Quay looking downstream, with residential buildings directly facing the quayside

Starting at the junction with South Green, there is a grass verge along the quayside incorporating a row of mostly young Norway Maple trees interspersed with individual semi-mature Lime, Rowan, Cherry, White Poplar, Sycamore and Hawthorn trees as illustrated in Figure 13.10. Trees are generally in fair physical and structural condition, but are of low arboricultural quality and value. While they currently provide some amenity value, their poor growing environment is likely to limit their future value.

Figure 13.10: South Quay looking east from near junction with South Green

A slipway is located on South Quay directly opposite the Arklow Marina on South Quay as illustrated in Figure 13.11. The John Tyrell Boatyard once stood on South Quay directly behind the slipway where the Anchor Mews development now stands, and boats built at the boatyard made their way across South Quay to be launched from the slipway. An information panel is located on top of the slipway telling the story of the John Tyrell Boatyard. A concrete flood defence wall extends from this location eastwards (i.e. downstream) along South Quay.

Figure 13.11: South Quay slipway opposite the Anchor Mews development

Opposite Harbour Road and Rockview Terrace, the Arklow Seafarers Memorial Garden (Refer to Figure 13.12) is a modest public space on the quayside that includes a simple paved central area with seating benches, and is flanked on either side by an area of grass and a further row of mostly young Norway Maple trees. The central paved area is also defined by a number of decorative Cordyline trees and low shrub planting. An information panel at the garden tells the story of the Arklow Offshore Wind Park incorporating the world’s first wind turbines of over 3MW to be installed at sea.

Figure 13.12: Arklow Seafarers Memorial Garden, South Quay

South Quay continues beyond this point to the harbour and harbour walls to the south of the Avoca River, and its built environment is characterised by typically two storey pitched roof industrial type structures associated with the harbour and port activities.

There are also substantial marshalling and storage areas surrounding the harbour, as well as the Arklow RNLI Lifeboat Station. South Quay provides access, both pedestrian and vehicular, to the South Pier and South Beach area and is a popular public walking and amenity area.

South Quay Wall

The quay wall along South Quay varies considerably in its construction, integrity and quality.

From Arklow Bridge to South Green, a concrete enclosure is located above the riverbed level outside the quay wall itself and houses an existing sewer pipe. A series of inspection chambers are also formed in concrete and rise up to the adjoining road level as illustrated in Figure 13.13. A low concrete stub wall lies on top of the quay wall as a kerb or barrier to prevent vehicles accidentally traversing the quay edge. The upper part of the quay wall, between the concrete housing and the stub wall, is variably faced with concrete lining or plastered. In some places, the plaster finish has eroded and revealed the rubble stone of the quay wall and vegetation is growing through the joints.

Figure 13.13: Poor condition and presentation of quay wall downstream of Arklow Bridge

At South Green, where the grass verge commences, and for a length of approximately 75m, the rubble stone quay wall is mostly visible save for local interventions where sewer outflows have been constructed through the wall as illustrated in Figure 13.14. Along this section of the wall, the large stone flags that form the top of the stone wall remain in-situ and form the junction with the grass verge on the quayside.

Figure 13.14: Section of quay wall where rubble stone remains visible and stone flags form top of wall

Further downstream, the quay wall is either faced in concrete or rock armour, or is formed with exposed steel sheet piles and concrete capping.

13.3.1.5 North Quay

The North Quay development site area includes a short section of the northern riverbank immediately upstream of the Arklow Bridge, and most of the North Quay itself from the Arklow Bridge to the junction with Mill Road.

Upstream of the Arklow Bridge, the proposed development encroaches on part of the proposed Natural Heritage Area (pNHA, Site Code 001931), including parts of the Avoca River channel and the adjoining marsh on the northern side of the river.

This area comprises the river bank of the Avoca River as far as a drainage ditch approximately 25m to the north. The area was previously partially cleared and a hardcore working area installed as part of a road upgrade project, and today comprises overgrown amenity grassland and spoil. Vegetation includes a linear cluster of trees and bushes that are in fair condition but are of limited value and potential.

Downstream of the Arklow Bridge, North Quay is notably different in character to both South Quay and River Walk on the southern side of the river channel. The primary difference is a result of the much larger scale and height of individual developments, and also from the combination of contemporary mixed use developments and older and derelict industrial buildings.

The Bridgewater Shopping Centre was opened in 2007, and provides a landmark contemporary waterfront set piece and is a significant regeneration development for Arklow town as illustrated in Figure 13.15. Immediately to the east, there is a recently constructed Aldi retail store with its carpark directly facing onto North Quay, and further east again, the three storey developments of the Arklow Shipping Company and the Marina Village residential development occupy a substantial portion of North Quay.

Figure 13.15: North Quay and Bridgewater Shopping Centre from Arklow Bridge

The North Quay roadway is of modern construction and character, having been upgraded in conjunction with new development projects described above. The road is quite narrow, with a single lane in both directions and no on-street parking. A footpath runs along the inside of the road, but not along the quayside.

The quayside comprises either a simple low concrete stub wall or a galvanised steel crash barrier to protect vehicles from the quay edge. The space between the barrier and the actual quay wall ranges in width from 1.5 to 2.5m and trees are planted within this narrow space (Refer to Figure 13.16). The trees are mostly young Norway Maple with some early mature Hybrid Poplar. Many of the trees are in poor to fair condition – some are dead – and have low vitality as a result of the limited space available for root development.

Figure 13.16: North Quay carriageway, showing narrow roadway and limited space on quayside for tree establishment

North Quay turns inland at the last block of the Marina Village and continues around the Arklow Marina harbour that was developed in place of the 19th century boatyard. The light tower of the Albatross lightship (NIAH No. 16322030) is located as a landmark on the North Quay at the marina entrance, and is clearly visible along North Quay as illustrated in Figure 13.17.

Figure 13.17: Light tower of the Albatross lightship seen from the entrance to Arklow Marina

The Marina Village residential development faces and defines the southern and western sides of the Arklow Marina. The Arklow Marina marks the transition from the mixed use retail, commercial and residential parts of North Quay to the industrial areas that lie to the east of the Arklow Marina. A range of industrial sheds and structures, some derelict and others in use, form the northern and eastern sides of the Arklow Marina (Refer to Figure 13.18).

Figure 13.18: View from Marina Village across Arklow Marina in the foreground and to industrial buildings beyond

North Quay Wall

The quay wall along North Quay, from the Arklow Bridge to the slipway opposite the Arklow Shipping Company, is of similar construction to that of South Quay with rubble stone walling capped with large stone flags. The quay wall is generally in better condition and repair than South Quay. From the slipway to the entrance to the Arklow Marina, the quay wall is concrete faced and a floating boardwalk provides access to boats moored along North Quay. Beyond the entrance to Arklow Marina, the quay wall is formed with steel sheet piling and a concrete capping.

