UISCE ÉIREANN : IRISH WATER

Ringsend Wastewater Treatment Plant Upgrade Project
Environmental Impact Assessment Report

TJ O'CONNOR & ASSOCIATES CONSULTING ENGINEERS

BARRY & PARTNERS consulting engineers

Royal HaskoningDHV Enhancing Society Together

Volume 3 - Ringsend Wastewater Treatment Plant
Part A: Report

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Preface

The structure of the Environmental Impact Assessment Report (EIAR) for the proposed Ringsend Wastewater Treatment Plant Upgrade Project (the Proposed Upgrade Project) is outlined in the preface at the start of each Volume of the EIAR for clarity. The Proposed Upgrade Project is located at two sites; the Wastewater Treatment Plant (WwTP) at Ringsend, Dublin 4 and a site proposed for the Regional Biosolids Storage Facility at Newtown, Dublin 11. Volume 1 and Volume 2 provide general information on the overall Proposed Upgrade Project. Volume 3 addresses the Ringsend WwTP component of the Proposed Upgrade Project and Volume 4 addresses the Regional Biosolids Storage Facility component of the Proposed Upgrade Project. Volume 5 provides drawings and large format images for both components. The volumes and sub-section titles are summarised as follows:

Volume 1: Non-Technical Summary

Volume 1 provides a non-technical summary of the information contained in Volumes 2, 3 and 4.

Volume 2: Introduction

Part A: Report

Volume 2 Part A provides a general introduction, outlines the EIA process, describes the scope of the Proposed Upgrade Project and presents the consideration of alternatives.

Part B: Appendices

Volume 2 Part B supplies data that is supplemental to the information in Volume 2 Part A and other volumes of the EIAR.

Volume 3: Ringsend Wastewater Treatment Plant

Part A: Report

Volume 3 Part A describes the environmental impacts specific to the Ringsend Wastewater Treatment Plant component of the Proposed Upgrade Project.

Part B: Appendices

Volume 3 Part B supplies data that is supplemental to the information in Volume 3 Part A and is specific to the Ringsend Wastewater Treatment Plant component of the Proposed Upgrade Project.

Volume 4: Regional Biosolids Storage Facility

Part A: Report

Volume 4 Part A describes the environmental impacts specific to the Regional Biosolids Storage Facility component of the Proposed Upgrade Project.

Part B: Appendices

Volume 4 Part B supplies data that is supplemental to the information in Volume 4 Part A and is specific to the Regional Biosolids Storage Facility component of the Proposed Upgrade Project.

Volume 5: Drawings

Part A: Ringsend Wastewater Treatment Plant Upgrade

Volume 5 Part A illustrates the information detailed in Volume 3 and is specific to the Ringsend Wastewater Treatment Plant component of the Proposed Upgrade Project.

Part B: Regional Biosolids Storage Facility

Volume 5 Part B illustrates the information detailed in Volume 4 and is specific to the Regional Biosolids Storage Facility component of the Proposed Upgrade Project.

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Glossary & Abbreviations

Acronym	Description
°C	Degrees Celsius
2-d	Two dimensional
AADT	Annual Average Daily Traffic
AAGR	Annual Average Growth Rate
ABP	An Bord Pleanála
ACA	Architectural Conservation Area
ADCP	Acoustic Doppler Current Profiler
AERMOD	Atmospheric dispersion model
AG	Air Guidance
AGI	Above Ground Installation
AGS	Aerobic Granular Sludge
AM	Before midday
ARCADY	Assessment of Roundabout CApacity and DelaY software
bgl	below ground level
BH	Borehole
Biocake	Dewatered, digested biosolids (not thermally dried)
Biofert	Thermally dried biosolids. May or may not be digested
BnM	Bord na Mona biofilters
BOD	Biochemical Oxygen Demand
BPIP	Building Profile Input Program
BS	British Standard
BWD	Bathing Water Directive
c.	circa (approximately)
Capacity (of the Ringsend WwTP)	The capacity is expressed as an annual average daily capacity and the plant will be designed to cater for significant daily, weekly and seasonal variations outside of this value.
CAT	Cable Avoidance Tool
CAW	Celtic Anglian Water
CBOD	Carbonaceous Biochemical Oxygen Demand
CC	Cricket club
CD	Chart Datum

CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CEMP	Construction Environmental Management Plan
CFA	Continuous Flight Auger
cfu	Colony Forming Units
CH_4	Methane
CHP	Combined Heat and Power
CIEEM	Chartered Institute of Ecology and Environmental Management
CIRIA	Construction Industry Research and Information Association
CIWEM	Chartered Institution of Water and Environmental Management
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2eq	Carbon Dioxide Equivalent
COD	Chemical Oxygen Demand
COMAH	Control of Major Accident Hazards
COP	Conference of the Parties to the Convention
cSAC	Candidate Special Area of Conservation
CSO	Central Statistics Office
CTD	Conductivity, Temperature & Depth
cu	Cubic
CUC	Capacity Upgrade Contract. Contract commenced in 2018 for elements of works permitted under planning application ref 29N.YA0010
d	Margalef's species richness index
DA	Depth Averaged
DB	Dublin Bay
dB	Decibels
DCC	Dublin City Council
DCDP	Dublin City Development Plan
DCPM	Dynamic Chlorophyll Phytoplankton Macroalgae
DEHLG	Department of Environment, Heritage and Local Government. The Department is now the Department of Housing, Planning and Local Government
DHI	International software development and engineering consultant firm headquartered in Denmark which specializes in hydraulic and hydrological modelling software
DIN	Dissolved Inorganic Nitrogen
Discharge Licence	EPA Wastewater Discharge Licence for the WwTP. The EPA issued a licence for Ringsend WwTP (licence reference number D0034-01) in 2010

DMRB	Design Manual for Roads and Bridges
DMURS	Design Manual for Urban Roads and Streets
DN	Do-Nothing
DoEHLG	Department of the Environment Heritage and Local Government. The Department is now the Department of Housing, Planning and Local Government
DoELG	Department of the Environment and Local Government. The Department is now the Department of Housing, Planning and Local Government
Downstream	DS
DPC	Dublin Port Company
DPM	Dublin Port Masterplan
DS	Do-Something
E. Coli	Escherichia Coliforms
e.g.	For example
ED	Electoral Division
EEC	European Economic Community
EEV	Enhanced Environmentally-friendly Vehicle
EFS	Effluent Fine Screening
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EIRP	Environmental Incident Response Plan
EIS	Environmental Impact Statement
ELPS	Expansion Lift Pumping Station
ELV	Emission Limit Values
EMRA	Eastern & Midland Regional Assembly
EMRWMP	Eastern-Midland Region Waste Management Plan
EPA	Environmental Protection Agency
EPR	Environmental Permitting Regulations
EQS	Environmental Quality Standard
ERBD	Eastern River Basin District
ERP	Emergency Response Plan
ERU	Environmental Research Unit
ESB	Electricity Supply Board
ESBN	Electricity Supply Board Networks
ESRI	Economic and Social Research Institute

etc.	Et cetera (and the rest)
ETS	Emissions Trading System
EU	European Union
F.C.	Football club
FGT	Flue Gas Treatment
FOG	Fats, Oils and Grease
GAA	Gaelic Athletic Association
GDA	Greater Dublin Area
GDD	Greater Dublin Drainage
GDSDS	Greater Dublin Strategic Drainage Study
GHG	Greenhouse Gases
GIS	Geographic Information System
GSI	Geological Survey of Ireland
GWPS	Ground Water Protection Scheme
H'	Shannon-Wiener Diversity Index
H'_{max}	Maximum possible diversity which could be achieved if all species were equally abundant
ha	Hectares
HA	Highways Agency
HGV	Heavy Goods Vehicles
Hr	Hour
HSA	Health & Safety Authority
HSE	Health Service Executive
Hz	Hertz
IAN	Interim advice note
ID	Identifier
IGH	Irish Geological Heritage Programme
IGI	Institute of Geologists of Ireland
IGSL	Irish Geotechnical Services Ltd.
ILPS	intermediate lift pumping station
INDCs	Intended Nationally Determined Contributions
INFOMAR	INtegrated Mapping FOr the Sustainable Development of Ireland's MArine Resource
ISO	International Organisation for Standardisation
ITM	Irish Transverse Mercator

IW	Irish Water
IWDG	Irish Whale and Dolphin Group
I-WeBS	Irish Wetland Bird Survey
J	Pielou's Evenness index
JNCC	Joint Nature Conservation Committee
kg	Kilogram
km	Kilometre
kt	Kilotonne
kV	Kilovolts
L	Lesser of the building height or projected building width in dispersion models
l	Litre
L_{A10}	Sound level that is exceeded for 10% of the sample period
$L_{A90,T}$	Background Sound Level, sound level that is exceeded for 90% of the sample period
L_{Aeq}	Equivalent continuous A-weighted sound pressure level
$L_{Aeq,T}$	Equivalent continuous sound level over the time period T (in seconds) Also known as the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period
$L_{Ar,T}$	Sound Rating Level
LAT	Latitudinal
L_{AX}	"A-weighted" Sound Exposure Level of the event considered (dB)
LGV	Large Goods Vehicles
Li	Locally important aquifer unproductive except for local zones
LOI	Loss on Ignition
Lo-Lo	Lift-on Lift-off
LONG	Longitudinal
LSOT	Long Sea Outfall Tunnel
LV	Light Vehicles
m	Metres
m OD	Metres Ordnance Datum
MAND	Major Accidents and/or Disasters
MCL	Motorcycles
mg	Milligram
ml	Millilitre

mm	Millimetre
MOTR	Mineral Oils Tax Relief
MPN	Most Probable Number
MRP	Molybdate Reactive Phosphate
MTL	Marine Terminals Ltd.
N	Nitrogen (unless otherwise defined within a Section)
N_2O	Nitrous Oxide
NBDC	National Biodiversity Database Centre
NECD	National Emissions Ceiling Directive
NH_3	Ammonia
$NH4^+$	Ammonium
NH4-N	Ammonium as N
NHA	Natural Heritage Area
NHWMP	National Hazardous Waste Management Plan
NIAH	National Inventory of Architectural Heritage
NIS	Nature Impact Statement
nMDS	Non-metric Multi-dimensional Scaling
NMVOC	Non-methane Volatile Organic Compounds
NO	Nitrogen Oxide
no.	Number
NO_2	Nitrogen Dioxide
NORA	National Oil Reserves Agency
NO_X	Nitrogen Oxides
NPF	National Planning Framework
npws	National Parks and Wildlife Service
NRA	National Roads Authority
NSS	National Spatial Strategy
NTA	National Transport Authority
NVMP	Noise and Vibration Management Plan
NWSMP	National Wastewater Sludge Management Plan
O_3	Ozone
OCU	Odour Control Unit
OGV	Other Goods Vehicles

OMP	Odour Management Plan
OPW	Office of Public Works
OS	Ordnance Survey
OSCADY	Optimised Signal Capacity and DelaY software
OSEMP	Operational Stage Environmental Management Plan
OSI	Ordnance Survey Ireland
OU_E / ouE	European Odour Units
$ou_E.s^{-1}$	Odour Emission Rate
P	Phosphorus
Pa	Pascal
PAGs	Project Appraisal Guidelines
PAH	Polycyclic Aromatic Hydrocarbons
PCL	Pedal Cycles
PE	The amount of wastewater received at a treatment plant (and its design capacity) is measured in units known as population equivalent (or PE). The wastewater received from all sources, e.g. industrial, tourism, commercial, residential, etc., is converted into these units, with one unit of PE representing the wastewater treatment load typically generated by a single person
pg	Page
pH	Potential of Hydrogen (scale used to specify acidity or basicity)
p_I	Proportion of the total count accounted for by the i^{th} taxa
PICADY	Priority Intersection CApacity and DelaY software
PM	After midday
PM_{10}	Particulate Matter < 10 µm
$PM_{2.5}$	Particulate Matter < 2.5 µm
pNHA	proposed Natural Heritage Areas
PO_4	Phosphate
POP's	Persistent Organic Pollutants
ppm	Parts per million
PPP	Public Private Partnership
PPV	Peak Particle Velocity
PRIMER ®	Plymouth Routines in Multivariate Ecological Research
PS	Pump Station
PSA	Particle Size Analysis
PST	Primary Settlement Tank

psu /PSU	Practical Salinity Unit
PSV	Public Service Vehicles
r_1	Distance at which L_{AX} is expressed
r_2	Distance to the assessment location
RBSF	Regional Biosolids Storage Facility
RC	Rotary Corehole
RFC	Ratio of Flow to Capacity
RHIB	Rigid Hull Inflatable boat
RMP	Record of Monuments and Places
Ro-Ro	Roll-on Roll-off
RPG	Regional Planning Guideline
RPS	Record of Protected Structures
RSA	Road Safety Authority
RSES	Regional Spatial & Economic Strategy
s	Second
S	Total number of taxa (see Section 5: Biodiversity – Marine)
S.D.R.A, SDRA	Strategic Development and Regeneration Area
SAAO	Special Amenity Area Orders
SAC	Special Area of Conservation
SAS	Surplus Activated Sludge
SBR	Sequencing Batch Reactor
SCADA	Supervisory Control And Data Acquisition
SDZ	Strategic Development Zone
SEA	Strategic Environmental Assessment
Seveso	The 'Seveso' Directive applies to around 10,000 industrial establishments across Europe where dangerous substances are used or stored in large quantities, mainly in the chemicals, petrochemicals, storage, and metal refining sectors
SFPA	Sea-Fisheries Protection Authority
SI	Statutory Instrument
SID	Strategic Infrastructure Development
SIMPROF	Similarity Profile
SIZ	Structure Influence Zone
SL	Surface Layer
SO_2	Sulphur dioxide

SPA	Special Protection Area
SRTM1	Shuttle Radar Topography Mission
SS	Suspended Solids
SUDS	Sustainable Drainage System
SUP	Stand Up Paddle
SUR	Standardised Unemployment Rate
T	Time interval
The Consultant	A consortium of T. J. O'Connor and Associates, J. B. Barry and Partners, and Royal HaskoningDHV
THP	Thermal Hydrolysis Process
TII	Transport Infrastructure Ireland
TON	Total Oxidized Nitrogen
TPH	Total Petroleum Hydrocarbons
Tr	Reference time interval
TRICS	Trip Rate Information Computer System
TRL	Transport Research Laboratory
TSAS	Trophic Status Assessment Scheme
TSS	Total Suspended Solids
TU	Toxic Unit
UK	United Kingdom
UK DEFRA	UK Department for Environment, Food and Rural Affairs
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
Upstream	US
USA	United States of America
UTM	Universal Transverse Mercator
UV	Ultraviolet
UWWT	Urban Wastewater Treatment
UWWTD	Urban Wastewater Treatment Directive
VDS	Village Design Statement
veh	Vehicle
VOCs	Volatile Organic Compounds
VRT	Vehicle Registration Tax
WFD	Water Framework Directive

WoRMS	World Register of Marine Species
WSSP	Water Service Strategic Plan
WtE / DWtE	Dublin Waste to Energy Facility
WWDL	Wastewater Discharge Licence
WwTP	Wastewater Treatment Plant
WwTW	Wastewater Treatment Works
WYG	White Young Green
YMCA	Young Men's Christian Association
yr	Year
α	Significance level (in statistics)
µm	Micrometre
Φ	Phi unit (for PSA analysis)

Section 1: Existing Environment

1.1 Introduction

This Section of the EIAR provides an overview of the existing environmental setting in which it is proposed to construct and operate the Ringsend WwTP component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component").

The Proposed WwTP Component will comprise an upgrade of an existing facility and consequently the existence and operation of the existing facility forms part of the existing environment. The existing Ringsend Wastewater Treatment Plant (WwTP), which is the subject of the upgrade proposals, is described in this section in order to provide a detailed baseline against which the Proposed WwTP Component can be compared.

Full details of the Proposed Upgrade Project and the Ringsend WwTP Component can be found in Volume 2, Section 3: Description of Proposed Upgrade Project.

Details of the baseline conditions and existing environment associated with each of the specific environmental topics are set out in the respective sections.

1.2 Site Location and Surrounding Environment

The existing Ringsend WwTP is located on the Poolbeg peninsula in Dublin City, with a final effluent discharge into the River Liffey Estuary c. 1 km to the east, adjacent to the ESB Poolbeg Power Station (see Figure 1-1). The Poolbeg peninsula is located along the southern bank of the River Liffey, at its eastern extremity, where the river enters Dublin Bay. The surrounding environment consists of Dublin City to the west, which is an urbanised landscape, and Dublin Bay to the east, which has several environmental designations, and is also an important recreational environment.

Figure 1-1: Location overview

1.2.1 Poolbeg Peninsula

The Poolbeg Peninsula is currently dominated by utility, industrial and amenity uses and has active deep water berthing and dockage facilities on the northern edge. The peninsula is a heavily industrialised environment, dominated in character by a number facilities regulated by the Chemicals Act (Control of Major Accident Hazards involving Dangerous Substances) Regulations 2015 (SI No. 209 of 2015) (the "COMAH Regulations"), which implement the Seveso III Directive (2012/18/EU). These are discussed and described in detail in Volume 3, Section 2.2.7.11.

The Dublin Waste to Energy Ltd. facility and the National Oil Reserves Agency facilities are the most proximate Upper Tier Seveso sites to the Ringsend WwTP.

The area beyond the immediate peninsula is largely residential to the south, commercial / residential to the west, and industrialised to the north, where most of the Dublin Port Company lands are located. The area on either side of the river is known as the Dublin Docklands.

On 17 May 2016, the Government designated Poolbeg West a Strategic Development Zone (SDZ). These lands comprising 34 hectares (or approx. 84 acres) were deemed to be of economic and social importance to the state (see Figure 1-2). The area includes the site of what was the Irish Glass Bottle Company (1-2). The designated area in the Order (SI No. 279 of 2016 - Planning and Development Act 2000 (Designation of Strategic Development Zone: Poolbeg West, Dublin City) Order 2016) is for a mixed-use development which may principally include residential (3000 - 3500 units), commercial and employment uses, including port related activities. Dublin City Council is the specified development agency under the SDZ designation.

Figure 1-2: Poolbeg West Proposed SDZ

1.2.2 Dublin Port

Dublin Port is the largest port on the island of Ireland handling almost 36.4 million tonnes of cargo/freight in 2017. It is also an extremely important international gateway to Ireland with 1.8 million passengers and over 600,000 vehicles passing in and out of the port in 2017. The port has direct connections through the Dublin Port Tunnel to the M50 and beyond to the national motorway network, in addition to national rail network connections. The Dublin Port Estate comprises an area of c. 260 hectares spanning both the north and south banks of the River Liffey, with most of the estate (215 ha) lying to the north of the river. In 2015, Dublin Port received planning approval to proceed with a major development of the Port (Alexandra Basin Redevelopment Project). The project includes:

- Works at Alexandra Basin West including construction of new quays and jetties, remediation of contamination on the bed of the basin, and dredging to deepen the basin;
- Infilling of the Basin at Berths 52 and 53 and construction of a new river berth with a double tiered Ro-Ro ramp; and
- Deepening of the navigation channel and approach to Dublin Port by 2.2 m from -7.8 m Chart Datum to - 10.0 m Chart Datum. This operation will result in approximately 8.76 million tonnes of material being dredged. Dublin Port has applied to the EPA for a Dumping at Sea Permit S0024-01 under the 'Dumping at Sea Acts, 1996 to 2009', to dispose of this material at the Burford Bank dredging's disposal site in Dublin Bay.

1.2.3 Dublin Bay - General Description

The River Liffey enters Dublin Bay at Ringsend in the channel formed between the North Bull Wall and the Great South Wall. The North Bull Wall is a natural bank reinforced by a stone embankment that is only inundated at half-tide. It therefore holds back the water flowing out of the harbour at and after half ebb. The navigation channel of Dublin Port runs close to the Great South Wall and extends from the Port area through the mouth of the harbour. Dublin Bay is a small, shallow sandy embayment. It is enclosed by two headlands, Howth to the north and Dalkey to the south. It is approximately 10 kilometres across the mouth of the bay and narrows to the mouth of the River Liffey.

The intertidal zone of the bay occupies the inner third of the bay. The bay slopes gently, reaching depths of 20 m at the mouth of the bay. The water depth decreases towards the harbour with depths of less than 5 m occurring in the inner half of the bay. The Burford Bank sits centrally across the mouth of Dublin Bay. The Burford Bank is a linear sand ridge about 5 km in length, which rises to within 5 m of the surface. The North Bull Island is a prominent physical feature in the bay which developed due to sedimentation accumulation after the construction of the North Bull wall in 1821. To the north of the channel are extensive areas which dry out at low water. These mudflats extend from the mouth of the River Tolka almost to the end of the Bull Wall and north-eastwards past the Bull Island Causeway to Sutton Creek, which is a narrow channel between Bull Island and Howth.

1.2.4 Recreational Facilities and Amenities

Dublin Bay is a high amenity area with a number of scenic views, walkways, natural interest areas and beaches. Throughout the year, significant numbers of people use the amenity of the bay, particularly at Howth Head, Bull Island, Clontarf, Poolbeg, Sandymount, Dun Laoghaire and Seapoint. Refer to Figure 1-1 and Figure 1-3 for an illustration of the surrounding recreational areas in Dublin Bay North and South.

Popular water-based activities in Dublin Bay include sailing, angling, swimming, rowing and water sports such as scuba diving, wind surfing, kite surfing and sea kayaking. These are further addressed in Section 12: Material Assets.

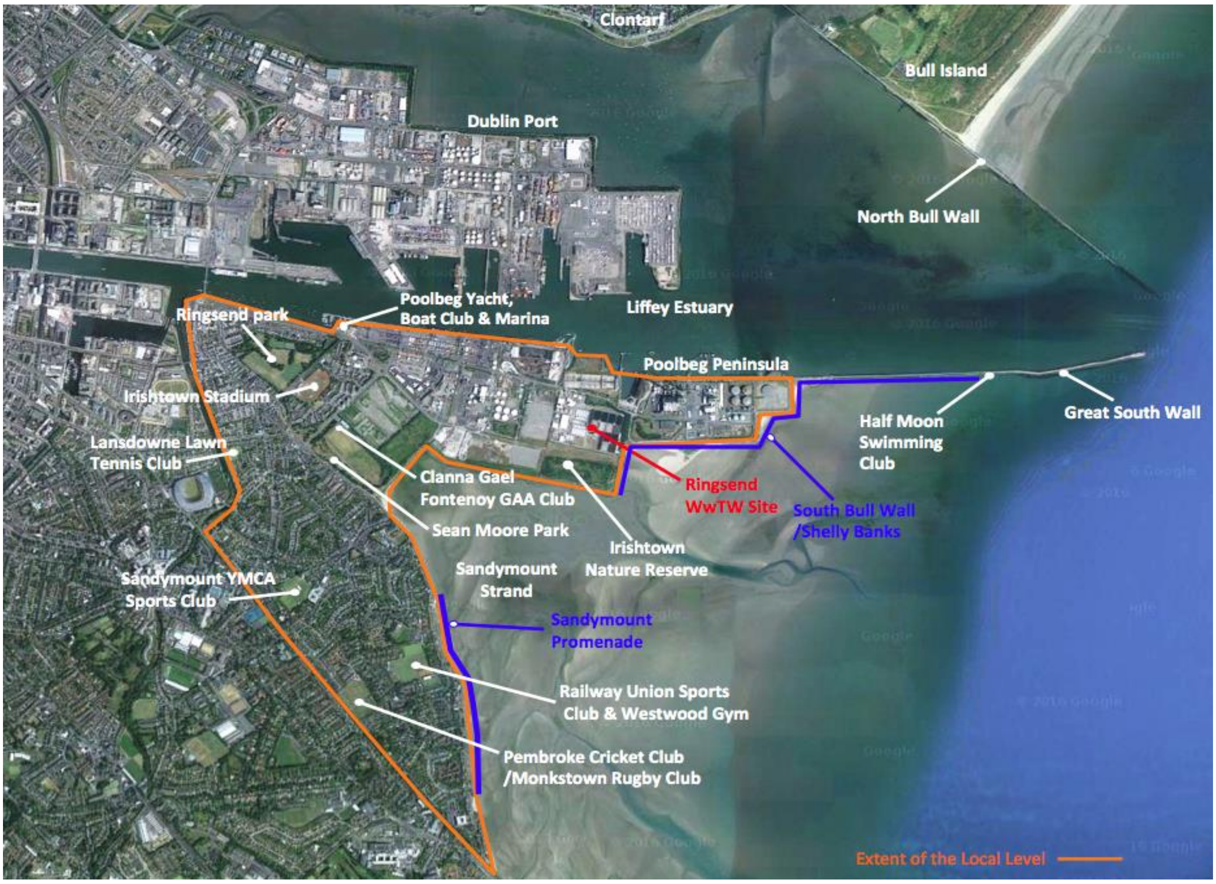

Figure 1-3: Recreational areas

1.2.5 Bathing Water Beaches

There are four bathing waters in Dublin Bay designated under EU Directive 2006/7/EC and Bathing Water Quality Regulations, SI No. 79 of 2008. Three of these waters fall within the Dublin City Council area (Dollymount, Sandymount and Merrion Strands) and one in the Dun Laoghaire-Rathdown Council area (Seapoint). All bathing waters are monitored by the local authorities during the bathing water season in accordance with the regulations. Dublin City Council also undertake monitoring at the Shelley Banks beach, the Great South Wall at the Half Moon Swimming Club, as well as the North Bull Wall, near Dollymount Strand. The classification of the designated bathing waters between 2015 and 2017 is shown in Table 1-1. The poor quality of Merrion Strand and Sandymount Strand are largely attributed to contamination of the Trimblestown and Elm Park Streams. Microbial source tracking studies have previously identified the presence of birds and dogs on Merrion Strand having an impact on bathing water quality. Further information on bathing water quality is contained in Section 4: Water.

Table 1-1: Bathing water classification (EPA 2015-2017)

Bathing Water	2017	2016	2015
Dollymount	Good Quality	Good Quality	Sufficient Quality
Sandymount	Poor Quality	Sufficient Quality	Sufficient Quality
Merrion	Poor Quality	Poor Quality	Poor Quality
Seapoint	Excellent Quality	Excellent Quality	Excellent Quality

1.2.6 River Liffey and Other Rivers

Details on the baseline water quality and the dynamics of these rivers is elaborated on in Volume 3, Section 4: Water.

There are a number of rivers discharging into Dublin Bay, which are grouped according to water management units, for the purposes of the Water Framework Directive (WFD). These groupings are labelled as follows (Table 1-2):

Table 1-2: Rivers discharging to Dublin Bay

Water Body	WFD Code	Status 2010-2015
Camac	IE_EA_09C020500	Poor
Poddle	IE_EA_09P030800	Unassigned
Dodder	IE_EA_09D010900	Moderate
Liffey	IE_EA_09L012360	Moderate
Tolka	IE_EA_09T011150	Unassigned
Santry Mayne Sluice	IE_EA_09S011100	Unassigned

There are also a number of smaller rivers and local streams discharging at various points around the bay coastline, e.g. Naniken, Wad. In addition, the two canals, the Royal and the Grand Canal, discharge to the River Liffey at Spencer Dock and Grand Canal Docks respectively. The Trimblestown and Elm Park Streams discharge to the Bay at Merrion Strand.

The Ringsend WwTP discharges to the Lower Liffey Estuary, which also incorporates the flows from the Camac and Dodder river groups, as well as numerous smaller tributaries and streams, e.g. Poddle and

Bradogue. The River Tolka and its tributaries discharge into their own estuary, located between the north side of Dublin Port and the Clontarf waterfront, and adjacent to the Liffey estuary.

The discharge from the River Liffey is the main freshwater input to the bay, with the Rivers Dodder and the Tolka the next major contributors of freshwater flows to the estuary.

The Santry River, which is part of the Santry Mayne Sluice water management unit, discharges adjacent to the North Bull Island causeway.

1.3 Water Framework Directive (WFD) and Urban Waste Water Treatment (UWWT) Directive Designations

The Directive 2000/60/EC establishing a framework for Community action in the field of water policy (the Water Framework Directive), and transposing regulations, European Communities (Water Policy) Regulations, 2003 (SI No. 722 of 2003), (as amended) establish a legal framework for the protection, improvement and sustainable management of rivers, lakes, groundwater and transitional (estuarine) and coastal waters. The classification scheme for water quality includes five status classes: 'high', 'good', 'moderate', 'poor' and 'bad' based on biological, chemical and morphological conditions monitored against a suite of environmental quality standards. There are different standards for Rivers, Lakes, Transitional and Coastal Waters. The water body status for the receiving waters associated with the discharge from the Ringsend WwTP is shown in Table 1-3 and Figure 1-4.

Table 1-3: Receiving water bodies WFD status

Water Body	WFD Code	Status 2007-2009	Status 2010- 2012	Status 2010-2015
Liffey Estuary Upper	IE_EA_090_0400	Moderate	Moderate	Moderate
Liffey Estuary Lower	IE_EA_090_0300	Moderate	Good	Moderate
Tolka Estuary	IE_EA_090_0200	Moderate	Moderate	Moderate
Dublin Bay	IE_EA_090_0000	Moderate	Good	Good
North Bull Island	IE_EA_090_0100	Unassigned	Unassigned	Unassigned

The Urban Wastewater Treatment Directive (91/271/EEC) has been transposed into Irish Legislation by the Urban Waste Water Treatment Regulations, 2001 (as amended). The Regulations list nutrient sensitive waters in the Third Schedule. The Liffey Estuary from Islandbridge weir to Poolbeg Lighthouse, including the River Tolka basin and South Bull Lagoon has been designated as a nutrient sensitive area. Since the Liffey River Estuary has been designated as "sensitive", the EU Urban Waste Water Treatment (UWWT) directive requires nutrient removal to achieve 10 mg/l Total Nitrogen and 1 mg/l Total Phosphorus, in addition to normal secondary treatment standards, for continued discharge at the existing outfall to the Liffey Estuary. The WwTP, as currently configured, was not designed to remove those nutrients.

The wastewater discharge licence as issued by the EPA sets thresholds that comply with the nutrient standards in the Directive. Meeting the standards in the Directive is a key compliance issue for Ireland in protecting our environment from the adverse effects of wastewater discharges. Failure to do so puts Ireland at risk of substantial fines from the Court of Justice of the European Union. Ireland therefore must provide the infrastructure to adequately collect and treat wastewater and prevent serious risks to human health and the environment.

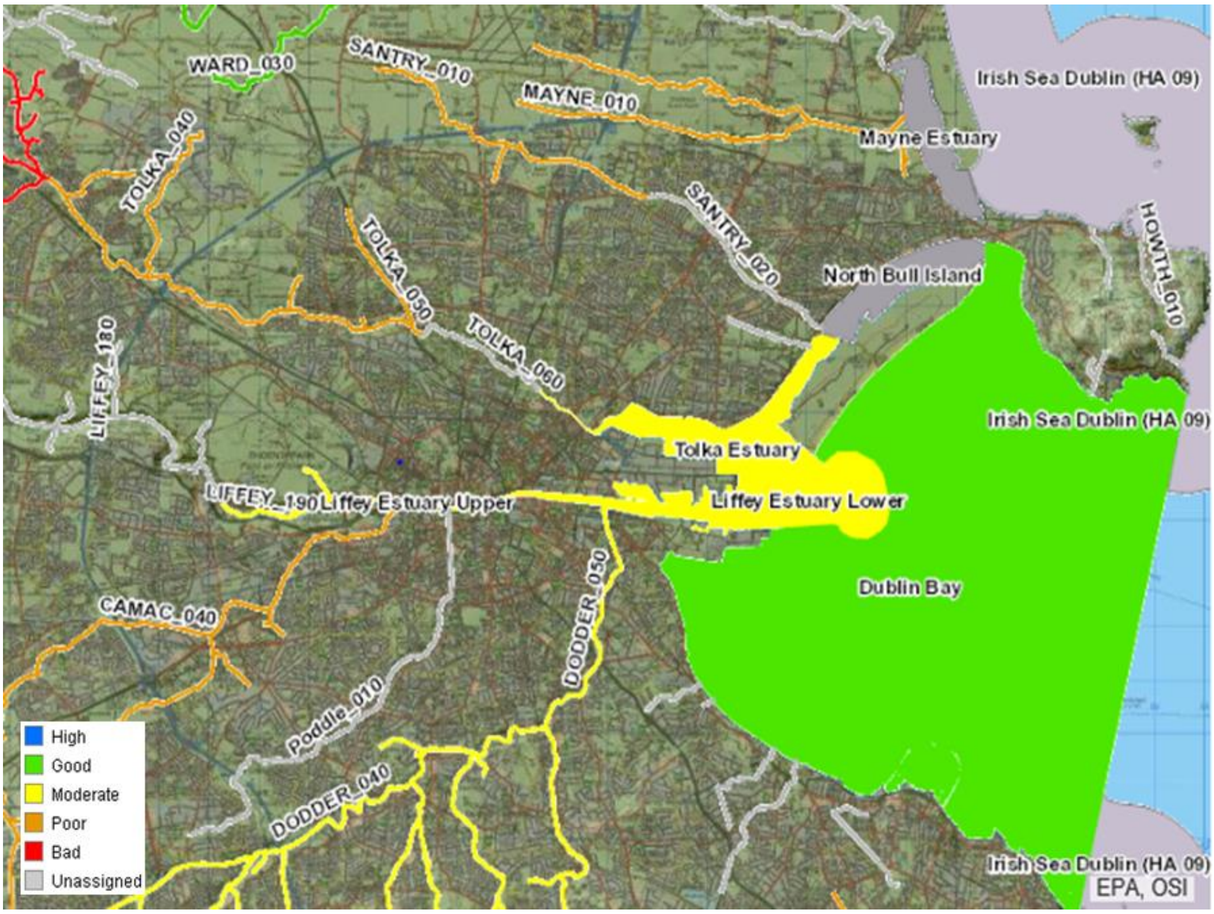

Figure 1-4: WFD status of water bodies

1.4 Conservation Designations

1.4.1 Introduction

The surrounding environment includes areas formally designated for nature conservation, which are listed here and will be assessed further in Section 5: Biodiversity - Marine and Section 6: Biodiversity - Terrestrial of this Volume of the EIAR.

The conservation designations include areas protected under international legislation, European legislation, national legislation and local planning objectives.

1.4.2 Natura 2000 Sites

European legislation provides, through the Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (Habitats Directive) and Council Directive 2009/147/EC on the conservation of wild birds (codified version) (Birds Directive) for a framework of designated sites to be protected from a conservation perspective. These sites are collectively described as Natura 2000 sites and consist of:

- Special Areas of Conservation (SAC), including candidate areas (cSAC), which are designated under the Habitats Directive; and
- Special Protection Areas (SPA) - areas which are designated under the Birds Directive.

1.4.2.1 Special Areas of Conservation (SAC)

The candidate Special Areas of Conservation within Dublin Bay are as follows:

- South Dublin Bay cSAC (Site Code: 000210);
- North Dublin Bay cSAC (Site Code: 000206);
- Howth Head cSAC (Site Code: 000202); and
- Rockabill to Dalkey Island cSAC (Site Code: 003000).

The spatial location and extent of these cSACs are illustrated in Figure 1-5.

1.4.2.2 Special Protection Areas (SPA)

The Special Protection Areas within Dublin Bay are as follows:

- South Dublin Bay and River Tolka Estuary SPA (Site Code: 004024);
- North Bull Island SPA (004006);
- Howth Head Coast SPA (004113); and
- Dalkey Islands SPA (004172).

The location and extent of these SPAs are illustrated in Figure 1-6.

1.4.3 National Legislation

National legislation provides, through the Wildlife Acts, for the designation of areas for the purposes of nature conservation. These areas are described as Natural Heritage Areas (NHA) or proposed Natural Heritage Areas (pNHA). The pNHAs and NHAs within the surrounding environment are listed as follows and are also illustrated in Figure 1-7:

- South Dublin Bay pNHA (000210);
- North Dublin Bay pNHA (000206);
- Howth Head pNHA (000202);
- Grand Canal pNHA (002104); and
- Royal Canal pNHA (002103).

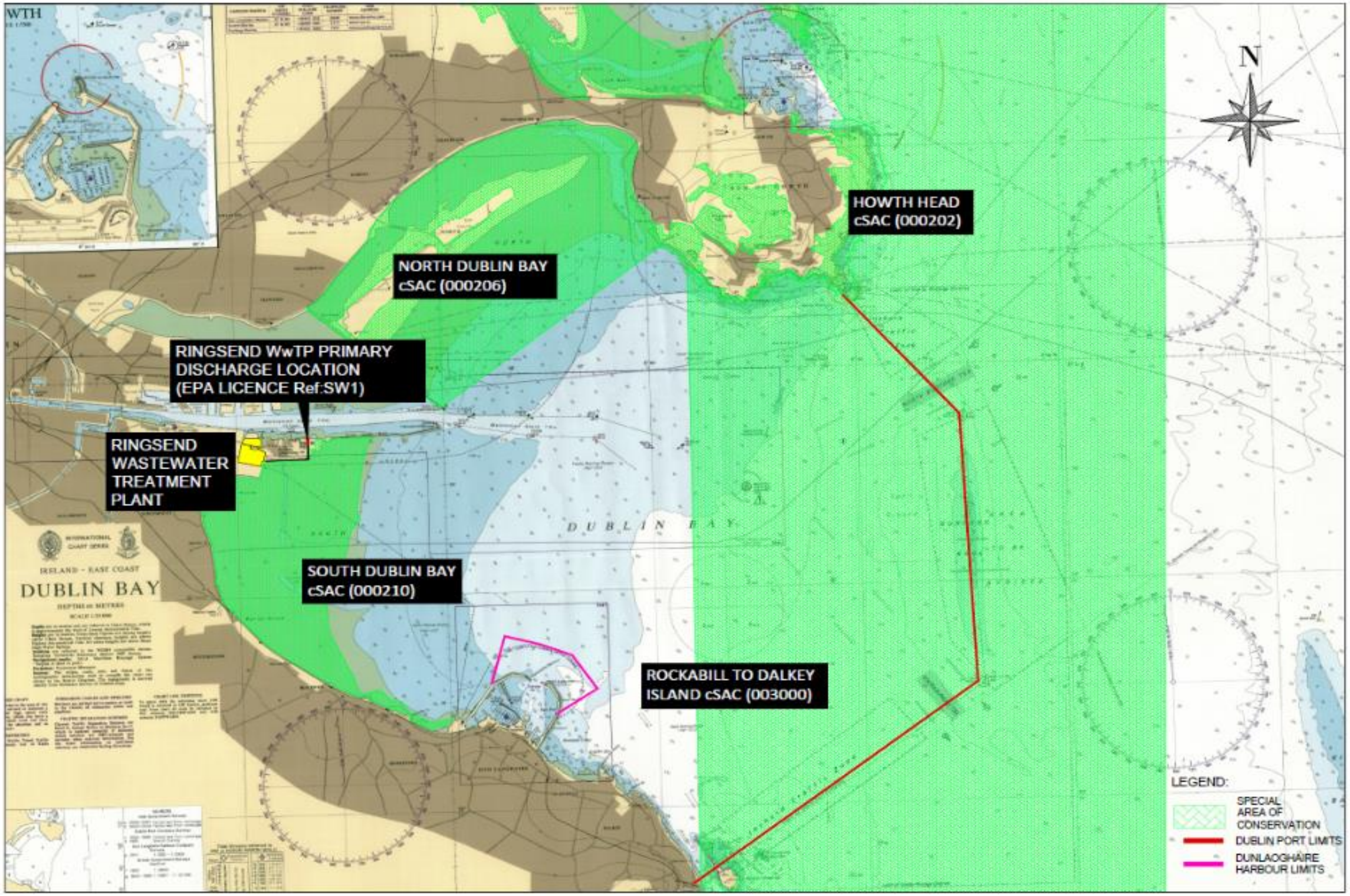

Figure 1-5: Special areas of conservation

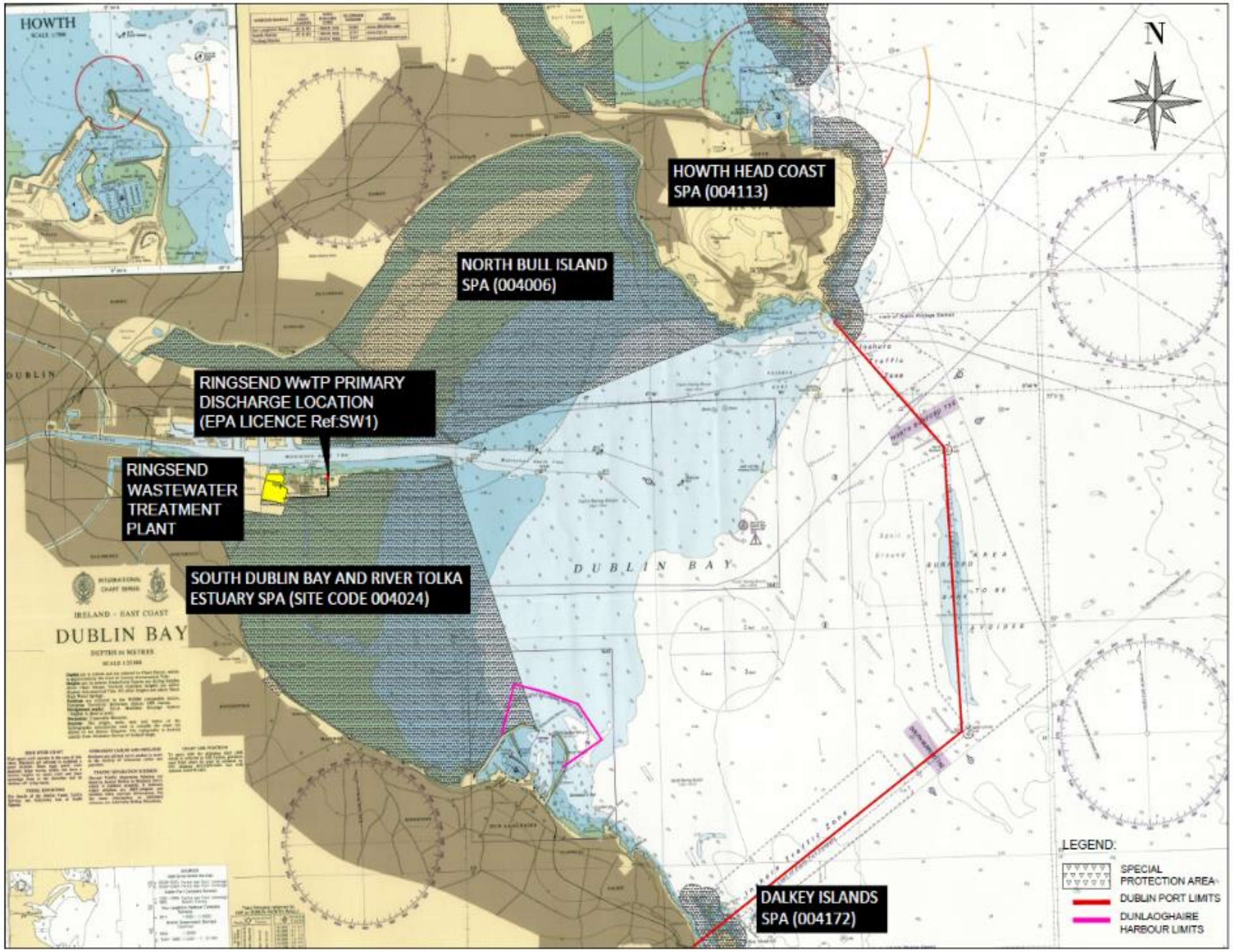

Figure 1-6: Special protection areas

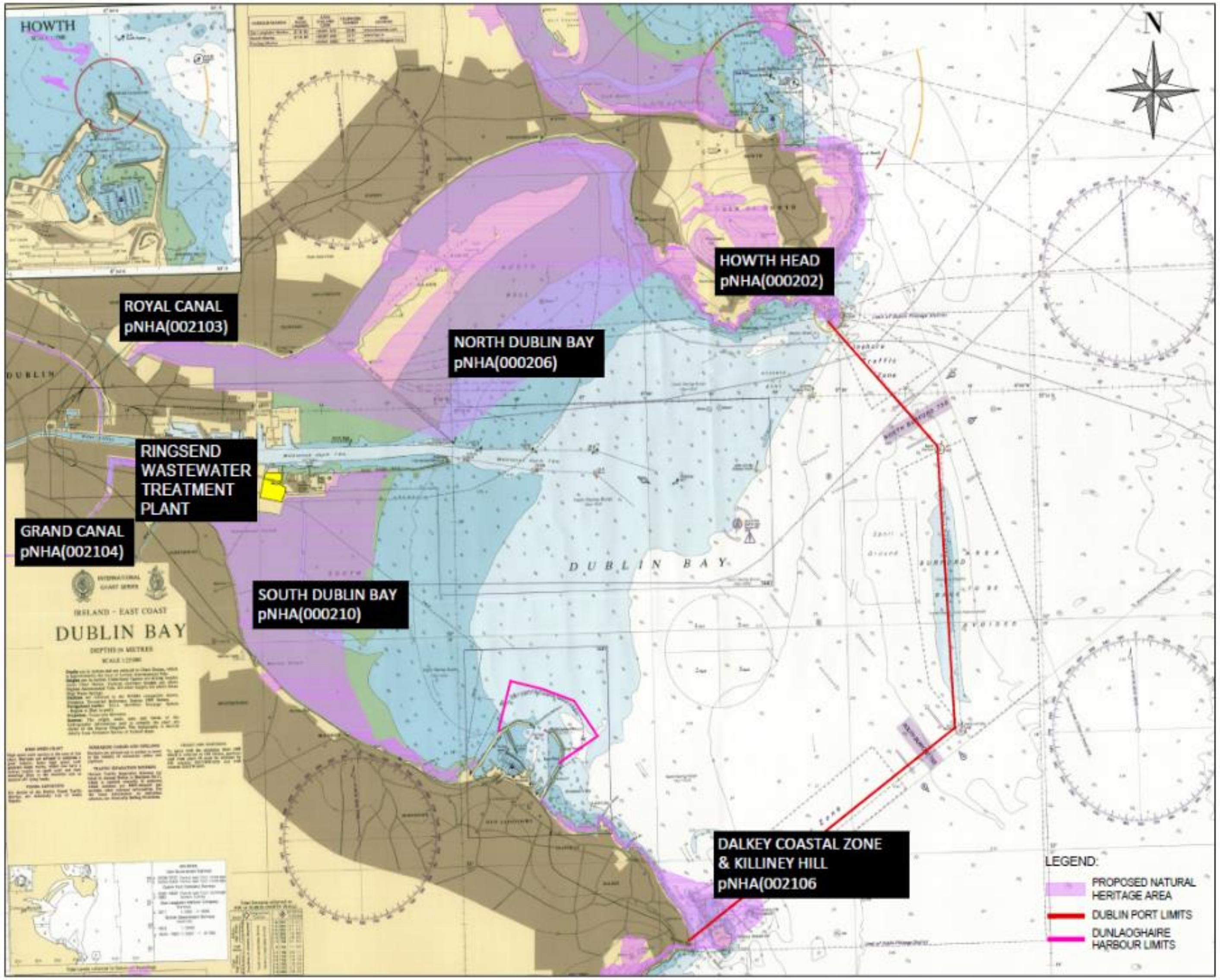

Figure 1-7: Proposed Natural Heritage areas

1.4.4 Dublin Bay UNESCO Biosphere

In 1981, UNESCO recognised the importance of Dublin Bay for conservation by designating the North Bull Island as a Biosphere Reserve because of its rare and internationally important habitats and species of wildlife. The North Bull Island Biosphere Reserve was expanded in 2015 to now cover the whole of Dublin Bay, reflecting its significant environmental, economic, cultural and tourism importance. The new Dublin Bay Biosphere Reserve extends to over 300 km^2 of marine and terrestrial habitat encompassing North Bull Island and ecologically significant habitats such as the Tolka and Baldoyle Estuaries, Howth Head, Dalkey Island, Killiney Hill and Booterstown Marsh. Over 300,000 people live within the newly enlarged Biosphere Reserve. The main objective of a biosphere reserve is to achieve the following three interconnected functions of:

- Conservation: protecting cultural diversity and biodiversity, including genetic variation, species, ecosystems and landscapes and securing services provided by such diversity;
- Development: fostering economic and human development that is environmentally and socially sustainable and culturally appropriate; and
- Logistic support: facilitating demonstration projects, environmental education and sustainable development education and training, research, and monitoring.

Within the Biosphere there are three different zones that which are managed in different ways:

- Core Protected Zone - in the Dublin Bay Biosphere this zone comprises 50 km^2 of areas of high natural value. Key areas include the Tolka and Baldoyle Estuaries, Booterstown Marsh, Howth Head, North Bull Island, Dalkey Island and Ireland’s Eye;
- Buffer Zone - 82 km^2 of public and private green spaces such as parks, greenbelts and golf courses, which surround and adjoin the core zone; and
- Transition Zone - 173 km^2 forming the outer part of the Biosphere. It includes residential areas, harbours, ports and industrial and commercial areas.

While the Biosphere designation does not strictly add any specific new legal protection, it greatly enhances the many legal protections that already exist by improving the coordination and management of the three functions in a holistic and integrated way.

1.5 Existing Ringsend Wastewater Treatment Plant

1.5.1 Site Development History

The use of the Poolbeg site for wastewater treatment (Figure 1-8) arose as part of the original development of a drainage network for Dublin city in the latter part of the 19th century. This infrastructure development included the construction of a sewage works, on the site of the current stormwater storage tanks, which are on the northern side of the Pigeon House Road (the Northern Site).

The 1906 facility was designed for a population of 325,000 and comprised primary sedimentation only, whereby the sewage was passed through settling tanks, and the gross organic solids removed from the flow as a sludge. The sludge was collected and dumped out to sea, while the treated sewage was discharged directly to the Liffey estuary.

Primary sedimentation, together with dumping of sludge at sea, remained the level of treatment provided for the duration of the 20th century, although the capacity of the system was expanded in line with the expansion of the sewer network, and the growth in population.

Major developments in the expansion of the sewerage system during this period included:

- **1970's:** Construction of Dodder Valley Sewer to convey wastewater from Dundrum, Templeogue and Tallaght for primary treatment at Ringsend WwTP;
- **1980's:** Construction of Grand Canal Tunnel Sewer to convey wastewater from Lucan, Clondalkin and Blanchardstown to Ringsend WwTP;
- **1990's:** Dun Laoghaire Scheme. Construction of a pumping station and subsea pipeline to divert wastewater from the Dun Laoghaire catchment to Ringsend WwTP;
- **2001:** Construction of the existing WwTP to cater for a PE of 1.64 million; and
- **2003**: Construction of a pumping station at Sutton and a subsea pipeline to Ringsend WwTP to divert the catchment serving north Dublin (Fingal, Howth, Baldoyle, Clontarf and Sutton).

The 1990's also saw the progression of the Dublin Bay project, of which the Sutton Pumping Station was an element, and which included a major redevelopment of Ringsend WwTP, converting it into a modern wastewater treatment plant, providing secondary treatment, with seasonal disinfection. The capacity of the facility, which had increased to serve a population of 925,000, was now designed to cater for a Population Equivalent (PE) of 1.64 million.

The new plant was constructed at the start of the 21st century and commissioned over the period from 2003 to 2005. In addition to providing full wastewater treatment, the new plant also saw a discontinuation of the practice of dumping of sewage sludge at sea. The new facility also included facilities for the treatment of the organic solids produced by the wastewater treatment process. These solids are now subject to a treatment process, which produces electricity for use on the plant, together with two fertiliser products (Biofert and Biocake), which are used in agriculture.

This project was designed to bring the facility and the final effluent discharge into compliance with the relevant European legislation, which required a secondary wastewater treatment process and improved standards for bathing waters.

Subsequent to the redevelopment of the Ringsend WwTP, two issues arose:

- The wastewater loading on the plant was greater than anticipated when the plant design was established; and
- The Lower Liffey Estuary was designated as sensitive under the EU Urban Waste Water Treatment Directive.

These two factors meant that while the upgrade completed in 2005 resulted in a significant improvement of the receiving water quality, the plant could not achieve the necessary standard of wastewater treatment to be compliant with the legislation, including removal of the nutrients Nitrogen and Phosphorus. The need to further expand the treatment capacity and enhance the treatment process was confirmed by the issue of a Wastewater Discharge Authorisation by the Environmental Protection Agency (EPA), which confirmed the nutrient removal requirements.

The plant also caused a significant odour nuisance in the wider community when it was first commissioned, which also created a need for further upgrades of the facilities. Improvements in odour management have been ongoing since 2005.

Planning permission was granted by An Bord Pleanála in 2012 for a further upgrade of the Ringsend WwTP, which included the following:

- Expansion of the WwTP average daily design capacity to 2.4 million PE;
- Provision of a long sea outfall tunnel to discharge the final effluent further out in Dublin Bay, near the Burford Bank; and
- Ancillary elements to improve the functionality and operability of the facility.

Notable alterations to the Ringsend WwTP facilities that have been completed since 2005, or are still ongoing, include:

- Expansion of sludge stream capacity, including additional drum thickeners, dewatering centrifuges and an additional anaerobic sludge digester, bringing the total number on site to four;
- Odour control modifications, including the provision of additional odour control units; and
- New site access at the south east corner of the site, and improvements along the Pigeon House Road to the east of the new access (undertaken as part of the 2012 permission).

Figure 1-8: Ringsend wastewater treatment plant location

1.5.2 Wastewater Collection Network and Catchment

The drainage catchment currently served by the Ringsend WwTP is entitled the Greater Dublin Area Agglomeration by the EPA wastewater discharge authorisation and comprises most of what would commonly be recognised as the Greater Dublin Area. The area is shown in the Figure 1-9 and excludes areas such as Swords and Malahide in Fingal, Leixlip in Kildare, and Shankill in Dun Laoghaire-Rathdown.

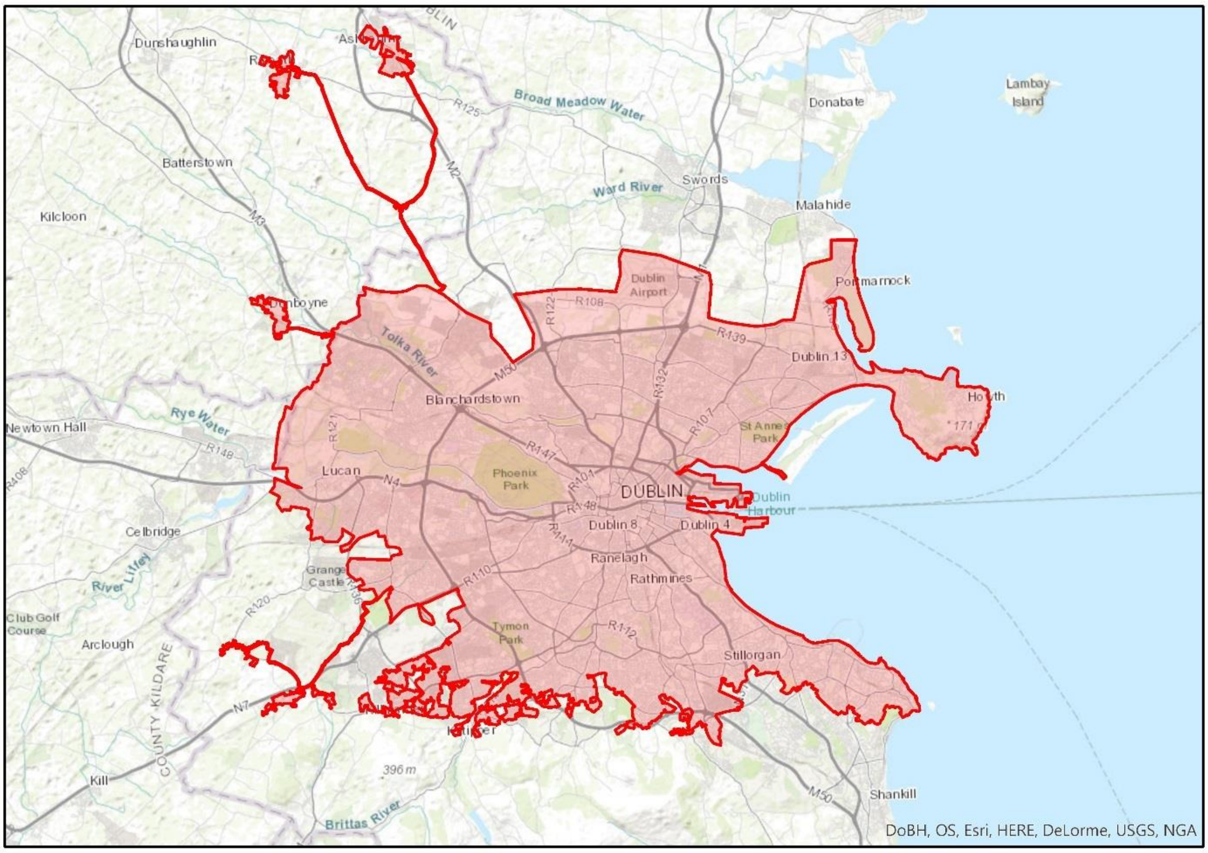

Figure 1-9: Greater Dublin area agglomeration

Volume 2, Section 1.4 of this EIAR identifies that the vision for the further expansion of treatment capacity for this catchment relies on the provision of a new wastewater treatment plant in North Dublin, the proposed Greater Dublin Drainage (GDD) Project. However, at present, and for the short-term future, the Ringsend WwTP is required to handle all of the wastewater generated within this catchment.

The collection of wastewater within the catchment is centred around 5 main arteries, as follows:

- **City Centre Sewers:** These sewers are the oldest element of the sewer network and collect the flows in along the line of the River Liffey, for discharge at the Ringsend Main Lift Pumping Station, from where it is pumped to the WwTP;
- **Grand Canal Sewer:** This sewer collects the wastewater from the western part of the city and also discharges into the Ringsend Main Lift Pumping Station;
- **Dodder Valley Sewer:** This sewer collects wastewater along the line of the River Dodder and discharges it directly into the WwTP;
- **Dun Laoghaire Pumping Station**: This pumping station collects all of the flows in the Dun Laoghaire area and pumps it to the WwTP; and
- **Sutton Pumping Station**: This pumping station collects all of the flows in the northern part of the catchment and pumps it to the WwTP.

In addition to wastewaters collected through the sewerage system, the Ringsend WwTP also receives wastewaters that are transported onto the site by tankers and discharged into the inlet works. Currently the Ringsend WwTP receives up to 10 tankers per day.

1.5.3 Layout of Existing Ringsend WwTP

The existing Ringsend WwTP consists of two sites (Figure 1-10) which straddle the Pigeon House Road. The main site is on the southern side of the road, while the storm tank site is on the northern side of the road. The total area of the combined sites is approximately 15 hectares.

1.5.3.1 Northern Site (3.5 Ha)

The Northern site consists of 6 open stormwater tanks with a combined volume of 62,100 m³ and overall dimensions of 280 m by 80 m. The tanks are largely constructed below ground level and are a refurbishment of the original Dublin Corporation sewage outfall works originally constructed in 1906, and subsequently converted into sludge holding tanks.

The original Dublin Corporation works had in turn been constructed on the reclaimed ground within the confines of the old Pigeon House Harbour.

Access to the site is off the Pigeon House Road, through an entrance on the eastern side of the southern boundary.

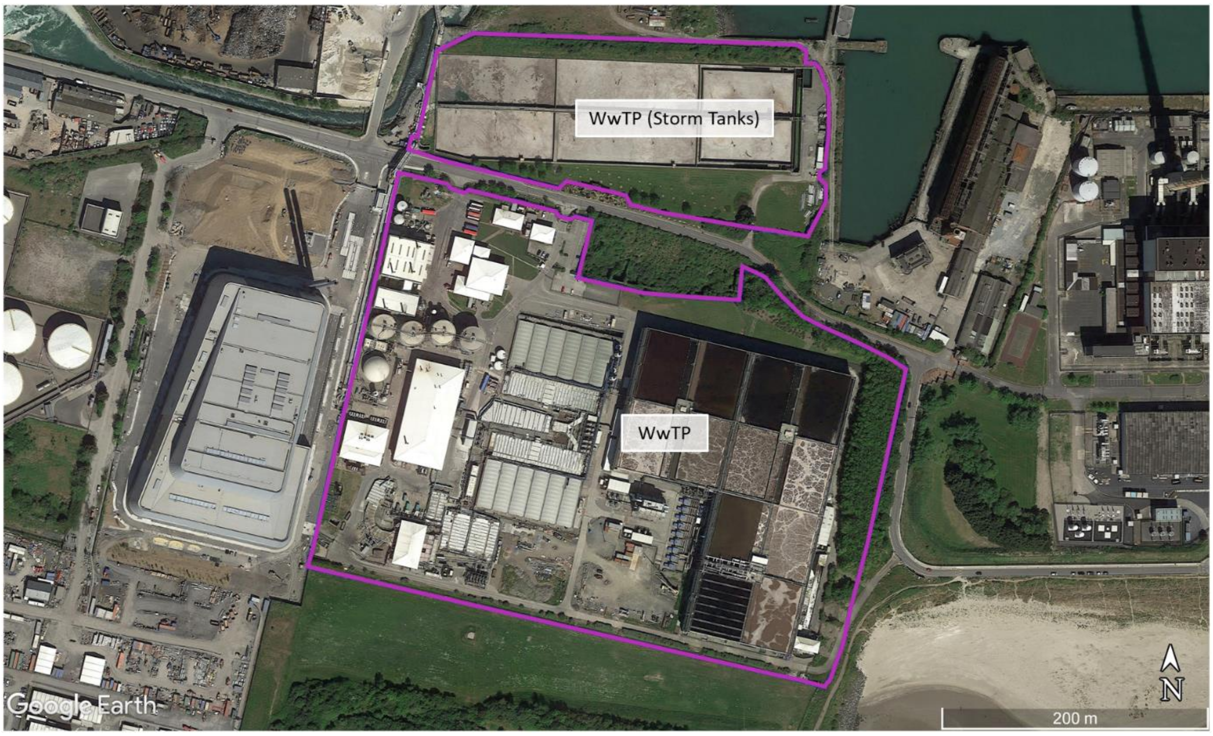

Figure 1-10: Existing Ringsend WwTP

1.5.3.2 Southern Site (11 Ha)

The main treatment site is heavily developed, with the exception of a 0.8 hectare space along the southern boundary, which has been reserved for future development.

The site is largely constructed on fill material of varying depths, and prior to the development of the existing WwTP, contained sewage treatment facilities, consisting of primary sedimentation tanks and supporting facilities.

Access to the site is off the Pigeon House Road, through one of two entrances towards the western side of the northern boundary.

The site, as currently developed, can be described as follows:

Eastern Area

The eastern part of the site contains the structures with the most significant mass and scale. These structures are the Sequencing Batch Reactor (SBR) tanks (Figure 1-10), which consist of 24 tanks, double stacked and with common walls, creating a L-shaped structure, with dimensions of 160 metres along the northern boundary and 230 metres along the eastern boundary. The height of the tankage is 20 metres, with some fixtures and fittings extending above this height. The SBR tanks are used in the secondary treatment of the wastewater, using a biological process to convert the soluble and non-settleable pollutant load into a biomass, for subsequent separation, creating an activated sludge stream for subsequent treatment.

The eastern boundary also includes a bund, constructed from infill material, which obscures part of the tankage along this boundary.

Additionally, there are UV (ultraviolet) disinfection facilities and treated effluent channels at the base of the tank walls at the south-eastern corner of the SBR tanks.

Western Area

The western part of the site contains a mixture of structures, including process vessels and buildings.

The most significant process vessels are 4 sludge digestion tanks, 18.5 metres diameter by 18 metres high, while the buildings comprise an administration and laboratory building, workshops and process buildings, of which the largest buildings are the process buildings, with heights in excess of 15 m.

Central and Southern Area

The central and southern area of the site is also densely developed, with the exception of the 0.8 hectare site reserved for future development. However, the maximum height of the structures are lower, at less than 10 metres.

The area contains the preliminary and primary treatment processes, including pumping, screening, grit removal and primary sedimentation.

1.5.4 Current Design Basis

The design basis for the current facility was developed during the 1990s and resulted in an estimation of the required plant capacity of 1.64 million Population Equivalent (PE). This figure was then developed into the design parameters set out in the following Table 1-4.

The plant was designed to permit a final effluent discharge to the Lower Liffey Estuary, via the cooling water discharge channel for the Poolbeg Power Station. The Lower Liffey Estuary was not designated as a nutrient sensitive area under the Urban Waste Water Treatment Regulations at that time and was not considered sensitive to eutrophication at that time. Consequently, there was no requirement identified to integrate nitrogen or phosphorus recovery facilities into the plant design.

However, the Dublin Bay Water Quality Management Plan (ERU, 1991) did identify ammonia as a parameter to be controlled and consequently the plant design did include for partial ammonia removal, to avoid impacts on migratory fish. Additionally, there was a requirement to ensure that the effluent discharge was compliant with requirements of the Bathing Water Legislation and the Blue Flag objectives for the beaches within Dublin Bay. Ultra-Violet Disinfection of treated effluent, during the bathing season (May to September), was also identified as a requirement for the discharge and implemented.

Arising from these requirements, the plant was then designed to provide secondary treatment with partial nitrification and disinfection, with the objective of achieving the effluent standards set out in the following Table 1-5.

Table 1-4: Current design parameters

Parameters	Units	Raw Influent	
		Average	Peak Daily Design
Population Equivalent	PE	1,640,000	2,626,667
Volume	m^3/day	492,480	n/a
Peak Flowrate	m^3/s	11.1	11.1
Biochemical Oxygen Demand (BOD)	kg/day	98,400	157,600
Suspended Solids	kg/day	101,100	194,300
Ammonia	kg/day	9,500	12,800
Total Nitrogen	kg/day	15,600	21,400
Total Phosphorus	kg/day	3,700	5,600

Table 1-5: Current Final Effluent Design Basis

Parameter	Emission Limit Value
CBOD	25 mg/l
COD	125 mg/l
Suspended Solids	35 mg/l
Ammonia (as N)	18.75 mg/l
Faecal Coliforms	100,00 MPN/100ml

In addition to the final effluent discharge point there is also a stormwater overflow outfall that discharges into the Lower Liffey Estuary beside the existing stormwater tanks. The existing plant is designed to manage stormwater flows and minimise the impact from overflows to stormwater holding tanks.

In addition to storage, the stormwater overflow is screened and settled to minimise the impact on the receiving water. The estimated maximum bacteriological impact from the overflow is 3,000,000 faecal coliforms MPN per 100 ml.

The wastewater treatment process produces sludges as a by-product, which are in turn converted into fertiliser products (biosolids) for use in agriculture. The Ringsend WwTP produces two types: Biofert, which is 92 % dry solids, and Biocake, which is 26 % dry solids. 16,395 tonnes (at 92% dry solids) of Biofert Solids were removed from the wastewater treatment plant in 2017. 1600 tonnes (at 26% dry solids) of sludge cake were removed from the wastewater treatment plant in 2017.

The treatment process to achieve these standards comprises the following elements:

- **Preliminary Treatment:** Comprising flow management, including stormwater handling and storage, screening and grit removal;
- **Primary Treatment:** Comprising sedimentation to remove gross organic solids and creating a primary sludge for treatment;
- **Secondary Treatment:** Comprising a biological process to convert the soluble and non-settleable pollutant load into a biomass, for subsequent separation, creating an activated sludge stream for subsequent treatment;
- **Disinfection:** Comprising ultra-violet radiation to reduce the pathogenic and other organisms in the final effluent discharge;
- **Sludge Thickening:** Comprising thickening, to reduce the volume, and storage of the primary and activated sludges;
- **Sludge Treatment:** Comprising hydrolysis and anaerobic digestion, which are thermal treatments which breakdown and stabilise the biological component in the sludge, producing energy as a by-product; and
- **Sludge Drying and Dewatering:** Comprising drying or dewatering of the treated sludge, to produce the final fertiliser products, Biofert and Biocake.

The possibility of nutrient removal being a future requirement was also considered and an area of 0.8 ha was left undeveloped along the southern boundary of the site to permit a future upgrade of the secondary treatment process to facilitate nutrient removal in the process.

1.5.5 Existing Process Description

The current Ringsend WwTP treatment processes comprise of a:

- Wastewater process stream, which treats the raw wastewater influent, producing a treated secondary effluent and primary and activated sludge as by-products; and
- Sludge process stream, which treats the primary and activated sludges, producing Biosolids.

Diagrams for each of the wastewater and sludge process streams are shown in the figures overleaf (Figure 1-11 and Figure 1-12), and the individual unit processes are further described in the following paragraphs.

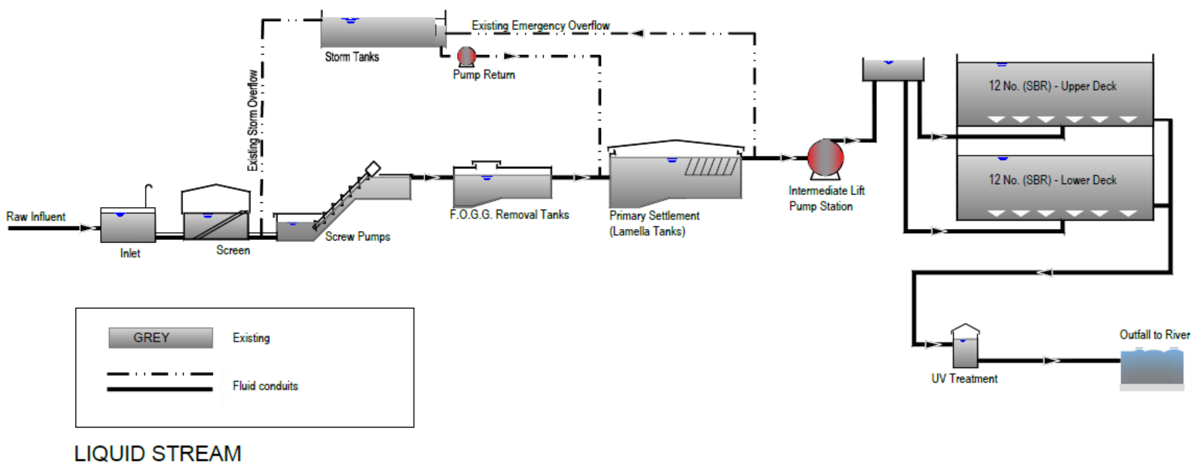

Figure 1-11: Process flow diagram – Existing wastewater treatment process

1.5.5.1 Preliminary Treatment

Incoming flows, whether by sewer or tanker, are initially received at the inlet works in the south west corner of the site, where the flows are screened and de-gritted, and fats oils, fats and greases (FOGs) are removed. Screenings and grit removed from the flow are washed to remove organic materials and compacted, in the case of screenings.

During wet weather events, flows in excess of the capacity of the main treatment processes are diverted to the stormwater holding tanks, which are located on the north side of the Pigeon House Road, for flow balancing and subsequent return to the main treatment process, or depending upon the severity of the wet weather event, overflow to the Liffey Estuary. The location of the outfall to the Liffey Estuary for any stormwater discharges is adjacent to the north-east corner of the tanks.

Currently the preliminary treatment facilities comprise screening, followed by stormwater handling, pumping and grit removal.

- The screening process is sized to handle the peak incoming flow of 23.5 m^3/s and comprises 6 mm wedge wire bar screens. The collected screenings are washed and compacted before being stored in a covered skip for subsequent disposal off-site.
- Flows which pass through the screens and are in excess of the current plant capacity of 11.1 m^3/s, are diverted to the storm water tanks, for storage and subsequent return to the main treatment stream, once the flows fall below the plant peak capacity. The stormwater tanks have a storage capacity of 62,100 m^3 and volumes received in excess of this capacity are discharged to the Lower Liffey Estuary.

Flows which pass through the screens and are at or below the current plant capacity of 11.1 m^3/s, are pumped forward by screw pumps, which lift the flows to the grit removal process. The grit collected from this process is washed and stored in a skip for subsequent disposal off-site.

1.5.5.2 Primary Treatment

Flows, having passed through the preliminary treatment process, are transferred to the primary treatment process, together with any flows returned from the storm tanks. Return flows from the storm tanks only arise during periods when the main incoming flows are below the peak flows.

The primary treatment process, comprises sedimentation tanks, located in the centre of the site. The primary sedimentation process allows gross organic solids to be settled out from the wastewater flows, creating a sludge known as primary sludge.

The primary sedimentation tanks consist of 12 rectangular tanks, with lamella settling plates and floor scrapers to collect the primary sludge in a hopper at one end of the tank.

The primary sludge is directed towards the sludge treatment process, while the settled wastewater is transferred towards the secondary treatment stage.

1.5.5.3 Secondary (Biological) Treatment

Secondary treatment is carried out in the Sequencing Batch Reactor (SBR) tanks, located on the eastern side of the site, where a biological aerobic process converts the suspended and dissolved pollutants into a biomass, known as an activated sludge. The activated sludge is then settled out of the wastewater and directed towards the sludge treatment process, while the settled wastewater, now described as a secondary effluent, is discharged to the final effluent outfall.

The current design of the SBR process permits the reduction of ammonia levels, in addition to the conversion of general carbonaceous pollution.

The existing SBR tanks operate collectively in 6 groups of 4, being 24 tanks in total. Each tank has a volume of 13,993 m³, giving a total volume for biological treatment of 335,832 m³. The SBR process originally operated in a classic fill, aerate, settle and decant sequence, however more recently the process operates on a continuous inflow / constant level basis.

1.5.5.4 Disinfection

The secondary effluent discharged from the SBR tanks into the final effluent channel passes through a UV disinfection process, which is located at the south-east corner of the site and operates during the bathing season (01 June - 31 August) to further reduce the pathogenic content in the final effluent.

1.5.5.5 Sludge Treatment

The primary and activated sludges are processed on the western part of the site, where they are thickened and passed through thermal hydrolysis and anaerobic digestion processes, before being further dewatered and dried.

The thermal hydrolysis and anaerobic digestion processes treat the primary and activated sludges further, destroying any pathogenic content and creating biogas for generation of heat and power, and a biosolids product for re-use off site.

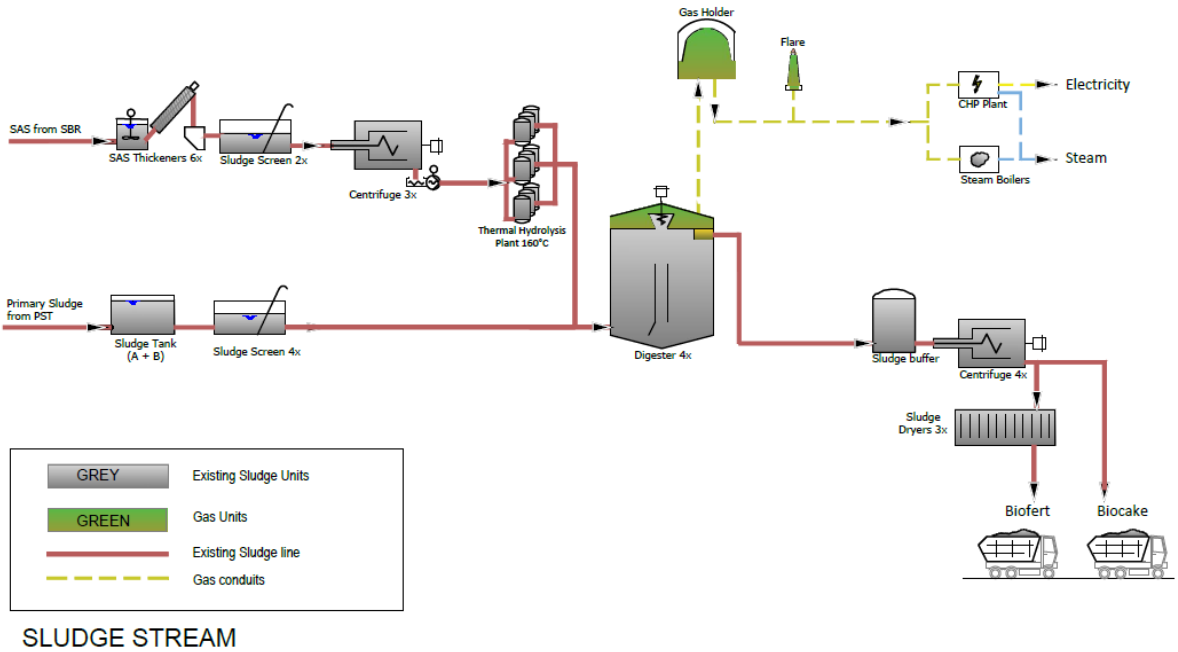

Figure 1-12: Process flow diagram – Existing sludge treatment process

1.5.5.6 Odour Treatment

The commissioning of the existing facility inadvertently resulted in an odour nuisance in the local community. Arising from this nuisance, Dublin City Council developed a Project Odour Goal to eliminate the nuisance and minimise the odours caused by the facility.

The Project Odour Goal sought to achieve an odour target at the WwTP site boundary of 10 $OU_{E,}$ (European Odour Units) which was to be exceeded no more than 50 hours per annum. Additional odour control measures were implemented at the plant to achieve this goal, and currently the odour control measures incorporated into the plant comprise the following measures:

- The plant head works, comprising the preliminary treatment process, is covered and vented through an odour control unit. The capacity of this odour control unit has been increased in recent years;
- The primary sedimentation tanks and associated flow channels have been covered in recent years and vented to an odour control unit;
- The intermediate lift pumping station (ILPS) has been covered and vented to an odour control unit in recent years;
- Fugitive emissions from the biogas sphere and the process buildings have been identified and sealed;
- Adjustments to the thermal hydrolysis process to prevent fugitive emissions from this process;
- Improvements to the odour control facilities for the sludge dryers and biogas systems; and
- Incorporation of sludge centrifuges into the process building and included in the odour control system.

The implementation of these measures has largely seen the elimination of the odour nuisance that was present during the early stage of the plant operation, with odour complaints to the plant operators (Celtic Anglican Water) currently numbering only a few per annum.

The development of the Project Odour Goal also includes the implementation of a site odour management plan, which is another key element in the management of site odours by the plant operators on a continuous basis.

1.5.6 Wastewater Discharge Authorisation

In 2001, after the commencement of the construction of the existing plant, the Liffey Estuary, from Islandbridge weir to Poolbeg Lighthouse, including the River Tolka basin and South Bull Lagoon, was designated as sensitive under SI 254 of 2001, Urban Waste Water Treatment Regulations.

This designation of the estuary in 2001 as sensitive, means that it was identified as being prone to eutrophication, and consequently urban wastewater discharges needed to have reduced levels of nitrogen and phosphorus present.

In 2007, SI 684 introduced the Waste Water Discharge Authorisation Regulations, which required the licencing or certification of wastewater discharges by the EPA. Dublin City Council applied for a licence for the Greater Dublin Area Agglomeration on 14 December 2007, and the EPA granted a licence on 27 July 2010 (Ref. D0034-01). This licence confirmed the requirements for nitrogen and phosphorus removal and set out the standards for the final effluent discharge at the Ringsend WwTP, as per Table 1-6.

The current plant is not designed to achieve the nitrogen and phosphorus standards set out in the licence and does not comply with standards as a result.

Additionally, the plant is also receiving loads in excess of its design capacity and consequently fails to achieve the necessary standards in respect of cBOD and COD.

Table 1-6: Ringsend WwTP final effluent discharge licence standards

Parameter	Emission Limit Value
pH	6 – 9
Toxicity	5 TU
Faecal Coliforms (1 May to 31 August)	100,000 MPN/100ml
cBOD	25 mg/l
COD	125 mg/l
Suspended Solids	35 mg/l
Total Nitrogen (as N)	10 mg/l
Total Phosphorus (as P)	1 mg/l

1.5.7 Influent Loading

The Ringsend WwTP currently receives influent loadings in excess of its design capacity. The details of the loadings in recent years are set out in Table 1-7.

Table 1-7: Ringsend WwTP average influent loadings

Year	PE (million)	Flow m^3/day	BOD kg /day	COD kg /day	TSS kg /day	Total N kg /day	Total P kg /day
2013	1.74	411,206	104,525	229,864	111,437	15,351	2,320
2014	1.78	454,957	106,679	224,723	111,435	14,496	2,252
2015	1.93	423,576	115,992	233,201	111,924	15,360	2,451
2016	1.81	410,874	114,223	225,570	107,649	15,572	2,445
2017	1.83	400,672	109,533	222,713	109,236	15,433	2,396

In addition to the wastewater flows that arrive via the collection network, the WwTP also receives wastewaters from tankers discharging within the site, including a combination of leachates and various commercial loads as set out in Table 1-8.

Table 1-8: Ringsend WwTP tankered wastewater volumes

Year	Volume
2013	70,447 m^3
2014	51,088 m^3
2015	70,407 m^3
2016	94,073 m^3
2017	115, 853 m^3

1.5.8 Treatment Plant Emissions

The Ringsend WwTP performance objectives are set out in the sub-sections above, which show the requirements relative to the plant design and the EPA licence requirements. As previously outlined, the current influent loads mean that the emission limit values in the Wastewater Discharge Licence are not being met. The current average plant performance relative to the final effluent discharge standards are set out in Table 1-9.

Table 1-9: Ringsend WwTP final effluent discharge

Year		Flow m³/day	BOD mg/l	COD mg/l	TSS mg/l	Total N mg/l	Total P mg/l	E. Coli MPN
2013	standard		25	125	35	10	1	100,000
	mean	411,206	19.9	80	35	13.9	3.9	n/a
	no. samples		139	249	249	100	102	67
	Maximum ELV exceedances permitted.		11	18	18	20	20	13
	no. > standard		28	21	70	86	102	0
2014	mean	454,957	17	73	31	14.8	3.4	n/a
	no. samples		145	248	248	101	101	69
	Maximum ELV exceedances permitted		12	18	18	20	20	14
	no. > standard		14	11	56	86	101	1
2015	mean	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	no. samples		142	247	246	101	101	60
	Maximum ELV exceedances permitted		12	18	18	20	20	12
	no. > standard		26	17	83	93	101	2
2016	mean	410,874	28	106	52	25.04	4.11	n/a
	no. samples		143	246	246	101	101	55
	Maximum ELV exceedances permitted		12	18	18	20	20	11
	no. > standard		52	29	129	100	101	2
2017	mean	400,672	n/a	n/a	n/a	18	4	n/a
	no. samples		143	246	246	102	102	52
	Maximum ELV exceedances permitted		12	18	18	9	9	5
	no. > standard		61	60	168	102	99	1

Note: Shaded Cells denote failure to meet Licence requirements

In addition to the final effluent discharge, there is also the stormwater discharge, which discharges on an intermittent basis, in response to rainfall. The stormwater discharges over recent years are summarised in Table 1-10.

The biosolids produced by the facility are the next most significant output from the facility, comprising a mixture of Biofert and Biocake. The quantities produced in recent years are summarised in Table 1-11.

Table 1-10: Stormwater Discharges

Year	Occurrences	Volume
	days/annum	m³/annum
2013	15	892,730
2014	33	2,554,350
2015	30	2,781,020
2016	15	892,730
2017	14	1,220,113

Table 1-11: Biosolids Production Figures

Year	Biofert			Biocake		
	% dry solids	tonnes/annum (wet)	tonnes/annum (dry solids)	% dry solids	tonnes/annum (wet)	tonnes/annum (dry solids)
2013	92	14,438	13,289	27	8,965	2,400
2014	91	15,561	14,236	26	5,934	1,543
2015	92	16,436	15,122	26	2246	548
2016	92	16,338	15,031	26	2644	698
2017	92	16,395	15,083	26	1600	416

These biosolids are currently moved to a storage location at Thornhill in County Carlow, to facilitate the management of the dispersal of the biosolids to agricultural land. It is proposed to transition to storage of biosolids to a new purpose built regional biosolids storage facility at Newtown, Dublin 11 as set out in the National Wastewater Sludge Management Plan (NWSMP).

Finally, screenings and grit are also removed from the plant and disposed to landfill.

All details pertaining to the proposed Regional Biosolids Storage Facility (RBSF) are contained in Volume 4 of this EIAR.

1.6 References

Dublin City Council (2017). Poolbeg West SDZ Planning Scheme 2017 (Interim Publication). [pdf]

Available at:
http://www.dublincity.ie/sites/default/files/content/Planning/OtherDevelopmentPlans/Documents/Poolbeg%20West%20Planning%20Scheme%20(Interim%20%20Document).PDF.

Environmental Research Unit, (1991). Dublin Bay Water Quality Management Plan

Section 2: Planning and Policy Context

2.1 Introduction

This Section of the EIAR considers both the strategic policy and supplementary planning and development policies which guide wastewater infrastructure. This Section also identifies the planning application history for both the Ringsend WwTP site and its surrounding context. As shown in Figure 2-1 below, the hierarchy of planning and policy context are reviewed at European, National, Regional and Local Level.

The details of the Environmental Impact Assessment (EIA) process is set out in Volume 2, Section 2: The EIA Process of this EIAR. This Section is focused solely on the governing planning policies and therefore does not intend to re-state the above process.

The Ringsend WwTP component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component") is also guided by a wide range of water and wastewater legislation and strategies. These are set out in Volume 3, Section 4: Water.

Figure 2-1: Planning and Policy Context Hierarchy

2.2 Planning and Development Policy Framework

2.2.1 European Policy Framework

The European policy framework for the Proposed WwTP Component consists of the Water Framework Directive and the Urban Waste Water Treatment Directive.

2.2.1.1 Water Framework Directive (WFD)

The Directive 2000/60/EC establishes a framework for Community action in the field of water policy (the Water Framework Directive), for the protection, improvement and sustainable management of rivers, lakes, groundwater and transitional (estuarine) and coastal waters.

The classification scheme for water quality includes five status classes: 'high', 'good', 'moderate', 'poor' and 'bad' based on biological, chemical and morphological conditions monitored against a suite of environmental quality standards. There are different standards for Rivers, Lakes, Transitional and Coastal Waters. The water body status for the receiving waters associated with the discharge from the Ringsend WwTP is shown in Table 2-1 and Figure 2-2.