13.3.1.6 The Old Wallboard site at Ferrybank

The eastern end of North Quay at Ferrybank is an extensive and substantially derelict former industrial area of flat ground located between the North Quay of the Avoca River and a rock revetment to the Irish Sea. The ground is low lying, generally at an elevation of approximately 2.5m above Ordnance Datum (OD), with the exception of the revetment that rises to approximately 5.5m OD providing an element of shelter from the sea.

This part of Ferrybank has a long association with industry, with the Arklow Chemical Works originally having been developed on the mudflats at this location back in the middle of the 19th century. The Chemical Works subsequently became Kynoch Limited explosive factory until after the First World War, and most recently operated as Arklow Gypsum Ltd. Arklow Gypsum Ltd closed down over 30 years ago, and the factory has been derelict ever since, and is commonly referred to as the ‘Old Wallboard site’.

The eastern end of North Quay is occupied by the Old Wallboard buildings and a range of other industrial sheds and structures of various scales, heights and forms. The ground on the Old Wallboard and adjoining sites comprise hardcore and tarmac marshalling and storage yards, with sparse ground cover and localised areas of naturally colonised scrub and occasional trees. A full description of vegetation on the site is provided in **Chapter 11**. The majority of these buildings and lands are derelict and have fallen into disrepair.

The Old Wallboard building is over 200m long and is located along the eastern side of this piece of land as illustrated in Figure 13.19. A grass strip of between 5 to 10m width runs between the eastern side of the building and the rock armour revetment. The northern part of the building, approximately 40m long and 35m wide, is the tallest part of the building with the ridge and stack rising to over 27m and 43m in height respectively. The remaining southern portion of the building is approximately 9.0m in height to the ridge, and is mostly a three bay structure approximately 40m wide, with the southernmost section reducing to a single bay of around 13m width.

In addition to the Old Wallboard building, there are also a number of other structures of various sizes including industrial sheds, storage silos, miscellaneous smaller ancillary buildings and a range of boundary walls and fencing in land parcels adjoining the Old Wallboard site. This part of Ferrybank is characterised as an expansive yet derelict port-related industrial area. While it has clear historical associations with the town, its derelict industrial appearance and adjacency to the sea increase its sense of remoteness and distance from the town.

Figure 13.19: Old Wallboard facility and other industrial structures at Ferrybank

13.3.1.7 The Revetment

A rock armour revetment extends from the northern pier at the harbour mouth, towards the north-west for approximately 2km to Arklow North Beach. The revetment forms the seaward boundary of the Old Wallboard site, and is typically 3m higher than the adjoining land and at an average gradient of 1 in 2.

From Mill Road northwards, the landward side of the revetment is formed in earth with scrub grass cover and the revetment incorporates a pedestrian walkway along the top that continues as far as Arklow North Beach and provides expansive views of the coastline. The grassed landward side of the revetment is at a gentler gradient of approximately 1 in 4. See Figure 13.19

Figure 13.20: Pedestrian walkway on top of revetment looking south towards the Old Wallboard site

13.3.2 Landscape Planning Designations

13.3.2.1 Overview

The Wicklow County Development Plan 2016 – 2022 (County Development Plan) 'Core Strategy' and 'Settlement Strategy' identify Arklow town as a 'Level 3 – Large Growth Town II' within the hinterland area of Dublin. Level 3 settlements in County Wicklow are prioritised to accommodate a large amount of population growth, to be strong active towns that are economically vibrant with high quality transport links to larger towns/cities.

The County Development Plan Core Strategy, as it applies to Arklow's Infrastructure Strategy, states:

- Sufficient wastewater treatment capacity is required to cater for the projected population within the plan area;
- Sufficient water supply is required capable of meeting the demands of projected population within the plan area;
- Measures to improve the capacity and efficiency of local roads and connections to national routes in close proximity to the plan area are required.

13.3.2.2 Landscape Planning Policy Objectives

The County Development Plan includes a Landscape Assessment of County Wicklow in Appendix 5. However, the assessment specifically excludes settlements, such as Arklow, which are:

"*within Levels 1-6 of the settlement hierarchy of the County Development Plan,…The exclusion of these areas was considered appropriate given the level of existing development within these areas and their designation within the County Development Plan.*" (page 8).

The County Development Plan also includes a range of general objectives and policies that apply to the landscape and visual environment of the county as a whole, however, the development plan refers to the Arklow and Environs Local Area Plan 2018-2024 (Arklow LAP) for specific objectives and policies.

The Arklow LAP includes a number of specific landscape and visual references that apply to the context of the proposed development. These are primarily focused on the existing strength of its waterfront location and the positive influence of the Avoca River on the town, as well as on potential enhancements to the landscape/townscape setting that can be derived from these assets.

In Chapter 5 of the Arklow LAP keys Areas, under 'Enhancing the Public Realm', the Arklow LAP notes:

"The elements in and around Arklow's town centre that contribute mostly to the quality of the public realm are the streetscape; landmark buildings and appearance of principal junctions / gateways; building frontages, in particular materials, colours and shop fronts; the relationship of the Main Street to the river; urban open spaces and parks, and the juxtaposition of structures to spaces and; footpaths, lighting, seating and other street 'furniture'" (page 29).

The Arklow LAP goes on to note that:

"The 'Waterfront Zone' (WZ) is made up of two distinct areas north and south of the river that have seen different development pressures and levels of activity over the year, but both sharing the common characteristics of water frontage onto the river and/or the sea and the presence of industrial lands / buildings, a large proportion of which is currently underutilised and vacant.…It is important that this area is developed in such a way that maintains the river and coast as an accessible, attractive and environmental amenity area." (page 32).

The importance of the Avoca River, its associated bridge, quays, navigation features, and riverside areas, which includes the 'Seafarers Memorial Garden' on South Quay, and the coastal waterfront to the east of Arklow are also identified as important amenity, heritage, recreational and tourism assets, which can be further improved through future enhancements. In this regard the Arklow LAP also notes that:

"The future development of a Waste Water Treatment Plant (WWTP) for the town will help to improve the river and beach quality and will in time open up the potential for the enhancement of the recreational and tourism uses in the waterfront" (page 33).

The Waterfront Zoning also includes in its description:

"*….To facilitate the provision of a new Waste Water Treatment Plant with an appropriate high quality architectural design/appearance."* (page 54).

Chapter 9 of the Arklow LAP notes that Irish Water is in the process of preparing an application for the development of a comprehensive WwTP to eliminate, in so far as possible, the current practice of discharging untreated wastewater directly into the Avoca River and to provide sufficient capacity for the waste water treatment required to serve the population target of Arklow and all associated community, employment and commercial demands. The LAP includes Infrastructure Objective T1 *"To support and facilitate the development of a waste water treatment plant in Arklow, at an optimal location following detailed technical and environmental assessment and public consultation."*

13.3.2.3 Key Landscape and Visual Objectives

The key landscape and visual objectives from the Arklow LAP includes Town Centre Objectives VP2 and VP9 which promotes better pedestrian linkages along the river, the coast and the main street, and VP10 which seeks to maintain the existing bandstand and Seafarers Memorial Garden and promotes opportunity for new urban spaces (page 30).