Table 2-1: Receiving Water Bodies WFD Status

Water Body	WFD Code	Status 2007-2009	Status 2010- 2012	Status 2010-2015
Liffey Estuary Upper	IE_EA_090_0400	Moderate	Moderate	Moderate
Liffey Estuary Lower	IE_EA_090_0300	Moderate	Good	Moderate
Tolka Estuary	IE_EA_090_0200	Moderate	Moderate	Moderate
Dublin Bay	IE_EA_090_0000	Moderate	Good	Good
North Bull Island	IE_EA_090_0100	Unassigned	Unassigned	Unassigned

Figure 2-2: WFD Status of Coastal and Transitional Water Bodies

2.2.1.2 Urban Waste Water Treatment Directive

The Urban Waste Water Treatment Directive (full title **Council Directive 91/271/EEC concerning urban waste-water treatment**) is a European Union directive regarding urban wastewater collection, wastewater treatment and its discharge, as well as the treatment and discharge of "*waste water from certain industrial sectors*". It was adopted on 21 May 1991. It aims "*to protect the environment from the adverse effects of urban waste water discharges and discharges from certain industrial sectors*" by mandating wastewater collection and treatment in urban agglomerations with a population equivalent of over 2,000, and more advanced treatment in places with a population equivalent above 10,000 in sensitive areas.

The Urban Wastewater Treatment Directive (91/271/EEC) has been transposed into Irish Legislation by the Urban Waste Water Treatment Regulations, 2001 (as amended). The Regulations list nutrient sensitive waters in the Third Schedule.

The Liffey Estuary from Islandbridge weir to Poolbeg Lighthouse, including the River Tolka basin and South Bull Lagoon has been designated as a nutrient sensitive area. Since the Liffey River Estuary has been designated as “sensitive”, the EU Urban Waste Water Treatment (UWWT) directive requires nutrient removal to achieve 10 mg/l Total Nitrogen and 1 mg/l Total Phosphorus, in addition to normal secondary treatment standards, for continued discharge at the existing outfall to the Liffey Estuary. The WwTP, as currently configured, was not designed to remove those nutrients.

The wastewater discharge licence as issued by the EPA sets thresholds that comply with the nutrient standards in the Directive. Meeting the standards in the Directive is a key compliance issue for Ireland in protecting our environment from the adverse effects of wastewater discharges. Failure to do so puts Ireland at risk of substantial fines from the Court of Justice of the European Union. Ireland therefore must provide the infrastructure to adequately collect and treat wastewater and prevent serious risks to human health and the environment in order to comply with the Urban Waste Water Treatment Directive.

The Proposed WwTP Component and RBSF will bring the project into line with the requirements of the Urban Waste Water Treatment Directive.

2.2.2 National Policy Framework

2.2.2.1 National Planning Framework – Ireland 2040

The National Planning Framework (NPF) was published by the Government of Ireland in February 2018, along with the National Development Plan 2018-2027; being a 10-year National investment plan. The NPF will shape the direction of development at a national scale, and subsequently direct the Regional Assemblies in preparing the Regional Spatial and Economic Strategies (RSES); which will supersede the present Regional Planning Guidelines in due course.

The NPF set out 10 National Strategic Outcomes which inter alia: ***Compact Growth*** is a top priority for the plan which the NPF outlines:

> *“Carefully managing the sustainable growth of compact cities, towns and villages will add value and create more attractive places in which people can live and work. All our urban settlements contain many potential development areas, centrally located and frequently publicly owned, that are suitable and capable of re-use to provide housing, jobs, amenities and services, but which need a streamlined and co-ordinated approach to their development, with investment in enabling*

infrastructure and supporting amenities, to realise their potential. Activating these strategic areas and achieving effective density and consolidation, rather than more sprawl of urban development, is a top priority." Pg.14

In the context of this Strategic Outcome, the NPF refers to the Proposed WwTP Component in *National Strategic Outcome 9* relevant to the Proposed Upgrade Project, including:

"Water

Implement the Greater Dublin Strategic Drainage Study, through ***enlarging capacity in existing wastewater treatment plants (Ringsend)*** *and providing a new treatment plant in North County Dublin - known as the Greater Dublin Drainage Project (GDD) Project."* pg. 148 (Highlights added)

"Effective Waste Management

Waste planning in Ireland is primarily informed by national waste management policies and regional waste management plans. Planning for waste treatment requirements to 2040 will require:

- **Additional sewage sludge treatment capacity** and a **standardised approach to managing wastewater sludge** and including options for the extraction of energy and other resources. (Highlights added)
- Biological treatment and increased uptake in anaerobic digestion with safe outlets for bio stabilised residual waste." pg.149

The NPF therefore recognises the importance of the Proposed WwTP Component as a piece of nationally strategic infrastructure to ensure the growth of the GDA occurs in a sustainable manner.

The Proposed RBSF Component is an essential component of the Proposed Upgrade Project and forms part of Irish Water's plans to standardise the approach to managing wastewater sludge in line with the objectives of the NPF. The NPF also recognises the importance of this piece of strategic infrastructure to ensure the growth of the GDA occurs in a sustainable compact manner.

The Proposed WwTP Component and RBSF is in accordance with the National Planning Framework.

2.2.2.2 National Development Plan, 2018 - 2027

The Government has recently approved the National Development Plan, 2018-2027. This provides a 10 year investment plan which aligns with the objectives of the National Planning Framework - Ireland 2040 (NPF) that was approved by the Government in February 2018.

As noted above, the NPF includes *National Strategic Objective 9* which provides for both the enlarged capacity at the Ringsend WwTP and also the introduction of a standardized approach to managing wastewater sludge.

The National Development Plan, 2018-2027 identifies the "*Strategic Investment Priorities 2018-2027*" under *National Strategic Objective 9* which relates to *"Sustainable Management of Water and other Environmental Resources".* Here it states that:

"Investment in our country's water services is critical in meeting the needs of our growing economy across the regions, of our people and their health and the protection and enhancement of the quality of our environment and ensures public health.

- Water Infrastructure Irish Water Investment Programme
- Eastern and Midlands Water Supply Project
- Greater Dublin Drainage Project
- Rural Water Investment Programme"

Under *National Strategic Objective 9* on page 83 of the National Development Plan, 2018-2027 *it* identifies that *"€8.5 billion will be invested by Irish Water over the period of the National Development Plan".* It then goes on to identify a number of specific projects, including:

*"**Ringsend Wastewater Treatment Plant (WTP) project**: This €190 million project will provide further capacity to support development in the Greater Dublin Region"*

Under 'Waste Management and Resource Efficiency' under *National Strategic Objective 9* on page 85 of the National Development Plan, 2018-2027 it states that:

"Investment in waste management infrastructure is critical to our environmental and economic well-being for a growing population and to achieving circular economy and climate objectives"

The Proposed WwTP Component along with the investment by Irish Water in the RBSF are consistent with National Strategic Objective 9 of the National Development Plan.

2.2.2.3 Water Services Strategic Plan - A Plan for the Future of Water Services (2015 – 2040)

In October 2015, the Water Service Strategic Plan (WSSP) was adopted by Ervia Board and was subsequently approved by the then Minister for Environment, Heritage and Local Government, as required by Section No. 33 of the Water Service No. 2 Act of 2013.

The WSSP, identified as a high level (Tier 1) plan within Irish Water's Plans and Projects, sets out the direction of Irish Water over a 25-year timeframe identifying a series of more detailed, Tier 2 and Tier 3 plans. The specific objectives in the provision of water services and the means to achieve this objective of the plan over the next 25 years are listed as (inter alia):

- Provide Effective Management of Wastewater;
- Invest in Our Future; and
- Challenges and Strategic Priorities.

The WSSP recognises the urgent need to resolve issues in the quality of our water services and in the integrity of the infrastructure. In this regard, the WSSP prioritised six areas which are required to be urgently addressed including (*inter alia)* 3 areas as follows*:*

1. Reducing Drinking Water Quality Problems;
2. Achieving Compliance with the Urban Wastewater Treatment Directive (UWWTD); and
3. Catering for Growth.

In terms of providing effective management of wastewater, the WSSP outlines 3 focused aims as follows:

WW1: *"Manage the operation of wastewater facilities in a manner that protects environmental quality."*

WW2: *"Manage the availability and resilience of wastewater services now and into the future."*

WW3: *"Manage the affordability and reliability of wastewater services."*

As part of the WSSP's strategic aim under wastewater management, the compliance with the UWWT is considered a priority for Irish Water. It is noted that the Proposed WwTP Component forms a crucial part of this compliance whereby:

"The upgrading of the Ringsend wastewater treatment plant will make a significant contribution to Ireland meeting its obligation under the UWWTD and increasing our compliance rate." pg.44

The Proposed WwTP Component is identified as a case study under Chapter 8 of the WSSP, called *'Invest in Our Future'* which outlines on page 85 that:

"Expansion and upgrading of the Ringsend Wastewater Treatment Plan is an urgent priority for Irish Water and a revision to the approved scheme to achieve required outcomes at least cost is currently being evaluated in partnership with Dublin City Council. Irish Water is proposing an innovative wastewater treatment technology for the upgrade and this innovative solution can result in a higher treatment standard to the benefit of Dublin Bay and a cost saving of €170 million compared to previous projects proposals."

Irish Water, in accordance with the WSSP considers that the Proposed WwTP Component, forms a key part of delivering innovative wastewater treatment under objective WW2. The Proposed WwTP Component, while also costing less, will be more resilient than the scheme permitted under ABP Reg. Ref. 29N.YA0010 and is in compliance with WW3, ensuring objectives of the Urban Wastewater Treatment (UWWT) Directive are delivered in accordance with WW1.

The Proposed WwTP Component is central in the delivery of wastewater services to the Dublin region.

The Proposed WwTP Component is consistent with the WSSP.

2.2.3 Supplementary National Framework

2.2.3.1 National Wastewater Sludge Management Plan (2016 - 2041)

In accordance with the objectives of Irish Water's WSSP, a National Wastewater Sludge Management Plan (NWSMP) aims to ensure that the management of wastewater sludge over the next 25 years is standardised nationwide. The NWSMP was published in September 2016. The objectives of Irish Water outlined under page 5 of the NWSMP are:

- To avoid endangering human health or harming the environment;
- To maximise the benefits of wastewater sludge as a soil conditioner and source of nutrients;
- To ensure that all regulatory and legislative controls are met, and due regard is taken of non-statutory Codes of Practices and industry guidance;
- To establish long term, secure and sustainable disposal routes and outlets;
- To ensure cost-effective and efficient treatment and reuse/disposal techniques;
- To reduce potential for nuisance from sludge transport and sludge facilities;
- To extract energy and other resources where economically feasible; and

- To drive operational efficiencies, e.g. through use of Sludge Hub Centres.

In the operation of the Proposed WwTP Component, the wastewater treatment process generates sludge which then requires further treatment to produce biosolids.

The NWSMP identifies that thermal hydrolysis and anaerobic digestion is the preferred treatment option. However, it also acknowledges that thermal drying will continue, where it is practical and economically viable. The NWSMP confirms on page 5 that the primary means of recovery of Biosolids is re-use, with a focus as a fertiliser and soil conditioner whereby the sludge might be disposed of in licenced facilities during off season times (to meet the requirements of the Code of Good Practice for Use of Biosolids in Agriculture) and in accordance with the Hierarchy of Waste Management and the EU's Action Plan for a Circular Economy.

The NWSMP sets out a strategy for future capital works, operating procedures, quality control and risk management systems to ensure a sustainable strategy for wastewater sludge management.

The objective of the NWSMP is to develop the network of 'hub' treatment sites and satellite dewatering plants, with 'hubs' optimised on a regional rather than county basis. The Ringsend Wastewater Treatment Plant is identified as a Sludge Hub Centre for the Greater Dublin Area.

The NWSMP provides for the creation of Regional Biosolids Storage Facilities, in order to facilitate land spreading and to provide for periods when application of fertilisers to land is prohibited in accordance with SI 32/2014 European Union (Good Agricultural Practice for the Protection of Waters) Regulations 2014, as amended by SI No. 134/2014 and SI No. 463/2014. It specifically acknowledges the absence of sufficient space for such facilities at Ringsend and anticipates the development of a regional sludge storage facility to cater for the needs of the region in conjunction with the Proposed WwTP Component.

As part of the proposed application, a new Regional Biosolids Storage Facility is to be developed. Volume 2, Section 3: Description of Proposed Upgrade Project and the entire Volume 4 outlines the specific environmental aspects relating to this new facility.

Where required, sludge may also be disposed of at an authorised and regulated facility, in accordance with Waste Management Legislation and requirements.

2.2.3.2 River Basin Management Plan for Ireland 2018 - 2021

The River Basin Management Plan for Ireland 2018-2021 (RBMPI) sets out a range of actions aimed at moving towards the objectives of the EU Water Framework Directive (WFD) at a national level. This re-arrangement will lead to a standardised approach to assessments and reporting. Further incorporated into the structure, regionalised administrative structures are in place to support and carry out the implementation of the National Plan (e.g. river basin district characterisation).

In terms of the Ringsend WwTP, it is located in Dublin City area of the Liffey Catchment. In terms of transitional waters, the current status (2010-2015) of the Liffey Estuary Lower remains 'moderate' and the coastal water of Dublin Bay has a 'good' status.

The intention of the RBMPI is to achieve or maintain a 'good' status for both by 2027.

The proposed upgrade to the Ringsend WwTP, is identified (pg. 146) as an upgrade to be undertaken in support of compliance with the requirements of the UWWTD.

The Proposed WwTP Component and the improvement in effluent quality will result in improvements to the water quality of the receiving waters of the Liffey Estuary and Dublin Bay and as such, is consistent with the objectives of the RBMPI.

The Proposed WwTP Component intends to bring forward the objectives, status and strategies from the previous plans. As outlined above, the Proposed WwTP Component is consistent with these objectives.

The Proposed WwTP Component is in accordance with the RBMPI.

2.2.4 Regional Policy Framework

2.2.4.1 The Regional Planning Guidelines for the Greater Dublin Area 2010 – 2022

The Regional Planning Guidelines (RPGs) for the Greater Dublin Area (GDA) provide a long-term sustainable planning framework for the GDA. The GDA area covers 7 no. Local Authorities, namely Dublin City, Dún Laoghaire-Rathdown, Fingal, South Dublin, Kildare, Meath and Wicklow. The Guidelines have a statutory basis in the Planning and Development Act 2000, as amended, ensuring Local Authorities, in the formulation of the Development Plan Core Strategy, must incorporate these guiding framework principles. This provides a strategic context for Development Plans and in turn creates co-ordinated investment in the provision of essential Infrastructure.

The RPGs for the GDA are currently under review and will be replaced by new Regional Spatial and Economic Strategy (RSES) for the Eastern and Midland Regional Assembly (EMRA) for the period of 2018 - 2030. An Initial Public and Stakeholder Consultation Issues Paper was published in November 2017 which facilitates public submissions and ends on 17 February 2018. In this regard, the RPGs remain the appropriate regional policy framework document until such time the RSES EMRA is adopted.

The RPGs note that the wastewater treatment network in the GDA is a mix of one major facility (at Ringsend) serving an area mostly comprised of the metropolitan area. The plan identifies that existing provision has only kept pace with the levels of growth. In this regard, the plan states that:

> *"the need for investment in new treatment facilities to serve the GDA is both pressing and immediate as key existing facilities and networks are reaching capacity."* pg. 128

In order to meet the future needs of the GDA, in recognition of the existing capacity, the strategy of the RPGs as outlined under Section 6.5.1 of the plan, Strategic Physical Infrastructure Policy (PIP3), seeks to:

> *"Protect and work to improve water quality in, and impacted by, the GDA and seek that investment in water and surface water treatment and management projects is prioritised to support the delivery of the economic and settlement strategy for the GDA through the coordinated and integrated delivery of all essential services supporting national investment"*

In achieving this policy, Table 11 titled '*Critical Strategic Projects - Wastewater & Surface Water*' identifies 10 critical projects needed to address Critical Strategic Physical Infrastructure Policy PIP3. In terms of the Proposed WwTP Component, Water Treatment Investment Priority 1 states that;

> *'Expansion of the Ringsend Waste Water Treatment Plant to ultimate capacity'*

The scope of this priority is to service the Metropolitan Area of the GDA in the context of these RPGs. While Local Authorities and the Department of Housing, Planning, Community and Local Government are the principal agencies, Irish Water (the applicant) has subsumed this role after the adoption of the RPGs. Irish Water has the responsibility of delivering water infrastructure nationwide and the Proposed WwTP Component seeks to realise Critical Strategic Physical Infrastructure Policy PIP3, particularly priority 1.

In achieving the strategic approach to infrastructure, the RPGs were guided by the population targets identified under national planning policy. The policies, objectives and key infrastructural projects use such figures, amongst other things, in the determination of a project's scale and timely delivery. The direction of the RPGs, guided by the NSS, rely on population targets in the provision of services. The population targets for the RPGs for the GDA 2010 - 2020 are illustrated in Table 2-2.

Table 2-2: Regional population targets 2010, 2016 and 2022, pg.82

	2008	2010	2016	2022
Dublin	1,217,800	1,256,900	1,361,200	1,464,200
Mid-East	514,500	540,000	594,600	649,700
State	4,422,00	4,584,900	4,997,000	5,375,200

The preparation of the RSES will be guided by the recently adopted NPF. As outlined under Volume 3, Section 3: Population and Human Health, the 2016 population figures for the GDA are in line with the figures in Table 2-2. This continued population increase provides justification towards maximising the treatment capacity of the Ringsend WwTP, ensuring that the current and future infrastructural requirements of the GDA are achieved. This will make sure that wastewater generated in the region, as population continues to grow and industrial needs continue to expand, is appropriately treated in order to safeguard human health and to protect the environment.

The Proposed WwTP Component is in accordance with Policy PIP3 - Priority 1 of the RPGs. In combination with the WSSP, the Proposed WwTP Component seeks to deliver on the strategic necessity of this project in progressing development for the wider GDA development area.

2.2.5 Eastern-Midlands Region Waste Management Plan 2015 - 2021

Waste Management Plans are statutory planning documents which set out the policies for the development of waste treatment infrastructure and sit on the same tier as the City and County Development Plans as a statutory plan. In the event of a conflict arising between an objective in the waste plan and that of a City or County Development Plan, the waste plan objectives take precedence[1]. The NWSMP discussed above, sits beneath the Eastern-Midland Region Waste Management Plan (EMRWMP) 2015 - 2021 in terms of the hierarchy of waste management plans.

The strategic vision of the Waste Management Plans is to rethink the approach to managing waste, by viewing waste streams as valuable material resources. Making better use of our resources and reducing the leakage of materials, as wastes, from our economies will deliver benefits economically and environmentally to the region.

[1] *Section 10A (b)(i) Waste Management Act 1996*

Section 2.3 of the EMRWMP sets out a range of waste planning documents which interact with the EMRWMP. The NWSMP is a document which is recognised as a component of the waste plan.

Section 7.4.7 of the EMRWMP notes that the management of sludge will be co-ordinated between Local Authorities and Irish Water regarding water and wastewater sludges to ensure they are managed in a safe and compliant manner. The following policies are of relevance to the Proposed RBSF Component:

> *H1: "Work with the relevant stakeholders and take measures to ensure systems and facilities are in place for the safe and sustainable management of sludges (sewage, waterworks, agricultural, industrial and septic tank) generated in the region having due regard to environmental legislation and prevailing national guidance documents, particularly in relation to the EU Habitats and Birds Directive."*

Accordingly, the EMRWMP includes 3 no. policy actions arising from policy H1 above. Of these, policy action H.1.1 targets annual meetings between Irish Water and Local Authorities regarding their plan objectives and associated treatment options for sludge waste. The Proposed RBSF Component is required to ensure that the Ringsend WwTP can operate to its maximum potential and to cater for the needs of the region. The biosolids by-product produced at the Ringsend WwTP (and at other WwTPs in the catchment, including the planned GDD Project) is to be stored at the proposed RBSF site prior to being collected to be spread on land as a soil conditioner and fertiliser.

This represents a safe and effective method of sludge/biosolids management which is in line with the policy direction set out in the EMRWMP. Furthermore, the site for the Proposed RBSF Component represents an effective and compatible use for this site.

The WwTP and RBSF components of the Proposed Upgrade Project accord with the relevant policy of the EMRWMP.

2.2.6 Supplementary Regional Policy Framework

2.2.6.1 Greater Dublin Strategic Drainage Study (2005)

The Greater Dublin Strategic Drainage Study, 2005 (GDSDS) set out the broad drainage requirements for the Greater Dublin Region. The scope of the report was to plan for the anticipated and/or assumed development of the GDA up to the year 2031 from its completion back in 2005.

The Ringsend WwTP requirements at the time were summarised as follows within the GDSDS:

> *"Ringsend - The existing plant is at capacity and needs immediate expansion for short term needs to meet the requirements of the nitrogen Discharge Standards for Dublin Bay as set out in the Urban Wastewater Treatment Regulations".* (Dublin Drainage Consultancy, 2005)

The study has defined the issues facing the Region's drainage and has taken a strategic approach to address them:

> *"To relieve overloading at Ringsend WwTP, while catering for committed development to 2011 of zoned lands and resolving pollution and flooding risks within the existing networks".* (Dublin Drainage Consultancy, 2005)

> *"To provide for necessary ongoing development in the Greater Dublin Region, while ensuring that existing networks, Ringsend and other local WwTPs can accommodate the needs of the existing catchments to 2031".* (Dublin Drainage Consultancy, 2005)

Section 10.8 - Wastewater Treatment Strategy summarises that:

> *"the Wastewater Treatment Strategy for the Dublin Region is in the first instance to maximise the capacity of existing facilities. This requires immediate expansion of Ringsend WwTW to its maximum capacity while engaging on an active programme of load management of existing and new non-domestic effluent loads to buy time to allow for the planning and construction of both the expansion of Ringsend and new regional drainage and WwTW infrastructure."* (Dublin Drainage Consultancy, 2005)

The Proposed WwTP Component and expansion to its maximum capacity within the confines of the site, is a key strategy of the GDSDS as highlighted above.

2.2.6.2 Greater Dublin Drainage Strategy: Overview and Future Strategic Needs (Irish Water, May 2018)

The original GDSDS was approved by the seven Local Authorities in the Greater Dublin Area in 2005 and established a strategy to deal with the expanding demands placed on the drainage network in the catchment.

In January 2014, Irish Water assumed responsibility for the provision of public Water Services previously provided by thirty-four Local Authorities. Prior to January 2014, Local Authorities provided water and wastewater services within the resources available to them, largely autonomously within their functional areas, and with limited cross boundary strengthening linkages between adjacent schemes. The operational heritage of Local Authorities on the transferred assets is invaluable and in managing continuity of service, Irish Water has entered into Service Level Agreements with Local Authorities for the operation of Irish Water's assets for the next twelve years.

The transfer of water services functions to Irish Water provided a unique opportunity to take, for the first time in Ireland, a strategic view of providing water services, at a national level, and also on projects which are strategic for Ireland. The findings of this Overview prepared internally by Irish Water of the GDDS is a result of this. This Overview does not represent a statutory document and was not subjected to public consultation, or strategic environmental assessment. This Overview does not seek to replace the GDSDS. It does however serve to provide an updated perspective on the 2005 assumptions which guided the GDSDS.

In 2017, Irish Water carried out an internal company review of the GDSDS having regard for the current loadings on WwTPs in the Greater Dublin region as well as future growth in the region. The findings of the review are outlined in the Irish Water document - *Greater Dublin Drainage Strategy Overview & Future Strategic Needs* (May, 2018). This report is included with this planning application. The review examined 2016 Census data, CSO Regional Population Projections and a Demographic Study carried out in 2014 by Irish Water as a part of the Water Supply Eastern and Midlands Region Project. In particular it updated the GDSDS projections for the 12 year's passage of time and extended the design horizon from 2031 to 2050. The review formed the basis for the most likely projected growth scenario within the Ringsend catchment, which is anticipated to be in region of 2.712m PE by the 2040 design horizon. This growth scenario provides a 20% allowance for headroom for growth which may be disproportional to the most likely scenario. Accordingly, Irish Water is continuing to progress plans for the Greater

Dublin Drainage (GDD) WwTP in north Dublin in accordance with the recommendations of the GDSDS. It is intended that the additional capacity will be constructed at GDD by 2024, together with provisions for intercepting the Blanchardstown Catchment (9C) and the rest of the North Fringe Catchments and transferring these flows to the new WwTP.

The Proposed WwTP Component is in accordance with the specific objective of the GDSDS study and subsequent internal review by Irish Water.

2.2.7 Statutory Local Framework

2.2.7.1 Dublin City Development Plan 2016 - 2022

The Dublin City Development Plan 2016 - 2022 (hereinafter: DCDP) provides the primary local statutory planning policy framework for development for the subject site. It has regard to the higher level national and regional strategic guidelines outlined in the above-mentioned points of this Section. Under the plans current format, there is no local area plan provision for the subject site, nor is there a proposed plan in place, however, the proximity of the site to the adjoining designated Poolbeg West Strategic Development Zone (Poolbeg West SDZ) and the interaction is noted below. The following policies, objectives and development standards of the City Development Plan that are of relevance to the Proposed WwTP Component are set out below.

2.2.7.2 Core Strategy

The Core Strategy is intended to set out the key strategies for the administrative area of Dublin City in line with the growth targets set out in the Regional Planning Guidelines for the Greater Dublin Area.

As set out under Section 2.3.7

> *"The efficient and timely delivery of necessary infrastructure capacity in advance of the planned quantum of development is a prerequisite for successful urban development. Ensuring the delivery of this infrastructure in a sustainable manner, which enhances the quality of the city's environment and facilitates the sustainable economic growth and co-ordinated development of the city, is also an essential requirement." (pg. 34)*

The Proposed WwTP Component will provide the wastewater infrastructure that is essential to accommodate the planned growth of the City (and its wider catchment) and therefore will enable the targets set out in the Core Strategy to be achieved.

The provision of the Proposed WwTP Component will provide the wastewater infrastructure that is essential to accommodate the planned growth of the City (and its wider catchment) and is therefore in accordance with the Core Strategy.

2.2.7.3 Policy Support for Project

The policy support for the Proposed WwTP Component is set out in great detail in Section 9.5.1 (page 146) of the Written Statement of the Dublin City Development Plan, 2016-2022. The expansion of the Ringsend WwTP, as noted in Chapter 9 - Sustainable Environmental Infrastructure, Section 9.5 - Policies and Objectives of the City Development Plan 2016 - 2022, is specifically acknowledged as an urgent priority for Irish Water and for the development of the Dublin Region. The Development Plan outlines that it is intended to upgrade and expand the treatment works to a capacity of c. 2.1 million PE from 1.64 million PE. The document does not specify the difference between 'maximum' and 'firm' capacity but supports Irish Water in delivering water services.

Earlier reports and Development Plans have referred to a "*firm*" capacity of 2.1 m PE, which relates to the capacity when the largest unit is out of service for repair or maintenance. At the time, it was envisaged that up to four treatment tanks would have to be taken out of service at one time. However, the design proposed will allow single tanks to be taken out of service, meaning that the "firm" capacity is closer to the full capacity of 2.4 m PE, especially considering that:

- The technology now available is superior to what could be considered in the reports accompanying the 2012 Approval, with AGS treatment technologies allowing greater treatment potential in the existing tank volumes;
- The capacity is expressed as an annual average capacity and the plant will be designed to cater for significant daily, weekly and seasonal variations outside of this value; and
- The required provision of headroom in the determination of required capacity encompasses resilience to cater for breakdown.

As a result of the above, reference throughout the remainder of this EIAR will include references to the Proposed WwTP Component having a capacity of 2.4 m PE.

The City Council is committed to working closely with and supporting Irish Water in the provision and maintenance of adequate public water and wastewater infrastructure throughout the city.

The relevant planning policy considerations contained within the Dublin City Development Plan which support the Proposed WwTP Component include the following policies:

> **SI1:** *"To support and facilitate Irish Water in the provision of high-quality drinking water, water conservation, and in the development and improvement of the water and wastewater systems to meet anticipated demands for clean and resilient water supplies and wastewater requirements for the city and region, all in accordance with the recommendations set out in the 'Greater Dublin Water Supply Strategic Study' and 'The Greater Dublin Strategic Drainage Study" (pg. 146)*

> **SI2:** *"To support and facilitate Irish Water to ensure the upgrading of wastewater infrastructure, in particular the upgrading of the Ringsend Wastewater Treatment Plan, and to support the development of the Greater Dublin Regional Wastewater Treatment plant, the North Docklands Sewage Scheme, the Marine Outfall and orbital sewer to be located in the northern part of the Greater Dublin Area to serve the Dublin region as part of the Greater Dublin Strategic Drainage Strategy." (pg. 146)*

> **SI3:** *"To ensure that development is permitted in tandem with available water supply and wastewater treatment and to manage development, so that new schemes are permitted only where adequate capacity or resources exists or will become available within the life of a planning permission." (pg. 146)*

It is clear that the Proposed WwTP Component is explicitly supported by Policy SI1 and SI2, and enables the available capacity for the development objectives under the DCDP (SI3).

Following on from the above policies, the Objectives of the Council are:

> **SIO1:** *"To support Irish Water in the implementation of the 'Water Services Strategic Plan - A Plan for the Future of Water Services" (pg. 146)*

> **SIO2:** *"To work closely with Irish Water to identify and facilitate the timely delivery of the water services required to realise the development objectives of this plan."* (*pg. 146)*
>
> **SIO5:** *"To protect existing wayleaves and buffer zones around public water service infrastructure."* (*pg. 148)*

The Proposed WwTP Component is in accordance with Policy support for Sustainable Environmental Infrastructure - SI1 and SI2 and objectives under SIO1.

2.2.7.4 Natural Watercourses and Water Quality

Volume 3, Section 4: Water examines the details of the Proposed WwTP Component and its potential impacts on water quality. In terms of policy relating to water quality, we refer to that section in the first instance, however, the following policies and objectives are noted under the Dublin City Development Plan:

> **SI4:** *"To promote and maintain the achievement of at least good status in all water bodies in the city." (pg. 149)*
>
> **SI5:** *"To promote the enhancement of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems." (pg.149)*
>
> **SI6:** *"To promote the protection and improvement of the aquatic environment, including through specific measures for the progressive reduction or cessation of discharges and emissions." (pg.149)*

Following on from the above policies, the Objectives of the Council are:

> **SIO6:** *"To implement the European Union Water Framework Directive through the implementation of the appropriate River Basin Management Plan and Programme of Measures." (pg. 149)*
>
> **SIO7**: *"To take into consideration the relevant River Basin Management Plan and Programme of Measures when considering new development proposals." (pg.149)*

The Proposed WwTP Component is in accordance with the Natural Watercourses and Water Quality objectives of the Development Plan.

2.2.7.5 Rivers, Canals and the Coastline

In addition,

> **GI17:** *"To develop sustainable coastal, estuarine, canal and riverine recreational amenities to enhance appreciation of coastal natural assets in a manner that ensures that any adverse environmental effects are avoided, remedied or mitigated." (pg.171)*

Following on from the above policies, the Objectives of the Council are:

> **GIO17:** *"To seek the continued improvement of water quality, bathing facilities and other recreational opportunities in the coastal, estuarine and surface waters in the city and to protect the ecology and wildlife of Dublin Bay." (pg.172)*

GIO19: *"To maintain beaches at Dollymount, Sandymount, Merrion and Poolbeg/Shelly Banks to a high standard, and to develop their recreational potential as a seaside amenity, in order to bring them to 'Blue Flag' standard subject to Article 6 Assessment of the Habitats Directive." (pg.172)*

The Council's approach to Water Infrastructure is towards promoting and supporting Irish Water in line with the Greater Dublin Strategic Drainage Study in order to develop the wastewater infrastructure network throughout the city for the plan period.

The Proposed WwTP Component will assist the City Council in meeting these Objectives.

The Proposed WwTP Component is in accordance with the policies relation to rivers, canals and the Coastline of the Development Plan.

2.2.7.6 Biodiversity

Dublin Bay is considered a major resource for the city which contains 3 no. internationally recognised biodiversity designations, identified in 2015. These designations form part of a UNESCO Biosphere designation. The three different designated zones, managed in different ways are as follows:

1. **Core Protected Zone** - in the Dublin Bay Biosphere this zone comprises 50 km² of areas of high natural value. Key areas include the Tolka and Baldoyle Estuaries, Booterstown Marsh, Howth Head, North Bull Island, Dalkey Island and Ireland's Eye;
2. **Buffer Zone** - 82 km² of public and private green spaces such as parks, greenbelts and golf courses, which surround and adjoin the core zone; and
3. **Transition Zone** - 173 km² forming the outer part of the Biosphere. It includes residential areas, harbours, ports and industrial and commercial areas.

The bay also hosts a number of Designated Conservation Areas, candidate Special Areas of Conservation and proposed National Heritage Areas. Section 1.4 of Volume 3 of the EIAR provides an overview of the existing designated conservation areas in the vicinity of the Ringsend WwTP.

Specified under Section 10.5.6 of the DCSP, titled *Biodiversity*, the following policies are of note:

GI23: *"To protect flora, fauna and habitats, which have been identified by Articles 10 and 12 of Habitats Directive, Birds Directive, Wildlife Acts 1976 - 2012, the Flora (Protection) Order 2015 S.I No. 356 of 2015, European Communities (Birds and Natural Habitats) Regulations 2011 to 2015." pg. 173*

GI24: *"To conserve and manage all Natural Heritage Areas, Special Areas of Conservation and Special Protection Area designated, or proposed to be designated, by the Department of Arts, Heritage Regional, Rural and Gaeltacht Affairs." pg. 173*

GIO23: *"To support the implementation of the 'Dublin City Biodiversity Action Plan 2015 - 2020', including inter alia (a) the conservation of priority species, habitats and natural heritage features, and (b) the protection of designated sites." pg. 174*

Outlined in the Biodiversity Action Plan 2015 - 2020, the Dublin Bay area and North Bull Island are indicated to be one of the most highly designated locations in the country for biodiversity. The designations are afforded under the EU Habitat Directive and EU Birds Directive.

The scope of this action plan has informed the preparation of the Nature Impact Statement (NIS) and Volume 3, Section 5: Biodiversity - Marine and Section 6: Biodiversity - Terrestrial of this EIAR.

The Proposed WwTP Component forms an essential part of the delivery of key infrastructure in the continued development of Dublin City. In combination with existing environmental features, it is considered that the Proposed WwTP Component is in accordance with the policies and objectives outlined above.

2.2.7.7 Land Use Zoning of the Subject Site

The Ringsend WwTP facility spans across two sites, divided by Pigeon House Road. For the most part, the facility is zoned Z7 (purple), however, along the eastern boundary of the northern site, a set down area associated with the storm tanks, is zoned Z9 (coloured green). As part of the Proposed WwTP Component, temporary construction compounds will be in place for the duration of the permission. Permission has recently been secured to use three compounds for a temporary period of 3 years. This application seeks to enable the use of two of these to be extended to 10 years, (in tandem with the omission of 3 no. compounds previously permitted) to be used to accommodate the Proposed Upgrade Project. The extent and scale of these zoned areas is shown in Figure 2-3.

Under Z7 zoning, the objective is:

> *"To provide for the protection and creation of industrial uses and to facilitate opportunities for employment creation including Port Related Activities"*.

'Public Service installations' are a permissible use within this zoning designation as illustrated in Table 2-3. A Wastewater Treatment Plant is considered to be a public service installation according to the City Development Plan.

A public service installation is defined in Appendix 21 on page 240 of Volume 2 of the Dublin City Development Plan 2016-2022 as follows:

> ***Public Service Installation***
>
> *"A building, or part thereof, a roadway or land used for the provision of public services. Public services include all service installations necessary for electricity, gas, telephone, radio, telecommunications, television, data transmission, drainage,* ***including wastewater treatment plants*** *and other statutory undertakers; bring centres, green waste compositing centres, public libraries, public telephone boxes, bus shelters etc, but does not include incinerators/waste to energy plants. The offices of such undertakers and companies involved in service installations are not included in this definition"* (Highlights added)

The Proposed WwTP Component is therefore consistent with the Z7 zoning objective for the lands.

The proposed temporary compounds associated with the Proposed WwTP Component are located on lands that are zoned Z7 (Compound C2 and C3) and Z14 and in small part Z9 (Compound C1). These temporary compounds are an ancillary aspect of the Proposed WwTP Component. The locations of these compounds are outlined in Volume 2, Section 3: Description of Proposed Upgrade Project. In all cases 'Public Service Installations' are types of development that are considered to be acceptable in principle as per the zoning matrix.

The objective under Z9 zoning seeks:

> *"To preserve, provide and improve recreational amenity and open space and green networks."*

'Public Service installations' are a permissible use within this zoning designation, provided it is not detrimental to the amenity of Z9 zoned lands, as illustrated in Table 2-4.

In the context of the Z9 lands, it is acknowledged that the Note accompanying the zoning states, *inter alia*, that:

> *"Generally, the only new development allowed in these areas, other than the amenity/recreational uses, are those associated with the open space use."*

In this case, the proposed use is temporary only. As a result, this temporary use will be removed at the end of the permission and does not conflict with the zoning objective as a result. The compound in question, C1, has recently received permission for use as a temporary construction compound (ABP Reference Number 29N.YM0004, January 2018).

The objective of the Z14 zone is:

> *"To seek the social, economic and physical development and/or rejuvenation of an area with mixed use, of which residential and 'Z6' would be the predominant uses ".*

'Public Service installations' are a permissible use within this zoning designation. The Proposed WwTP Component on the Z14 lands is therefore consistent with that zoning objective (see Table 2-5).

Figure 2-3: Dublin city development plan 2016 – 2022, zoning map F

2.2.7.8 Land Use Zoning Matrix for the subject site

Table 2-3: Z7 Zoning matrix under the Dublin City Development plan 2016 - 2022 pg.245

	Zoning Objective - Z7
Permissible Uses	Betting office, Boarding Kennel, Car park, Chemical processing and storage, Childcare facility, Civic and amenity/recycling centre, Enterprise centre, Garage (motor repair/service), General industrial uses, heavy vehicle park, Household fuel depot, Industry (light), Open space, Outdoor poster advertising, Park and Ride facility, petrol station, Port-related industries and facilities, public house, **Public service installation**, Scrap yard, Storage depot (open), Support office ancillary to primary use, Transfer station, Transport depot, Warehousing.
Open for Consideration	Advertisement and advertising structures, Amusement/leisure complex, Bed and Breakfast, Buildings for the health, safety and welfare of the public, Car trading, Community facility, Cruise shipping and marine services in port area, Cultural/recreational building and uses, Factory shop, Guest house, Hotel, Media-associated uses, Nightclub, Place of worship, Restaurant, Science and technology-based industry, Take-away.
Note	The majority of these lands are located in the Port area (see Chapter 4, Chapter 16 and section 16.21 of the DCDP). Generally the primary uses in these areas are those that can result in a standard of amenity that would not be acceptable in other areas. They can sometimes lead to disamenities which would need to be managed through the planning process to safeguard residential amenity when necessary. Activities include industry, other than light industry; manufacturing repairs, open storage, waste material treatment, and transport operating services. These areas require a measure of protection from other non-compatible clean uses as this can result in conflict and limit the expansion of the primary use in the area.

Table 2-4: Z9 Zoning matrix under the Dublin City Development plan 2016 - 2022 pg.246

	Zoning Objective - Z9
Permissible Uses	Cemetery, club house and associated facilities, municipal golf course, open space (see Appendix 21 land use definitions of the DCDP) **Public service installation which would not be detrimental to the amenity of Z9 zoned lands.**
Open for Consideration	Car park for recreational purposes, Caravan park/camp site (holiday), community facility, Craft centre/craft shop, crèche, cultural/recreational building and uses, Golf course and clubhouse, Kiosk, neighbourhood retail (in accordance with highly exceptional circumstances above) tea room, café/restaurant.
Note	This zoning includes all amenity open space lands which can be divided into three broad categories as follows: public open space, private open space, and sports facilities in private ownership. The provision of public open space is essential to the development of a strategic green network. The chapters detailing the policies and objectives for landscape, biodiversity, open space and recreation and standards respectively, should be consulted to inform a proposed development (see Chapter 10 and section 16.2 of the DCDP). Generally, the only new development allowed in these areas, other than the amenity/recreational uses, are those associated with the open space use. Specifically, residential development shall not be permitted on public or privately-owned open space.

Table 2-5: Z14 Zoning matrix under the Dublin City Development plan 2016 - 2022 pg.249

	Zoning Objective - Z14
Permissible Uses	Betting Office, Buildings for the health, safety and welfare of the public, Childcare facility, Community facility, Conference centre, Cultural/recreational building and uses, Education, Embassy office, Embassy residential, Enterprise centre, Green/clean industries, Halting site, Home-based economic activity, Hotel, Industry (light), Live-work units, Media-associated uses, Medical and related consultants, Offices, Open space, Park and ride facility, Part off- licence, Place of public worship, Public service installation, Residential, Restaurant, Science and technology-based industry, Shop (neighbourhood), Training centre.
Open for Consideration	Advertisement and advertising structures, Bed and Breakfast, Car park, Car trading, Civic and amenity/recycling centre, Factory shop, Financial institution, Funeral home, Garage (motor repair/service), Garden centre, Golf course and clubhouse, Hostel, Internet café, Nightclub, Off-licence,

	Zoning Objective - Z14
	Outdoor poster advertising, Petrol station, Pigeon lofts, Public house, Take-away, Veterinary surgery, Warehousing (retail/non-food)/Retail Park, Warehousing.
Note	These are areas, including large-scale public housing area, where proposals for comprehensive development or redevelopment have been, or are in the process of being prepared. These areas also have capacity for a substantial amount of development in developing areas in the inner and outer city. Z14 areas are capable of accommodating significant mixed-use development; therefore, developments must include proposals for additional physical and social infrastructure/facilities to support same. In the case of Z14 lands that are identified for key district centres, all uses identified as permissible uses and open for consideration uses on zoning Z14 lands will be considered.

Surrounding Land Use Zoning

The Poolbeg peninsula broadly consists of three identified land use zoning objectives, namely Z7, Z9 and Z14. The urban characteristics and land use zoning objectives change to a more established residential pattern of development when moving in a southerly and westerly direction starting along the Sean Moore Road.

Located at the south-west corner of the subject site is an area subject to a Strategic Development and Regeneration Area (S.D.R.A) designation. The Identified S.D.R.A No. 6 - 'Docklands (including Docklands SDZ area and Poolbeg West SDZ) area is zoned as Z14 which is:

> *"To seek the social, economic and physical development and/or rejuvenation of an area with mixed use of which residential and "Z6" would be the predominant uses."*

This S.D.R.A area to the north of the subject site extends around the Pigeon House Dock, incorporating the associated buildings and protected structures (RPS no. 6795 and RPS no. 6796). This area is severed from the primary block of the S.D.R.A area at the former Irish Glass Bottle Site. Under Statutory Instrument No. 279 of 2016, the larger Poolbeg West SDZ area broadly defined by Sean Moore Road to the west and south Banks road to the north was designated a Strategic Development Zone (SDZ). This is considered in more detail at section 2.3 below.

The proposed temporary construction Compound 1 will be positioned along the eastern section of the proposed Poolbeg West SDZ for a temporary period of 10 years.

For the Poolbeg West, a Planning Scheme has been prepared (discussed in more detail below) which identifies the corridor reservation for the Eastern By-Pass. Permanent development proposals are restricted in this area pending *"the final routing of the Eastern By-Pass is finalised"*. As such, no permanent development proposals can be proceeded with until such time as the final routing for that road is resolved. The extent of this area is illustrated in Figure 2-9. The entire proposed temporary construction compound (Ref. C1) is located within the designated corridor reservation for the Eastern By-Pass. As such, the temporary use of this compound associated with the construction of the Proposed WwTP Component is not prejudicial to the implementation of the Planning Scheme for Poolbeg West as these lands can be available to accommodate development at the appropriate time.

2.2.7.9 SDRA 6 Docklands (SDZ and Wider Docklands Area)

The Dublin City Development Plan (DCDP) identifies a number of Strategic Development and Regeneration Areas (SDRA's) as areas where proposals for comprehensive development or re-development have been or are in the process of being prepared. The relevant SDRA for the purposes of the Proposed WwTP Component is: SDRA 6 Docklands (SDZ and Wider Docklands Area) which is separated into three elements:

- Docklands Area;
- North Lotts and Grand Canal Docks Strategic Development Zone (SDZ); and
- Poolbeg West.

The existing Ringsend WwTP is positioned in close proximity to the Poolbeg West SDRA area. As set out under Section 15.1.1.9 of the City Plan, the Poolbeg West site shown in Figure 2-4 is seen by City Council as:

> *"…an opportunity for the city to deliver significant levels of private and public housing, employment, schools, community and recreational facilities within the life of the Development Plan"* (Dublin City Council, 2016)

The DCDP outlines how a masterplan will be required to demonstrate how the SDRA principles will be delivered on a phased basis. The following guidelines principles will apply:

- Social and Economic;
- Use and Urban Form;
- Movement and Sustainability; and
- Environment.

The Poolbeg West SDZ has recently been designated a Strategic Development Zone (SDZ) and a Planning Scheme for these lands in line with these guiding principles was made by resolution by Dublin City Council on 02 October 2017 (and currently on appeal to An Bord Pleanála) Further details in relation to this Planning Scheme document are outlined under section 2.3 below.

South Bank Road, which runs along the east boundary of the S.D.R.A area forms part of the primary route onto the Pigeon House road from which the Ringsend facility is accessed. During the construction phase, Shellybanks road will form the main construction access to the site. Additional access along the South Bank Road provides access to Compound C1. Specific Traffic details are outlined under Volume 3, Section 13: Traffic.

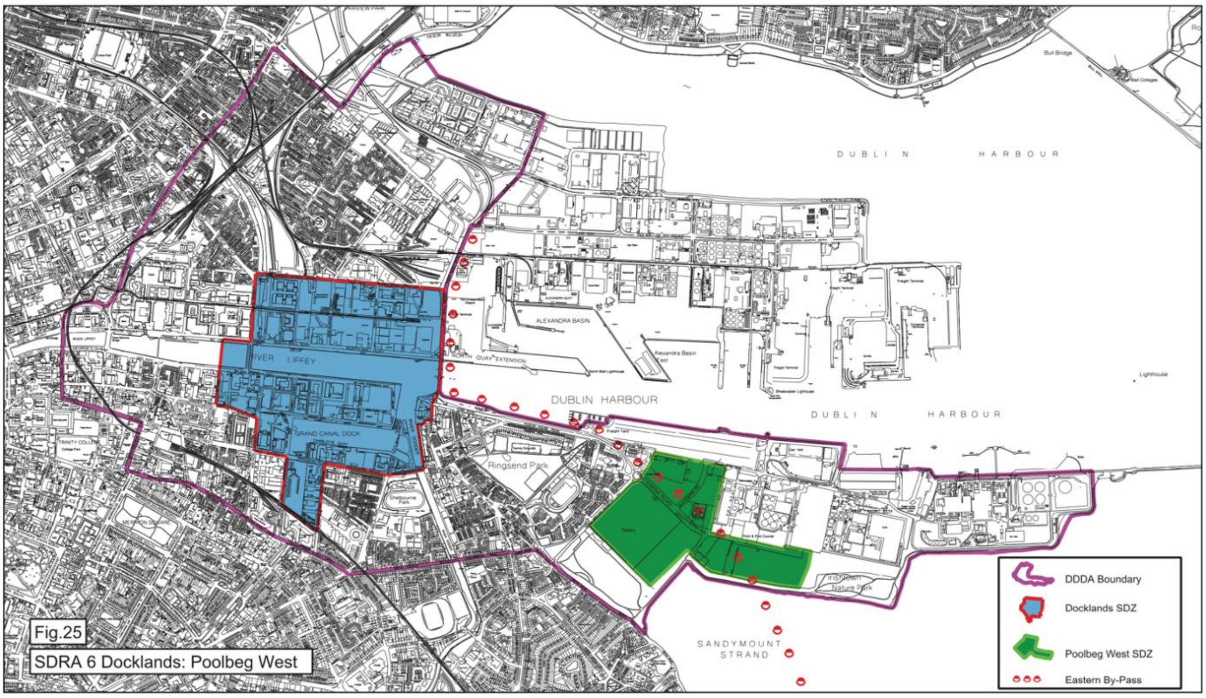

Figure 2-4: Dublin City Development SDRA 6 docklands: Poolbeg West pg. 273

The alignment of the road objective for the Eastern By-Pass crosses through the Poolbeg West lands. The road objective does not pass through the Proposed WwTP Component site, however there is the potential for the eastern by-pass to go through the proposed temporary Compound C1. The extent of the Eastern By-Pass corridor is illustrated under Figure 2-9.

2.2.7.10 Built Heritage

- Remnants of Pigeon House Fort (Ref. No. 6794) is included in the Register of Protected Structures as per Appendix 24 of the DCDP and is situated partly within the Proposed WwTP Component site;
- The area around the Pigeon House Harbour, to the east of the site, is designated as a Conservation Area under the Development Plan as identified with red hatching in Figure 2-3 above; and
- Located along the Pigeon House Road between the principal waste facility to the south and storm tanks to the north, is a designated Zone of Archaeological Interest.

The extent of these structures, and the interactions with the Proposed WwTP Component on these designations are discussed further under Volume 3, Section 11: Cultural Heritage of this EIAR.

2.2.7.11 Seveso Directive Site

The Zoning Maps of the DCDP identify the location of 'Seveso' designated sites with a large red dot (see Figure 2-5).

The SEVESO designation is provided for under the European Communities (Control of Major Accident Hazards involving Dangerous Substances) Regulations 2015, commonly known as the SEVESO III Directive. It was introduced into Irish Law through the EC (Control of Major Accident Hazards Involving Dangerous Substances) Regulations 2015 (SI No. 209 of 2015), as amended.

A document entitled *'Policy & Approach of the Health & Safety Authority to COMAH Risk-based Land-use Planning (September 2009)'* sets out the policy of the Health & Safety Authority (HSA) on the land use planning requirements of the SEVESO III Directive.

The Directive aims to prevent major accident hazards involving dangerous substances and chemicals and the limitation of their consequences for people and the environment. In this respect controls relate to:

- The siting of new establishments;
- Modifications to existing establishments; and
- Development in the vicinity of an establishment which, by virtue of its type or siting, is likely to increase the risk or consequences of a major accident.

The Health and Safety Authority provides advice to planning authorities where appropriate in respect of planning applications for development within a certain distance of the perimeter of these sites.

Appendix 12 of the DCDP, outlines a list of Seveso sites in the City, including their respective *'consultation zone'*. There are some activities listed in an *'Upper Tier'* and others in a *'Lower Tier'* of activity. Where proposals arise for development within these 'consultation zones' the Control of Major Accidents Hazards (COMAH) Regulations place an onus on the Planning Authority to consult with the HSA regarding the proposal to ensure they are appropriate and would not cause any undue safety concerns.

The Zoning Maps of the DCDP identify the location of 'Seveso' designated sites with a large red dot (see Figure 2-5). Details of the Seveso sites within the general vicinity of the Ringsend WwTP is provided in Section 1.2 of this Volume of the EIAR.

There are 7 no. Upper Tier Seveso Establishments within the general vicinity of the Ringsend WwTP with reference to the DCDP - Appendix 12, with only 2 of these located on the Poolbeg Peninsula (highlighted in bold below). The name, location and respective consultation zones as detailed in Appendix 12 of the City Development Plan are set out as follows;

- Calor Teoranta, Tolka Quay, Alexandra Rd. Dublin 1 (600 m from perimeter);
- **Dublin Waste to Energy Ltd, Pigeon House Road, Dublin 4 (300 m from bund wall);**
- Esso Ireland Ltd. Dublin Joint Fuel Terminal, Alexandra Rd. Dublin 1 (400 m from perimeter);
- Fareplay Energy Ireland, Tankfarm 1, Alexandra Road and Tankfarm 2, Tolka Quay Road, Dublin Port, Dublin 1 (400 m from perimeter);
- Indaver Ireland Ltd, Tolka Quay Road, Dublin Port, Dublin 1 (700 m from perimeter);
- **National Oil Reserves Agency, Ringsend Oil Storage, Pigeon House Road, Ringsend, Dublin 4 (300 m from perimeter);** and
- Tedcastles Oil Products, Yard 2, Tolka Quay Road, Dublin Port, Dublin 1 (400 m from perimeter).

The Dublin Waste to Energy Ltd. facility and the National Oil Reserves Agency facilities are the most proximate Upper Tier Seveso sites to the Ringsend WwTP. The Ringsend WwTP facility is not within the consultation zone of the National Oil Reserves Agency facility, which is in excess of 300 m away and therefore beyond the consultation zone in that case.

Figure 2-5: Location of Seveso sites – Map F Dublin city development plan 2016 - 2022

There are 8 no. Lower Tier Seveso Establishments within the port area. The Proposed WwTP Component is in proximity to only 2 of these (highlighted in bold below), with the remainder in the north Docks area around Alexandra Road and are at least 850 m away across the River Liffey. Thus, the Ringsend WwTP is outside the consultation zone for those facilities. The other most proximate Lower Tier Seveso sites are identified in the list below for convenience.

- **Utility Operations & Maintenance Services Ltd. t/a Synergen Ltd., Dublin Bay Power Plant, Pigeon House Road, Ringsend, Dublin 4 (300 m from bund wall);**
- **ESB Poolbeg Power Station, Pigeon House Road, Ringsend, Dublin 4 (300 m from bund wall);**
- ESB North Wall Generating Station, Alexandra Road, North Road, Dublin 1 (300 m from bund wall);
- Iarnród Éireann, Alexandra Road, North Wall, Dublin 1 (300 m from bund wall);
- Iarnród Éireann, Iarnród Éireann Maintenance Works, Inchicore, Dublin 8 (300 m from bund wall);
- Topaz Energy Ltd, Terminal 1, Alexandra Road, Dublin Port, Dublin 1 (400 m from perimeter);
- Topaz Energy Ltd, Yard 3, Alexandra Road, Dublin Port, Dublin 1 (300 m from perimeter); and
- Tedcastles Oil Products, Yard 1, Promenade Road, Dublin 1 (400 m from perimeter).

These most proximate Lower Tier Seveso sites are between 200-375 m away from the boundary of the existing Ringsend WwTP. This existing relationship will remain unchanged.

Presently, there are 55 full time staff employed at the existing Ringsend facility. The most proximate Seveso site, the Dublin Waste to Energy facility, is constructed and operational immediately adjacent to the Ringsend WwTP site. The project was permitted in the knowledge and understanding that the Ringsend WwTP existed and operates with the employment levels currently in place. The Proposed WwTP Component will increase this employment level by approximately 15 persons.

It is expected that up to 150 construction employees will be present on site during the peak construction period revolving around the extension to the SBRs at the Ringsend WwTP.

During the 2012 Planning Application, it is noted that ABP consulted with the HSA, as the competent authority, and that the HSA did not submit a response or comment upon same. As a result, it can be concluded that the HSA did not have any objection to the proposed upgrade having regard to the Seveso sites in proximity. We note that the Health and Safety Authority will be consulted by ABP in this case also.

As part of the Scoping for this EIAR, the views of the HSA were sought during the informal public consultation process. No response was received from the HSA. Further details of this can be found at Volume 2, Section 2: The EIA Process.

As a result, it can be concluded that the HSA did not have any objection to the Proposed WwTP Component having regard to the Seveso sites in proximity. Furthermore, the HSA are one such body which An Bord Pleanála have identified they will be consulting once a planning application for the Proposed Upgrade Project is lodged.

2.3 Poolbeg West SDZ Planning Scheme

Poolbeg West SDZ, following its designation by the Government, is an area which will accommodate a mix of uses, both residential and commercial. According to Statutory Instrument No. 279 of 2016, the Strategic Development Zone is an area:

> *"which may principally include residential development, commercial and employment activities includes, office, hotel, leisure and retail facilities, port related activities and the provision of educational facilities, transport infrastructure, emergency services and the provision of community facilities."*

On 02 October 2017, Dublin City Council adopted the Poolbeg West Planning Scheme. At the date of writing this EIAR, the Planning Scheme is on appeal to An Bord Pleanála and it has been decided to hold an Oral Hearing of that appeal. The location of the Ringsend WwTP site lies outside of this SDZ area. Temporary Compound C1 is located within the boundary of the Planning Scheme.

This Scheme covers an area of 34 ha, the extent which is illustrated in Figure 2-6 below.

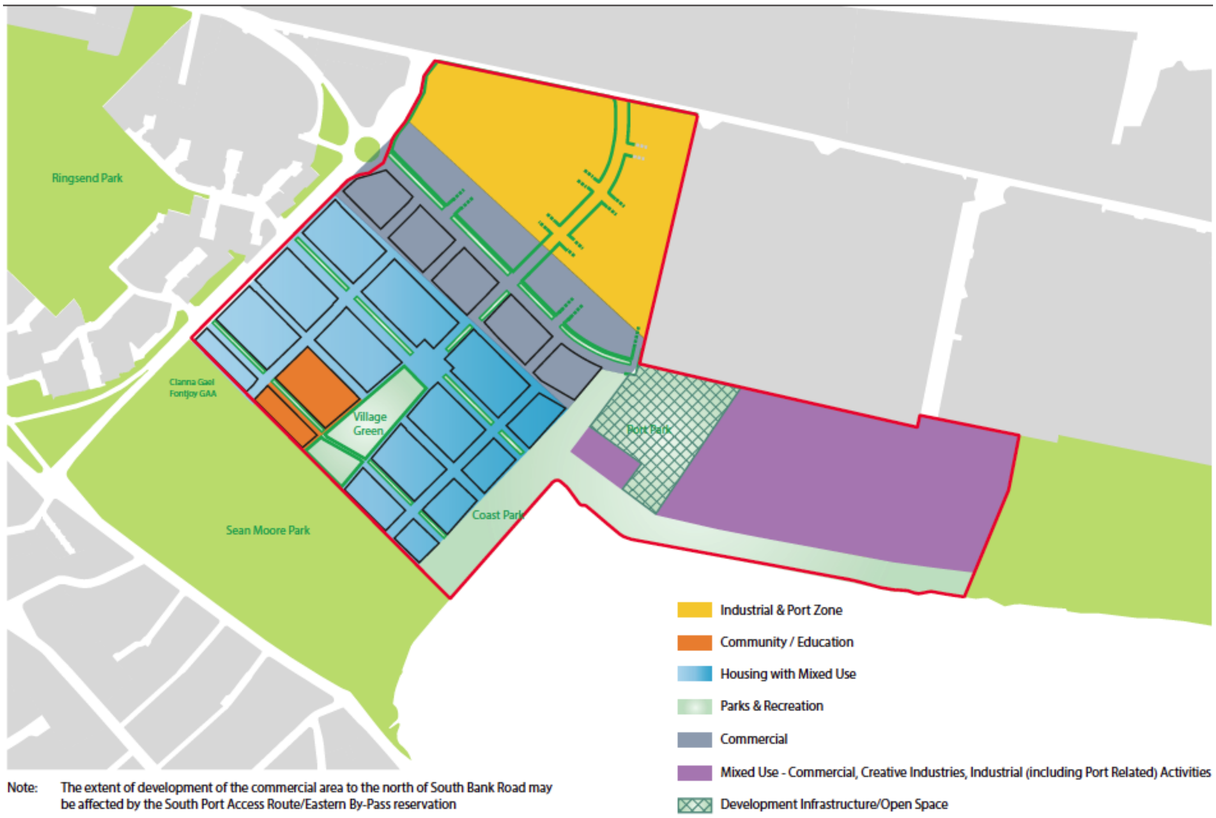

Figure 2-6: Land uses for the Poolbeg West SDZ planning scheme

The Planning Scheme is guided by the series of principles outlined under the Development Plan SDRAs policies which are summarised under section 2.2.3 above. From these points, the Planning Scheme sets out 3 key themes as follows:

1. Connect with the physical, environmental, economic and social fabric of the city, the bay and adjoining neighbourhoods;
2. Create a new sustainable urban neighbourhood that responds to the area's unique location and enhances the enjoyment of local amenities; and
3. Protect the special status of Dublin Bay, the intrinsic functions of the port/municipal facilities and the amenity of existing and future residents.

The Planning Scheme, in its current form, intends to accommodate 3,000 - 3,500 dwelling units with a gross density of up to 238 units per hectare on lands to the south of South Bank Road. In this context, the Planning Scheme notes a potential population arising from the scheme of 8,000 persons. In addition, the Scheme enables the development of 80,000 - 100,000 sq.m employment floorspace equivalent to 8,000 workers. The distribution of land uses across the SDZ lands is illustrated in Figure 2-6.

The envisaged land use along the north section of the South Bank Road is Industrial and Port Zone. Along the eastern section portion which stretches towards the existing Ringsend WwTP facility is identified for 'Mixed Use - Commercial, Creative Industries, Industrial (including Port Related) Activities'. The central sector of the SDZ lands is targeted to deliver the other residential, commercial, shopping and open space uses.

Based on the indicative layout and design of the Planning Scheme, the nearest residential unit (Housing with mixed use - blue area) could be interpreted to be approximately 670 m from the south-west corner of the Ringsend WwTP site.

The existing Ringsend WwTP is not located within the designated Planning Scheme area or any completed section of the proposed works. However, as part of the construction of the Proposed WwTP Component, outlined under Volume 2, Section 3: Description of Proposed Upgrade Project, a temporary compound (C1) is proposed to be located along the eastern section of the SDZ Planning Scheme area. These lands, illustrated in purple under Figure 2-6 are identified as:

> *"Mixed Use - Commercial, Creative Industries, Industrial including Port Related Activities."*

In terms of the Phasing, the Planning Scheme designates the mixed-use area along the eastern section of the lands as 'B2'. This phase of development states:

> *"B2 in the SDZ are identified for Mixed Use - Commercial, Creative Industries, Industrial (including Port Related Activities). This enables a range of uses on these lands including those associated with Dublin Port and film studios, together with TV and digital content production studios. The latter uses may include the provision of sound stages, post production and digital services, workshop areas, ancillary support and administration buildings and back lot areas (outdoor storage, green landscaping)." pg.46*

This particular provision was included as a Material Amendment to the Draft Planning Scheme. This Material Amendment is the subject of an appeal with An Bord Pleanála.

In terms of phasing, the Planning Scheme is divided into 2 no. streams: one for commercial, residential, retail and community uses along the southern portion of the SDZ lands; the other is related to the port and port-related and industrial activity zonings to the north and east of the SDZ.

For this zoning, the Planning Scheme envisages that:

> *"For Block B2, this site is proposed for unitised cargo storage in the long term, with a commercial element on the western boundary facing onto the buffer park zone, which could consist of hotel, office or other commercial and/or leisure and limited retail/cafe type uses. This zone is directly impacted by the transport corridor reservation, and will be reviewed following resolution of the reservation. Meanwhile the area is proposed as a public park to provide a transition between the new residential area and the cargo storage area. Block B2 will be served by a reopened new link extending northwards to Pigeon House Road (outside the SDZ) and not westwards to South Bank Road."*

Building heights will be predominantly 28 metres in height, whereby commercial buildings would reach 4 - 7 stories and up to 9 storeys for residential. The Planning Scheme specifies that mid-rise heights (of up to 50 m) can also be accommodated at a limited number of locations. These locations are identified under the Planning Scheme as areas of key open space, major access routes or viewpoints. There are a number of taller building locations identified. These accommodate buildings of up to 12 storeys, 16 storeys, 18 storeys, 20 storeys and a single building of up to 28 metres in height.

Building heights and the indicative urban layout of the SDZ Planning Scheme is illustrated under Figure 2-7 which identifies the B2 lands closest to the Ringsend WwTP as an area for the potential development of up to 28 m in height.

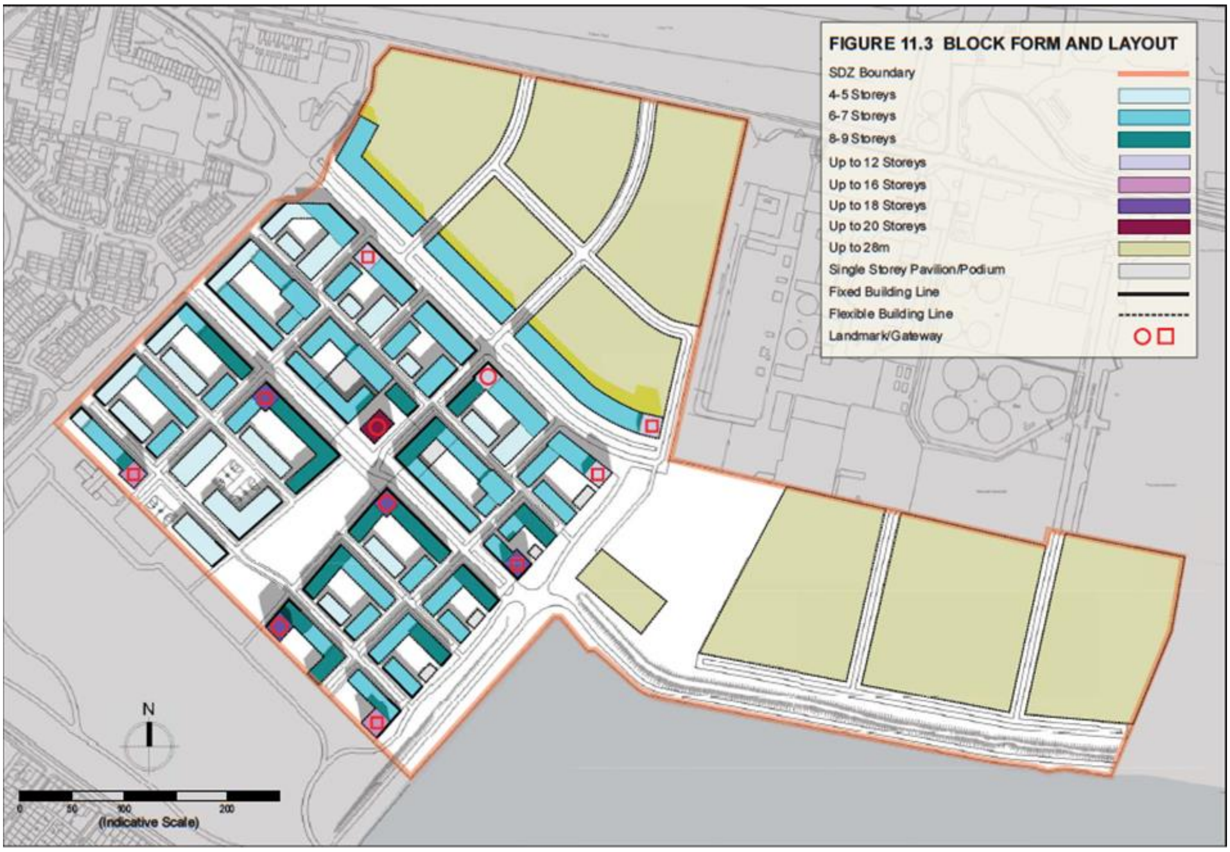

Figure 2-7: Block form and layout

In terms of the street network, Section 11.2.1 of the Planning Scheme proposes an alternative access route to the port/industrial lands along the former alignment of the Pigeon House Road. According to the Scheme, this is to remove traffic (including HGVs) from more sensitive/more intensively developed areas of Poolbeg West. The Planning Scheme, under page 64, requires a number of junction and crossing improvements to facilitate the access to the Planning Scheme area, as follows:

- The roundabout at the junction of Sean Moore Road and South Bank Road is to be replaced with a signalised junction;
- The junction between Pine Road and Sean Moore Road is to be signalised to cater for movements to/from a new Central Boulevard;
- The junction along South Bank Road and Pigeon House Road will be signalised; and
- An existing crossing adjacent to the Clanna Gael is to be moved north to align with Bremen Road and the School/Coastal Park Green Link.

According to Appendix 2 of the Planning Scheme, the proposed access to the 'B2' lands is via the existing entrance which connects to Pigeon House Road. This is shown in Figure 2-8 below.

Unlike the residential zone within the Planning Scheme, there is no detail regarding the quantum of uses expected to be delivered within the B1 or B2 zones.

The Planning Scheme identifies the reservation corridor for the Eastern By-Pass. Permanent development proposals are restricted in this area pending *"the final routing of the Eastern By-Pass is finalised"*. The extent of this area is illustrated in Figure 2-9.

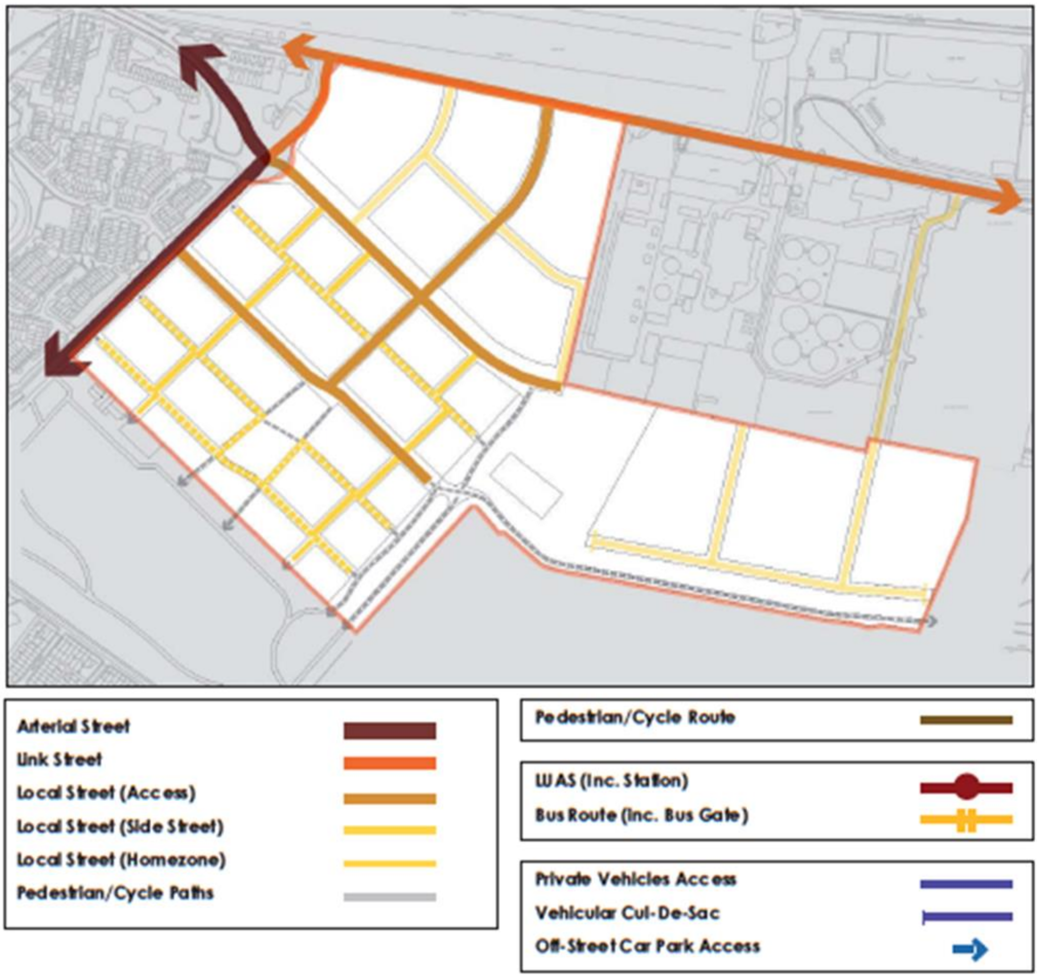

Figure 2-8: Street hierarchy, extract from Appendix 2 of the SDZ planning scheme

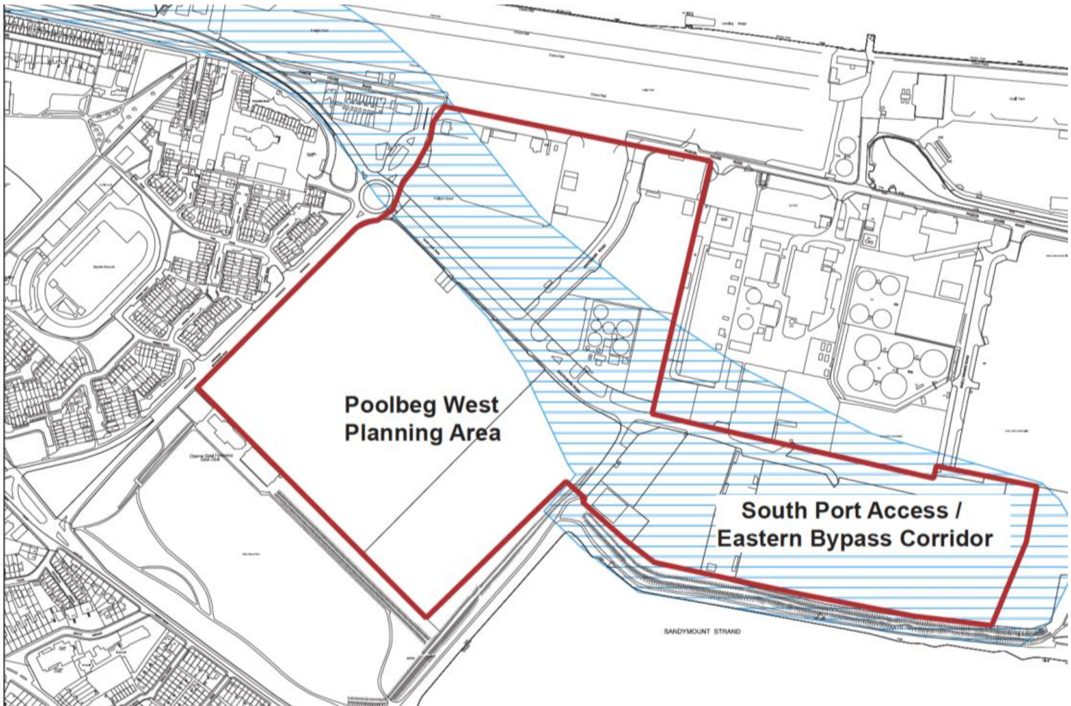

Figure 2-9: South Port Access/Eastern bypass corridor, extract from the SDZ Planning Scheme

The entire proposed temporary construction compound (Ref. C1) is located within the designated corridor for the Eastern By-Pass. As such, no permanent development proposals can be proceeded with until such time as the final routing for that road is resolved. As such, the temporary use of this compound associated with the construction of the Proposed WwTP Component is not prejudicial to the implementation of the Planning Scheme as these lands can be available to accommodate development at the appropriate time.

The Proposed WwTP Component, particularly the proposed temporary compound, does not prejudice the future aim and objectives of the SDZ Planning Scheme.

The Proposed WwTP Component will facilitate the development of the Poolbeg West SDZ lands.

2.3.1 Local Planning Frameworks

2.3.1.1 Draft Dublin Port Masterplan 2040

The Ringsend WwTP site is situated within the south quay area of the Dublin Port. The Port have prepared a Draft Masterplan 2040 (DPM) which sets out a non-statutory framework for development of Dublin Port and its activities up to 2040 (see Figure 2-10). As part of the DPM, the port company intends to carry out reviews with respect to the economic viability of the development options.

A period of consultation ran from 16 April 2018 until 25 May 2018 requesting the comments and views from the public in relation to the DPM. In terms of the existing DPM, there are 8 no. strategic objectives which underpin the masterplan which are set out as follows:

- Port Function;
- Investment and Growth;
- Integrating with the City;
- Movement and Access;
- Environment and Heritage;
- Recreation and Amenity;
- Security; and
- Future Review.

The DPM outlines a list of development options which form part of the ports capacity expansion. The plan further explains that these options are not a prescriptive menu of development but considered to be a set of possible options which would require further assessment in relation to the demand and capacity of Dublin Port and relevant planning consent requirements (Dublin Port Company, 2018).

There are 2 no. development options which are proposed in close proximity to the existing Ringsend WwTP facility described as follows:

> Development option M - hectares 3.5, *"A new deepwater multi-purposes berth is proposed as an eastwards extension of the existing South Bank Quay."* pg 42
>
> Development option N - hectares 10.7, *"If the existing MTL container terminal is redeveloped for Ro-Ro, then the Port will have a shortage of container terminal for Lo-Lo.*
>
> It is proposed, therefore, that a new deepwater Lo-Lo container terminal be developed by the creation of deepwater berths along the River Liffey in front of the ESB's Poolbeg Power Station.

> In doing this, provision will be made to provide for the power station's cooling water intake and outfall and also for NORA's petroleum loading and offloading requirements." pg. 42

Given the close physical relationship between the Ringsend WwTP and the working Docks area, it is important to acknowledge the presence and indicative development proposals of this non-statutory draft Masterplan document.

The Proposed WwTP Component does not prejudice the implementation of the Draft Masterplan 2040, published by Dublin Port.

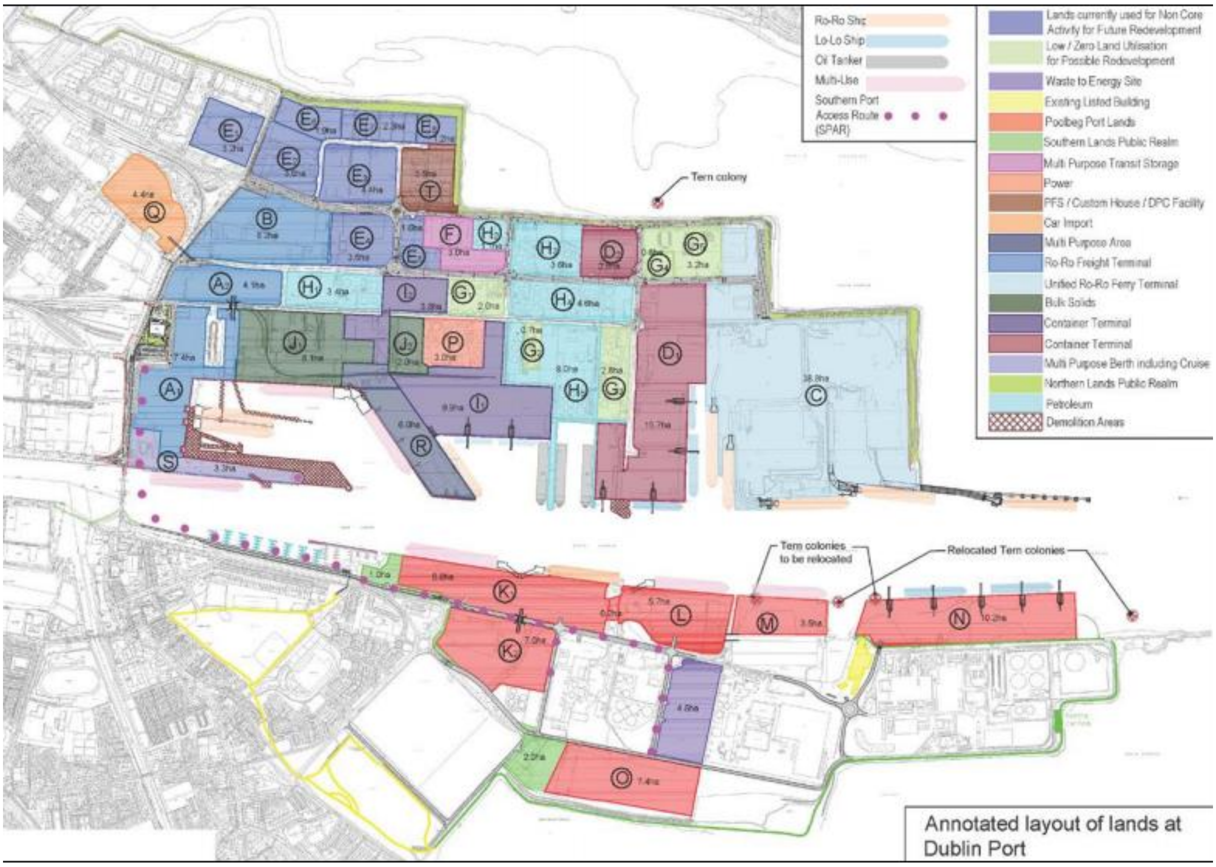

Figure 2-10: Draft Dublin Port Masterplan 2040 options, extract from the Dublin Port Masterplan 2018. pg. 36

2.3.1.2 Sandymount Village Architectural Conservation Area Report 2013

The Sandymount Village and Environs Architectural Conservation Area (ACA) Report was prepared and adopted in 2013. The extent of the ACA can be illustrated in Figure 2-11 below. This is replicated in Map F of the City Development Plan 2016-2022.

The over-arching policy of the ACA area is set out under policy POL 1, which seeks to generally protect and conserve the character and setting of the ACA ensuring development proposals will respect and complement the unique character of Sandymount Village, in line with the setting of protected structures in accordance with development standards.

The Proposed WwTP Component is in excess of c. 1 km north-east of the ACA and is considered not to negatively impact on the defining characteristics of the ACA or the ability to adhere to the policies and objectives of the ACA in the future. Further detail in relation to landscape is outlined under Volume 3, Section 14: Landscape of this EIAR.

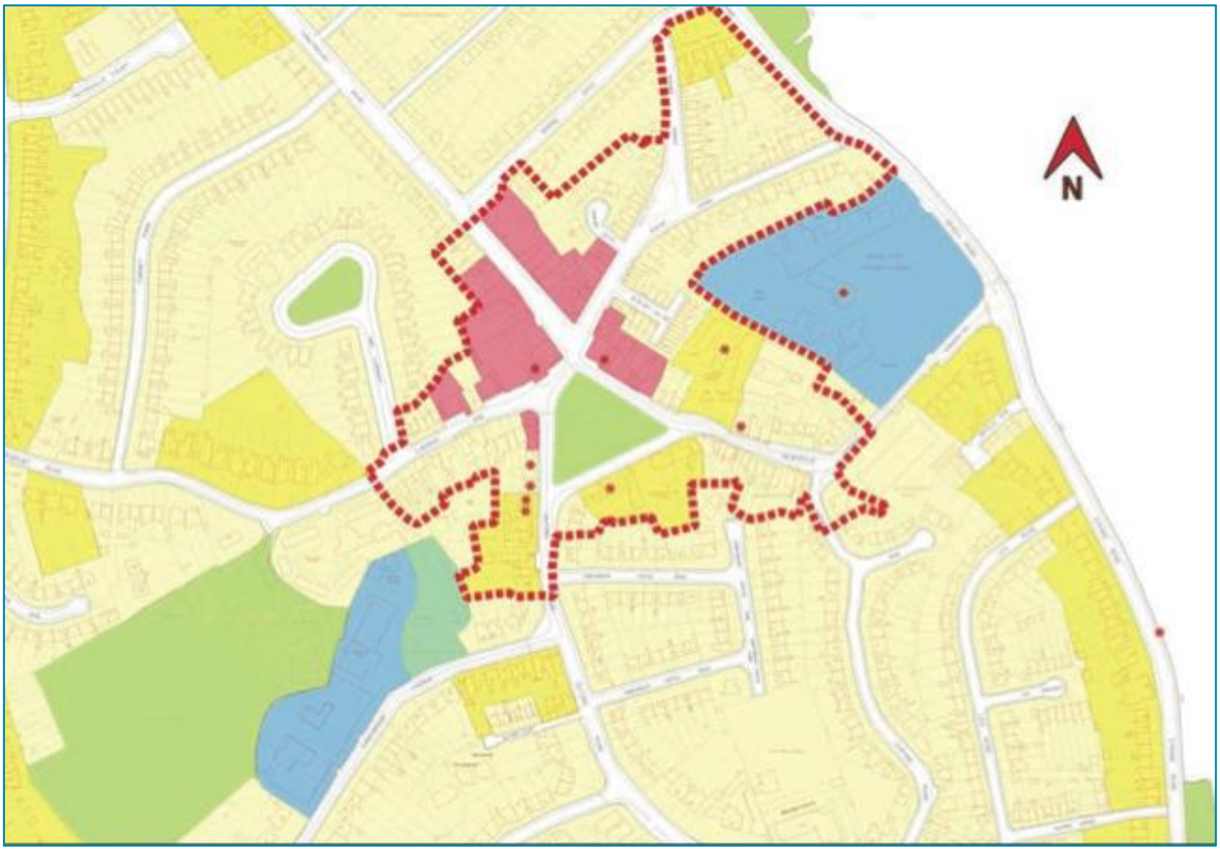

Figure 2-11: ACA Boundary Map- source: Sandymount ACA Document

2.3.1.3 Village Design Statement, Sandymount, September 2011

The aims of Sandymount Village Design Statement (VDS) are to:

1. Record what is distinctive and important to the residents of Sandymount to ensure these features are protected and/or enhanced through the local planning system and other relevant socio-economic programmes;
2. Devise design principles to guide future development within Sandymount and adjacent areas which would impact on village character;
3. Provide advice and up-front guidance on local design issues to decision makers and developers;
4. Suggest how specific projects that will benefit Village residents and their environment may be initiated; and
5. Act as a focus for the community to participate and collaborate effectively in the local planning process as well as in regards to other aspects of life in the Village.

The VDS's structure revolves around 5 principal aims which underpin the plan with identified key development areas. Upon review of document, *'The Strand & Promenade'* area is more specific to the Proposed WwTP Component whilst acknowledging the wider objectives of the plan.

The shared vision for *'The Strand & Promenade'* area is listed as being:

1. The location of the Village on the edge of the wide expanse of Dublin Bay allows wide sea views and the feeling of 'openness', which is an important aspect of Sandymount's sense of place;
2. View across the sands, including views of the Poolbeg chimneys, are a positive feature and development that would diminish these views is not generally favoured; and

3. Concerns were also raised about potential developments that might affect the sea wall and areas of soft sand used by families.