Waterfront Objectives require that new development be of a high quality and suitably set back from the water's edge to provide public routes and places along waterfronts (page 34).

Tourism and Recreation Objective TR6 promotes and encourages the recreational use of the coastline, and the river and that proposals respect the natural amenity and character of the area, and listed views and prospects to and from the area (page 44). There is only one listed view and prospect in the wider context of the development area (see below).

Heritage Objective HT2 protects the listed prospect of special amenity (from the R750/coast road towards the sea) from development that would either obstruct the prospect or form an obtrusive or incongruous feature in the prospect. This listed view is east towards the coast from the R750 – however, it is located over 750m north of the site of the proposed WwTP and outside of the visual context of the site (page 51).

Heritage Objectives HT3 and HT5 seek to protect and enhance architectural and archaeological heritage, as well as the coastal character of the settlement, including features of the natural landscape and built structures that contribute to its special interest.

13.3.3 Landscape/Townscape and Visual Significance and Sensitivity

Landscape and visual significance and sensitivity may be highlighted by landscape (or townscape) or visual designation or reference in national, county or local statutory documents or by identification in appropriate publications and reports (e.g. other landscape and visual assessments).

In relation to the proposed development, significant and sensitive landscape (or townscape) aspects of relevance include:

- The Avoca River corridor within the urban settlement, including its banks and adjoining marshland, quay walls, tree plantings, memorial garden and other features;
- Arklow Bridge;
- The adjoining urban structure of the town which encloses and fronts the river corridor; and
- The open character of the coastal waterfront, which includes associated maritime and navigation features.

In relation to the proposed development, significant and sensitive visual aspects of relevance include:

- Views along, to and from the river edge, Arklow Bridge and from the Avoca River itself;
- Views to and from the coastal waterfront;
- Views from surrounding residential areas; and

- Views from surrounding footpaths, amenity areas and features.

13.4 Likely Significant Effects

13.4.1 Do-Nothing Scenario

The site is the setting for a wide range of harbour, river and port-related activities, residential and mixed-use development, retail, employment and commercial uses, town centre facilities and amenities, and quayside amenities and open spaces. These uses are likely to remain and potentially further develop and be enhanced into the future.

In the scenario where the proposed development did not proceed as planned, and given the necessity for a WwTP at Arklow to facilitate future growth, it is likely that the eastern end of the North Quay area may remain substantially unchanged in the short to medium term, and the derelict industrial character will remain.

13.4.2 Assessment of Effects During Construction

The construction stage of the overall proposed development is currently anticipated to be approximately 3.5 to 4 years. Due to the nature of the project however, construction of different elements of the overall project within different parts of the overall project area will be focussed on shorter periods during the overall programme.

13.4.2.1 Interceptor Sewers and Alps SWO and Stormwater Tank

The proposed interceptor sewers will be constructed in a phased manner, with tunnelling shafts being constructed sequentially over a period of approximately 16 months.

Connecting tunnels and pipework installation will also be phased, commencing around 6 months after the tunnelling shafts commence, and finishing approximately 1 month after the last tunnel shaft. Open cut trenching and construction of the Alps SWO and Stormwater Tank will commence later in the programme, starting at around month 20 and continuing for approximately 10 months.

Effects on Landscape/Townscape Character

A contractor compound will be established within an existing industrial yard and facility to the immediate south of South Dock at Arklow Harbour that is considered low sensitivity. The scale and short-term nature of the compound is such that it will have potential for limited visual disruption and to locally slight negative landscape/townscape effects for those within or passing through the South Dock area at Arklow Harbour.

Working areas and construction activities will be localised to different areas of the overall project development site in accordance with construction phasing.

These will include areas within recognised sensitive areas along North Quay and South Quay, Arklow Bridge and River Walk, and have potential to result in locally moderate to significant temporary or short-term effects on landscape/townscape character during construction, especially as a result of the physical disruption that is commonly associated with such construction activity, and also the movement of construction vehicles and the use of site lighting.

North Quay

Upstream of Arklow Bridge and immediately adjacent to the Ferrybank roundabout, a c. 55m long section of the Avoca River comprising spoil and overgrown amenity grassland will be established as a hoarded working area for the construction of tunnelling shaft TSN1, manholes MHN1 and MHN2 and pipework to form a connection with the existing foul and surface water networks within the area. While this area is part of the Arklow Town Marsh pNHA, it has already been substantially disturbed and modified, and is considered to be of moderate landscape/townscape sensitivity.

Construction activity within this area has the potential for locally moderate/slight temporary to short term effects on landscape/townscape character during construction.

Downstream of Arklow Bridge, North Quay caters substantially for residential, retail, commercial and amenity uses and is generally more contemporary in character than the southern side of the Avoca River. Closer to the Arklow Bridge, the actual quay wall comprises substantially its original stone construction and connects to Arklow Bridge (which is a protected structure), whereas further downstream, the quay wall has been concrete faced. North Quay is therefore considered to be of moderate landscape/townscape sensitivity.

Construction activities along North Quay will entail the establishment of a series of hoarded working areas, together with associated localised traffic diversion and management arrangements. The interceptor sewer will be built using a series of six tunnel shafts and tunnelling within and below the roadway of North Quay. Construction will be ‘rolling’ between these working areas and as such will be localised to shorter sections of the overall quayside at any one time. A number of trees including T81 to T88, and T99 to T101 will be removed to facilitate the establishment of working areas at tunnelling shaft TSN2 and TSN3. These will be replanted post construction.

Construction activity at North Quay has the potential for locally moderate/slight temporary to short term effects on landscape/townscape character during construction.

River Crossing

The river crossing interceptor will be tunnelled underground and below the river bed between Mill Road and South Quay, but will require the establishment of tunnelling shafts on either side of the river channel, and set within secure working areas.

The northern shaft (TSN6 in working area N12) will be located in the context of mostly derelict industrial lands, and is considered low sensitivity, and has potential for temporary to short term slight negative effects on landscape/townscape character during construction.

The southern shaft (TSS3 in working area S18) will be established on the South Quay at the existing Seafarers Memorial Garden, and also in the context of residential settlements, and therefore is considered to be high sensitivity. Construction activities will include dismantling and storage of the elements of the Seafarers Memorial Garden, and has potential for temporary to short term significant/moderate negative effects on landscape/townscape character during construction.

South Quay

South Quay caters substantially for residential and passive amenity uses downstream of Arklow Bridge. River Walk, upstream of Arklow Bridge, also includes retail and commercial uses. Taken together with the scale and character of the built environment, South Quay is considered to be of high landscape/townscape sensitivity.