In recognition of its contribution to Sandymount's cultural and natural heritage, it is an objective of the plan to retain the Strand and sea wall as a primary visual and recreational amenity for residents and visitors, pg. 20. The principle objectives for the area include *inter alia:*

> *'Pedestrian links should be improved between the strand and Sean Moore Park, and via the Nature Walk to Irishtown Nature Park and the Great South Wall.'*

The VDS identifies the next steps to be taken in line with the above objectives, indicating that the current direction, as highlighted as project 5, is to address the Flood Risk and Preservation of the Sea Wall and Martello Tower. It is indicated that a project brief is outlined in order to establish a working group considering the flood issues and a proposed feasibility study for flood protection. Furthermore, it is noted that: the potential issues that are likely to occur in the area include *inter alia*: Preservation of coastal amenity, e.g. views, beach access, footpath, etc.; and the Preservation of pedestrian amenity alongside cyclists and vehicular traffic.

With specific reference to the Volume 2, Section 3: Description of Proposed Upgrade Project and Volume 3, Section 14: Landscape, the Proposed WwTP Component is not considered to prejudice the provision of the pedestrian link to the adjoining natural amenities outlined under the *'The Strand and Promenade'* in the future as the Proposed WwTP Component does not interfere with the existing coastal walkway linking the Great South Wall, Irishtown Nature Park and Sean Moore Park.

2.4 Planning Application History

2.4.1 Subject site

The planning history of the Ringsend WwTP is set out below and illustrated under Figure 2-12 below. There have been a number of approvals for development and upgrading of the Ringsend WwTP over the period of its operation. The most relevant planning history for the site is that identified below, as it is a current permission for the upgrading of the facility.

2.4.1.1 Current Approval – ABP Reg. Ref. 29N.YA0010

To address the overloading and 'nutrient-sensitive' designation issues that had been identified, studies for an expansion of the Ringsend WwTP were commenced by Dublin City Council (DCC) in 2008. In addition to examining the options for expanding and retrofitting the current plant for full nutrient removal at the existing site, DCC examined a further option permitted under the Urban Wastewater Treatment Directive.

This option involved relocating the treated effluent outfall to a point outside the area subject to the 'sensitive area' designation, together with an expansion in 'secondary' treatment capacity only (carbonaceous BOD removal only) at the works. This is described as the Secondary Treatment/Long Sea Outfall Tunnel (LSOT) Option.

In April 2012, under Section 226 of the Planning and Development Act 2000 (as amended), Dublin City Council made an application to ABP for the extension to the Ringsend WwTP (LSOT option). The application included an EIS and NIS, which considered the entire development, as proposed.

Figure 2-12: Ringsend WwTP planning history map

The key element of the works was the expansion of the WwTP which was originally designed to treat an average influent loading of 1.64 million PE to its maximum achievable design capacity of 2.4 million PE.

Following an oral hearing, An Bord Pleanála granted approval for the proposed development on 16 November 2012, subject to 16 no. Conditions (ABP Ref. 29N.YA0010). This is referred to as the 2012 Approval throughout this EIAR and planning application.

This Planning Approval encompasses the following three principal elements:

- Additional secondary wastewater treatment capacity at the wastewater treatment works site (approximately 400,000 population equivalent) including associated solids handling and ancillary works;
- A 9 kilometre Long Sea Outfall (in tunnel), commencing at an onshore inlet shaft approximately 350 metres east of the wastewater treatment works and terminating in an underwater outlet riser/diffuser in Dublin Bay; and
- Road network improvements in the vicinity of the site (during the construction phase).

Commencement of Current Planning Approval

Certain works common to the 2012 Approval and the Proposed WwTP Component by Irish Water are being carried out. A number of works under Element 1 (Surgical Works) have been completed and others are under way/about to commence construction, including the design and construction of Element 2 (400,000 PE Expansion). Some land-based aspects of Element 3 (LSOT) were implemented by DCC as advanced works in 2013 in order to avail of EIS/NIS implementation windows (Condition 10) and to comply with Condition 13 of the 2012 Approval.

These advanced works include:

- The installation by the ESB of LSOT power cables (for the LSOT Tunnel Boring Machine) across the Brent Geese Amenity Grassland [Advanced Works 1];

- Construction of a c. 120 m long access road from the Pigeon House Road to the south-east corner of the existing WwTP [Advanced Works 2]; and
- The installation of services, pedestrian safety measures and the strengthening and upgrading of the Pigeon House Road for a distance of c. 675 m east of the entrance to the ESB Poolbeg P.S. Site [Advanced Works 3].

2.4.1.2 Amendment Permissions

Temporary works/measures - ABP Reg. Ref. 29N.YM0002

IW (as the agency with responsibility to carry out the SID) sought alterations to the foregoing approval under Section 146B of the Planning and Development Act, 2000 (ABP Ref: 29N.YA0010). These alterations comprised minor temporary works/measures and are listed below as follows:

- Temporary construction access onto the Pigeon House Road c. 100 m west of the main entrance into ESB Poolbeg Power Station;
- Temporary removal of two small areas of landscaping bunds located on the WwTP property along its eastern perimeter;
- Temporary haul road (c. 80 m long) connecting the existing internal WwTP roads along the southern and eastern boundaries of the site.

An Bord Pleanála confirmed approval of the Section 146B application on 24 June 2016 under reference 29N.YM0002 for the above mentioned alterations. These works commenced in Q1 2018.

Revisions to Compound Areas - ABP Reg. Ref. 29N.YM0004

Irish Water, under Section 146B, applied for alterations to the previously approved temporary construction compounds required to build the approved upgrade of the Ringsend WwTP under ABP Ref: 29N.YA0010 and, if the Proposed Development is approved, for the Proposed WwTP Component.

Prior to determining this Section 146B application, An Bord Pleanála considered it necessary to undertake a period of public consultation. During this period members of the public were afforded the opportunity to submit observations following the Board's request in accordance with Section 146B of the Planning and Development Act 2000, as amended. A number of observations were submitted.

The application was submitted in July 2017 and ABP granted approval on 12 January 2018 following the period of consultation noted above.

This use of these compounds commenced in Q1 2018.

Amendment Permission - (Condition no.1)

An application for revisions to the wording of Condition no. 1 of the 2012 approval is being made concurrent with this planning application and seeks the following change in wording, underlined:

> *"The development shall be carried out and completed in accordance with the plans and particulars lodged with the application and the information contained in the environmental impact statement, including all mitigation measures contained therein, as amended by the further plans and particulars submitted at the oral hearing, except as may otherwise be required in order to comply with the following conditions, <u>and except as modified by any other consent granted in respect of the permitted development in which case the development shall be completed in accordance with those varied plans and particulars.</u>"*

The purpose of the amendment is to clarify the relationship between the approval and future consents under the Planning and Development Act, 2000 (as amended) including any consent granted for the Proposed Upgrade Project, and to ensure that there is clarity as to the conditions that apply to future consented development on the site.

2.4.1.3 Developments in the Surrounding Area

There are a number of existing and/or approved third party projects in the vicinity which have been identified that have the potential to interact with the Proposed WwTP Component. These projects are being included here as they could result in cumulative impacts arising. They are also assessed, where appropriate, in the other sections of the EIAR.

Dublin Waste to Energy - ABP Reg. Ref. PL29S.EF2022

This application was lodged by Dublin City Council for approval under Section 226 of the Planning and Development Act, 2000 (as amended), for a waste to energy facility at Pigeon House Road, Poolbeg Peninsula, Dublin 4. The Dublin Waste-to-Energy project is a Public Private Partnership (PPP) between Dublin City Council (acting on behalf of the four Dublin Local Authorities) and Covanta. This application was granted subject to conditions in November 2007 by An Bord Pleanála. It was subsequently granted a waste licence by the Environmental Protection Agency in December 2008, and received authorisations from the Commission for Energy Regulation in September 2009.

The construction of this waste to energy plant is complete and the facility is now fully operational. It is located immediately west of the existing Ringsend WwTP.

West of the Waste to Energy Site (ESB) - Reg. Ref. 2234/17

ESB have applied for and were granted planning permission on the 18 May 2017 for the creation of a new vehicular entrance to the southern boundary of ESB lands from South Bank Road. The works shall also include the infilling of low lying areas to a depth of up to c. 4 metres above Ordnance Datum and subsequent use for open storage within ESB Lands. The fill material is to be extracted from existing ESB sites including the Poolbeg ESB site to the east.

Alexandra Basin Redevelopment - ABP Reg. Ref. PL29N.PA0034

Dublin Port Company was granted planning permission subject to conditions, on 08 July 2015, under Section 37E of the Planning and Development Act 2000 (as amended), for the redevelopment of Alexandra Basin and Berths 52 and 53 together the dredging of the channel of the River Liffey together with associated works in Dublin Port.

The proposed development consists of the redevelopment of Alexandra Basin and Berths 52 and 53 together with associated works in Dublin Port and the dredging of the Liffey approach channel and is broken into 3 no. parts: works to Alexandra Basin, works to Berth 52 and 53, and works to the Liffey Channel. These can be summarised as follows:

Alexandra Basin:

- The infilling of graving Dock No. 2 having an area of 6,055 m^2;
- The excavation and restoration of historic Graving Dock No. 1;
- The demolition of the bulk jetty having an area of 3,200 m^2;
- A section of North Wall Quay extension having an area of 21,700 m^2;
- Extension of Alexandra Quay West of 130 m in length;
- New 273 m long Ro-Ro jetty and provision of three Ro-Ro ramps; and

- The dredging of: 470,000 m^3 of contaminated material to a depth of -10.0 m Chart Datum (CD) over an area of 194,000 m^3 within the redeveloped Alexandra Basin and its remediation.

Berth 52 and 53:

- The demolition of existing berths 52 and 53;
- Jetty at Berth 52 having an area of 500 m^2;
- Concrete Dolphin at Berth 53 having an area of 500 m^2;
- The construction of:
  - A new river berth at Berths 52/53, 300 m long;
  - New 75 m mooring jetty at new river berth;
  - New 40 m long mooring jetty to extend existing berth 49, 50 m long;
- The infilling of the Terminal 5 Ro-Ro basin, an area of 45,650 m^2;
- Raising of existing levels by 1.4 m over an area of 95,000 m^2; and
- Dredging of new river berth to -10.0 m CD.

Liffey Channel:
Construction of a marina protection structure to a height of +7.0 m CD and a length of 220 m on the south side of the river channel. Dredging of the shipping channel to a depth of -10 m CD from a point 55 m to the east of the East link bridge, to a location in the vicinity of Dublin Bay, a total distance of 10,320 m.

This approval is now being implemented by the Dublin Port Company.

ESB Site and Surrounding Lands

Reg. Ref. 2130/18 - Development consisting the demolition of existing two-storey administration building (534 sq.m); construction of a new two-storey building (563 sq.m) containing an administration area, staff facilities and a non-ferrous metals recovery area. This application received Final Grant on 30 April 2018, subject to 7 no. conditions.

Reg. Ref. 2234/17 - The development will consist of the creation of a new vehicular entrance to the southern boundary of ESB lands from South Bank Road including the erection of a new 4.5 m wide 2.6 m high entrance gate in the existing 2.6 m high palisade boundary fence. The works shall also include the infilling of low lying areas within the development boundary of the site (1.13 ha) to a depth of up to c. 4 metres above Ordnance Datum and subsequent use for open storage within ESB Lands and all ancillary site and development works. This application received Final Grant on 18 May 2017, subject to 7 no. conditions.

Reg. Ref. 3493/12 - Retention permission for the increase in capacity at its waste recovery facility for Construction and Demolition Waste from 5000 tonnes per annum (as permitted under condition no. 1 (2) of An Bord Pleanála Planning Permission Ref. ABP PL 29S.109837) to a maximum of 20,000 tonnes per annum and retention permission to expand the waste streams accepted at the facility to include non-hazardous waste. The proposed development is the subject of a Waste Facility Management Permit application. The development is located within the curtilage of a Protected Structure (Ref. No. 6793). This application received Final Grant on 31 July 2013, subject to 8 no. conditions.

Reg. Ref. 3664/16 - Development for RETENTION: Permission for the retention and continuation of use of the following: (i) signage to the front of the premises; (ii) a single storey portable cabin structure with a floor area of 7.5 Sq metres in use as a security hut; (iii) two single storey prefab buildings in use as ancillary offices and staff welfare facilities with a floor area of 67 Sq metres and 160 sq metres respectively; (iv) a two storey prefab building to be used as ancillary storage with a floor area of 76 Sq metres. This application received Final Grant on 12 December 2016, subject to 4 no. conditions.

Reg. Ref. 3794/16 - The development will consist of the reinstatement of the recessed vehicular access, fencing and gates on the line of the original access to the ESB Station lands at Poolbeg. This application received Final Grant on 12 January 2017**,** subject to 7 no. conditions.

Reg. Ref. 2650/16 - The development consists of permission for 670 m of 2.6 m high palisade fencing and associated gates to secure an internal area within the Poolbeg Generating Station Compound. This application received Final Grant on 29 June 2016, subject to 6 no. conditions.

Reg. Ref. 3360/09 - Planning permission granted for the provision of c. 522,000 litre Fire Water Storage Tank, provision of c. 40,000 litre firefighting foam storage tank, provision of c. 50,000 litre dye storage tank and tertiary containment bunding to the existing secondary containment bunding at site.

Reg. Ref. 3644/09 - Planning permission granted for an extension to the existing three storey Control Room Building**.** This application received Final Grant on 09 October 2009, subject to 7 no. conditions.

Reg. Ref. 2752/08 - Planning permission granted for the retention of alterations to Poolbeg 220 kV GIS Station consisting of 2.65 metres high palisade fence and gates, 3.40 metre high grassed berm. This application received Final Grant on 13 August 2008, subject to 2 no. conditions.

While the above mentioned planning histories reflect the granted permissions in the area, it is considered that these developments will not prejudice the Proposed WwTP Component.

National Oil Reserves Agency

Reg. Ref. 2656/16 - On 13 April 2016, planning permission was applied for, for a development consisting of a new single storey operational room adjacent to the existing terminal entrance /exit gate onto Shelly Banks Road, a new transformer, a new pump-pad, a truck loading gantry, a new fire protection system and associated works which, according to the Applicant, will result in the site being upgraded to Upper Tier under the Seveso Regulations, once the development is completed. Dublin City Council issued a Notification of Decision to Grant Permission on 19 December 2016. The Final Grant of Permission for this development was issued on the 03 February 2017, subject to 10 no. conditions**.**

2.4.2 Greater Dublin Drainage - ABP Reg. Ref. PL06F.PC0152

This is an Irish Water project that has the potential to interact with the Regional Biosolids Storage Facility (RBSF) which forms part of the Proposed Upgrade Project. This project is being included here as it could result in cumulative impacts arising. It is envisaged that a planning application for the Greater Dublin Drainage project (GDD) will be lodged with An Bord Pleanála during the period the Bord are considering this application. The application for GDD will also seek permission for the RBSF.

The Greater Dublin Strategic Drainage Study (GDSDS) took a high-level view of the wastewater drainage and treatment requirements of the Greater Dublin Area (GDA) as a whole. The Final Strategy Report and subsequent Strategic Environmental Assessment (SEA) were prepared in 2005 and 2008 respectively on behalf of the seven local authorities that form the GDA, to guide the future provision of wastewater infrastructure in the region. Irish Water completed site selection in 2013 and identified the preferred solution for the future development of wastewater treatment in the wider Dublin region as being:

- An underground orbital sewer and two pumping stations;

- A wastewater treatment plant (WwTP) on a 23-hectare site at Clonshaugh; and
- An outfall pipe from the treated wastewater discharging 1 km north-east of Ireland's Eye (6 km out to sea)

Following the site selection process, Irish Water is currently undertaking studies towards the preparation of an Environment Impact Assessment Report (EIAR) and Natura Impact Statement (NIS) for the selected site. These will be submitted as part of an application for planning permission to An Bord Pleanála in due course.

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Section 3: Population and Human Health

3.1 Introduction

3.1.1 Population

This Section of the EIAR assesses the potential impacts (and resulting effects) likely to occur as a result of the Ringsend WwTP component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component") on the population in the area together with the effects on Human Health.

Full details of the Proposed Upgrade Project and the Ringsend WwTP component can be found in Volume 2, Section 3: Description of Proposed Upgrade Project.

This Section and assessment have been completed having regard to the guidance outlined in the Environmental Protection Agency documents *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (Draft, August 2017) and *Advice Notes for Preparing Environmental Impact Statements* (Draft, September 2015).

The population of the regional and local area comprises three elements, namely: the resident population, the working population (employment) and the visitor community (amenities) of the study area.

As discussed in more detail under Volume 3, Section 2: Planning and Policy Context of this EIAR, the *Regional Planning Guidelines for the Greater Dublin Area 2010 – 2022* and *Greater Dublin Strategic Drainage Study* (2005) identifies the infrastructural requirements to meet the forecasted population increase over each respective plan period. The increase in population outlined under these reports is reflected in the current trend of population growth as noted under Table 3-1.

Assessments of other environmental factors are referenced in this Section to address potential anticipated Population and Human Health impacts in accordance with the Draft EPA Guidelines (2017).

In order to provide a clear assessment of potential impacts and effects, the demography, employment aspects and visitor attractions of the population are identified in this Section. The potential impacts of the Proposed WwTP Component on the study area Population and Human Health have been assessed, taking cognisance of the various other Sections of this EIAR, namely:

- Volume 3, Section 4: Water;
- Volume 3, Section 7: Land and Soils;
- Volume 3, Section 8: Air and Climate;
- Volume 3, Section 9: Noise and Vibration;
- Volume 3, Section 10: Odour;
- Volume 3, Section 13: Traffic; and
- Volume 3, Section 14: Landscape.

It should be noted that there are numerous inter-related environmental topics described throughout this EIAR document, which are also of relevance to Population and Human Health. Issues such as the potential likely and significant impacts of the Proposed WwTP Component on water, land and soils, air quality and climate, noise and vibration etc. are of intrinsic direct and indirect consequence to Human Health.

The potential impacts (and resulting effects) of each of the above have been addressed under each respective Section of this EIAR and have been considered in the context of this Section. Furthermore, the interactions between these environmental topics are considered under Volume 3, Section 16: Environmental Interactions of this EIAR.

3.1.2 Human Health

The consideration of effects on Human Health is very broad in scope. Ultimately, all the impacts of a development on the environment may cause effects on the local and wider population, both positively and negatively. The requirement that direct and indirect significant effects of a project on Human Health be considered comes from Article 3(1)(a) of the EIA Directive 2014/52/EU.

The EIA process, as described in Volume 2, Section 2 of this EIAR, identifies impacts, or changes in factors that may result from the Proposed WwTP Component. Some of these have the potential to influence health effects, either directly or indirectly. Direct effects are those that could result from the release of harmful or toxic emissions to air and water or from impacts from noise or odour. Direct effects may also present as health risks from hazards associated with the Proposed WwTP Component, such as traffic and construction activities. Indirect effects relate to such impacts on biodiversity, cultural heritage and archaeology and, more generally, on how the Proposed WwTP Component may effect changes to the living conditions and environment of the population.

Consideration of individual impacts and effects have been provided in discrete Sections of this EIAR by the relevant specialists. Where potential impacts are identified, appropriate mitigation measures are recommended to ameliorate or reduce those impacts to appropriate levels.

The purpose of this human health assessment is to firstly examine potential impacts as identified within the EIA process and determine their potential for significant effects on human health. Secondly, having assessed the analysis, should determine the predicted health and well-being outcomes that may be associated with the Proposed WwTP Component. Lastly, the human health impact assessment considers whether the assessment covers all vectors through which human health impacts could be caused, including adequate consideration of inter-relationships of impacts.

3.2 Methodology

This Population and Human Health Section has been completed in line with the details outlined under Volume 2, Section 2: The EIA Process, which has been guided by the *Draft Guidelines on Information to be Contained in Environmental Impact Assessment Reports* (EPA, 2017) and the *Draft Advice Notes for preparing Environmental Impact Statements* (EPA, 2015).

3.2.1 Population

The intention of this Section is to describe (i) the characteristics of human activity in the study area, (ii) any likely significant effects of the Proposed WwTP Component on population, absent mitigation, (iii) suitable mitigation measures and (iv) the residual impacts after mitigation.

This involves the examination, compilation and analysis of information relating to the *'study area'*. Consideration is also given to the wider population of the Greater Dublin Area.

The methodology used in relation to population in this Section relies on a desk-based study of published reference documents. An examination of the following material was carried out:

- Information provided by the Central Statistics Office (CSO), who are tasked with collection, compilation, extraction and dissemination for statistical purposes of information relating to economic, social and general activities and conditions in the State. The scope of the CSO data considers the following years: 2002, 2006, 2011 and 2016. This provided detailed figures for population at a regional level and at the local area level;
- The Regional Planning Guidelines for the Greater Dublin Area 2010-2022, which outline future population growth in the Greater Dublin Area;
- Existing visitor attractions have been identified alongside employment areas through the use of online business directories, maps and site visits;
- ESRI Quarterly Economic Commentary, which outlines employment trends; and
- Consideration has also been given to the land use zoning characteristics, as outlined under Volume 3, Section 2: Planning and Policy Context of this EIAR.

Once the appropriate population statistics were identified, an analysis of the potential direct and indirect impacts at both the construction stage and operational stage of the Proposed WwTP Component was undertaken. The effects of the Proposed WwTP Component are assessed in terms of Quality, Significance, Magnitude, Probability, Duration, and Type as detailed in Volume 2, Section 2: The EIA Process.

3.2.2 Human Health

The Human Health element of this assessment has been prepared in accordance with the following guidelines:

- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU) (European Union, 2017);
- Advice Notes for Preparing Environmental Impact Statements September - Draft (EPA, 2015); and
- Guidelines on the Information to be contained in Environmental Impact Assessment Reports - Draft (EPA, 2017).

It should be noted that, in accordance with Draft EPA Guidelines (2015 and 2017), this Human Health Assessment does not duplicate the assessments found in other specialist Sections of this EIAR (as outlined in Section 3.1.1 above). Instead, it focuses on the potential impacts that have been identified and assesses from a medical perspective their potential to cause significant effects on human health and well-being.

This approach is supported by the Draft EU Guidelines (2017) which states that *"…environmentally related health issues (such as health effects caused by the release of toxic substances to the environment, health risks arising from major hazards associated with the Project, effects caused by changes in disease vectors caused by the Project, changes in living conditions, effects on vulnerable groups, exposure to traffic noise or ai*r pollutants) *are obvious aspects to study. In addition, these would concern the commissioning, operation, and decommissioning of a Project in relation to workers on the Project and surrounding population*."

Accordingly, the methodology adopted for this assessment is as follows:

- Identification of Sensitive Receptors relevant to human health and well-being;
- Description of health profiles and statistics within the study area;

- Literature review of medically published journals and papers relevant to the Proposed WwTP Component and associated impacts;
- Review of the Proposed WwTP Component description and associated potential impacts;
- Assessment of potential for those impacts to effect human health; and
- Assessment of significance of effects, according to health-based standards.

Health based standards are set both nationally and internationally to protect the vulnerable members of society. They have an in-built measure of significance and are set at levels where there will be no significant health effects. For each impact as identified in the EIAR, the appropriate standard relevant to the protection of human health has been identified and brought forward for assessment.

Adopting a health-based, standards-based approach complies with the Draft EPA Guidelines (2017), which state:

'*The evaluation of effects on these pathways is carried out by reference to accepted standards (usually international) of safety in dose, exposure or risk. These standards are in turn based upon medical and scientific investigation of the direct effects on health of the individual substance, effect or risk. This practice of reliance upon limits, doses and thresholds for environmental pathways, such as air, water or soil, provides robust and reliable health protectors [protection criteria] for analysis relating to the environment*'.

Finally, to support the identification of potential human health effects, the responses to issues raised during the consultation process (refer to Volume 2, Section 2: The EIA Process) on the Proposed WwTP Component and which are of relevance to human health, have been reviewed and are addressed in this Section.

3.2.3 Study Area

Given the regional significance of the Proposed WwTP Component, there are two natural population areas, known as Study Areas, to consider; the Regional level and Local level.

3.2.3.1 Regional level

As outlined in Figure 3-1 below, the current WwTP catchment encompasses a significant part of the metropolitan area of the Greater Dublin Area. The Proposed WwTP Component, outlined under Volume 2, Section 3: Description of Proposed Upgrade Project of this EIAR, describes the required works at the subject site in order to increase the capacity and change the treatment process at the existing Ringsend WwTP. It is in this context that the Proposed WwTP Component will generate increased capacity for wastewater treatment within its catchment, enabling the continuation of development to proceed without significant limitations on capacity.

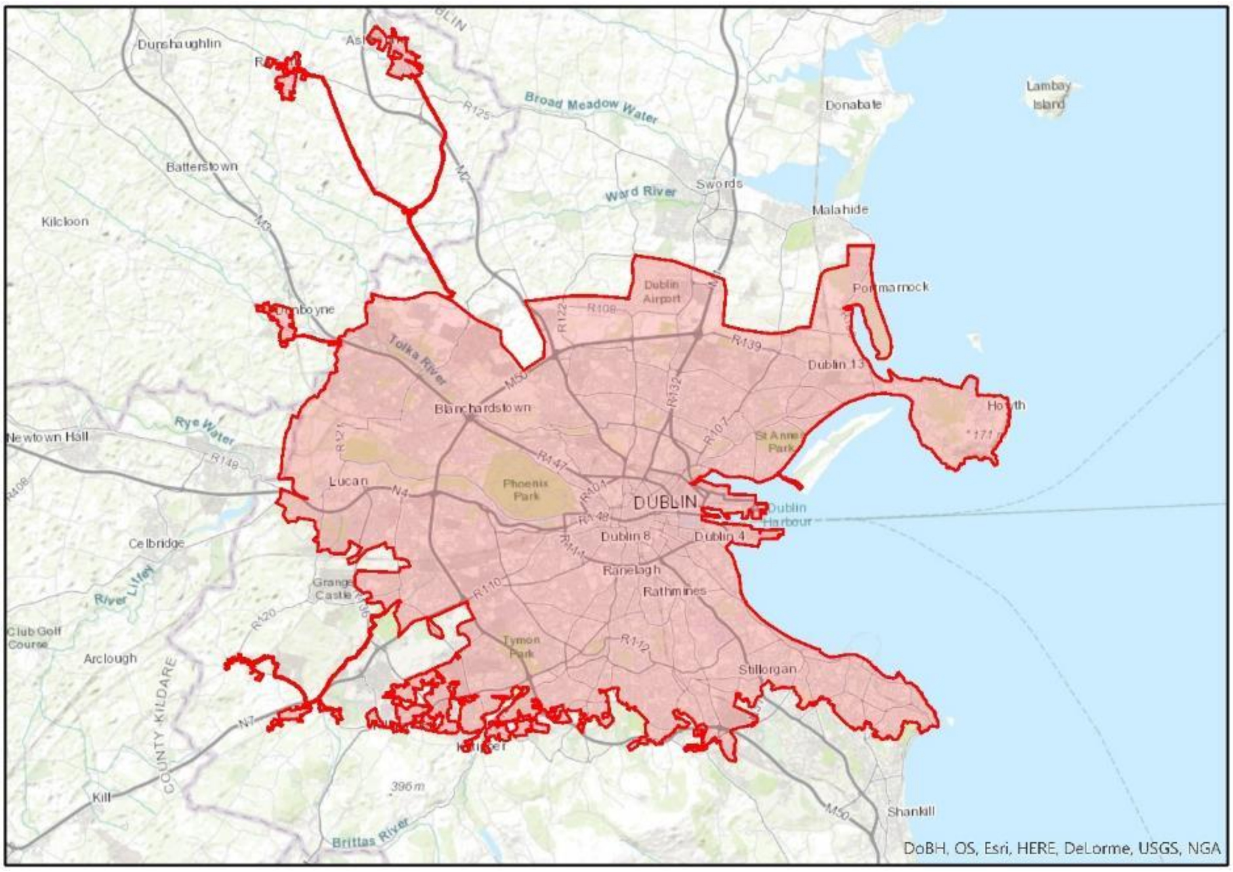

Figure 3-1: Existing Ringsend WwTP catchment

3.2.3.2 Local Area

The Proposed WwTP Component, the subject of this EIAR Section, is located at the existing Ringsend WwTP. Located along the Poolbeg peninsula, the wastewater treatment site is bounded primarily to the north by Pigeon House Road and is approximately 11 ha in size. The site is positioned along the eastern section of the Pembroke East A Electoral Division (ED) shown in Figure 3-2. The existing facility and its surrounding land uses can be characterised as industrial in nature and this is reflected in the Z7 Industrial zoning objective for the area as set out in the Dublin City Development Plan 2016-2022. In addition, lands west of the subject site, Z14 zoning objective provide for a SDZ Planning Scheme which aims to create a new residential / economic community. Specific details in relation to land use zoning and policies and objectives for the local area are outlined under Section 2: Planning and Policy Context of this Volume of the EIAR. In determining the extent of the local catchment, the 3 no. types of population elements (i.e. resident, visitor and employment) have been considered. The nearest established resident dwellings are placed approximately 950 m (Strand Road) from the site, with the existing Coast Guard Cottages (11 no.) being approximately 975 m from the boundary of the existing WwTP. Figure 3-2 below demonstrates spatially, the proximity of these housing units to the subject site. The employment aspects include the southern section of Dublin Port and its related activities. The visiting population aspect considers recreational attractions of the area at this coastal location. For the purposes of this Section, the extent of the local area has been defined by the proximity of the nearest residential units, as shown in Figure 3-2. The Electoral Divisions (EDs) which accommodate these identified units form the local area, which enables effective examination of available population data.

Figure 3-2: Location of residential and commercial address points in the context of the Proposed WwTP Component, nearest residential units circled in orange (Department of Housing, Planning and Local Government, 2018)

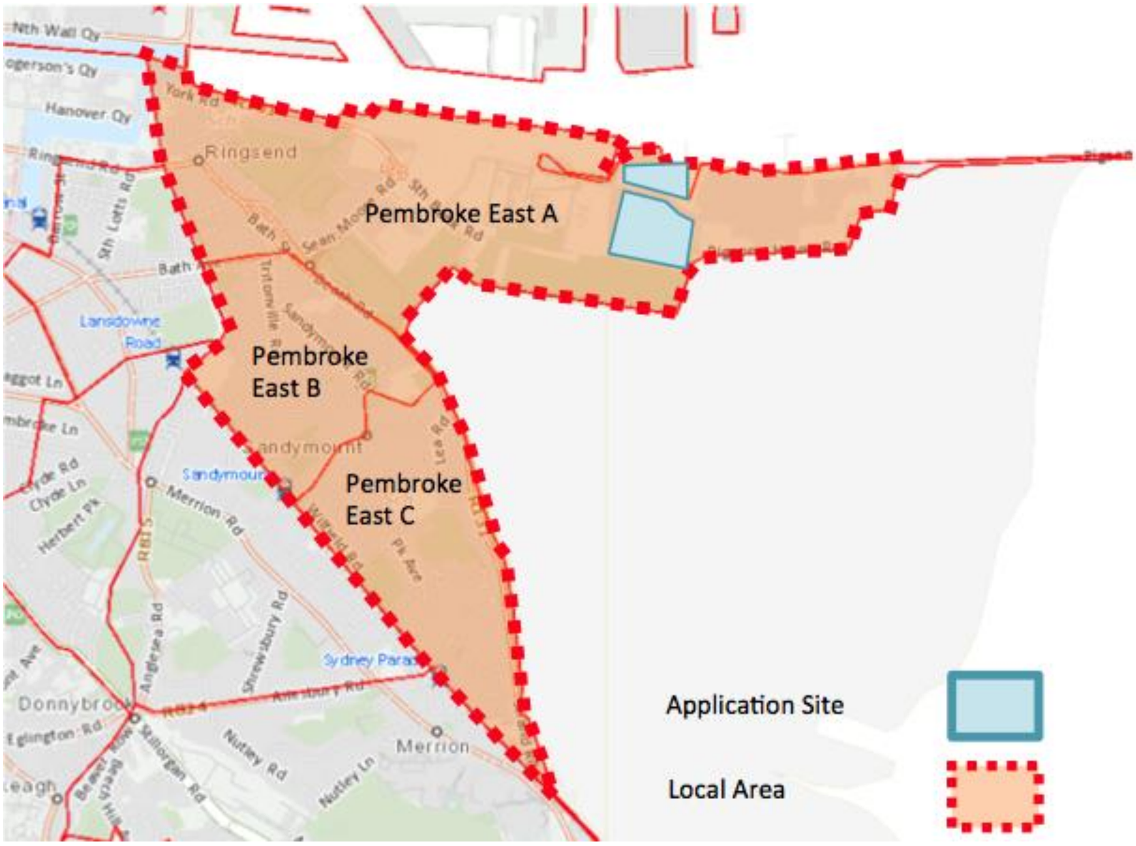

Figure 3-3: Location of the proposal in the context of the Local Area (Source: cso.ie/en/census)

The 3 no. EDs which form the scope of the Local Study Area for the purpose of the population are illustrated in Figure 3-3 and are:

- Pembroke East A;
- Pembroke East B; and
- Pembroke East C.

The 3 no. EDs which define the local area covers an area of approximately 3.64 sq.km (CSO).

The Local Area is generally described as coastal along the south east, with Dublin Port related activities along the north and with the East Link toll bridge defining the north-western boundary. The River Dodder defines the western boundary, with the Dart/inter-city rail line outlining the south-west section. Areas within this boundary are generally referred to as: Ringsend, Poolbeg, Irishtown and Sandymount.

3.3 Existing Environment

3.3.1 Population

In assessing the receiving environment in terms of population and human health, its composition can generally comprise of three principal elements, namely:

- The resident population;
- The working population (employment); and
- The visiting community (amenities).

Each of these populations will experience changes in the environment in different ways.

3.3.1.1 Resident Population

The Ringsend WwTP currently serves a regional population comprising a significant portion of the metropolitan area of the Greater Dublin Area. As such, it is useful to identify what that population comprises. Whilst this population may not be immediately aware of the Proposed WwTP Component, it is nevertheless relevant to acknowledge same given the function of the Proposed WwTP Component as a regional facility within the Greater Dublin Strategic Drainage Strategy. As outlined under Section 2: Planning and Policy Context of this Volume of the EIAR, the delivery of this infrastructure will facilitate the continuation of development within its catchment.

Regional Level

Table 3-1 identifies the projected population targets for the Greater Dublin Area as outlined in the 2010 - 2022 Regional Planning Guidelines. The Dublin and Mid-East area (Meath, Wicklow, Kildare) makes up the Greater Dublin Area, with the existing catchment serving a significant portion of the metropolitan area. Back in 2010, the 2016 population target was identified as 1,955,800.

Table 3-1: Regional Population Targets 2010, 2016 and 2022 (The Regional Planning Guidelines Office, 2010)[2]

	2008	2010	2016	2022
Dublin	1,217,800	1,256,900	1,361,200	1,464,200
Mid-East	514,500	540,000	594,600	649,700
GDA	1,732,300	1,796,900	1,955,800	2,113,900
State	4,422,00	4,584,900	4,997,000	5,375,200

Table 3-2: Population Change at State, Regional, Dublin City and Local Area 2002-2016 (Source: cso.ie/en/census)

	2002	2006	% Change from 02- 06	2011	% Change from 06 - 11	2016	% Change from 11 - 16
State	3,917,203	4,239,848	8.2%	4,588,252	8.2%	4,761,865	3.8%
Regional	1,535,446	1,662,536	8.3%	1,804,156	8.5%	1,907,332	5.7%
Dublin City	495,781	506,211	2.1%	527,612	4.2%	553,165	4.8%
Local Area	11,799	11,995	1.7%	12,541	4.6%	12,816	2.2%

The 2016 Census figures provide us with the latest indication of how the growth in the GDA compares with the population targets set by the Regional Planning Guidelines.

The Regional Planning Guidelines for the GDA envisage a population of 1,955,800 by 2016, whereas the 2016 Census shows that the population was actually 1,907,332. This shows that the actual population is somewhat below the 2016 target; by -2.4%. The GDA population increased by c.5.7% since the 2011 figure, which is a slightly slower rate of growth than the previous two inter-censal periods; which were both in excess of 8% growth. The current emphasis of government is to build more affordable houses and in accordance with prevailing planning policy documents, which focus on consolidating development within existing urban areas, particularly in the GDA, there is the potential for increased population growth. Thus, while the current population is somewhat below the estimated 2016 target, the current government policy could potentially result in the RPG target for the GDA set out in the year 2022 being achieved.

Local Area

The extent of the Local Area is illustrated in Figure 3-3. Comparatively speaking, while it is evident from Table 3-3 below that the population change within the local study area has increased, albeit at a slower rate, it has not increased to the same extent as Dublin City as a whole.

It is equally clear that the Local Area has not grown at the rate of growth experienced within the GDA as a whole over the same period when compared to Table 3-2 above.

The nearest residential dwellings are positioned at approximately 950 metres south-west of the Proposed WwTP Component, located along the Beach Road/Strand Road. In addition, there are further

[2] *Source: Regional Planning Guidelines for the Greater Dublin Area, 2010 - 2022, Table 4 pg.82*

residential dwellings located along Pigeon House Road, north of Seán Moore Road. These dwellings are approximately 975 metres west of the Ringsend site. Figure 3-2 above identifies the location of the dwellings.

As illustrated in Table 3-3 below, the Local Area accommodates a population of 12,816 persons according to the 2016 Census of Population. This area is where the population is most likely to be aware of change arising from the Proposed WwTP Component. The 2016 figure represents an increase of 275 persons, comprising a +2.2% change from the 2011 figure of 12,541 persons.

Table 3-3: Population of the Local Area (Source: cso.ie/en/census)

Electoral Division	Population in 2002	Population in 2006	% Change from 02 - 06	Population in 2011	% Change from 06 - 11	Population in 2016	% Change 11 - 16
Pembroke East A	4,304	4,754	+ 450 (+ 10.4%)	4,929	175 (+3.6%)	5,078	149 (+3.0%)
Pembroke East B	3,595	3,480	- 115 (- 3.2%)	3,608	128 (+3.6%)	3,818	210 (5.8%)
Pembroke East C	3,900	3,761	- 139 (- 3.6%)	4,004	243 (+6.46%)	3,920	-84 (-2.1%)
Total	11,799	11,995	+ 196 (+ 1.7%)	12,541	546 (+4.5%)	12,816	275 (+2.2%)

The Local Area has undergone minor changes in population over the years 2002 - 2016 as shown in Table 3-3. In 2002, the population represented 11,799 in the area, increasing to 12,541 (+6.28%) in 2011. The figures above indicate a relatively static population, particularly when compared to the growth levels of Dublin City and the GDA generally, as shown in Table 3-2. The 2016 Census figures indicate a reverse in the trend, whereby Pembroke East B and Pembroke East C have undergone a reduction in the number of residents, as compared to the modest increase of just 149 and 210 people in Pembroke East A and Pembroke East B respectively. Overall however, there was only a very modest increase in population in the immediate area over the period.

It is recognised that the recent designation by Government of the Poolbeg West lands (including the former Irish Glass Bottle site) as a Strategic Development Zone (SDZ) will result in a significant increase in the population within the Local Area. Section 2: Planning and Policy Context of this Volume of the EIAR outlines the design parameters and development potential for this area. In summary, as many as 3,500 new homes are planned for this SDZ as part of a mixed-use development and could result in a new population of 6,500 - 8,000 people in the Pembroke East A Electoral Division (ED). The proposals for residential development at Poolbeg West are being put forward in the knowledge of the presence of the Ringsend WwTP at Poolbeg. The new homes in Poolbeg West will be nearer to the Ringsend WwTP than the closest dwellings at present.

Apart from the Poolbeg West SDZ there is very little opportunity for infill housing in the Local Area. The areas zoned for residential development are almost entirely build-up.

As shown under Volume 3, Section 2: Planning and Policy Context of this EIAR, the land use zoning corresponds with the established pattern of residential uses and can broadly be grouped into 3 areas. Firstly, the residential component, secondly the transitional section and thirdly the industrial section (location of the Proposed WwTP Component). The industrial land use area accommodates large infrastructural uses essential to the day-to-day operation of Dublin City. It incorporates the ESB power generating station, the existing Ringsend WwTP, the Dublin Waste to Energy Facility and various elements related to the activities of Dublin Port including quays, docks and storage yards.

3.3.1.2 Working Population

According to the CSO, the seasonally adjusted standardised unemployment rate (SUR) is slowly falling at a national level. The current national figure stands at 6.4% (July 2017) (Central Statistics Office, 2017). This trend is decreasing generally on a monthly basis from 12.2% in January 2014. While there are slight increases to this figure occurring in irregular months, the general cumulative direction of the figure is showing a decrease in unemployment.

The Quarterly Economic Commentary, Winter 2017 Statement (McQuinn *et al.*, 2017) outlines that unemployment is expected to fall to 5.4% in 2018.

Regional Level

Table 3-4, sourced from the CSO, shows the total percentage of unemployed as per Census 2011 and 2016 (no. of people seeking 1st job in addition to no. of people unemployed expressed as a percentage of the total population). The table indicates a reduction in unemployment across the State, GDA, Dublin City and Local Level for the 2011 to 2016 period.

Table 3-4: Number of Persons looking for First Job and Unemployed having lost previous job (Source: cso.ie/en/census)

	2011 – 1st Job	2011 of Unemployed	2016 – 1st job	2016 of Unemployed	2011 – 2016 change (%)
State	34,166	390,677 (9.2%)	31,434	265,962 (6.2%)	-31.9%
Regional Level	13,975	145,049 (8.8%)	12,771	99,248 (5.9%)	-29.6%
Dublin City	5,086	46,613 (8.8%)	4,686	34,514 (6.2%)	-26%
Local Level	63	701 (5.5%)	60	503 (3.9%)	-28.2%

Beyond the Local Area and within Dublin City, the catchment of the Ringsend WwTP services the Central Business District of Dublin, comprising the Docklands area and Dublin City Centre. At a regional level, the Ringsend WwTP services major urban areas in the surrounding Local Authorities.

Under the Dublin City Development Plan 2016 - 2022, there is over 800 hectares of employment zoned land (Z6 and Z7) throughout the city. In conjunction with the Z5 city centre zoning, this forms a significant proportion of the employment generation for the city. This concentration of employment in Dublin City Centre forms part of the c. 750,000 plus working population in the Greater Dublin Area as a whole, considered to be dependent on the wastewater requirements (Dublin City Council, 2016).

According to the Quarterly National Household survey, this area comprises c. 669,100 workforce (Q2 2017) (Central Statistics Office, 2017) and parts of c. 262,500 workforce in the mid-west (Q2 2017) (Central Statistics Office, 2017). In addition, the unemployment rate for the Dublin stands at 6.3%.

The workforce outlined above can be considered to rely on the continued treatment of wastewater. In this context, the employees are dependent on the efficient, safe treatment of waste from the system in order to maintain the continued economic activity.

Local Level

In terms of the Local Area as a whole, Table 3-4 indicates that the unemployment rate in 2016 stood at c. 3.9%. Compared with the 2011 figure of 5.5%, there is a downward trend in unemployment within the Local Area. This change represents a reduction of 28.2% between 2011 and 2016.

A large proportion of the working population in the Local Area relates to the major industrial activities in the Poolbeg Peninsula, generally related to the Port activities (including transport, shipping, cargo and storage), the ESB power generating station, the waste to energy facility, the existing WwTP and medium sized industrial units.