Construction activities along South Quay will entail the establishment of a series of hoarded working areas, together with associated localised traffic diversion and management arrangements. The sewer will be laid by a combination of tunnelling and open cut trenching methods, and, like the North Quays, will be 'rolling' throughout these working areas and will be localised to shorter sections of the overall quayside at any one time. Construction effects are described in two distinct sections as follows:

- Avoca River Crossing to South Green; and
- South Green to Arklow Bridge.

The Avoca River Crossing to South Green section of the sewer is to be constructed on the landside using tunnelling techniques.

A series of four tunnel shafts will be constructed along South Quay; one (TSS3) within the Seafarers Memorial Garden; one (TSS2A) in the carriageway adjoining the Seafarers Memorial Garden; one (TSS2) in the grass verge area outside residential dwellings on South Quay; and the fourth (TSS1) on South Quay near the junction with South Green.

Working areas will generally be on the carriageway and quayside, however, working areas S15A and S15B will be located within the front gardens of four private properties to facilitate residential access during the construction of a tunnel shaft (TSS2). Working area S16 will encroach into three private front gardens.

The establishment of working areas will necessitate temporary traffic restrictions on South Quay immediately downstream of South Green and at the junction with Harbour Road, as well as localised traffic management diversions. Existing quayside trees within the working areas will be removed, these will include T33 to T52, T60 to T72, and the Cordyline trees at the Seafarers Memorial Garden.

The residential context is such that the Avoca River to South Green area is considered to be of high sensitivity, and construction has potential for to result in localised temporary to short term, significant/moderate negative effects on landscape/townscape character during construction.

The South Green to Arklow Bridge section of the sewer will be constructed within the Avoca River using permanent sheet piling (in the river bed) to facilitate open cut trenching at the toe of the existing quay wall. A 10m wide temporary causeway will be established along the southern side of the river so as to facilitate excavation work, haulage and construction. Following installation of the sewer, a new quay wall will be formed along the sheet piling, and back filling will result in land reclamation and quayside widening by up to 6m width. The alignment of the sewer and the construction of a new quay wall outside the existing quay wall has resulted from the coordination between the design team for the proposed development and the design team for the proposed Arklow Flood Relief Scheme. Construction will require a series of connecting working areas, both on land and in river, and localised traffic diversion and management will be required to maintain access.

The residential and river context is such that the South Green to Arklow Bridge area is considered to be of high sensitivity, and although construction will be locally temporary to short term, the likely effects on landscape/townscape during construction are considered to be temporary to short term, significant/moderate negative.

<u>Arklow Bridge</u>

In the immediate vicinity of the Arklow Bridge, the design of the interceptor sewer and quay wall has been developed so as to maintain the alignment of the existing quay wall immediately adjoining the bridge and to minimise potential adverse effects on the appearance and setting of Arklow Bridge. Construction of the sewer at the Arklow Bridge will be below the existing river bed.

Additionally, and arising from coordination of the proposed development with the proposed Arklow Flood Relief Scheme, the first two (most southern) arches of Arklow Bridge will require underpinning. The riverbed under these two arches will also be lowered by approximately 1m to mitigate against any potential flood risk associated with the proposed development. It should be noted that the riverbed under the first arch will accommodate the proposed sewer will be covered to the existing riverbed level. Once the sewer is installed, the riverbed under the first arch will be backfilled and finished to the existing riverbed level using salvaged granite flags from the South Quay wall further downstream. The granite flag finish will be similar to the existing riverbed detail under a number of the existing arches. The difference in riverbed levels at the first and second arch will be formed with a 1 in 2 slope that will be stone faced.

Arklow Bridge is a protected structure and a distinctive part of the urban fabric of Arklow town. It is of high sensitivity, and landscape/townscape effects during construction will be temporary to short term, significant/moderate negative.

River Walk

The River Walk section is approximately 450m long, and will be constructed using open cut and cover construction within the carriageway between Arklow Bridge and River Lane, and within the existing riverside footpath between River Lane and The Alps. Construction will require a series of connecting working areas along the carriageway, pathway and river edge, and localised traffic and pedestrian diversion and management will be required to maintain access. Pedestrian access to River Walk, from River Lane to the Alps, will be restricted for the duration of construction. Construction will require the removal of some of the existing river side trees along this section, including T1 to T11 and T22, T23, and T24. Tree protection in accordance with BS 5837:2012 will be established around T25 and T26, however given the confines of the site at these trees, specific arboricultural advice will be required and may pollarding may be considered.

The mixed-use residential, retail, commercial, town centre and riverine context is such that the area is considered to be of high sensitivity, and although construction will be locally temporary to short term, potential landscape/townscape construction effects are considered to be significant/moderate.

Alps SWO and Stormwater Tank

In the vicinity of the Alps SWO, the construction working area will extend from within the escarpment where the SWO will be located, and as far as the river bank, with pedestrian access restricted as noted above. A temporary pedestrian route will be established during construction to provide access to the upstream section of the river walk from the Vale Road. Existing trees T31 and T32 within the escarpment, together with existing shrub and ground cover, will be removed. On the riverbank, tree protection in accordance with BS 5837:2012 will be established around T29 and T30 to ensure these trees are retained.

This area, and in particular the riverbank walk, is considered to be of high sensitivity, and although construction will be locally temporary to short term, potential landscape/townscape construction effects are considered to be significant/moderate.

Effects on Views

Views will be altered during construction by the presence of construction compounds, movement of construction traffic and personnel, use of site lighting, and also by temporary and permanent changes to the existing environment necessitated by the construction work.

River Walk

Upstream of Arklow Bridge, within the river corridor, sensitive views include views along the river bank, to and from Arklow Bridge and the Avoca River, and views from the surrounding residential areas, footpaths and amenity areas.

The open cut nature of the construction of the sewer, together with the associated continuous hoarding around working areas and movement of construction traffic, will result in physical disruption, tree removal, pedestrian access restrictions and local traffic management between the Alps and Arklow Bridge, with potential for locally temporary to short term significant/moderate negative visual effects during construction.

Arklow Bridge

At Arklow Bridge, where the bridge joins South Quay and the proposed sewer is to be constructed under the first arch, the nature and detail of the construction activities has potential for temporary to short term significant/moderate negative visual effects during construction.

South Quay

Downstream of Arklow Bridge, sensitive views include views along the quays, to and from the Arklow Bridge and the Avoca River, and views from the surrounding residential areas, footpaths and amenity areas.

Along South Quay, construction will involve a combination of open cut construction in the river bed, installation and use of a temporary construction access causeway in the river channel, and construction of a new quay wall between Arklow Bridge and South Green. Construction further downstream will also involve tunnel shafts and tunnelling within the existing South Quay. Potential visual effects will arise from localised and continuous working areas and from the movement of construction traffic, and will be temporary to short term, and significant/moderate during construction.

North Quay

Along North Quay, construction will involve a tunnel shaft and open cut sewer connections in the river bank immediately upstream of Arklow Bridge, and tunnel shafts and tunnelling within the existing North Quay downstream of Arklow Bridge. Potential visual effects will arise from localised working areas and the movement of construction traffic, and will be temporary to short term, and moderate/slight during construction.

13.4.2.2 WwTP, Outfalls and Revetment

At the WwTP site, there will be a period of around 12 months of site clearance, demolition and civil works, followed by the upgrade to the revetment, construction of new buildings, outfalls and ancillary site development works for a further 20 months (approximately). A construction access road will be located along the toe of the existing revetment adjoining the sports facilities between Mill Road and Seaview Avenue.

Effects on Landscape/Townscape Character

The WwTP contractor compound will be established within the WwTP site. The WwTP site is part of an existing wider industrial setting of North Quay and is considered low sensitivity.

The scale and short-term nature of the compound in this context, and in the context of the South Quay and South Dock on the opposite side of the Avoca River, is such that it will not result in any significant effects on landscape/townscape character during construction.

During the first 12 months (approximately), construction activities will include the establishment of secure site hoarding, clearance of the site, demolition of the existing structures and ground based civil works. The most notable change in the character of the site area will result from the gradual demolition of the existing buildings – in particular the stack and the taller portion of the Old Wallboard factory building to the north of the WwTP site which are both quite distinctive from many directions and vantage points within and beyond the town environs.

The main construction works will include building the Inlet Works and Process buildings, ancillary site development works including building the Sludge Tank Enclosure, Administration building and site landscaping, excavation and reconstruction of the existing revetment to a higher level, and construction of the long sea outfall and SWO. The use of site lighting will be apparent from a range of locations around the town and along the coastal revetment, and will change in its configuration to suit construction requirements. The presence and use of terrestrial cranes, excavators and machinery, and specialist marine construction platforms and equipment, will be of particular visual interest. The operation of such equipment will be apparent from the coastal walkway and adjoining open spaces and amenity areas to the north, and from across the river at South Quay, South Dock and South Pier. This will not result in significant effects on landscape/townscape character during construction as such activities are commonplace in coastal, port and industrial settings.

Taken together with the scale and extent of overall development, construction activity, traffic, etc., landscape effects have the potential to be significant and negative at an immediate and more confined local level – particularly from Mill Road, from the more sensitive residential and amenity areas around Arklow Marina (including Marina Village), and to a lesser degree from the coastal walkway to the north and from the South Quay area where the development area is part of a wider quayside, port and coastal setting. It is noted that all of these areas are already significantly influenced by the nature and scale of existing industrial developments at the eastern end of Ferrybank in the North Quay and Mill Road area.

Effects on Views

Within the river corridor, from upstream of the Arklow Marina on North Quay and from upstream on Anchor Mews on South Quay, and from Arklow Bridge, the taller part of the existing Old Wallboard factory building (discounting the existing stack), is only partially and intermittently visible as it is located beyond the buildings and ridgelines of the Marina Village apartment buildings on North Quay. The change in views from these areas during construction will be the gradual removal of the existing Old Wallboard factory building, followed by the presence of cranes on the skyline as the new buildings are constructed.

As the proposed buildings are only around 60% of the height of the tallest ridge of the existing Old Wallboard ridge, it is anticipated that the new buildings will remain below the skyline of the Marina Village apartment buildings. Potential visual effects in this area will therefore be temporary to short term, slight and not significant during construction.

Downstream of Anchor Mews on South Quay (including the area around the Seafarers Memorial Garden, the harbour and South Pier), the existing Old Wallboard building is generally more visible than upstream as it is only partially screened by a number of industrial buildings and other structures located on North Quay. From this downstream area, construction activity including cranes on the skyline will be more apparent than further upstream, and the new buildings will also become visible on the skyline as they are constructed. Potential visual effects will be temporary to short term, moderate to slight during construction.

Visual effects during construction have the potential to be significant and negative at an immediate and more confined local level – particularly from Mill Road and from the more sensitive residential and amenity areas around Arklow Marina (including Marina Village), and to a lesser degree from the coastal walkway to the north where the WwTP site is part of a wider quayside, port and coastal setting. It is noted that all of these areas are already significantly influenced by the nature and scale of existing industrial developments at the eastern end of the North Quay and Mill Road area.

13.4.2.3 Cumulative Effects

A number of other development proposals are currently permitted or proposed in Arklow town as discussed in **Sections 2.6.6 and 2.6.7 of Chapter 2**. The nature and scale of these developments are such that construction of these projects at the same time as the proposed development, would not give rise to significant effects on the landscape and visual resource.

The proposed Arklow Flood Relief Scheme has also been considered during this assessment. It is likely that the proposed Arklow Flood Relief Scheme, if it proceeds, will include localised additions and modifications to quay walls, river embankments and to hard and soft landscaping. Design coordination between the proposed project and the design of the proposed Arklow Flood Relief Scheme to date is such that the detail of the proposed development anticipates the proposed Arklow Flood Relief Scheme, and that the proposed Arklow Flood Relief Scheme works can build on and be facilitated by the proposed development.

Cumulative construction effects of the proposed Arklow Flood Relief Scheme with the proposed development will not give rise to significant effects on the landscape and visual resource.

13.4.3 Assessment of Effects During Operation

During operation, the landscape and visual effects will primarily be associated with the presence of the WwTP at Ferrybank and modifications to parts of the South Quay wall as the interceptor sewers will be underground and the existing environment will be reinstated to its pre-construction condition, or similar.

13.4.3.1 Interceptor Sewers and Alps SWO and Stormwater Tank

The interceptor sewer network will be underground and once construction has completed, the existing environment will be mostly reinstated to its pre-construction condition, or similar.

Effects on Landscape/Townscape Character

The interceptor sewers will be underground and within the quay areas along the Avoca River. Upon completion of construction, all working areas impacted by construction activity will be reinstated to their pre-construction condition, including re-planting of trees removed to facilitate construction work areas and traffic diversion. On this basis, likely effects on landscape/townscape character have the potential to be locally short term moderate and negative leading to neutral as reinstated vegetation establishes during operation.

The area of the South Quay immediately downstream of Arklow Bridge will be altered in that South Quay will be widened by approximately 6m over a length of around 300m. This will present as a new quay wall (in place of the existing quay wall that is piecemeal in appearance and comprising concrete elements in poor condition and poor visual quality) and also as a wider quayside. The widened quayside will be seeded providing a grass verge along this section of South Quay. Effects on landscape/townscape character during operation have the potential to be locally permanent significant/moderate and positive as the quayside is widened providing additional riverside amenity space and the existing piecemeal quay wall is replaced with a new quay wall of consistent appearance and build quality.

In the immediate vicinity of the Alps SWO and stormwater tank, along its frontage onto the riverfront walkway, the new security fencing and marshalling area behind the fence will give rise to localised significant/moderate negative effects on landscape/townscape, as the built facility will be incongruous with the riverside setting.

Effects on Views

The effect on views arising from the interceptor sewers, once operational will be short term and moderate/slight as construction areas are reinstated and the quays and riverbank restored to their pre-construction condition.