This working population does not necessarily live within the Local Area but rather works in the area. Information contained within the Census of Population regarding employment is referring to the employment characteristics of those who live in the area. They may not work in the same area. The working population can be considered broadly to work at the following locations within the identified Local Area:

1. Ringsend Wastewater Treatment Facility;
2. Dublin Port and its related uses;
3. Electricity Supply Board (ESB);
4. National Oil Reserve Agency (NORA);
5. Dublin Waste to Energy Plant;
6. Hammond Metal Recycling Facility;
7. Marine Terminals Limited;
8. Rushfleet Containers;
9. Kilsaran South Bank Road;
10. Gary Keville Traffic Management company and GKT Heavy Haulage depot;
11. Dublin Bay Power Plant;
12. ED & F Man Liquid Products Ireland Limited; and
13. Ringsend Recycling centre.

The location of the above-mentioned facilities is shown in Figure 3-4 below.

The provision of day to day services to the resident population (i.e. restaurants/pubs and small-scale local shops and other amenities) are located at Sandymount Village and Ringsend.

There are presently approximately 40 full-time employees at the Ringsend WwTP facility.

It is recognised that the recent designation by Government of the Poolbeg West lands (including the former Irish Glass Bottle site) as a Strategic Development Zone (SDZ) will result in a significant increase in the working population within the study area. Section 2: Planning and Policy Context of this EIAR outlines the design parameters and development potential for this area. In summary, as many as 8,000 new jobs are planned for this SDZ as part of a mixed-use development. This will significantly increase the working population of this area.

Figure 3-4: Indicative location of Employment areas

3.3.1.3 Visiting Community

The visiting population comprises the visiting persons who could be attracted to the various tourism/leisure and recreational amenities located throughout the study area. The two types of attractions in the area can be characterised as formal and informal areas. Formal attractions comprise specific areas like cricket clubs, tennis courts, stadiums etc. whereas informal areas would incorporate open spaces and areas where the defined recreational use is not specified.

Regional Level

At the Regional Level, the Ringsend WwTP provides the necessary wastewater treatment for aspects of the visiting community, comprising: tourism, leisure and recreational amenities located within the Regional Level. According to Fáilte Ireland Visitor Attraction Survey 2016, revised in 2018, the following are the top 10 formal fee and free visitor attractions at a Regional Level:

1. Guinness Storehouse;
2. Dublin Zoo;
3. National Aquatic Centre;
4. Book of Kells;
5. The National Gallery of Ireland;
6. Irish Museum of Modern Art;
7. National Botanic Gardens;
8. St Patrick's Cathedral;
9. National Museum of Ireland - Archaeology, Kildare Street; and
10. Science Gallery at Trinity College Dublin.

In terms leisure and recreational amenities, the Regional Level would include a wide variety of informal and formal recreational spaces catering for various activity types. This would include, but is not limited to:

1. Hotels, Bars and Restaurants;
2. National Football Stadiums;
3. Sports Clubs, GAA and Soccer pitches; and
4. Public Parks.

There are formal National and Regional attractions adjacent to the Local Area but are outside of the defined Local Area. Sandymount Strand itself is also a popular destination for a variety of informal outdoor recreational activities for both locals and visitors alike.

Local Level

The most notable informal attraction in the local level is the recreational coastal walkway, which can be broadly defined as beginning at the Merrion Gates and extending along Sandymount promenade towards Sean Moore Park onto the Irishtown Nature Reserve and continuing onto the Great South Wall. When the sea level permits, direct routes across Sandymount Strand are possible. It is further noted that the Sandymount Strand area is also a popular destination for a variety of informal outdoor recreational activities and serves a wide catchment of south Dublin and beyond. The Ringsend WwTP is located beside the informal pathway from the Irishtown Nature Reserve to the public access route towards the Great South Wall.

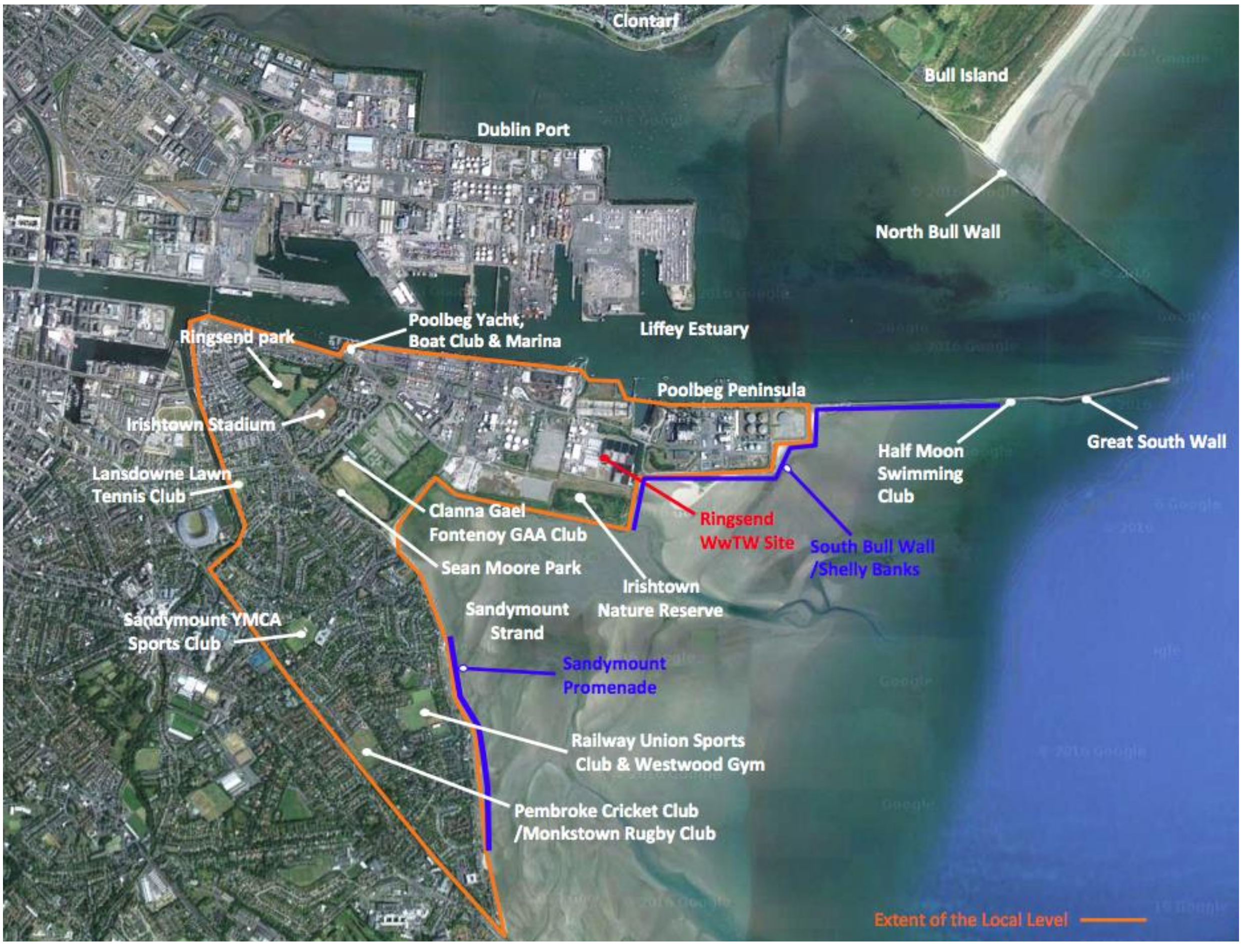

Figure 3-5: Location map of amenity and recreation areas in the Local Level

Furthermore, large numbers transit through the area on their way to and from sporting and cultural events at the Aviva Stadium, which is located immediately west, but outside the Local Area.

The list of formal and informal amenity and recreational areas in the study area, which contribute to the characteristics of the area are listed as follows and shown in Figure 3-5:

- Pembroke Cricket Club/Monkstown Rugby Club;
- Sandymount YMCA Sports Club;
- Lansdowne Lawn Tennis Club;
- Railway Union Sports Club & Westwood Gym;
- Irishtown Stadium;
- Ringsend Park;
- Poolbeg Yacht, Boat Club & Marina;
- Clanna Gael Fontenoy GAA Club;
- Sean Moore Park;
- Sandymount Strand, Promenade;
- Half Moon Swimming Club;
- Shelly Banks/Great South Wall;
- Great South Wall; and
- Poolbeg Yacht Club and Marina.

In addition, due to the coastal nature of the local area, bathing forms a part of the attraction for the visiting population, particularly during the warmer months. There are a number of access points located along the shoreline. Given the characteristics of the high / low tide in the area, entry into the water can take place along the eastern section of the coastline.

3.3.2 Human Health

To gather a baseline description of the existing environment in which the Proposed WwTP Component is situated, it is appropriate to inspect published health profiles and statistics (e.g. Dept. Of Health: Health In Ireland, Key trends 2017). This gives an overall indication of health trends in Ireland and allows for examination of reported health at a more local level. The Health Profile for Dublin City (Lenus, 2015) indicates that Dublin City has a higher than average number of persons who report their health as being bad or very bad 2% (national 1.5%) or who have a disability 14.9% (national 13.0%) (see Table 3-5 and Table 3-6). Cancer incidence rates are higher than average for female malignant melanoma, male colorectal cancer and male and female lung cancers (County level data). Mortality rates are above national average for heart disease and stroke in those aged under 65 years (County level data).

The 2016 Census figures also provide the latest figures with regard to the self-rated health reported disability within the population and carers in society, both at a national and local level. The data also suggests that Dublin City has a higher than average number of persons who report their health as being bad or very bad, or who have a disability (see Figure 3-6 and Figure 3-7).

Table 3-5: Percentage of population with a stated disability

	% population with a disability
State	13.50%
Dublin SPA*	13.10%
Dublin City (LA)*	14.70%
Pembroke – South Dock (MD/LEA)*	11.50%

*Geographical Hierarchy:
SPA =Strategic Planning Area, LA = Local Authority, MD/LEA = Municipal District or Local Electoral Area

Table 3-6: General Health Reporting

	Very Good	Good	Fair	Bad	Very Bad
State	59.40%	27.60%	8.00%	1.30%	0.30%
Dublin SPA*	59.60%	26.60%	7.40%	1.30%	0.30%
Dublin City (LA)*	55.60%	27.20%	8.50%	1.70%	0.40%
Pembroke – South Dock (MD/LEA)*	57.10%	23.70%	6.40%	1.10%	0.30%

*Geographical Hierarchy:
SPA =Strategic Planning Area, LA = Local Authority, MD/LEA = Municipal District or Local Electoral Area

At a local level, the reported statistics are largely consistent with the Dublin City and national averages (see Table 3-7 and Table 3-8).

Table 3-7: Percentage of population with a stated disability by Electoral Districts in the Local Area

Electoral Area	% population with a disability
Pembroke East A	15.20%
Pembroke East B	11.40%
Pembroke East C	11.10%

Table 3-8: General Health Reporting by Electoral Districts in the Local Area

Electoral Division	Very Good	Good	Fair	Bad	Very Bad
Pembroke East A	57.10%	25.90%	8.90%	1.80%	0.40%
Pembroke East B	63.30%	23.10%	6.20%	1.00%	0.20%
Pembroke East C	65.50%	23.20%	5.50%	0.50%	0.10%

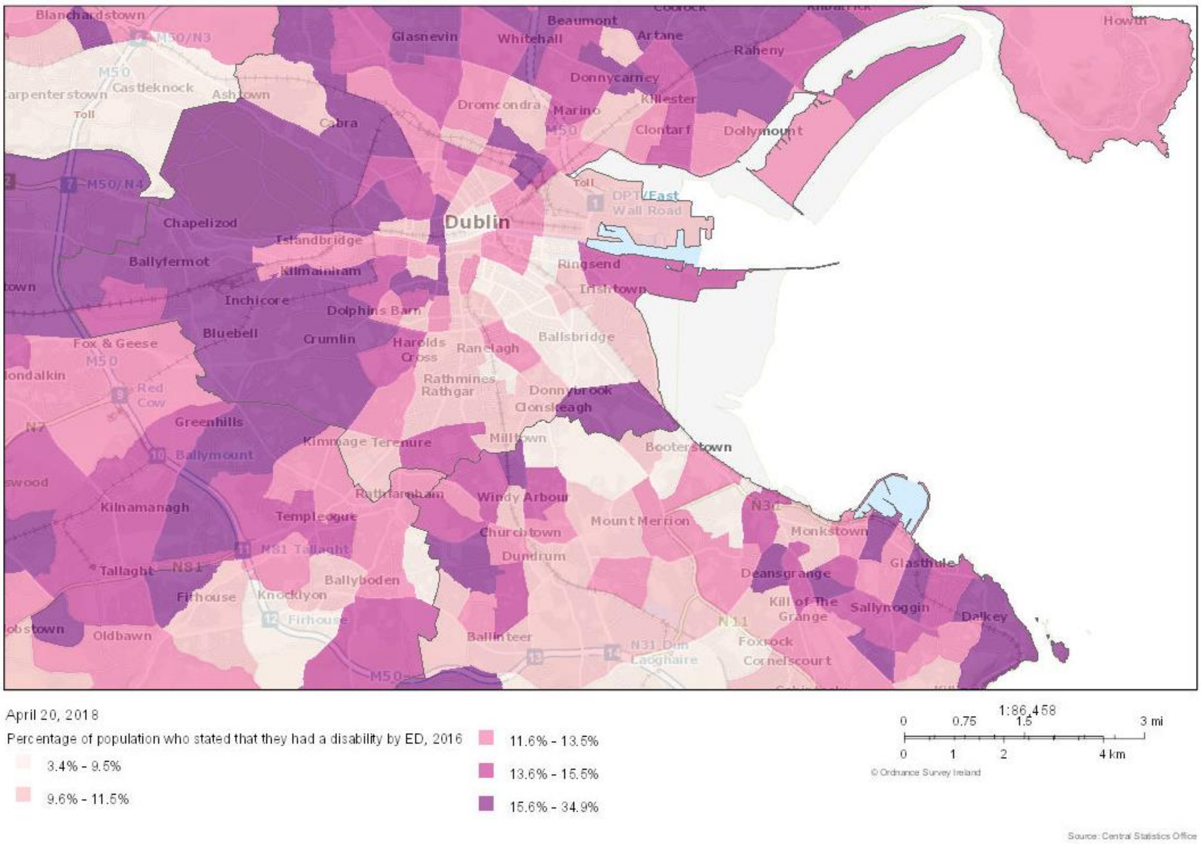

Figure 3-6: Percentage of Population who stated they had a disability by Electoral District, 2016 (Source: CSO)

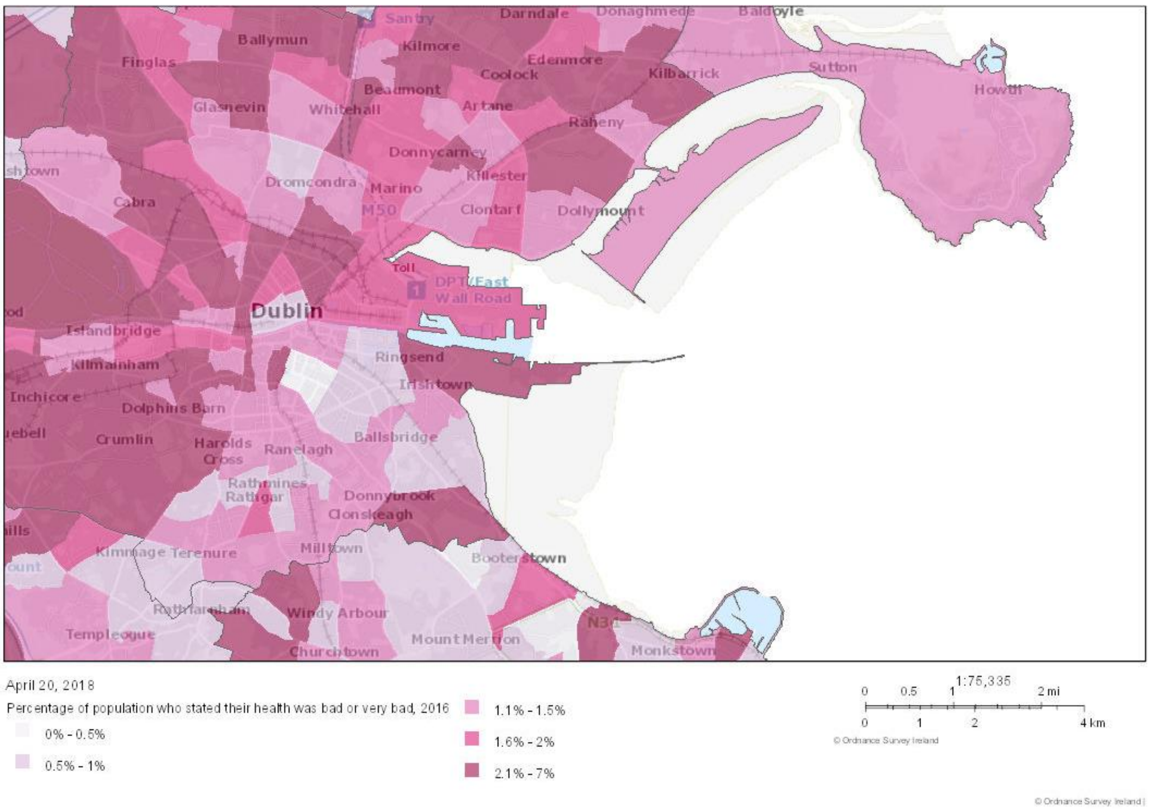

Figure 3-7: Percentage of Population who stated their health was bad or very bad by Electoral District, 2016 (Source: CSO)

Section 4.2.1 of the Draft EPA Guidelines (2015) advise that the location of sensitive neighbouring occupied premises with the potential to be directly affected by the Proposed WwTP Component be indicated. In particular:

- Homes;
- Hospitals;
- Hotels and holiday accommodation;
- Schools and rehabilitation workshops;
- Tourism and recreational facilities and amenities; and
- Economic activities such as visitor attractions based on cultural / historic or natural assets.

The above sections provide a detailed description of the local, working and residential population that live within and visit the local and regional area. It is also noted that sensitive receptors have also been identified within each of the specialist Sections and assessed according to the guidelines that are relevant to that expertise.

In addition, the following facilities are also present within the Local Area that are relevant to Human Health:

- Irishtown Health Centre, Irishtown Road, Dublin 4, Ireland;
- St. Patrick's Boys National School, Cambridge Road, Dublin 4;
- St. Patrick's Girls National School, Cambridge Road, Dublin 4;
- Ringsend College / Collaiste na Rinne, Cambridge Road, Dublin 4; and
- Ringsend Community Centre, Thorncastle Street, Dublin 4;

There are also a number of amenities in the area that facilitate activities and exercise, including for example sport facilities such as tennis, basketball and soccer in Ringsend Park.

In the Regional Area, the bathing facilities in Dublin Bay are considered as being vulnerable to water pollution. These include Dollymount Strand, Sandymount Strand, Merrion Strand and Seapoint.

In addition to the sensitive environmental receptors identified in the sub-section above, a number of submissions were received during the Public Consultation process that related to Human Health. This assessment has reviewed the public consultation report for consideration in the overall assessment. The range of submissions received can be summarised as follows:

- Provision of mitigation measures for water quality both during construction and operational phases, with regular monitoring;
- Provision of mitigation measures for noise and vibration both during construction and operational phases, with regular monitoring;
- Provision of mitigation measures for air quality both during construction and operational phases, with regular monitoring;
- Protection from contamination of water bodies, as well as the safe processing, recovery and management of sludge, phosphate and any other residual semi-solid material generated from sewage or wastewater treatment processing;
- Concern about what odours might come from the plant and how this would affect the public;
- A request was made for a dust mitigation plan to protect local premises;
- A pest control plan and adequate pest control measures to deal with displaced rodents; and
- A request was made for a traffic management plan to be put in place and that audits for all relevant hazardous materials, such as asbestos, are carried out prior to demolition.

These submissions as raised have been considered as part of the overall assessment by the relevant specialists. The findings of the public consultation exercise for the Proposed WwTP Component is compiled and presented in the *Scoping of Environmental Impact Statement & Natura Impact Statement; Report on Public Consultation*, provided in Appendix 2C. Details on how matters were raised in the public consultation phase are provided in Volume 2, Section 2.5.1.

3.4 Characteristics of the WwTP Component of the Proposed Upgrade Project

3.4.1 Construction Phase

A detailed description of the Proposed Upgrade Project and Proposed WwTP Component is provided in Section 1 and Section 3 of Volume 2 of this EIAR. These facilities are required to provide for the increased capacity of 2.4 million PE and to achieve the required effluent standards. Volume 2, Section 3: Description of Proposed Upgrade Project and the Construction Management Plan outlines the specific details in relation to the Proposed WwTP Component.

The proposal to upgrade the treatment facilities at Ringsend WwTP will involve significant interaction with the existing plant.

The Ringsend WwTP will remain operational for the duration of the construction works in order to cater for the treatment of wastewater of the Greater Dublin catchment. In this context, it will be necessary to carry out the Proposed WwTP Component on a phased basis over a period of 7 to 10 years.

The more intensive period of construction activity occurring in the initial 2-3 years is associated with the construction of additional Secondary Treatment capacity and associated works, including pipes and connections. Full details of the construction stages of the Proposed WwTP Component can be found in Volume 2, Section 3: Description of Proposed Upgrade Project of this EIAR.

As part of the construction phase of the Proposed WwTP Component, 3 no. construction compounds will be utilised to accommodate construction activity (see Figure 3-8). The 3 no. compounds are to be located adjacent to the existing Ringsend WwTP site. There are 2 no. construction compounds for the duration of the development of the site (C1 and C2) and the remaining compound (C3) is required for 3 years, which is during the intensive construction period. Permission already exists for Compound C3 to be used for a period of 3 years as part of the 2012 Approval. Volume 2, Section 3: Description of Proposed Upgrade Project outlines specific details in relation to the characteristics of the construction compounds.

Figure 3-8: Construction Compound Areas

Construction Activities associated with the Proposed WwTP Component include additional vehicle movements in the Local Area and these are discussed in more detail under Volume 3, Section 13: Traffic. In addition, cranes and temporary hoarding/screening will be in place during the construction period which would be noticeable to people passing close to the construction site. This is discussed in detail under Volume 3, Section 14: Landscape and forms a normal part of the general construction activity.

It is envisaged that up to 150 no. operatives will be engaged on-site during the peak construction phase of 2019/2020.

3.4.2 Operational Phase

At the operational phase, the Ringsend WwTP will have increased capacity for wastewater treatment to an average maximum design capacity of 2.4 million PE within the confines of the site. This enables the Ringsend WwTP to facilitate the regional growth of its catchment.

3.5 Potential Impacts

3.5.1 Do-Nothing Impacts

3.5.1.1 Regional Level

The 'Do-nothing' scenario at a regional level would result in the treatment of wastewater continued to be provided at Ringsend WwTP. Regional impacts would relate primarily to the restricted increase of the resident, employment and visiting population.

3.5.1.2 Local Level

The 'Do-nothing' scenario would result in potential direct impacts at a local level, following the regional level, which would, if not developed, impact on the expansion of the resident population, employment and visiting populations.

As a result of the 'Do-nothing' scenario, there would be no potential for direct and indirect social and economic benefits arising from the Proposed WwTP Component for the local and regional level.

3.5.1.3 Human Health

The 'Do-nothing' scenario would continue to facilitate the impairment of water quality in Dublin Bay which could indirectly contribute to increased risks of infection level, which would, if not developed, impact on the expansion of the resident population, employment and visiting populations.

3.5.2 Construction Phase

3.5.2.1 Resident Population

Regional Level

Specific to the Proposed WwTP Component, there is no potential for a likely significant adverse direct effect on the overall population growth figures of the Greater Dublin Area or the study area arising from the Proposed WwTP Component during its construction phase. Furthermore, it is not considered likely that there will be any adverse indirect impact to the population of the Greater Dublin Area arising from the construction phase.

Local Level

There is the potential for adverse indirect impacts of short to medium-term duration to the resident population arising from the construction phase of the Proposed WwTP Component. These impacts will arise due to normal activities associated with a temporary construction phase of a project. In terms of impacts, a factor worth noting is the general character of the immediate vicinity of the site itself. The Poolbeg area is one where there is a lot of activity of an industrial nature. This has been on-going for decades and as a result, people attribute this area to industrial related uses over the years. For the resident population outside the immediate vicinity of the site, the more obvious indication of construction will be the presence of cranes on site, or the passing of construction vehicles on the public roads. The details of these specific effects and the proposed mitigation measures are discussed in detail under Volume 3, Section 8: Air and Climate, Volume 3, Section 13: Traffic and Volume 3, Section 14: Landscape.

As outlined above, the nearest residential population in the Local Area are positioned approximately 950 m south-west of the proposed site at Ringsend along Strand Road/Beach Road, or slightly further away along on the northern end of Seán Moore Road, as shown under Figure 3-2. The construction activities are primarily focused on site and in the immediately adjoining construction compounds and do not directly affect the residential population in the Local Area.

The implementation of the Poolbeg West Planning Scheme (once approved) will ultimately result in an indicative layout which locates dwellings closer to the subject lands than exist at present. However, the SDZ Planning Scheme incorporates a range of employment uses, including Port uses, that will likely act as a buffer along the eastern section of the SDZ lands.

From the perspective of the resident population, indirect impacts in the form of HGV movements during the construction phase would have the potential for negative short-term impacts, particularly in conjunction with the development of Alexandra Basin project and Poolbeg West SDZ. The details of these specific impacts and the proposed mitigation measures are discussed in detail under Volume 3, Section 13: Traffic.

3.5.2.2 Working Population

Regional Level

The construction phase is likely to have indirect positive impacts on ancillary support services in the building supply services, professional and technical professions, etc. These beneficial impacts on economic activity will be largely temporary but will contribute to the overall future viability of the construction sector and related services and professions over the construction period.

Local Level

The associated construction activity in the short to medium-term will see an increase in the working population for this period in this area. This will assist in addressing the national and local unemployment rates, which is a positive impact. It is anticipated that up to 150 construction workers will be employed on site during the peak construction period.

The influx of construction workers also has the potential to impact positively on businesses within the immediate study area (i.e. the villages of Sandymount and Ringsend) and in surrounding areas that offer a range of ancillary services for the workers (e.g. cafés/restaurants) and the service providers (i.e. materials, products, etc). This will facilitate further employment opportunities in the local service industry to arise. The likely effect of the Proposed WwTP Component is a positive, short to medium-term economic effect which is imperceptible on the local economy within the study area.

3.5.2.3 Visiting Community

Regional Level

The Ringsend WwTP will continue to operate during the course of the construction phase. The treatment of wastewater arising from the visiting population at a Regional level. There is no potential for a likely significant adverse direct effect on the visiting community at the Regional Level arising from the Proposed WwTP Component during its construction phase.

Local Level

The visiting population, in particular those who would avail of the walkway through Irishtown Nature Park and along the Great South Wall will be most aware of the construction activities taking place, particularly the activity scheduled to occur at or around the south-east corner of the site. Such an impact has the potential to be indirect, slightly adverse and short to medium term in nature.

Other visitors, particularly those using Merrion Strand are also likely to be aware of construction activity on the site. Any such impact is expected to be neutral in the context of existing activities in the immediate vicinity of the site, including the day to day activities at Dublin Port.

Visitors to the area immediately surrounding the Proposed WwTP Component will have the potential to be conscious of greater volumes of construction traffic on the local roads for the duration of the construction stage. Due to the longer construction programme, these impacts are expected to be indirect, slightly negative and short-term during the construction period, with the greatest impact during the peak construction period between 2019 and 2020. The details of these specific impacts and the proposed mitigation measures are discussed in detail under Volume 3, Section 8: Air and Climate and Volume 3, Section 13: Traffic.

The remaining recreational activities, located 1 km or further away from the site within the Local Area, will continue to operate largely unaware of the on-site construction activities, although there is potential for these visitors to be aware of increased traffic movements that arise.

3.5.2.4 Human Health

The impacts from the construction phase from the different Sections within this EIAR have been summarised in Table 3-9 below. Where residual impacts have been identified as neutral or imperceptible, it can be objectively concluded that there will be no potential for a significant negative effect on Human Health and consequently, they can be excluded from further consideration. Sections that identify emissions or the potential for significant effects have been screened for further examination or assessment.

Table 3-9: Summary of Potential Construction Impacts and effects on Human Health

Section	Section	Summary of predicted Impact	Potential for significant effects on Human Health
Section 4	Water	Effluent Discharge to Dublin Bay will comply with Water Framework Directive (WFD), Urban Waste Water Treatment Directive (UWWTD) and Bathing Water Directive (BWD). There is an anticipated deterioration of water quality in 2019/2020 due to construction and upgrade activities.	Potential effects on Bathing Water Quality, and on population groups that utilise Dublin Bay as an Amenity.
Section 5	Biodiversity - Terrestrial	No significant residual impacts on Biodiversity.	No significant effect on Human Health.
Section 6	Biodiversity -Marine	There will be a reduction in discharged nutrients and suspended solids and as a result, benthic diversity, will have a positive impact on bird and marine mammals that forage.	No significant effect on Human Health.
Section 7	Land and Soils	Removal and appropriate disposal of contaminated soils.	No significant effect on Human Health.
Section 8	Air and Climate	Potential for dust arising from construction activities.	Potential dust impacts on surrounding areas. Air quality.
Section 9	Noise and Vibration	Noise emissions from a range of plant and machinery both during construction and operational phases.	Potential effects from construction noise.
Section 10	Odour	Predicted odour concentrations are below the adopted odour annoyance criterion of 3 $ouE.m^{-3}$ as the 98th percentile of hourly averages, as set out under the existing 2012 approval. Predicted odour concentrations at the Ringsend WwTP boundary do not breach the Ringsend Project Odour Goal (10 $ouE.m^{-3}$ as the 99.4th percentile of hourly average, as set out under the existing 2012 Approval.	Potential effects for Human Health.
Section 11	Cultural Heritage	No significant residual impacts on Cultural Heritage.	No significant effect on Human Health.
Section 12	Material Assets	No significant residual impacts on Material Assets.	No significant effect on Human Health.
Section 13	Traffic	Increased Traffic volumes due to construction and operation.	Potential for traffic emissions (noise / air quality).

Section	Section	Summary of predicted Impact	Potential for significant effects on Human Health
			Increase in traffic accidents/ injuries/deaths.
Section 14	Landscape	No significant residual Landscape or visual impact will remain on amenities, activities, character, uses or views within either the Poolbeg or Dublin Bay areas.	No significant effect on Human Health.
Other	Raised at public consultation	Potential for pets and rodents to be attracted to or displaced by construction and operational activities.	Rodents are potential vectors of disease.

From Table 3-9, and the feedback from the public consultation, the following sections were identified for further assessment with respect to Human Health.

- Water Quality;
- Air and Climate - Dust;
- Noise;
- Odour;
- Traffic; and
- Pests.

These potential impacts are considered individually in this sub-section. Where applicable, human health impacts have been assessed with respect to relevant standards and guidelines.

Water Quality

The Proposed WwTP Component proposes to discharge treated effluent into Dublin Bay. The details on the nature and the quality of this treated effluent, together with the modelling and assessment are detailed in Volume 3, Section 4: Water of this EIAR.

It is noted that the Dublin Bay waters are not utilised as a resource for human consumption (i.e. an abstraction point for drinking water), but it is utilised as a recreational area and for swimming. Furthermore, Dublin Bay is a resource for fish and shellfish intended for human consumption Potential impacts from water quality on Biodiversity, which is detailed in Volume 3, Section 5: Biodiversity - Marine and Section 6: Biodiversity - Terrestrial could also indirectly impact human health and well-being, through their enjoyment and use of this amenity.

Accordingly, the Bathing Water Directive and Bathing Water Quality Regulations SI 79/2008 (as amended) are an appropriate determinant of the potential for significant effects on Human Health. It is an objective of the Regulations to improve the protection of bather's health and set strict standards for water quality. It takes a pro-active approach to the assessment of possible pollution risks, and to the management of bathing waters. It also places considerable emphasis on promoting increased public involvement, and for improved dissemination of information on bathing water quality to the general public.

Bathing waters are now classed into four quality categories which are based on 'Excellent', 'Good', 'Sufficient', or 'Poor' with a minimum target of 'Sufficient' required to be achieved for all bathing waters. The ratings are based on the amount of colony forming units of microbiological parameters *E.coli* and *Intestinal Enterococci* within a sample. Table 1-1 and Table 3-10 below outlines the standards:

Table 3-10: Bathing Water Quality Thresholds

Parameter	Excellent	Good	Sufficient
E.coli (Coastal) (cfu/100ml)	250*	500*	500**
Intestinal enterococci (coastal) (cfu/100ml)	100*	200*	185**

(*) based on a 95-percentile evaluation (**) based on a 90-percentile evaluation

Volume 3, Section 4: Water of this EIAR determines that the construction phase will not impact on designated bathing waters and as such, there are no associated effects on Human Health. However, during the construction phase, the winter of 2019/2020 is expected to result in a reduction in the final effluent quality while the construction phase of the Proposed WwTP Component is underway, as aspects of the WwTP are decommissioned on a phased basis during upgrade works. During this period, it has been identified in the Section 4: Water that there will be minor and temporary dis-improvements in BOD and Suspended Solids currently predicted during the 2019/2020 season. This has the potential to cause indirect impacts to bathers in Dublin Bay during the winter of 2019 and 2020.

Bathers are identified as being vulnerable to the quality of the water in which they swim. Numerous illnesses are associated with bathing in natural waters, and recent studies results suggest that bathers in coastal waters generally have a greater risk of experiencing a variety of illnesses compared to non-bathers (*Leonard et. al,* 2018).

Whilst present, this identified impact is not considered as significant due to the timing and duration of the impaired water quality, as well as extent to which the effects will be observed. The works are expected to occur during the winter of 2019/2020 when recreational swimmers are at seasonally low levels. Furthermore, the water quality assessment provided in Section 4 of this EIAR suggest that this impact will not result in an overall deterioration in Bathing Water Quality at designated Bathing Areas.

Consequently, it can be concluded that the construction phase of the Proposed WwTP Component will not give rise to significant impacts on human health due to water quality impacts

Air and Climate

Volume 3, Section 8: Air and Climate of this EIAR identifies two impacts associated with the construction phase - namely dust and emissions associated with traffic generated through construction activities, including nitrogen oxides, carbon dioxide and benzene.

Dusts (or particulate matter) can be classified as either total inhalable dust or respirable dust. The different categories relate to the size of the particulates in the atmosphere. Respirable dust is finer and thus able to penetrate further into the lungs, where it can remain. The main health effects associated with dust exposure are bronchitis, asthma and in extreme cases cancer.

Controlling activities that generate dust during the construction phase of the Proposed WwTP Component will protect human health and is discussed in detail in Section 8 of this Volume of the EIAR. The maximum permissible emission level for dust deposition over a one-year period is 350 mg/m^2/day at any receptors outside the site boundary. This value is a generally adopted threshold, which is set at a level considered appropriate for the protection of Human Health and to allow for the enjoyment of amenities in the vicinity of the Proposed WwTP Component.

In relation to traffic emissions during the construction phase of the Proposed WwTP Component, the air quality dispersion modelling has found that there will be an imperceptible impact for all pollutants at all receptors assessed. No other aspect of the Proposed WwTP Component will give rise to Air and Climate impacts with a potential to cause adverse Human Health effects.

It can therefore be concluded that, throughout the 10-year construction phase of the Proposed WwTP Component, there will not be significant adverse effects on Human Health, following the implementation of mitigation measures and best practice standards and guidelines as detailed in Section 8: Air and Climate.

Consequently, it can be concluded that the construction phase of the Proposed WwTP Component will not give rise to significant impacts on human health due to potential air quality impacts.

Noise and Vibration

Volume 3, Section 9: Noise and Vibration of this EIAR identifies potential noise impacts from the construction phase of the Proposed WwTP Component - mainly from activities involving piling, excavation of the site and the erection of onsite structures over a phased period. These primary sources of noise are expected to arise from onsite construction works and activity in the proposed construction compounds, as well as increased additional traffic on public roads.

Noise has the potential to impact on Human health, and the health effects of exposure to significant construction noise levels are well documented (e.g. Seizas *et al.*, 2005). Exposure to elevated background noise can also lead to hypertension and ischemic heart disease and impact on mental health through annoyance, sleep disturbance, and decreased concentration and activity (Passchier-Vermeer W., 2000).

The nearest noise receptors are located approximately 950 to 1250 metres from the nearest boundary of the site. The noise model and assessment determine that construction activities at the site will not give rise to significant noise levels and will comply with standards and threshold noise limits (BS8223:2014), which are set to protect human health and exposure to undue noise levels Therefore, it can be concluded that construction noise will not give rise to significant adverse effects on human health.

Odour

The Proposed WwTP Component has the potential to cause nuisance odours and thereby requires careful consideration. Volume 3, Section 10: Odour of this EIAR identifies potential odour emissions that may emanate from the site during the construction phase of the Proposed WwTP Component. A literature review was undertaken (Government of Alberta, 2017, Institute for Air Quality Management, 2014) on odour and its effects on human health.

The relationship between odours and physiological or psychological health is extremely complex and it is recognised that a human being utilises a number of cerebral functions to analyse a smell. Responses to an odour are influenced by a wide variety of odour characteristics (e.g., hedonicity, familiarity) and individual factors (e.g., subjective expectations, personal experience with an odour). Different odours induce different responses, and odours appear to influence cognitive and mood profiles (Government of Alberta, 2017).

Human beings can become emotionally distressed by the odour - a direct action of our cerebral amygdala as part of our higher senses of the cerebrum. Epidemiology studies have shown that exposures to environmental odours from sources such as livestock facilities, sewage treatment plants and industrial sources can lead to factors associated with negative mood (stress, gloom, depression, anger and fatigue). At a community level, prolonged exposure can lead to social unrest phenomenon about the odours to which they are being exposed.

At high concentrations, health symptoms and physiological responses to unpleasant odours can begin to develop, with irritant symptoms that can include:

- Sore itchy eyes (conjunctival irritation by the presence of a compound in a certain odour);
- Throat irritation (mucous membrane irritation by the presence of a compound in a certain odour);
- Dry coughing (again mucous membrane irritation);
- Nausea;
- Possible vomiting; and
- With certain compounds (such as hydrogen sulphide H2S), severe exposure to certain odours can cause aerobic cellular paralysis and lead to loss of consciousness.

Historically, the Ringsend WwTP has been the subject of numerous odour complaints and in response, a project odour goal was implemented, with the implementation of an odour management plan. This has resulted in a significant fall in the number of complaints the WwTP has received.

During the construction phase, the existing criteria of $3ou_E.m^{-3}$ for the site will continue to be met throughout construction activities, save where those construction activities require temporary shut-down of existing odour control units to facilitate new connections to the units. The risk of off-site impacts will be managed in accordance with the site's Odour Management Plan (OMP) with all steps being made to minimise the magnitude and duration of potential impacts. The odour assessment concludes that these incidents are unlikely to result in a perceptible change in off-site odour concentrations.

Consequently, odour impacts during the construction phase will be within existing limits, save for occasional additional impacts as described above. Such impacts are considered to be temporary and minor in terms of human health effects.

Traffic

The World Health Organisation (2006) considers road traffic one of the most important determinants of health in Europe. Traffic-related air pollution, noise, crashes and social effects can combine to generate a wide range of negative health consequences, including increased mortality, cardiovascular, respiratory and stress-related diseases, cancer and physical injury. These impacts can impact on residential communities in which the traffic is generated and particularly vulnerable groups such as children and elderly people, cyclists and pedestrians.

Volume 3, Section 13: Traffic of this EIAR details the predicted impacts on traffic volumes in the local area arising from construction activities associated with the Proposed WwTP Component. Emissions associated with these traffic volumes have also been assessed, namely in Section 8: Air and Climate and in Section 9: Noise and Vibration. Both types of emissions have the potential to cause adverse effects on Human Health, and have been assessed in the above sub-sections. Air quality models and noise models that are based on predicted traffic numbers demonstrate that construction traffic will not give rise to exceedances of thresholds that protect human health.

The other obvious potential health impacts associated with changes in construction traffic activity include increased risk of road traffic accident and injury. This is considered under human health as well as in Volume 3, Section 15: Risk Management (Major Accidents and Natural Disasters).

As detailed in Volume 3, Section 13 of this EIAR, a traffic management plan will be implemented throughout the construction phase. Construction traffic will not give rise to increased journey times and traffic disruption following the implementation of mitigation measures and best practice standards and guidelines.

It is considered that the implementation of the traffic management plan will therefore minimise emissions associated with construction traffic volumes as well as minimise the risk of the occurrence of traffic accidents. Therefore, it can be concluded that construction traffic will not give rise to significant adverse effects on human health. No mitigation measures are required from a human health perspective further to those outlined in Volume 3, Section 13: Traffic of this EIAR.

Rodent and Pest Control

Rodent-borne diseases and their associated risks for public health is a well researched topic (e.g. Meerburg, Singleton & Kijlstra, 2009) and there are a large number of known pathogens that are directly or indirectly transmitted by rodents, including salmonellosis, toxoplasmosis, ornithosis and leptospirosis (CIEH, 2009). These diseases and their associated vectors present significant risks to human health.

Construction activities, particularly on brownfield sites have the potential to result in the disruption and dispersion of rodents that habitually move through sewer networks in and around the site, and inadvertently facilitate the potential spread of diseases.

At the Ringsend WwTP, there is an ongoing pest management program utilised on site. The operator has contracted a specialist pest control company to conduct a minimum of 4 site visits per annum, during which bait and traps are inspected or replaced. Site inspections are monitored and where there is evidence of a potential rodent problem, additional control measures are implemented. A specific query to the contractor as part of this assessment confirmed that there is no current or ongoing pest problems at the site.

3.5.3 Operational Phase

3.5.3.1 Resident Population

Regional Level

There is no potential for a direct negative impact on the resident population of the Greater Dublin Area arising from the Proposed WwTP Component during its operational phase.

There is however potential for an indirect moderate positive long-term impact on the population of both the Greater Dublin Area and the regional area arising from the Proposed WwTP Component. The growth in the population will facilitate the growth of the Greater Dublin Area, which in turn supports development of residential, commercial and industrial projects. The development of residential schemes will provide additional homes which are key to sustaining growth, while commercial and industrial projects will support increased job opportunities and increased economic growth. The upgrading and modernisation of the wastewater infrastructure will also support the protection of public health and the environment.

Local Level

In addition, the future population of the local level is expected to increase as the Poolbeg West SDZ lands will be facilitated as a result of the Proposed WwTP Component. The resident population within the study area will be facilitated for continued growth as a direct result of the operational phase of the Proposed WwTP Component.

3.5.3.2 Working Population

Regional Level

A potential indirect, positive, moderate long-term impact of the operational phase of the Proposed WwTP Component is that the planned developments within the Greater Dublin Area served by the Proposed WwTP Component can occur and with this, the employment benefits associated with both the construction phases and operational phases of those developments can be expected to generate further significant additional jobs.