Trees removed during construction will be replanted upon completion, and upon establishment, will further reduce the effect on views to negligible and neutral.

The new quay wall and widened quayside immediately downstream of Arklow Bridge will have a positive visual effect during operation in rationalising the piecemeal appearance of the existing quay wall and increasing riverside amenity space on the quay itself.

The security fencing and marshalling area behind the fence at the Alps SWO compound will have locally significant/moderate negative visual effects during operation as the fencing and infrastructure compound would be incongruous with the riverbank setting.

This will reduce over time to moderate/slight and neutral as the adjoining meadow grass areas establish and the presence of the compound becomes more accepted.

Effects on views are discussed further in conjunction with reference to representative photomontages in **Section 13.6.1.2.**

13.4.3.2 WwTP, Outfalls and Revetment

Effects on Landscape/Townscape Character

The WwTP will be a newly constructed industrial/infrastructural element within the Ferrybank area that has a long standing association with industrial facilities and activity. The architectural design and design rationale in **Chapter 4** describes how the WwTP has been designed to be of high architectural quality that is commensurate with and anticipates the emerging Waterfront development at Ferrybank and along North Quay. Lighting within the site area will mostly be low level bollard type lighting with low light spill. Lighting will be integral with the outer cladding of the buildings and will provide indirect and low intensity illumination of the outer surfaces of the building that will render the form of the building visible at night.

Whilst the WwTP buildings will take the place of the long established Old Wallboard building, the extent of change is such that effects on landscape/townscape character during operation have the potential to be perceived as significant and negative at an immediate and more confined local level of the site.

From the wider townscape and coastal areas, the WwTP buildings will be substantially lower than the high portion of the existing Old Wallboard building, and somewhat higher than the lower portion, and will generally have a reduced presence on the skyline when viewed from most directions. In particular, the WwTP buildings will have a negligible presence from Arklow Bridge and the upstream areas of South Quay, and will appear more consistent in height with other adjoining industrial buildings when viewed from the coastal walkway.

From the locality of the harbour area and South Pier, the proposed development will represent a substantial change and will be readily visible, however the character of the area from these locations is already strongly influenced by the nature and scale of existing industrial developments.

Landscape/townscape effects may be perceived initially as significant/moderate and negative, but will reduce over time to become neutral as the change becomes more accepted, and as the wider site area develops further as anticipated in the Arklow LAP.

The upgraded revetment will be around 2m higher than the existing revetment, but will otherwise be consistent in character with the existing and will not result in any significant effect on landscape/townscape character during operation.

The sea outfall pipes will be within the seabed and will not be visible and thus will not result in any significant effect on landscape/townscape character during operation.

Effects on Views

The visual environment, in the immediate locality of the WwTP site will change with the removal of the Old Wallboard building and the introduction of the proposed new buildings. While the proposed development will extend to a similar footprint as the Old Wallboard buildings, it will be substantially lower than the high portion of the existing Old Wallboard building, and somewhat higher than the lower portions. As such, the proposed development will generally be less prominent that the existing, but from certain areas, particularly from the downstream parts of South Quay, from the harbour area and from South Pier, the expanse of the building will be more noticeable. The visual effects have potential to range initially from locally Significant/Moderate to Moderate/Slight and negative during operation, reducing to neutral over time as the change becomes accepted.

From with wider townscape, from Arklow Bridge and further upstream, the visual effects have the potential to be Slight/Not Significant and neutral during operation.

Effects on views are discussed further in conjunction with reference to representative photomontages in **Section 13.6.1.2**.

13.4.3.3 Cumulative Effects

A number of other developments are currently permitted or proposed in Arklow town as discussed in **Sections 2.6.6 and 2.6.7 of Chapter 2**. The nature and scale of these developments are such that development of these projects in combination with the proposed development would not give rise to significant effects on the landscape and visual resource.

In the locality of the proposed WwTP at the Old Wallboard site, Ferrybank, the Arklow LAP anticipates substantial and more intensive mixed use redevelopment along the North Quay and around the Arklow Marina that will transform this area from its current derelict industrial character to a new urban waterfront setting.

Immediately west of the proposed WwTP, there is an existing grant of permission, Reg. Ref. 15857, for the demolition of the existing industrial unit between Mill Road and the Arklow Marina, and for redevelopment to include two five storey mixed use blocks with residential and retail uses.

It is likely that additional mixed use developments will be proposed along North Quay facing the Avoca River; between Arklow Marina and Mill Road; and around the northern parts of Mill Road. Such developments would intensify the built environment of the locality and gradually transform its current derelict and under-utilised industrial appearance to a more intensive and active urban environment. While development as anticipated in the Arklow LAP will result in substantial change in the built environment, however, such change is planned, and each individual development will be subject to separate applications for planning, in EIA if appropriate, and environmental effects will be considered in any grants of permission.

The planned Arklow Flood Relief Scheme (FRS) has also been considered during this assessment. It is likely that the FRS, if it proceeds, will include localised additions and modifications to quay walls, river embankments and to hard and soft landscaping. Design coordination between the proposed project and the design of the FRS project to date is such that the FRS works will build on and be facilitated by the proposed development works. As such, cumulative operational effects of the FRS project in combination with the proposed development will be localised along the quays and riverfront, and are not likely to give rise to significant effects on the landscape and visual resource. The Arklow FRS will be subject to its own EIAR in due course.

13.5 Mitigation Measures and Monitoring

Mitigation measures have been considered from the outset of the design development for the proposed development, both in isolation, but also in conjunction with the planned Arklow Flood Relief Scheme.

13.5.1 Mitigation During Construction

Mitigation during construction in relation to landscape and visual effects include:

- The nature of the construction activities in the townscape environment is such that there will always be disruption. Mitigation during construction relates to phasing of construction activity to different working areas sequentially to minimise the duration of significant effects arising from construction activities at any one location, and/or effective pedestrian and traffic management to minimise inconvenience and ensure access is maintained as appropriate.
- While the establishment of working areas, tunnelling shafts and traffic diversion will require felling of many existing quayside trees, the detailed design has identified opportunities to protect and retain most of the more valuable Willow trees along the riverside walkway upstream of Arklow Bridge that contribute to the setting of the Avoca River and provide a high degree of visual amenity in this locality.
- Where trees are required to be removed along South Quay and North Quay for construction, such trees are of lower value and will be re-planted post construction so as to reinstate the existing visual environment along the quayside.
- All tree protection works will be implemented strictly in accordance with BS5837:2012
- Requirement for detailed construction management plans that set out robust tree protection methodologies in accordance with BS5837: 2012, where trees are to be retained, including in particular the Willow trees upstream of Arklow Bridge, and ensuring that tree protection is implemented and maintained throughout construction.

- Careful dismantling, storage and ultimate reinstatement of the Seafarers Memorial Garden has been identified as important to the locality and contemporary culture of the area, and a detailed method statement will be required from the appointed contractor to ensure the feature is satisfactorily reinstated following construction.
- For the most part, (excluding the land reclamation areas downstream of Arklow Bridge along South Quay), the existing finishes will be reinstated post construction. Where land is reclaimed downstream of Arklow Bridge, the widened quayside will incorporate a simple grass verge between the existing low wall concrete kerb upstand and the new quay wall. This will provide a quayside finish that is consistent with the existing quayside, and will facilitate potential further public realm plans anticipated as part of the proposed Arklow Flood Relief Scheme); and
- Reinstated vegetation is undertaken by a suitably qualified landscape contractor, and their contract will include 2 year aftercare.

13.5.2 Mitigation During Operation

Mitigation during operation in relation to landscape and visual effects will include:

- The design of the proposed development has been coordinated with the separate design development of the planned Arklow Flood Relief Scheme, including coordination of the quay wall design at South Quay – Arklow Bridge and other structural components to avoid duplication and redundancy, and also in anticipation of quayside public realm upgrades on River Walk, South Quay and North Quay likely to occur as part of the planned Arklow Flood Relief Scheme.
- All tree protection works, planting and aftercare will be implemented strictly in accordance with BS5837:2012.
- As set out in **Chapters 3 and 4**, the architectural vision and design details anticipate the WwTP as a high quality architectural set-piece that will take the place of the Old Wallboard facility at Ferrybank. It is to contribute to the regeneration of the area and to catalyse future urban waterfront development as anticipated in the Arklow LAP.
- The specimen building design at the proposed WwTP will be further developed by the Architect. The Architects services will be maintained, to ensure that all build ups and finishes are completed to the correct specification and standard of build quality; and
- The detail and alignment of the interceptor sewer and the land reclamation proposals along South Quay have been developed to protect the setting and integrity of Arklow Bridge. The full extent of the nineteen arches will remain visible from both upstream and downstream, and the southern quay wall detail will be stepped locally to retain the integrity and visibility of the first (i.e. southernmost) arch.

- The proposed structural interventions and reinforcement to the Arklow Bridge will have negligible visual effect above low water level. Nonetheless, the alignment of the interceptor sewer under the southernmost arch, and the riverbed in the adjoining two arches will be reduced. The trench for the sewer will be backfilled and covered to the level of the existing riverbed and finished using salvaged flag stones from the existing south quay wall further downstream. During operation, this will provide a riverbed finish through the southern arch that is consistent with other bridge arches, and will also purposefully reuse the salvaged fabric of the south quay.

13.5.3 Monitoring

13.5.3.1 Monitoring During Construction

A Construction Environmental Management Plan (CEMP) will be required to ensure the mitigation measures set out above are implemented during construction, and that any shortcomings are remedied immediately. The Outline CEMP is included in **Appendix 5.1** and it is likely that the appointed contractor will need liaise with residents and other stakeholders in advance of establishing working areas so as to minimise the effects of working areas on residents and their properties. Additionally, reinstatement of the Seafarers Memorial Gardens will require the provision of a proposed reinstatement layout for agreement with the local community and Local Authority prior to carrying out the works.

13.5.3.2 Monitoring During Operation

Monitoring during operation relates principally to the aftercare of reinstated landscape areas to ensure the proper establishment of soft landscape as proposed. Any plants or trees that fail will be required to be replaced in the next available planting season.

13.6 Residual Effects

13.6.1.1 Overview

Residual landscape/townscape effects will generally relate to the new WwTP element and revetment, the widened South Quay area immediately south of Arklow Bridge, and the Alps SWO and stormwater storage compound as it interfaces with the riverside walkway.

Residual Landscape/Townscape effects within the townscape of Arklow and its wider environs will vary considerably throughout the townscape of Arklow town and its wider environs, and these are described with reference to the series of photomontages for a range representative locations throughout the project development area and it context.

The overall residual landscape/townscape and visual effect is considered to be moderate and neutral, or less.

13.6.1.2 Photomontages

A series of photomontages, illustrating the physical and visual appearance of the proposed development, has been prepared from a range of publicly accessible locations that are representative of the river corridor within the town and of the more open views in the surrounding environment. The Photomontage views show the post construction scenario, and are included within **Appendix 13.1 and Volume 3.**

Figure 13.21: Location of photomontage viewpoints (Refer to **Appendix 13.1 and Volume 3** for further detail)

Views 1 and 2

Views 1 and 2 (Refer to **Figures 13.1.1A to 13.1.2B in Volume 3 and Appendix 13.1**) are along River Walk approaching the Alps SWO and stormwater storage site from either direction. The natural setting and the amenity value of this location render the sensitivity as high.

While the majority of works will be underground at this location, the introduction of a fenced utility compound and the removal of some of the distinctive riverside willow trees will change the character and visual amenity of the riverside walk.

The landscape and visual effect on views from this locality will be localised significant/moderate and negative, reducing over time to moderate/slight neutral as the reinstated trees and meadow grasses become established and the presence of the compound becomes more accepted.

Views 3 and 4

Views 3 to 4 (Refer to **Figures 13.1.3A to 13.1.4B in Volume 3 and Appendix 13.1**) are along River Walk between the town carpark and Condren's Lane, and looking downstream. The town centre location and natural setting of this location render the sensitivity as high.

There is open visibility along the river edge to the Avoca River. The interceptor sewers are to be constructed using open cut trenches along this section, however the existing environment will be reinstated to its pre-construction condition upon completion. These views illustrate limited changes post construction other than the replacement of some riverside trees further downstream and slightly increased visibility of buildings at the Bridgewater Shopping Centre in the distance.

The landscape and visual effect on views from this locality will be slight/not significant and neutral as reinstated trees become established.

View 5

View 5 (refer to **Figures 13.1.5A and 13.1.5B in Volume 3 and Appendix 13.1**) is from River Walk at Condren's Lane looking downstream. The town centre location and riverside setting of this location render the sensitivity as high.

The character of the view is similar to that of View 3 and 4 however there are presently more riverside trees at this location, and the existing Old Wallboard building and chimney are partially visible in the distance. Some of the foreground riverside trees will be removed to facilitate open cut trench construction. Post construction, foreground trees will be replanted and the existing Old Wallboard building and chimney will be gone. Visibility of the proposed WwTP will be negligible as it will appear at a similar height but behind the ridges of the Marina Village development on North Quay. Views downstream towards North Quay will be more open.

The landscape and visual effect on views from this location will be moderate/slight negative, reducing over time to slight/not significant and neutral as reinstated trees become established.

Views 6 to 8

Views 6 to 8 (Refer to **Figures 13.1.6A to 13.1.8B in Volume 3 and Appendix 13.1**) are from South Quay between Arklow Bridge and Fogarty's Terrace. The architectural heritage value of Arklow Bridge and the residential nature of South Quay render the sensitivity as high.