Local Level

No likely significant negative impacts have been identified that will arise to the working population during the operational stage.

The slight positive, long term, direct impact of the Proposed WwTP Component is that there will be 15 no. additional employees at the Ringsend WwTP.

3.5.3.3 Visiting Community

Regional Level

It is considered that no likely significant negative impacts will arise to the regional visiting population at the operational stage.

Local Level

There is a potential impact that the visiting population, particularly those using the coastal walkway, will be conscious of a change in the appearance of the overall complex arising from adjustments to landscaping and boundaries to the site. Impacts on the visual appearance and landscape during the operational phase of the Proposed WwTP Component are outlined in more detail under Volume 3, Section 14: Landscape and Volume 3, Section 12: Material Assets.

It is envisaged that there could be indirect, secondary, positive impacts arising from the Proposed WwTP Component for visitors to Sandymount Strand due to the overall improvements in water quality that are expected to arise as a result of the Proposed WwTP Component.

3.5.3.4 Human Health

The residual impacts from the operational phase of the Proposed WwTP Component have been summarised in Table 3-11 below. Where residual impacts have been identified as neutral or imperceptible, it can be objectively concluded that there will be no potential for significant effects on Human Health and consequently, they can be excluded from further consideration. Sections that identify emissions or the potential for significant effects have been brought forward for further examination or assessment.

Table 3-11: Summary of potential operational impact and effects on human health

Section	Section	Summary of predicted Impact	Potential for significant effects on Human Health
Section 4	Water	Effluent Discharge to Dublin Bay will comply with Water Framework Directive (WFD), Urban Waste Water Treatment Directive (UWWTD) and Bathing Water Directive (BWD).	There will be an expected improvement in water quality in Dublin Bay. No potential for significant effects on Human Health provided water quality standards are met.
Section 6	Biodiversity - Terrestrial	No significant residual impacts on Biodiversity.	No significant effect on Human Health.
Section 7	Land and Soils	There are no significant residual impacts on Land and Soils.	No significant effect on Human Health.
Section 8	Air and Climate	No significant impacts associated with the operational phase.	No significant effect on Human Health.
Section 9	Noise and Vibration	Noise emissions from a range of plant and machinery during operational phases.	Potential effects from operational noise.
Section 10	Odour	Odour Annoyance Criterion - 3 ouE.m^{-3} as the 98th percentile of hourly averages at receptor locations. Odour Goal - 10 ouE.m^{-3} as the 99.4th percentile of hourly averages at the boundary of the wastewater site.	Consider for potential effects on Human Health.
Section 11	Cultural Heritage	No significant residual impacts on Cultural Heritage.	No significant effect on Human Health.
Section 12	Material Assets	No significant residual impacts on Material Assets.	No significant effect on Human Health.
Section 13	Traffic	Increased Traffic volumes due to operational activities.	Potential for traffic emissions (noise / air quality). Increase in traffic accidents/ injuries/deaths.
Section 14	Landscape	No significant residual landscape or visual impact will remain on amenities, activities, character, uses or views within either the Poolbeg or Dublin Bay areas.	No significant effect on Human Health.

From Table 3-11 above, the following sections were identified for further assessment with respect to Human Health.

- Water Quality;
- Noise;
- Odour; and
- Traffic.

These potential impacts are considered individually in this section. Where applicable, human health impacts have been assessed with respect to relevant standards and guidelines.

Water Quality

The Proposed WwTP Component proposes to discharge treated effluent into Dublin Bay. The details on the nature and the quality of this treated effluent, together with the modelling and assessment are detailed in Volume 3, Section 4: Water of this EIAR.

It is noted that the Dublin Bay waters are not utilised as a resource for human consumption (i.e. an abstraction point for drinking water), but it is utilised as a recreational area and for swimming. Furthermore, Dublin Bay is a resource for fish and shellfish intended for human consumption. Potential impacts from water quality on Biodiversity, which is detailed in Volume 3, Section 5: Biodiversity - Marine and Section 6: Biodiversity - Terrestrial could also indirectly impact human health and well-being, through their enjoyment and use of this amenity.

Accordingly, the Bathing Water Directive and Bathing Water Quality Regulations SI 79/2008 (as amended) are an appropriate determinant of the potential for significant effects on human health. It is an objective of the Regulations to improve the protection of bather's health and set strict standards for water quality. It takes a pro-active approach to the assessment of possible pollution risks, and to the management of bathing waters. It also places considerable emphasis on promoting increased public involvement, and for improved dissemination of information on bathing water quality to the general public.

Bathing waters are now classed into four quality categories which are based on 'Excellent', 'Good', 'Sufficient', or 'Poor' with a minimum target of 'Sufficient' required to be achieved for all bathing waters. The ratings are based on the amount of colony forming units of microbiological parameters *E.coli* and *Intestinal Enterococci* within a sample. Table 3-10 in Section 3.5.1.4 of this EIAR outlines the standards.

Volume 3, Section 4: Water of this EIAR determines that the operation phase will result in an overall improvement in water quality, and it is not expected that the operation of the Proposed WwTP Component will impact on designated bathing waters.

Bathers are identified as being vulnerable to the quality of the water in which they swim. Numerous illnesses are associated with bathing in natural waters, and recent studies results suggest that bathers in coastal waters generally have a greater risk of experiencing a variety of illnesses compared to non-bathers (*Leonard et. al,* 2018).

Therefore, it can objectively be concluded that the Proposed WwTP Component will give rise to indirect positive impacts, due to improvements in water quality, though the risks identified remain ever-present due to background inputs from variety of natural (e.g. bird droppings) and anthropogenic sources.

Noise

Volume 3, Section 9: Noise and Vibration of this EIAR identifies potential noise impacts from the operation phase of the Proposed WwTP Component - mainly from noise emission from plant and machinery used to operate the site. Noise generated by additional traffic on public roads during the operational phase has also been considered.

Noise has the potential to impact on Human health, and the health effects of exposure to significant construction noise levels are well documented (e.g. Seizas *et al.*, 2005). Exposure to elevated background noise can also lead to hypertension and ischemic heart disease and impact on mental health through annoyance, sleep disturbance, and decreased concentration and activity (Passchier-Vermeer W., 2000).

The nearest noise receptors are located approximately 950 to 1250 metres from the nearest boundary of the site. The noise model and assessment determine that operational noise levels will not give rise to significant impacts and effects on the local population. Therefore, it can be concluded that construction noise will not give rise to significant adverse effects on Human Health.

Odour

Volume 3, Section 10: Odour of this EIAR identifies potential odour emissions that may emanate from the site during the construction phase of the Proposed WwTP Component. A literature review was undertaken (Government of Alberta, 2017, Institute for Air Quality Management, 2014) on odour and its effects on Human Health.

The relationship between odours and physiological or psychological health is extremely complex and it is recognised that a human being utilises a number of cerebral functions to analyse a smell. Responses to an odour are influenced by a wide variety of odour characteristics (e.g., hedonicity, familiarity) and individual factors (e.g., subjective expectations, personal experience with an odour). Different odours induce different responses, and odours appear to influence cognitive and mood profiles (Government of Alberta, 2017).

Human beings can become emotionally distressed by the odour - a direct action of our cerebral amygdala as part of our higher senses of the cerebrum. Epidemiology studies have shown that exposures to environmental odours from sources such as livestock facilities, sewage treatment plants and industrial sources can lead to factors associated with negative mood (stress, gloom, depression, anger and fatigue). At a community level, prolonged exposure can lead to social unrest phenomenon about the odours to which they are being exposed.

At high concentrations, health symptoms and physiological responses to unpleasant odours can begin to develop, with irritant symptoms that can include:

- Sore itchy eyes (conjunctival irritation by the presence of a compound in a certain odour);
- Throat irritation (mucous membrane irritation by the presence of a compound in a certain odour);
- Dry coughing (again mucous membrane irritation);
- Nausea;
- Possible vomiting; and
- With certain compounds (such as hydrogen sulphide H_2S), severe exposure to certain odours can cause aerobic cellular paralysis and lead to loss of consciousness.

Historically, the Ringsend WwTP has been the subject of numerous odour complaints and in response, a project odour goal was implemented, with the implementation of an odour management plan. This has resulted in a significant fall in the number of complaints the WwTP has received.

During the operational phase, the existing criteria of $3ou_E.m^{-3}$ for the site will continue to be met throughout construction activities, save where those construction activities require temporary shut-down of existing odour control units to facilitate new connections to the units. The risk of off-site impacts will be managed in accordance with the site's Odour Management Plan (OMP) with all steps being made to minimise the magnitude and duration of potential impacts. The odour assessment concludes that these incidents are unlikely to result in a perceptible change in off-site odour concentrations.

Consequently, odour impacts during the operational phase will continue to be managed and maintained within the existing limits. Though not anticipated, any infrequent exceedances of project odour limits are considered to be temporary and insignificant in terms of effects from a human health perspective.

Traffic

The World Health Organisation (2006) considers road traffic one of the most important determinants of health in Europe. Traffic-related air pollution, noise, crashes and social effects can combine to generate a wide range of negative health consequences, including increased mortality, cardiovascular, respiratory and stress-related diseases, cancer and physical injury. These impacts can impact on residential communities in which the traffic is generated and particularly vulnerable groups such as children and elderly people, cyclists and pedestrians.

Volume 3, Section 13: Traffic of this EIAR details the predicted impacts on traffic volumes in the local area arising from operational phase of the Proposed WwTP Component. Emissions associated with these traffic volumes have also been assessed, namely in Section 8: Air and Climate and in Section 9: Noise and Vibration. Both types of emissions have the potential to cause adverse effects on human health and have been assessed in the above sub-sections. Air quality models and noise models that are based on predicted traffic numbers demonstrate that construction traffic will not give rise to exceedances of thresholds that protect human health.

The other obvious potential health impacts associated with changes in construction traffic activity include increased risk of road traffic accident and injury. This is considered under human health as well as in Volume 3, Section (Major Accidents and Natural Disasters).

As detailed in Volume 3, Section 13 of this EIAR, a traffic management plan will be implemented throughout the construction phase. Construction traffic will not give rise to increased journey times and traffic disruption following the implementation of mitigation measures and best practice standards and guidelines.

It is considered that the implementation of the Traffic Management Plan will therefore minimise emissions associated with construction traffic volumes as well as minimise the risk of the occurrence of traffic accidents. Therefore, it can be concluded that construction traffic will not give rise to significant adverse effects on Human Health. No mitigation measures are required from a Human Health perspective further to those outlined in Volume 3 Section 13: Traffic of this EIAR.

3.6 Mitigation Measures

3.6.1 Construction Phase

3.6.1.1 Resident Population

Regional Level

The construction phase of the Proposed WwTP Component is not likely to create any significant adverse effects on the resident population. Therefore, no ameliorative, remedial or reductive measures are proposed.

Local Level

There are no specific mitigation measures proposed relating to the resident population during the construction phase, other than those planned under other specific Sections of this EIAR under Volume 3, Section 4: Water, Volume 3, Section 8: Air and Climate, Volume 3, Section 9: Noise and Vibration, Volume 3, Section 10: Odour and Volume 3, Section 13: Traffic and the accompanying Construction and Environmental Management Plan.

In addition, it is standard practice to prepare a Construction Management Plan and a Traffic Management Plan for this type of development, part of which would include a dedicated point of contact. This will ensure that a communication channel remains open between the project team and the local residents. The local population will be kept informed of developments and the dedicated point of contact will be available for local residents to raise any matters arising during the course of the construction phase.

3.6.1.2 Working Population

Regional Level

The construction phase of the Proposed WwTP Component is not likely to create any significant adverse effects on the working population. Therefore, no ameliorative, remedial or reductive measures are proposed.

Local Level

The Proposed WwTP Component will be designed and constructed to the best industry standards, with priority being given to the health and safety of employees, local residents and the community at large. All contracts will be tendered to reputable and competent contractors with a track record in the safe delivery of this type of work. A Construction Management Plan and a Traffic Management Plan forms part of the Proposed WwTP Component.

Only contractors who adhere to Irish Water's strict health and safety standards will be invited to tender for the works. All workers will be required to conform to the Health and Safety plans of their respective employers, which will be subjected to regular audits by Irish Water and their consultants.

There are no specific mitigation measures proposed relating to other working populations of the area, as any potential impacts identified are positive.

3.6.1.3 Visiting Community

Regional Level

The construction phase of the Proposed WwTP Component is not likely to create any significant adverse effects on the visiting population. Therefore, no ameliorative, remedial or reductive measures are proposed.

Local Level

The construction phase will be managed in such a way as to mitigate the impact caused to the visiting population in that activities will occur at different areas of the WwTP and use different compounds at different stages of construction. Details on the proposed phasing of the Proposed WwTP Component is outlined under Volume 2, Section 3: Description of Proposed Upgrade Project. As such, visitors using the coastal walkway will be most keenly aware of construction activity in the south-east corner of the site and less so when the expansion works are on-going, due to this being further away.

They are likely to be less aware of activity taking place within the site itself as this will be screened from view by existing structures.

In overall terms, the construction phase of the Proposed WwTP Component can be described as predominantly medium term in nature. The intensive construction period is expected in the first two to three years.

There are no specific mitigation measures proposed relating to the visiting population as none are required beyond that which was already planned under other specific Sections of this EIAR, namely, Volume 3, Section 4: Water, Volume 3, Section 8: Air and Climate, Volume 3, Section 9: Noise and Vibration, Volume 3, Section 10: Odour and Volume 3, Section 13: Traffic and the accompanying Construction and Environmental Management Plan.

3.6.1.4 Human Health

Mitigation measures relevant to protecting human health during the construction phase have been applied to the Proposed WwTP Component according to the relevant Sections in this EIAR. These have been examined and determined to be of a sufficient standard to protect human health and well-being.

In addition to these identified measures, it is recommended that a rodent and pest control plan is put in place so as to manage and limit any potential disturbance to populations that may utilise the site. The pest control plan should be in accordance with the Chartered Institute of Environmental Health's "*Pest minimisation Best practice for the construction industry"* guidelines or a similar appropriate standard.

3.6.2 Operational Phase

3.6.2.1 Resident Population

Regional Level

The operational phase of the Proposed WwTP Component is not likely to create any significant adverse effects on the demographics of the resident population at a Regional Level. Therefore, no ameliorative, remedial or reductive measures are proposed.

Local Level

There are no specific mitigation measures proposed relating to the resident population, as none are required. Specific mitigation measures in relation to other impacts on the resident population inter alia, Volume 3, Section 4: Water, Volume 3, Section 8: Air and Climate, Volume 3, Section 9: Noise and Vibration, Volume 3, Section 10: Odour, Volume 3, Section 13: Traffic and Volume 3, Section 14: Landscape are dealt with in their respective Sections of this EIAR.

3.6.2.2 Working Population

Regional Level

The operational phase of the Proposed WwTP Component is not likely to create any significant adverse effects on the working population at a Regional Level. Therefore, no ameliorative, remedial or reductive measures are proposed.

Local Level

There are no specific mitigation measures proposed relating to the working population, as none are required. Specific mitigation measures in relation to other impacts on the resident population inter alia, Volume 3, Section 13: Traffic, Volume 3, Section 4: Water and Volume 3, Section 8: Air and Climate are dealt with in their respective Sections of this EIAR.

3.6.2.3 Visiting Community

Regional Level

The operational phase of the Proposed WwTP Component is not likely to create any significant adverse effects on the visiting community at a Regional Level. Therefore, no ameliorative, remedial or reductive measures are proposed.

Local Level

There are no specific mitigation measures proposed relating to the visiting population, as none are required. Specific mitigation measures in relation to other impacts on the resident population inter alia, Volume 3, Section 13: Traffic, Volume 3, Section 4: Water and Volume 3, Section 8: Air and Climate are dealt with in their respective Sections of this EIAR.

3.6.2.4 Human Health

Mitigation measures relevant to protecting Human Health during the construction phase have been applied to the Proposed WwTP Component according to the relevant Sections in this EIAR. These have been examined and determined to be of a sufficient standard to protect human health and well-being.

No further mitigation requirements have been identified from a human health perspective.

3.7 Residual Impacts

3.7.1 Construction Phase

3.7.1.1 Resident Population

Regional Level

It is not predicted that there will be an indirect or direct likely significant impact on the resident population of the Regional level.

Local Level

There is no predicted indirect or direct likely significant impact on the population of the Local Area arising from the Proposed WwTP Component during its construction phase. During the construction phase, the resident population along the transportation route will be aware of increased activity, particularly related to the increases in traffic on the local road network (see Volume 3; Section 13: Traffic).

The Proposed WwTP Component will facilitate the provision of between 3,000-3,500 new homes at Poolbeg West SDZ.

3.7.1.2 Working Population

Regional Level

There is predicted to be a direct positive impact on the working population arising from the construction phase of the Proposed WwTP Component due to the jobs provided by this stage of the Proposed WwTP Component.

Local Level

The Working Population in proximity to the site would be aware that the site is undergoing a construction phase. This will be most evident from the movement of construction vehicles through the area and the presence of up to an estimated 150 construction workers in the area during peak periods of construction. This will be perceived as occurring within the wider context of employment activity in

Poolbeg as port-related activities are already taking place, along with the envisaged operation of the Dublin Waste to Energy facility. This is predicted to give rise to an indirect neutral impact arising.

3.7.1.3 Visiting Community

Regional Level

It is not predicted that there will be a direct likely significant impact on the visiting population of the Regional level.

Local Level

The visiting population, either those using the coastal pathway, or those driving along Pigeon House Road to the South Great Wall, will be most aware of the construction activity associated with the Proposed WwTP Component. The use of this walkway or any other amenities in the area will not be precluded as a result of the Proposed WwTP Component. These indirect construction impacts are considered to be short term slight negative impacts relating to the construction of the Proposed WwTP Component.

3.7.1.4 Human Health

The Proposed WwTP Component will result in a deterioration of water quality during 2019/2020 as the tanks are taken off-line on a phased basis for upgrade. This presents a potential indirect impact to the 'bathing population' in so far as it may render identified bathing areas as being unsuitable for bathing. The duration of this impact is predicted to be less than one year and if that, is temporary. The magnitude of this impact is estimated to be 'Slight', though this is largely dependent on overall water quality in the area at the time and whether the current bathing restrictions in place will continue to remain in place over that time.

3.7.2 Operational Phase

3.7.2.1 Resident Population

Regional Level

There is no predicted likely direct impact on the resident population arising from the operational phase of the Proposed WwTP Component.

The ability for the targeted growth of population within the GDA to occur will be facilitated by the Proposed WwTP Component. This is a significant indirect and positive impact of the Proposed WwTP Component.

Local Level

The existing resident population at the Local Level will perceive very little direct change from the existing conditions which prevail in the area at present. The significant indirect benefits that will occur, such as improved bathing water quality, odour controls and an enhanced public sewerage system are expected to go largely un-noticed by the general public.

3.7.2.2 Working Population

Regional Level

There is no predicted likely direct impact on the working population arising from the operational phase of the Proposed WwTP Component.

The ability for the targeted growth of population within the GDA to occur will be facilitated by the Proposed WwTP Component. This is a significant indirect and positive impact of the Proposed WwTP Component.

Local Level

The direct impact of the Proposed WwTP Component is that there will be 15 no. additional employees at the Ringsend WwTP facility.

There is no predicted likely significant direct impact on the working population at the local area arising from the operational phase of the Proposed WwTP Component.

The predicted impact results in a neutral impact arising for the working population as it is considered, once complete, the Proposed WwTP Component will continue to operate in the same manner as is currently the case.

3.7.2.3 Visiting Community

Regional Level

There is no predicted likely direct impact on the visiting population arising from the operational phase of the Proposed WwTP Component.

Local Level

The visiting population, particularly those on foot or bicycle using the coastal route will be most aware of the altered boundary treatment at the southern and eastern corner of the Proposed WwTP Component. Overall, a neutral to slight adverse indirect impact is predicted along this section. Specific details in relation to the landscape, visual appearance and associated mitigation measures associated with the Proposed WwTP Component are described under Volume 3, Section 14: Landscape.

3.7.2.4 Human Health – Residual Impact Operational Phase

Sufficient mitigation measures have been identified in this and other Sections of the EIAR to ensure that no residual impacts or effects on human health are anticipated. The overall improvement of water quality within Dublin Bay can be considered as an indirect positive impact on human health.

3.7.3 Interactions

3.7.3.1 Population

There are numerous inter-related environmental topics described in detail throughout this EIAR Section which are relevant to Population and Human Health. The population (i.e. the resident, working and visiting) will interact with the Proposed WwTP Component during construction and operational phases.

Water

The potential interactions with Water and the Proposed WwTP Component during the construction is that there is a minor and temporary environmental disimprovement in respect of the Biochemical Oxygen Demand (BOD) and Suspended Solids (SS), during a short winter period (2019/2020). This has the potential to impact on the Local Area Resident and Visiting Populations in the short term. This short-term construction impact is weighted against the operational design of the Proposed WwTP Component which is to achieve the final general effect of a positive outcome in terms of Water Quality.

The potential for water impacts and the appropriate mitigation measures to ensure the likely effects are minimised where possible, during construction and operational phases, are set out in Volume 3, Section 4: Water of this EIAR.

Land and Soils

The potential interaction with Land and Soils with the Proposed Ringsend WwTP Component during the construction phase relates to the removal of made ground. This will not be directly noticeable to the Local Area Visiting Population as it could be perceived as general construction activity. However, construction contractors will be required to prepare a specific Environmental Management Plan including waste and invasive species management plans. The movement of construction traffic containing the removal of soils are discussed below and outlined under the Traffic and Transport Section for further mitigation measures, Volume 3, Section 13: Traffic

Appropriate mitigation measures to ensure the likely effects are minimised where possible during construction and operational phases are set out in Volume 3, Section 7: Land and Soils of this EIAR.

Air and Climate

The greatest potential impact arising from Air and Climate on the population is air quality during the construction phase of the Proposed WwTP Component. This is expected to be in the form of construction dust emissions and the potential for nuisance dust. This would have a potential impact for the Local Area Visiting population in the immediate vicinity of the site under construction. However, a dust mitigation measure forms part of the CEMP which fugitive emissions of dust from the site are expected to be insignificant and will not pose a nuisance at nearby receptors.

Mitigation measures to ensure the likely effects are minimised where possible during construction and operational phases are set out in Volume 3, Section 8: Air and Climate of this EIAR.

Noise and Vibration

During construction, there is an interaction between the visiting Local Area population who would pass by the Ringsend WwTP site. Sources of noise are expected to arise from onsite construction works, activity in the proposed temporary construction compounds as well as increased traffic on the public roads. In terms of the operational phase, noise will arise from additional wastewater treatment plant items and additional vehicular traffic on public roads.

Appropriate mitigation measures to ensure the likely effects are minimised where possible during construction and operational phases are set out in Volume 3, Section 9: Noise and Vibration of this EIAR.

Odour

Odour interacts with the visiting Local Area population who would pass by the Ringsend WwTP site. During the construction phase, the existing criteria of $3ou_E.m^{-3}$ for the site will continue to be met throughout construction activities, save where those construction activities require temporary shut-down of existing odour control units to facilitate new connections to the units. The risk of off-site impacts will be managed in accordance with the site's Odour Management Plan (OMP) with all steps being made to minimise the magnitude and duration of potential impacts. The Odour assessment concludes that these incidents are unlikely to result in a perceptible change in off-site odour concentrations.

Appropriate mitigation measures to ensure the likely effects are minimised where possible during construction and operational phases are set out in Volume 3, Section 10: Odour of this EIAR.

Traffic

There is an interaction between the Resident and Visiting Population at the Local Area. Volume 3, Section 13: Traffic of this EIAR details the predicted impacts on traffic volumes in the local area arising from construction activities associated with the Proposed WwTP Component. Emissions associated with these traffic volumes have also been assessed, namely in Section 8: Air and Climate and in Section 9: Noise and Vibration. Both types of emissions have the potential to cause adverse effects on human health, and have been considered in the above sections. Construction traffic will not give rise to significant adverse effects on human health in relation to noise pollution or air quality.

Appropriate mitigation measures to ensure the likely effects are minimised where possible during construction and operational phases are set out in Volume 3, Section 13: Traffic of this EIAR.

Landscape

The Local Area Visiting and Resident Population interact with the construction and operational phases of the Proposed WwTP Component. According to Section 14, while the Proposed WwTP Component will not have any other direct impacts on landscape or visual zonings or designations, the works do fall within the context of views from Irishtown Nature Reserve, Shellybanks Beach and adjoining areas. The Proposed WwTP Component is located within an area of clearly established industrial/utility use and the site of the Proposed WwTP Component is an existing wastewater treatment facility. Therefore, the main impacts are construction-related and the mitigation measures focus on minimising associated landscape and visual impacts.

Appropriate mitigation measures to ensure the likely effects are minimised where possible during construction and operational phases are set out in Volume 3, Section 14: Landscape of this EIAR.

3.7.3.2 Human Health Interactions

Human beings can generally be regarded as 'Receptors' in an Environmental Impact Assessment, and as such there is the potential for interactions between human health and all other aspects of an Environmental Impact Assessment. Consequently, the human health impact assessment is primarily formulated on the consideration between these interactions. For further details of human health interactions, please refer to Sections 3.5.1.4 and 3.5.2.4 of this Section.

3.7.4 Cumulative Impacts

3.7.4.1 Construction Phase

Resident Population

Given the planned construction programme for the Proposed WwTP Component, it is considered likely that construction works relating to elements of the Poolbeg West SDZ lands will also be underway, with both programmes likely to overlap after 2020. This will not give rise to a direct impact on the growth of the resident population. Indirectly however, the resident population, especially those along Beach Road/Strand Road and Sean Moore Road will be aware of this cumulative construction activity which is further discussed under Volume 3, Section 13: Traffic of this EIAR.

Working Population

The likely cumulative impact of the Proposed WwTP Component during construction is, in general, that the local working population will benefit from the existing employment and services in the vicinity of the site creating a positive indirect impact for the local area.

Visiting Community

It is possible during the construction phase of the Proposed WwTP Component that construction of the development at the Poolbeg West SDZ will also have commenced. As a result, the likely cumulative impact experienced by the visiting community during the construction phase will generally be a heightened awareness of construction activity on the Poolbeg Peninsula and at a more widespread level than is being proposed for the Proposed WwTP Component given the extent of lands encompassed by the SDZ.

3.7.4.2 Operational Phase

Resident Population

The likely cumulative impact of the Proposed WwTP Component is that the resident population of the Greater Dublin Area will be capable of growing to its target population levels over time due to the increased capacity of the Ringsend WwTP. This will enable objectives at both national and regional levels to be met. This is a significant indirect and positive impact of the Proposed WwTP Component.

With regard to the immediate area, the provision of the Proposed WwTP Component will specifically enable the re-development of the Poolbeg West SDZ lands so as to accommodate a large scale mixed-use new community. It is understood that this could comprise of up to 3,000 - 3,500 new homes on a phased basis. This could accommodate an additional population in this area of approximately 6,500 - 8,000 people. This is a significant indirect and positive impact of the Proposed WwTP Component.

Working Population

The likely cumulative impact of the Proposed WwTP Component is, in general, that the working population of the Greater Dublin Area will be capable of expanding significantly over time due to the increased levels of construction activity and the development of employment generating uses in the Capital City that the Proposed WwTP Component will accommodate. This will have significant widespread economic benefits to the region and the State as a whole. This is a significant indirect and positive impact of the Proposed WwTP Component.

With regard to the immediate area, the provision of the Proposed WwTP Component will facilitate the re-development of the Poolbeg West SDZ lands to occur so as to accommodate a large scale mixed-use new community, including significant employment generating uses. This is a significant indirect and positive impact of the Proposed WwTP Component.

Visiting Community

The likely cumulative impact experienced by the visiting population is one where the visiting community will become more conscious of Poolbeg as a built-up area of Dublin, as it is envisaged that the completion of the new community centred around Poolbeg West will present an urban edge to the coastal walkway. As these lands are zoned for development, such a transformation is to be expected.

3.7.4.3 Human Health

No cumulative impacts with the potential to give rise to significant adverse effects on human health have been identified. The Worst-Case Impact amounts to the Proposed WwTP Component not proceeding (i.e. planning permission is not approved) and reflects the 'Do-nothing' impact in this particular case.

3.8 Monitoring

Monitoring of the specific aspects in relation to the growth of population from the Proposed WwTP Component is not required. Specific monitoring in relation to other environmental topics are outlined, where necessary, under each respective Section of this EIAR.

3.9 Difficulties Encountered

No significant difficulties were encountered in compiling the required information.

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Section 4: Water

4.1 Introduction

This Section is concerned with the potential impact of the WwTP Component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component") on the surface water receiving environment. Analysis of potential impacts on the groundwater receiving environment are considered in Section 7.

The scope of the water quality assessment is focused on the discharge from the treatment plant, and considers the change in impact arising from the future increase in the final effluent flow, together with the future improvement in the quality of the final effluent.

The increase in final effluent flow arises from the increase in wastewater volumes received at the Ringsend plant as development happens within the catchment served by the plant. The reduction in concentration of the primary parameters arises from the increased level of treatment and more consistent performance which will be achieved by the proposed aerobic granular sludge (AGS) process to be provided at the plant.

The assessment of the changes in the final effluent discharge focuses on the environmental impact of the discharge on the local receiving waters by reference to the relevant European and Irish legislation.

The water quality assessment is primarily concerned with the impact arising from the future improvement in the final effluent quality.

The assessment secondarily considers where, within the receiving water environment, the benefit of the future reductions will be experienced. A computer model (DHI MIKE3 FM) is used to estimate where the changes will be observed.

Finally, a second computer model (CEFAS DCPM) is used to assess the specific impacts of nutrients on the Tolka Estuary, which is identified as being the area particularly influenced by the discharge.

Appendices 1 and 2 to this section, contain full reports on the modelling exercises carried out, with the summary details set out in the main text of this section.

The assessment seeks to determine whether the expanded plant with the new AGS process, producing a higher quality effluent, can continue to discharge to the local receiving waters without impacting on the ability of the waters to comply with the relevant European and Irish legislation.

4.1.1 Scoping

The scope of this assessment was initially considered at Section 5.2.3 of the Scoping Document published in March 2016, circulated to statutory stakeholders and publicised in the wider community.

The scoping document identified that the final effluent discharge from the wastewater treatment plant into the Lower Liffey Estuary as being the only likely significant impact to the surface water environment.

The consultation process identified other concerns amongst some stakeholders in respect of:

- Microplastics;

- Specific Pollutants, Priority Substances and Priority Hazardous Substances, as those terms are defined under the European Communities Environmental Objectives (Surface Waters) Regulations 2009; and
- Changes to the Dublin drinking water supply.

The potential inclusion of these topics in the impact assessment was considered, but it was decided not to include them in the scope of this EIAR. Municipal wastewater treatment processes provide treatment for biological pollutants and settleable solids, but do not provide any treatment process for the removal of industrial chemicals, or other compounds, arising from industrial or commercial activities, or any solids too small to settle out of the wastewater, such as microplastics. These compounds need to be managed at source, before they are discharged into the wastewater collection system, through trade effluent discharge licences, product regulation and similar methods, as the wastewater treatment process does not provide effective removal.

Microplastics, industrial chemicals or changes to the drinking water supply are thus issues that are not managed or controlled by the wastewater treatment plant and any necessary controls must be provided upstream in the wider community.

The inability of wastewater treatment processes to remove such compounds is also reflected in the approach adopted in the regulation of the existing wastewater discharge authorisation (EPA Licence D0034-01) for the agglomeration served by Ringsend. Specifically, the regulation process, including the Annual Environmental Report, in respect of Specific Pollutants, Priority Substances and Priority Hazardous Substances is concerned with the risk assessment and screening of the catchment rather than seeking to achieve any particular standard in the final effluent discharge from the Ringsend Wastewater Treatment Plant.

Separately it is also noted that the assessments contained in the annual environmental reports in respect of this licence have not identified any actual or likely environmental impacts on the local surface waters as a result of priority substances in the influent wastewater received at the Ringsend facility.

Separately Volume 2, Section 3 describes how there may be a reduction in the final effluent quality during the Winter of 2019 / 2020, while parallel construction activities are taking place, which will necessitate the temporary decommissioning of some of the existing process units. This requirement had not been identified at the time of writing of the March 2016 scoping document and as a consequence the scope of this EIAR has been expanded to include an assessment of this construction phase impact.

In summary, the scope of this Section of the EIAR is essentially as described in the March 2016 scoping document, with the addition of an assessment of the impact of reduced effluent quality during part of the construction phase. There has been no expansion of the scope in respect of microplastics, priority substances, or other environmental issues that are independent of, and cannot be influenced by the Proposed WwTP Component.

4.2 Methodology

The methodology for the assessment of the impact of the treated effluent discharge initially identifies the principal parameters, which could impact on the receiving waters, which were identified at the scoping stage and are:

- Biochemical Oxygen Demand (BOD);
- Suspended Solids (SS);

- Ammonia (NH3/NH4+);
- Dissolved Inorganic Nitrogen (DIN);
- Molybdate Reactive Phosphate (MRP); and
- Escherichia Coliforms (E. Coli).

The parameters are then individually assessed by comparison between the current and future quantities discharged. This assessment permits a determination as to whether the future discharge will result in an improvement or disimprovement in the local receiving environment.

The assessment then further considers how that environmental change interacts with the receiving waters and how significant is the change in the context of the relevant legislation. This next step is carried out using two different types of computer models to assess the environmental impact from the Ringsend discharge, as follows:

- DHI MIKE 3 FM model; and
- CEFAS DCPM model.

The DHI MIKE 3 FM model analyses how the final effluent discharge disperses within the receiving water, while the CEFAS DCPM model analyses the biological response to the final effluent being discharged into the receiving water. The CEFAS DCPM model is additionally focused on the particular area of the receiving water, which is most influenced by the final effluent discharge.

The modelling is supported by data gathered from field surveys and desktop studies.

4.2.1 DHI MIKE 3 FM Model

The MIKE 3 FM model is a hydrodynamic and thermal model, based on the flexible mesh approach, which has been developed for oceanographic, coastal and estuarine environments. The modelling platform has been developed by DHI and is recognised internationally as being at the forefront of the marine modelling industry.

The MIKE 3 model simulates the 3-dimensional flow due to tidal and other currents and calculates buoyancy effects due to gradients in temperature and salinity.

The model domain includes the Lower Liffey Estuary, the Tolka Estuary and Dublin Bay in order to ensure a correct prediction of circulation in these area that are of primary interest for the water quality impact assessment. The model boundaries are located sufficiently offshore so that they do not influence the assessment. The approximate geographical coverage of the model being used for this assessment is shown in Figure 4-1.

The model uses a flexible mesh, which allows for a varying resolution across the model domain. In particular, it was ensured that the mixing zone around the Ringsend WwTP outfall was suitably resolved in order to capture the dispersion of the effluent into the estuary and its discharge into Dublin Bay (see Figure 4-2). In this area the minimum resolution was 15-20 m. Elsewhere, the resolution was typically 100 m in the Liffey and Tolka estuaries and 200-400 m within Dublin Bay. The vertical model resolution was set such that 8 layers were equally distributed over the water depth.

The hydrodynamic model requires accurate bathymetric information for the area being modelled. Inputs to the model include information regarding the variations in tides, riverine inputs (flow, temperature) and any other significant local discharges (e.g. power station outfalls). The data required for the construction of the model was obtained from a range of sources, both project specific and from earlier studies of the area.

The hydrodynamic accuracy of the constructed model was assessed through a calibration exercise, whereby the water levels, currents, temperature and salinity predicted by the model, are compared against the observed data throughout the Dublin Bay and its estuaries.

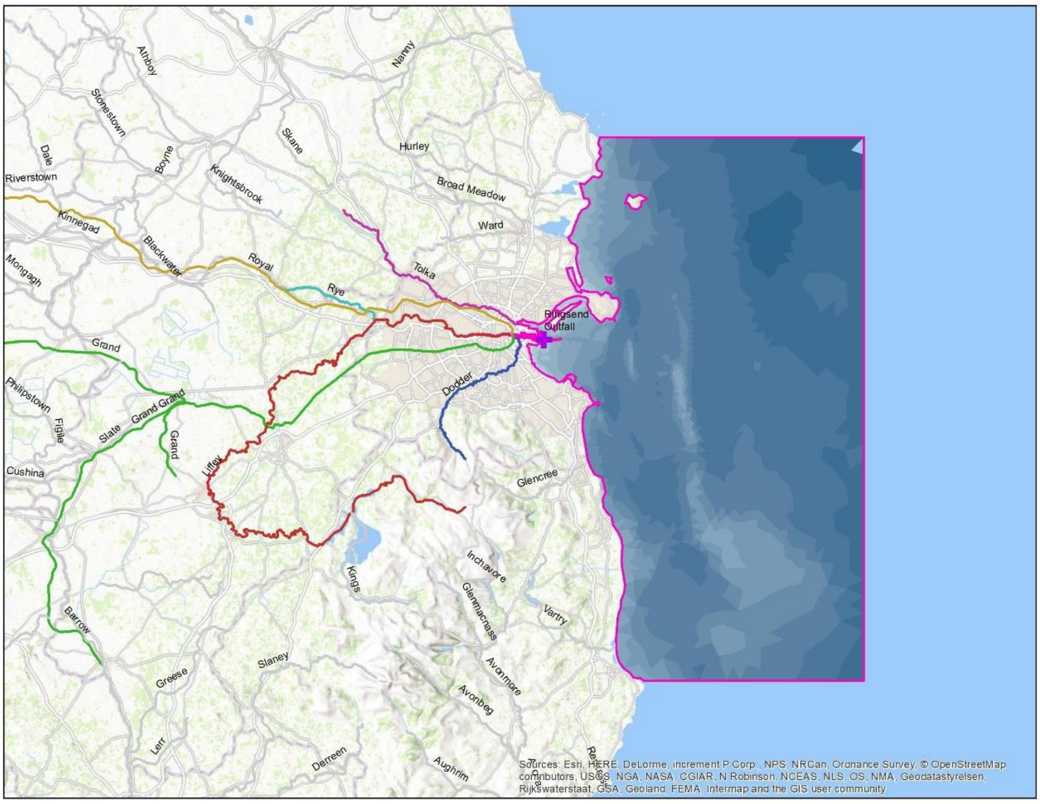


Figure 4-1: Geographical Coverage of MIKE 3 Model

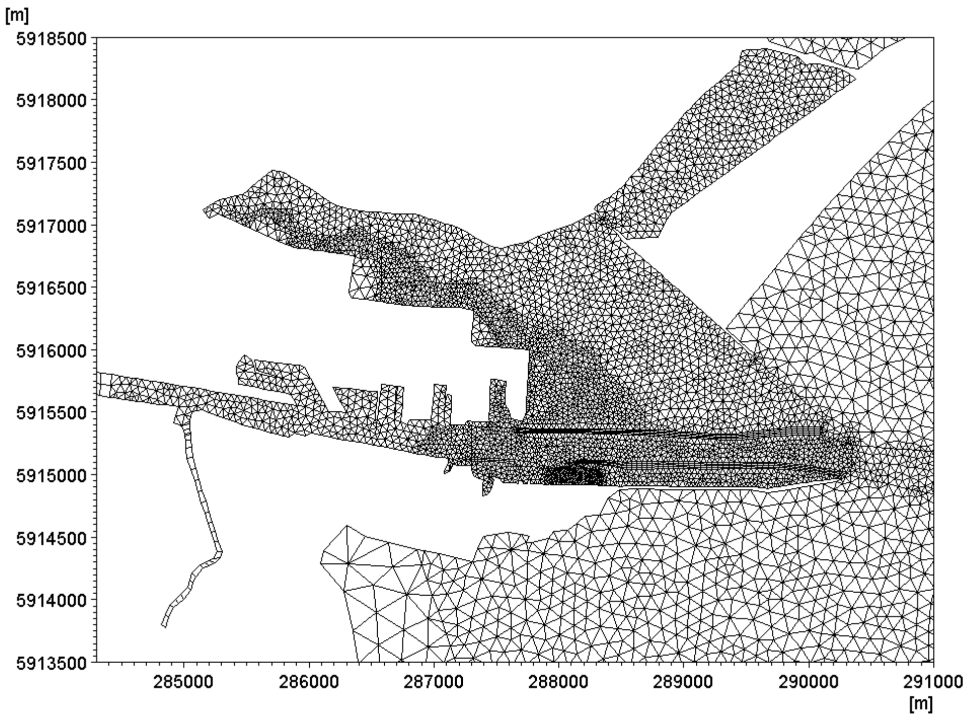


Figure 4-2: MIKE 3 model – horizontal mesh resolution

Once the MIKE 3 hydrodynamic and thermal model had been set up and confirmed to be fit for its purpose, it was then used to assess the spreading and fate of various dissolved and suspended substances within the water body under the influence of fluid transport and associated dispersion processes. In this particular assessment these substances are those water quality parameters, which are listed at the start of this methodology section.

The ability of the model to predict the distribution of parameters within the receiving waters was assessed through a validation exercise, whereby the spatial variation in the concentrations of a given parameter as predicted by the model, were compared against the parameter concentrations as observed through sampling and analysis.

The final model setup was then used to simulate the fate of the various parameters in the discharge from Ringsend at various points through the water column and during the various stages of the tide. Analysis of these model results was used to determine the water quality environment. The effects of seasonality and different climatic conditions (e.g. high rainfall events) on the receiving water was also assessed.

4.2.2 CEFAS DCPM Model

This is the secondary impact assessment model, and is a model which was specifically developed to assess the biological response (chlorophyll and macroalgae) to nutrient (nitrogen and phosphorus) inputs in estuaries. The model is entitled the Dynamic Chlorophyll Phytoplankton Macroalgae (DCPM) Model and was developed by CEFAS for the Environment Agency of England and Wales. The model has also been used by the EPA to assess the impact of nutrients in Irish estuaries, specifically Argideen and Blackwater.

The model was used in this instance to assess the relationship between nutrient levels and macroalgae biomass in the Tolka Estuary. The Tolka Estuary is the focus of this model because the DHI MIKE3 model identified the Tolka Estuary as experiencing the greatest impact from the Ringsend final effluent discharge.

The Tolka Estuary experiences extensive growths of opportunistic macroalgae during the summer, and it is currently classified, under the Water Framework Directive, as moderate. The purpose of the model was to assess the impact of the nutrients, discharged with the Ringsend WwTP final effluent, on the algae growth within the Tolka estuary, and hence assess the impact on the overall water quality.

The DCPM model is a simpler model, when compared to the MIKE 3 high resolution flexible mesh model used for the main modelling exercise. The hydrodynamic inputs for the DCPM model were based on figures generated by the MIKE 3 model, specifically the interaction at the boundary of the DCPM model, to estimate the relative proportions of freshwater and saline flows into the estuary from the Liffey and Dublin Bay at various stages of the tide, including the concentration of nutrients and the impact from the Ringsend WwTP discharge.

4.2.3 Model Build and Calibration

The MIKE 3 model was initially constructed using available data and then refined and calibrated for the area of interest using data from additional marine surveys.

The DCPM was calibrated from the boundary conditions identified in the MIKE 3 model, at the entrance to the Tolka Estuary.