Views from this area are of the Avoca River and the wider North Quay, and of the immediate locality of South Quay. The Old Wallboard building and chimney are readily visible beyond the Marina Village development, and the South Quay comprises a simple concrete upstand that sits on top of the of the old quay wall below the road level. Post construction, the Old Wallboard building and chimney will no longer be on the skyline.

Visibility of the proposed WwTP building will be negligible from Arklow Bridge as the WwTP will appear at a similar height but behind the ridges of the Marina Village development on North Quay, and will increase gradually further downstream as the profile of the Process building starts to come into view in the distance.

Along this section of South Quay, the biggest change will be to the immediate quayside as the quays will be extended in width by c. 6.0m providing a new grass amenity area along the quayside.

The landscape and visual effect on views from this locality will be significant/moderate and positive with the wider quayside incorporating a new grass amenity space.

Views 9 and 10

View 9 and 10 (Refer to **Figures 13.1.9A to 13.1.10B in Volume 3 and Appendix 13.1**) are from South Quay between South Green and Anchor Mews looking down and upstream. The residential nature of the area renders the sensitivity as high.

Quayside trees, when in leaf, tend to focus views along South Quay while permitting views directly across the river to North Quay. Many of the trees along the quayside will be removed to facilitate the establishment of hoarded working areas, however these will be re-planted post construction as part of the reinstatement works. In addition, a number of front gardens of private properties boundaries will be encroached on during construction, and these will be reinstated to their pre-construction condition. The proposed WwTP is not particularly visible in either of these two views, however, where views between the trees and across the river are available, the WwTP would be apparent in a similar manner to that shown in View 11 below.

The landscape and visual effect on views from this locality will be significant/moderate and negative post construction, leading to slight/not significant and neutral as the reinstated trees become established and restore the appearance of the quayside tree screening.

Views 11 to 13

View 11 to 13 (Refer to **Figures 13.1.11A to 13.1.13B in Volume 3 and Appendix 13.1**) are from South Quay at the Seafarers Memorial Garden, at the entrance to Arklow Harbour looking directly across the Avoca River, and from south of the Arklow Harbour. The amenity and substantially residential context renders the sensitivity of this area as high.

From South Quay, there are panoramic views of the mixed use North Quay area and an increasing sense of the derelict industrial area at Ferrybank across the river, the Arklow Harbour and its industrial context, and of the transition from the town to the sea. Post construction, the Old Wallboard building and chimney will be gone, and the WwTP plant buildings will be clearly visible as contemporary industrial structures forming a new backdrop to the remaining industrial structures in the foreground along North Quay. Full details of the architectural quality of the buildings and site landscape strategy are provided in **Chapter 4**.

The landscape and visual effect on the views from these locations may be perceived initially as significant/moderate and negative as the new buildings will represent a substantial change to the appearance of the area, and alter the skyline of the Ferrybank site. Landscape and visual effects will however reduce over time to become neutral as the change becomes more accepted, and also as sites along the North Quay are developed as anticipated in the Arklow LAP and will form a new urban riverfront elevation along North Quay and will gradually screen the WwTP from the river corridor.

View 14

View 14 (Refer to **Figures 13.1.14A and 13.1.14B in Volume 3 and Appendix 13.1**) is from the end of South Pier at the entrance to the town from the Irish Sea. The existing revetment, piers and Old Wallboard facility present a strong built edge to the sea, and the harbour, with parts of the town and hills visible beyond. The coastal, port, amenity and industrial context render the sensitivity of this area as medium.

Post construction, the WwTP including the upgraded revetment will present a modified but strong built edge to the sea. The landscape and visual effect on the view from this location will be moderate/slight and negative as the scale of the new buildings will represent a substantial change to the appearance of the area, and visual connection to the town and hills beyond will be reduced.

View 15

View 15 (Refer to **Figures 13.1.15A and 13.1.15B in Volume 3 and Appendix 13.1**) is from North Quay in the vicinity of the Aldi store. The residential, retail, commercial and riverside context render the sensitivity as high.

The existing mixed use buildings along North Quay substantially limit visibility eastwards to the area of the proposed WwTP facility. The chimney of the existing Old Wallboard facility is intermittently visible over and beyond the ridgelines of the foreground and intermediate buildings. Post construction, the Old Wallboard building will no longer be visible, and the proposed WwTP buildings will be screened from view behind the ridgelines of the foreground and intermediate buildings. A small number of trees along North Quay that will be removed to facilitate the establishment of construction work areas will be replanted.

The landscape and visual effect on the views from along North Quay are slight/not significant and neutral.

Views 16 and 17

Views 16 and 17 (Refer to **Figures 13.1.16A to 13.1.17B in Volume 3 and Appendix 13.1**) are from the eastern environs of Marina Village at the Arklow Marina and from within the Marina Village development boundary. The residential and amenity nature of this area is such that the sensitivity is high.

The external context from these areas is of the existing substantially derelict industrial lands at Ferrybank. Currently, the Old Wallboard building and chimney are clearly visible amongst other industrial units to the east of Marina Village and around the Arklow Marina. Post construction, the proposed WwTP buildings will take the place of the Old Wallboard facility.

It will be partially visible in the context of remaining industrial units, but not alter the industrial character of that context.

The landscape and visual effect on the views from these locations will be slight/not significant and neutral.

Views 18 and 19

Views 18 and 19 (Refer to **Figures 13.1.18A to 13.1.19B in Volume 3 and Appendix 13.1**), are from the existing revetment walkway approaching the WwTP site from the north. The coastal and amenity context render the sensitivity as high.

Views from this coastal location are expansive and include the seascape, landscape and townscape. The Old Wallboard building and chimney are the tallest elements in the view southwards and mark the Ferrybank industrial area at the end of the revetment. The proposed WwTP will take the place of the Old Wallboard facility, but will be lower than it and will appear more consistent in height with the ridges of other adjoining industrial units. It will not be as immediately noticeable as the existing facility but its presence will continue to mark the Ferrybank industrial area at the end of the revetment.

The landscape and visual effect on the views from these locations will be significant/moderate and neutral.

View 20

View 20 (Refer to **Figures 13.1.20A to 13.1.20B in Volume 3 and Appendix 13.1**) is from the R772 Dublin Road approaching Arklow from the north. The sensitivity of the view is medium.

At this location, the existing Old Wallboard building and chimney come into view framed by the road corridor in the distance beyond the rooftops at Ferrybank. Following construction, the proposed WwTP will also be visible but its form and reduced height are such that it will be less noticeable that the existing building.

The landscape and visual effect on the views from this location will be not significant.

13.7 References

EPA (2015) *Advice Notes for preparing Environmental Impact Statements*

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European Commission (2017) *Environmental Impact Assessment of Projects: Guidance on the Preparation of the Environmental Impact Assessment of Projects*

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Wicklow County Council (2018) *Arklow and Environs Local Area Plan 2018-2024*

Wicklow County Council (2016) *Wicklow County Development Plan 2016 – 2022*