4.2.3.1 Available Data

- The available data utilised for the initial model build, included an existing hydrodynamic model of Dublin Bay, prepared and used by DHI for previous studies, specifically:
- Dublin Waste to Energy Project. Numerical Modelling of Cooling Water to the River Liffey (Elsam, 2006);
- Barrage Project 2030 – Dublin (CDM 2008); and
- Dublin Ocean Outfall Study (CDM 2009-2013).
- This model was updated using bathymetric data from various sources, including:
- EMODNet Bathymetry data for the Irish Sea;
- Data from a survey that DHI conducted in 2005, as part of the Dublin Waste to Energy Project;
- Lidar of part of the Tolka and particularly Bull Island (Source: OPW) 2012;
- Soundings of the Clontarf Basin/estuary (Source: OPW) 2012;
- Soundings of the Liffey Estuary 2003. This area was surveyed as part of Irish National Seabed Survey
  (rebranded INFOMAR); and
- Soundings of the Dodder estuary (Source 2006).

Tidal water levels for the model open boundaries were provided from DHI's regional tidal model of the Irish Sea, which was in turn forced by surface elevations from the DHI global tidal model.

Flow data for the major riverine inputs of the Liffey, Camac, Tolka, Dodder, Slang, and Santry plus a number of smaller rivers and streams were taken from available gauged flow data made available through the EPA Hydronet data portal. Representative flow rates from these rivers were determined from a statistical analysis of the gauged data. To provide realistic estimates of discharges, the statistical analysis was based on hydrometric records of up to 20-years. These were supplemented by estimates of the flow from other studies in the area.

4.2.3.2 Marine Survey

The area of the MIKE 3 model of highest resolution, and hence the main area of interest, is the inner part of Dublin Bay and the Lower Liffey and Tolka Estuaries. This is the area where the final effluent from the Ringsend WwTP will discharge and where the initial dilution and mixing with the receiving water will occur.

A marine survey was undertaken in this area of interest to provide field measurements to allow the calibration of the MIKE 3 model for this area. The survey took place during September and October 2015 and comprised the following elements:

ADCP Survey

Acoustic Doppler Current Profiler (ADCP) surveys use an instrument mounted on the seabed to measure the water velocity at various heights above the bed. The instrument also measures the water temperature and depth of water at the location of the installed unit.

Three units were installed for the survey, in Dublin Bay and in the Liffey and Tolka Estuaries, and left in place for a full spring/neap tidal cycle. Current speed and direction were monitored in 1 m increments from 1 m above the instrument to just below the surface.

CTD Survey

Conductivity, Temperature and Depth (CTD) surveys use an instrument lowered from the surface to measure the salinity and temperature profile at various depths below the surface. The survey also measured speed and direction at the same locations and depths.

Six locations were selected for the survey, 2 in each of Dublin Bay and the Liffey and Tolka Estuaries. Measurements were carried out hourly for a full tidal cycle, subject to restrictions imposed by water depths and available light for safe operations.

The ADCP and CTD survey locations are shown in Figure 4-3.

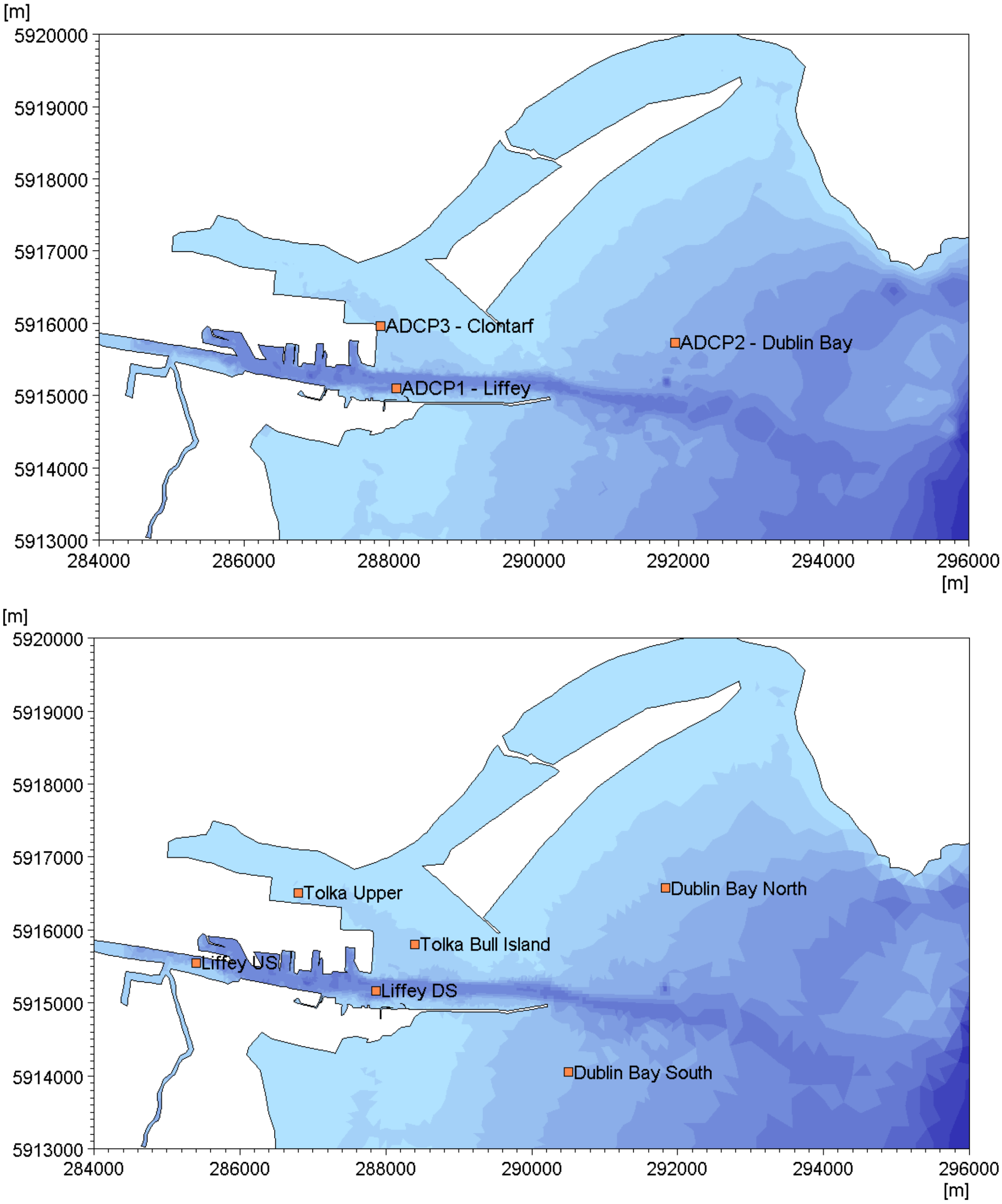


Figure 4-3: Locations for ADCP survey (upper panel) and CTD Survey (lower panel)

Additional survey data

The survey data as described above was supplemented by water levels from tide gauges at Dublin Port and at Ringsend (Dublin City Council). DHI also made use of available information from previous ADCP surveys of the area for previous projects in Dublin Bay. This included data of two ADCP's deployed close to Burford Bank in outer Dublin Bay from 2010. A 3-day survey of Dublin Bay using a vessel-mounted ADCP (whereby the ADCP is deployed off the side of a moving vessel to measure the spatial variation in current speeds along the vessel route), was also performed by DHI in 2009.

4.2.3.3 Model Calibration

The subsequent calibration of the built model for hydrodynamic and thermal parameters is described in detail in Appendix 4A.

The calibration established that the built model was consistent with the earlier models and was a suitable tool for describing the bulk water movements within the area of interest.

4.2.4 Model Water Quality Validation

Having established and calibrated the MIKE 3 model for hydrodynamic and thermal parameters, the next step was to validate the model by comparing its output to the ongoing field sampling of the receiving waters, specifically BOD, DIN and MRP in this instance.

4.2.4.1 Water Quality Monitoring

The water quality in the receiving water is monitored on an ongoing basis by the Environmental Protection Agency and Dublin City Council. The sampling locations are shown in the Figure 4-4 and Figure 4-5. The sampling is performed on a discrete basis but are typically performed 4-6 times per year and more commonly in the bathing water season (i.e. throughout the summer months June - August).

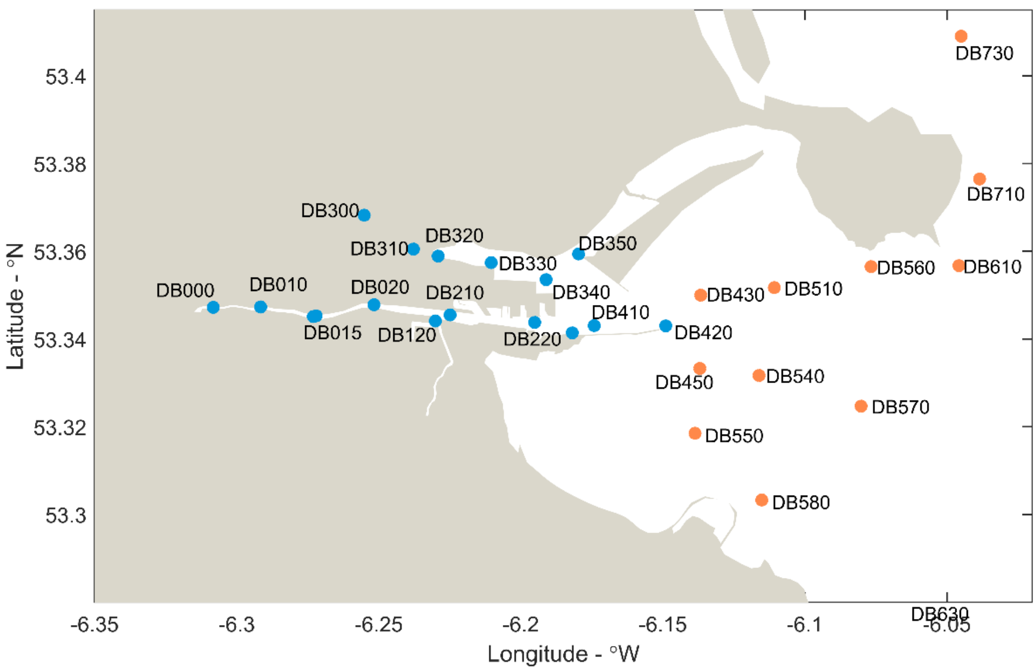


Figure 4-4: EPA Water Quality Sampling Locations
(Blue – Transitional Waters / Orange – Coastal Waters)

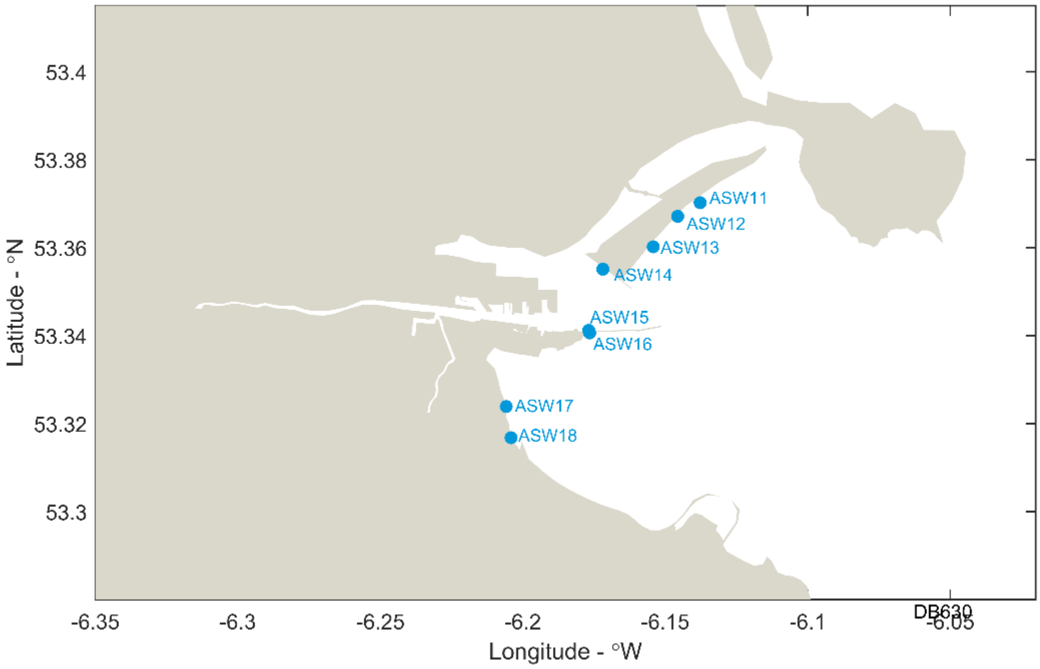


Figure 4-5: Bathing Water Sampling Locations for Dublin Bay

These datasets were analysed to establish typical concentrations of pollutants over the baseline periods (2013 – 2015, inclusive). The purpose of this assessment was twofold.

- To provide background loads/concentrations that enter the system via the rivers, streams, and canals; and
- To validate the concentrations predicted by the water quality model at various locations in the harbour and in Dublin Bay.

4.2.4.2 Validation of MIKE 3 Water Quality Model

The model was then validated against the parameters of BOD, DIN and MRP for six selected locations, which were chosen from the available sampling sites as being suitably dispersed and thus considered representative of the overall receiving waters, as shown in Figure 4-6. This included three sites within the estuary (transitional water) and three sites within Dublin Bay (coastal waters):

Transitional Waters:
DB210 – Lower Liffey Estuary, downstream of East Link Toll Bridge;
DB340 – Tolka Estuary, Clontarf Boat Club; and
DB420 – Lower Liffey Estuary, Poolbeg Lighthouse.
Coastal waters:
DB510 – 2.5 kilometres ENE of Poolbeg Lighthouse;
DB550 – No. 4 Buoy, 2.5 kilometres E of S. Poolbeg Lighthouse; and
DB570 – 5 kilometres ESE of Poolbeg Lighthouse.

The water quality parameters being considered are non-conservative and decay naturally in seawater, with the rate of decay subject to temperature and salinity in most cases. Decay constants were applied within the model to provide a more realistic assessment of the fate of these water quality parameters. These constants have been developed through the previous WwTP modelling studies at Ringsend and have been updated to reflect seasonal variations where applicable.

The detail of the validation of the model is described in Appendix 4A.

The validation process produced results that were consistent with the field sampling records, providing further confidence in the ability of the model to describe the impact of the final effluent discharge on the local receiving waters.

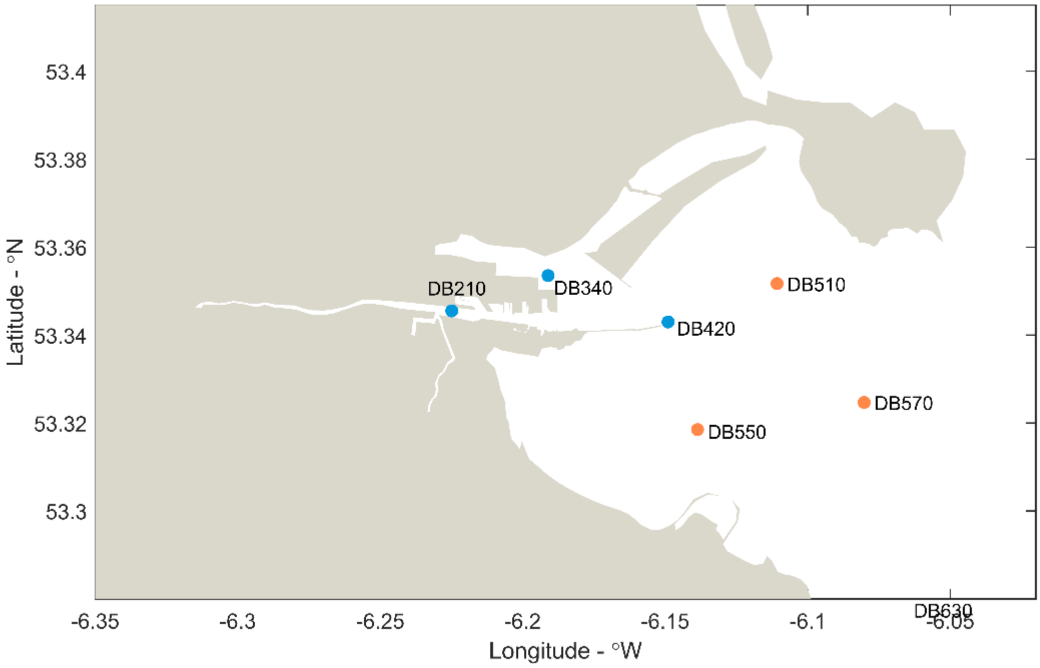


Figure 4-6: Water Quality Sampling Locations used for Model Validation
(Blue – Transitional Waters / Orange – Coastal Waters)

4.2.5 Assessment of Environmental Impact

The constructed MIKE3 and DCPM models were then used to compare the environmental impact from the existing and future scenarios. The details of the comparisons carried out are described in Appendix 4A, while the analysis of the model outputs is described in the following sections.

4.3 Existing Environment

The scoping has identified the impact of the final effluent discharge on the receiving surface waters as being the only likely significant environmental impact. As a consequence, the existing environment to be assessed is limited to Dublin Bay and the River Liffey, and the discharge outfalls from the Ringsend Wastewater Treatment Plant.

4.3.1 Receiving Waters

The receiving waters comprise the Liffey and Tolka Estuaries, together with the wider Dublin Bay.

Figure 4-7: Aerial View of Dublin Bay
(showing Liffey & Tolka Estuaries, Poolbeg, North Bull Island and Howth)

The River Liffey and Tolka Estuaries are bound by the Great South Wall and the North Bull Wall, which together form the entrance out into the wider Dublin Bay (see Figure 4-7). The Liffey estuary is largely formed by Dublin Port and its shipping channel, whereas the Tolka estuary is a comparatively shallow lagoon.

Dublin Bay itself is a relatively small, shallow sandy embayment, which is enclosed by two headlands, Howth to the north and Dalkey to the south. It is approximately 10 kilometres across the mouth of the bay and narrows to the mouth of the River Liffey.

The intertidal zone of the bay occupies the inner third of the bay. The bay slopes gently, reaching depths of 20 m at the mouth of the Bay. The water depth decreases towards the harbour with depths of less than 5 m occurring in the inner half of the bay. The Burford Bank sits centrally across the mouth of Dublin Bay. The Burford Bank is a linear sand ridge about 5 km in length, which rises to within 5 m of the surface. The North Bull Island is a prominent physical feature in the bay which developed due to sedimentation accumulation after the construction of the North Bull Wall in 1821. To the north of the channel are extensive areas which dry out at low water. These mudflats extend from the mouth of the River Tolka almost to the end of the North Bull Wall and north eastwards past the Bull Island Causeway to Sutton Creek, which is a narrow channel between Bull Island and Howth.

4.3.2 Applicable Legislation

The relevant legislation which governs the wastewater discharge and the receiving waters are as follows:

4.3.2.1 Water Framework Directive

The European Union Water Framework Directive (2000/60/EC) establishes a framework for the protection of surface waters and groundwaters within Member States, and requires that Member States implement a range of measures to classify, assess and improve water bodies to a *good status* (see Figure 4-8).

Figure 4-8: WFD Status of Coastal and Transitional Water Bodies
(Green = "Good" status: Yellow = "Moderate" status) (EPA)

The *good status* is assessed by reference to a range of biological, chemical and morphological characteristics, which vary depending upon the nature of the water body, whether groundwater, lake, river, transitional or coastal. This directive has been implemented within the Republic of Ireland by means of Statutory Instruments:

- SI No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended); and
- SI No. 722/2003 - European Communities (Water Policy) Regulations, 2003 (as amended).

Earlier legislation concerned with the protection of water quality had been more focused on particular areas, such as the protection of salmonid fish species, or the control of hazardous substances. However, this directive has a very wide scope and deals with most aspects of water quality. Consequently, certain earlier European directives and Irish legislation are no longer applicable, the notable exception being bacteriological quality, as it impacts on bathing waters and shellfish.

The relevant receiving waters for the assessment of the Proposed WwTP Component, are set out in Table 4-1.

Table 4-1: Receiving Water Bodies Quality Status 2010 – 2015 (EPA)

Water Body	Category	Sub-Category	Status
Liffey Estuary Upper	Transitional	Overall Status	Moderate
		Biological Status or Potential	Moderate
		Hydromorphological Conditions	Bad
		Supporting Chemistry Conditions	Moderate
Liffey Estuary Lower	Transitional	Overall Status	Moderate
		Biological Status or Potential	Moderate
		Hydromorphological Conditions	Poor
		Supporting Chemistry Conditions	Good
		Chemical Surface Water Status	Good
Tolka Estuary	Transitional	Overall Status	Moderate
		Biological Status or Potential	Moderate
		Hydromorphological Conditions	Poor
		Supporting Chemistry Conditions	Moderate
Dublin Bay	Coastal	Overall Status	Good
		Biological Status or Potential	Good
		Hydromorphological Conditions	Good
		Supporting Chemistry Conditions	Good
		Chemical Surface Water Status	Good
North Bull Island			Unassigned

4.3.2.2 Bathing Water Directive

The European Union Bathing Water Directive (2006/7/EC) establishes procedures and standards for bathing waters. The minimum required standard for bathing waters is *sufficient*.

This directive has been implemented within the Republic of Ireland by means of Statutory Instruments;

SI No. 79/2008 - Bathing Water Quality Regulations 2008, as amended.

The relevant bathing waters for the assessment of the Proposed WwTP Component, are set out in Table 4-2.

Table 4-2: Bathing Waters Status 2014 – 2017 (EPA)

Bathing Water	2014	2015	2016	2017
Dollymount Strand	Good	Sufficient	Good	Good
Sandymount Strand	Good	Sufficient	Sufficient	Poor
Merrion Strand	Sufficient	Poor	Poor	Poor
Seapoint	Excellent	Excellent	Excellent	Excellent

Dublin City Council also undertake monitoring at the Shelley Banks beach, the Great South Wall at the Half Moon Swimming Club, as well as the North Bull Wall, near Dollymount Strand.

4.3.2.3 Urban Waste Water Treatment Directive

The European Union Urban Waste Water Treatment Directive (91/271/EEC as amended) establishes the general requirement that all agglomerations, with some minor exceptions, are to be provided with collecting systems for urban wastewater and secondary treatment facilities to treat the collected wastewater before discharge. In addition, there is a requirement for Member States to identify more sensitive areas, where a higher level of treatment is required, to prevent eutrophication or for other reasons.

- This directive has been implemented within the Republic of Ireland by SI No. 254/2001 - Urban Waste Water Treatment Regulations, 2001 (as amended).

The Liffey Estuary from Islandbridge weir to Poolbeg Lighthouse, including the River Tolka basin and South Bull Lagoon has been designated as a nutrient sensitive area. Since the Liffey Estuary has been designated as "sensitive", the EU Urban Waste Water Treatment (UWWT) directive requires nutrient removal to achieve 10 mg/l Total Nitrogen and 1 mg/l Total Phosphorus, in addition to normal secondary treatment standards, for continued discharge at the existing outfall to the Liffey Estuary.

The designation of a water body as sensitive is dependent upon the TSAS (trophic status assessment scheme), which is used by the EPA to make recommendations as to whether a water body should be designated or not. The TSAS assesses the water body against the following indicators of trophic status:

- DIN (Dissolved Inorganic Nitrogen);
- MRP (Molybdate Reactive Phosphate);
- Chlorophyll;
- Macroalgae; and
- DO (Dissolved Oxygen).

The assessment applies different standards to the winter and summer seasons, which is a reflection of the varying biological activity as a result of the differing temperatures and reaches separate determinations in respect of the two different times of year.

4.3.2.4 River Liffey and Other Rivers

There are a number of rivers discharging into Dublin Bay, which are grouped according to water management units, for the purposes of the Water Framework Directive (WFD). These groupings are labelled as follows:

- Camac;
- Dodder;
- Liffey;
- Tolka; and
- Santry Mayne Sluice.

There are also a number of smaller rivers and local streams discharging at various points around the bay coastline, e.g. Naniken, Wad.

In addition, the two canals, Royal and Grand, discharge to the River Liffey at Spencer Dock and Grand Canal Docks respectively. The Trimblestown and Elm Park Streams discharge to the Bay at Merrion Strand.

The Ringsend WwTP discharges to the Lower Liffey Estuary, which also incorporates the flows from the Camac and Dodder river groups, as well as numerous smaller tributaries and streams, e.g. Poddle and Bradogue. The River Tolka and its tributaries discharge into its own estuary, located between the north side of Dublin Port and the Clontarf waterfront, and adjacent to the Liffey estuary.

The discharge from the River Liffey is the main freshwater input to the bay, with the Rivers Dodder and the Tolka the next major contributors of freshwater flows to the estuary.

The Santry River, which is part of the Santry Mayne Sluice water management unit, discharges adjacent to the North Bull Island causeway.

4.4 Characteristics of the WwTP Component of the Proposed Upgrade Project

The Ringsend WwTP has two wastewater discharges, as follows:

- Final Effluent Discharge (SW1Dublin), which is located in the Poolbeg Power Station Cooling Water Discharge Channel; and
- Storm Water Overflow Discharge (SW2Dublin), which is located at the Pigeon House Harbour.

The SW1Dublin and SW2Dublin designations are defined within the relevant EPA Waste Water Discharge Licence No. D0034-01, and associated applicant documents, and the locations are indicated in Figure 4-9.

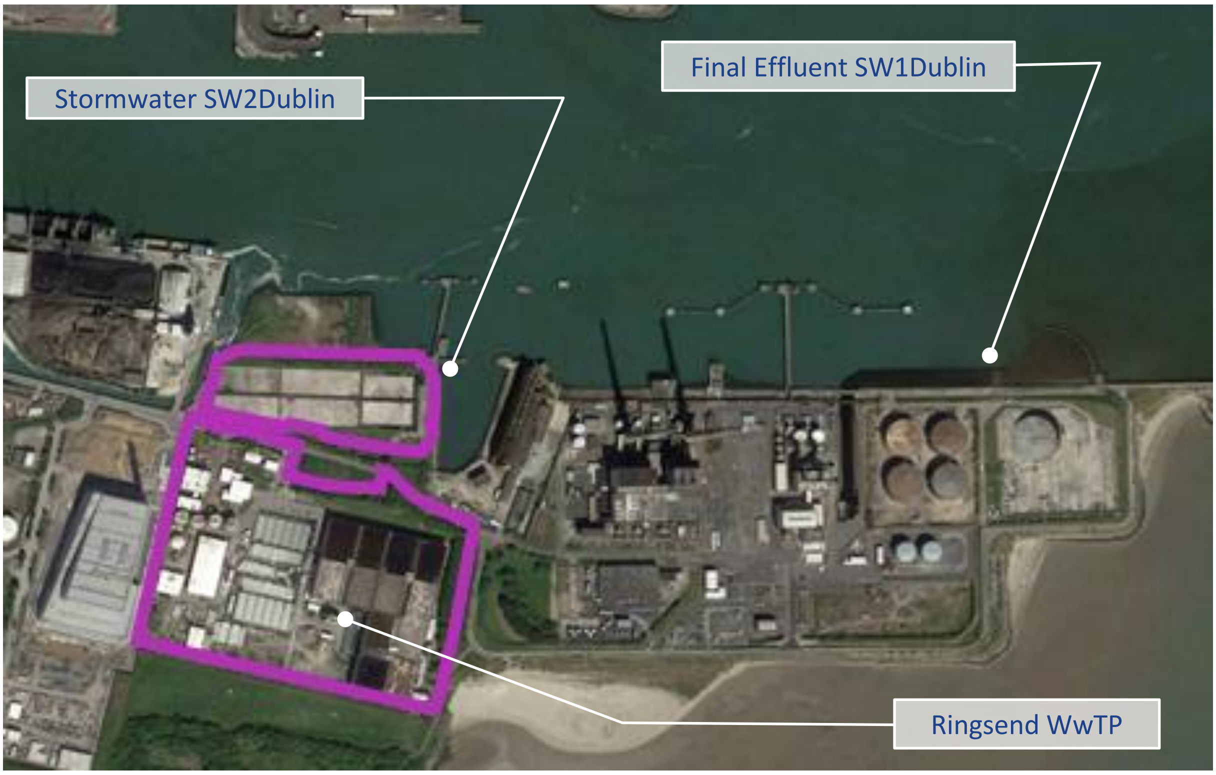


Figure 4-9: Wastewater Discharge Locations

The wastewaters discharge into the Lower Liffey Estuary, but also have the potential to impact on the adjoining water bodies, particularly the Upper Liffey Estuary, Tolka Estuary and wider Dublin Bay.

The required standards for the final effluent discharge are set out in Schedule A.1 of the discharge licence and are summarised in Table 4-3.

Table 4-3: Final Effluent Discharge Standards

Parameter	Unit	Emission Limit	Comment
pH		6-9	
Toxicity	TU	5	
Faecal Coliforms	MPN/100ml	100,000	During the bathing season
BOD	mg/l	25 mg/l	Peak 50 mg/l
COD	mg/l	125 mg/l	Peak 250 mg/l
Suspended Solids	mg/l	35 mg/l	Peak 87.5 mg/l
Total Nitrogen (N)	mg/l	10 mg/l	Annual Average
Total Phosphorous (as P)	mg/l	1 mg/l	Annual Average

It should be noted that while the final effluent licence has standards in respect of total nitrogen and total phosphorous, the water quality legislation and the impact assessment is concerned with DIN and MRP. The relationship between DIN and total nitrogen and MRP and total phosphorous are similar. DIN and MRP both represent the soluble inorganic fraction present in the water, which is available for biological uptake. Total nitrogen and total phosphorous also include insoluble inorganic and soluble organic fractions which are not measured as part of DIN and MRP.

The DIN and MRP concentrations included in the modelling exercise for the existing and future scenarios reflect the actual estimated concentration in the final effluent. In this regard the future final effluent concentrations for DIN and MRP relate reasonably well to the licence requirements for total nitrogen and total phosphorous. The corresponding future total nitrogen and phosphorous levels are expected to be at or below the licence levels. The future DIN is estimated to be between 80 and 90% of total nitrogen, while the future MRP is estimated to be between 70 and 80% of total phosphorous.

4.5 Do-Nothing Impact

In the event that the Proposed WwTP Component is not progressed, then the current difficulties achieving the required final effluent standards will continue and the quality will further disimprove as the wastewater influent volumes increase in line with increases in economic activity and population growth in the Greater Dublin Area.

4.6 Impact Assessment - Operating Phase

4.6.1 Biochemical Oxygen Demand (BOD)

The environmental impact from BOD has been initially assessed by comparing the average amount of BOD currently discharged in the final effluent against the average amount to be discharged when the plant reaches its future design load, as set out in Table 4-4 below.

Table 4-4: Final Effluent Discharge – BOD – Estimated Average

Biochemical Oxygen Demand	Flow	Concentration	Load
Current	4.91 m^3/s	20.6 mg/l	8,739 kg/day
Future	6.95 m^3/s	12.0 mg/l	7,206 kg/day

The improvement in effluent quality achieved by the Proposed WwTP Component thus compensates for the increase in flow through the plant and results in a 17.5% overall reduction in the average daily load of BOD discharged to the environment. These figures indicate that there will be a positive effect on the receiving water environment in respect of BOD.

The environmental impact is then further assessed, using the Mike 3 Model, by comparing the impact of the existing average discharge against the future average discharge, as shown in the figures below (see Figure 4-10, Figure 4-11 and Figure 4-12). The plots show that, with the exception of a local mixing area adjacent to the discharge point, the BOD concentration quickly drops to below 4 mg/l, in both the existing and future scenarios. 4mg/l being the Environmental Quality Standard (EQS) for BOD for good status in transitional waters as set out in European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI 272 of 2009), as amended.

The plots show depth averaged values, being the modelled value that best reflects the water sampling procedure for this parameter. The plots are 95 percentile plots, showing values which will not be exceeded 95% of the time, in line with the EQS as set out in the legislation.

Appendix 4A shows some additional model runs, with estimated peak BOD concentrations, rather than averages. These additional plots allow an assessment of the potential variation around the average discharge on any given day, and demonstrate the positive impact from the more consistent performance that is achievable from the AGS process, which varies less from the average than the current process.

The plots shown here have been selected for inclusion in this section, as they show the least improvement between the existing and the future scenarios, and are thus most relevant to the worst-case impact assessment. The plots based on the peak values show a greater improvement between current and future, and are consequently less interesting from the worst-case perspective.

In conclusion there will be a positive imperceptible effect in respect of the BOD parameter.

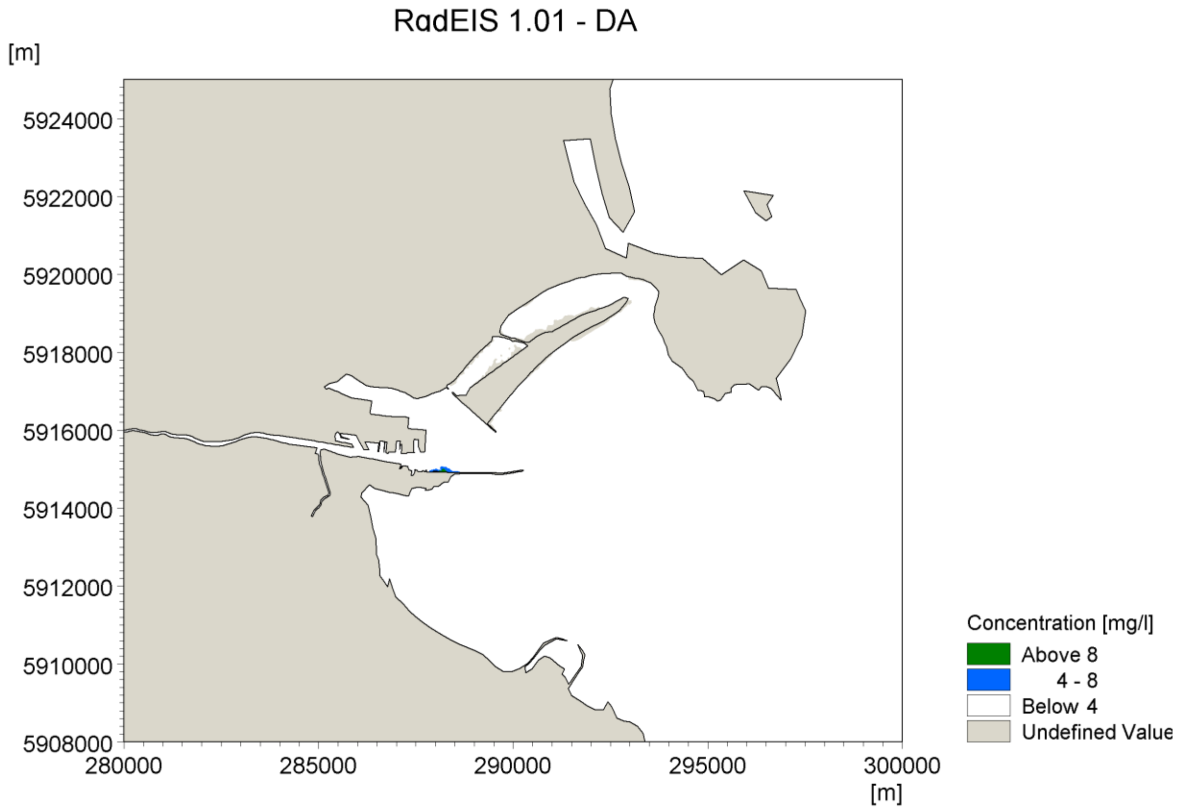


Figure 4-10: Existing Average BOD Discharge (depth averaged 95%ile)

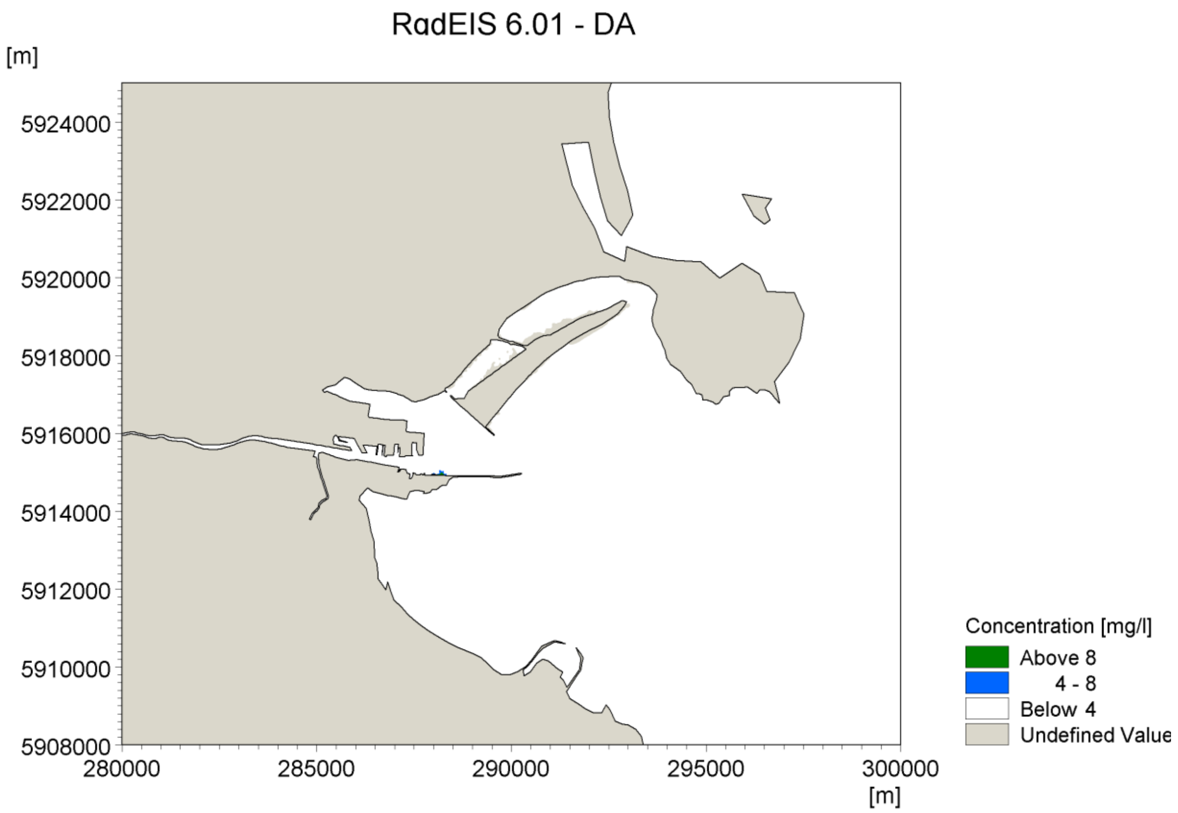


Figure 4-11: Future Average BOD Discharge (depth averaged 95%ile)

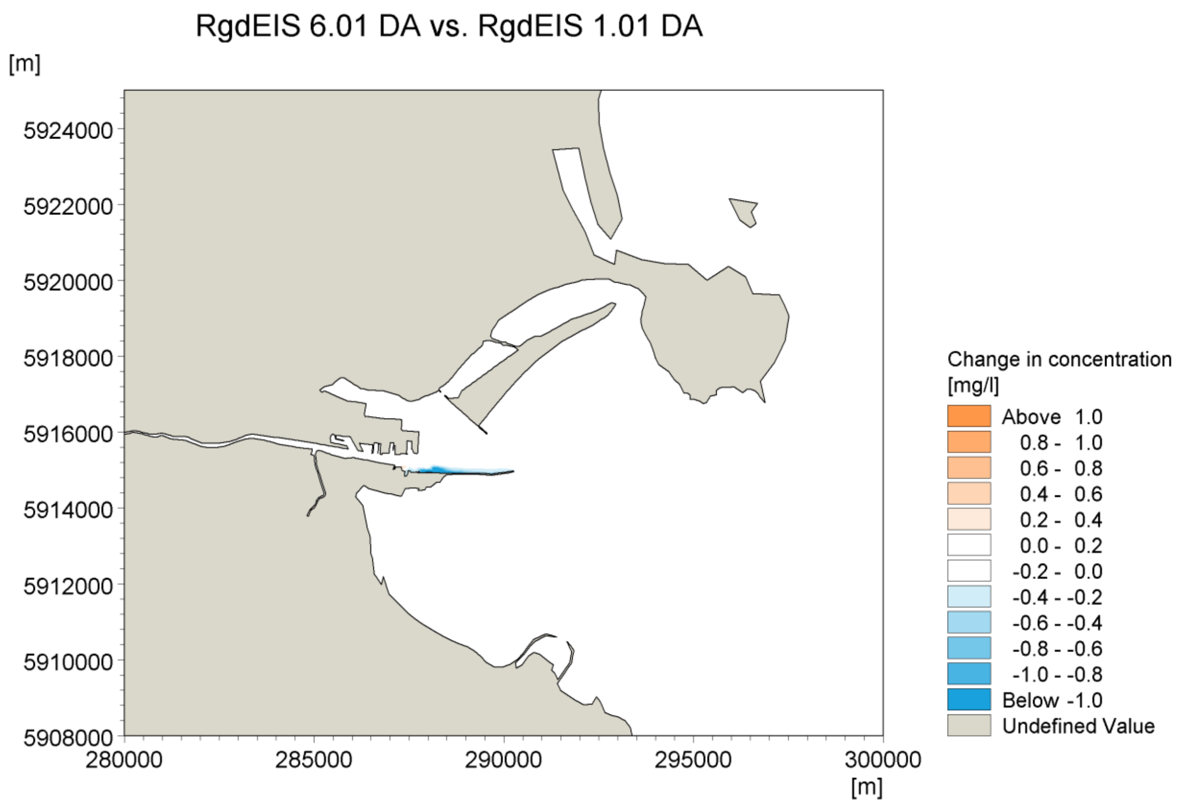


Figure 4-12: Future Change in Average BOD Discharge (depth averaged 95%ile)

4.6.2 Suspended Solids (SS)

The environmental impact from suspended solids has been initially assessed by comparing the average amount of SS currently discharged in the final effluent against the average amount to be discharged when the plant reaches its future design load, as set out in Table 4-5 below.

Table 4-5: Final Effluent Discharge - SS - Estimated Average

Suspended Solids	Flow	Concentration	Load
Current	4.91 m3/s	38.2 mg/l	16,205 kg/day
Future	6.95 m3/s	17.5 mg/l	10,508 kg/day

The improvement in effluent quality achieved by the Proposed WwTP Component thus compensates for the increase in flow through the plant and results in a 35.2% overall reduction in the average daily load of SS discharged to the environment. These figures indicate that there will be a positive effect on the receiving water environment in respect of suspended solids.

The environmental impact is then further assessed, using the Mike 3 Model, by comparing the impact of the existing average discharge against the future average discharge, as shown in the figures below (see Figure 4-13, Figure 4-14 and Figure 4-15). The plots show that, with the exception of a local mixing area adjacent to the discharge point, the suspended solids concentration quickly drops to below 5 mg/l, in both the existing and future scenarios.

Suspended solids are not a parameter that is included in the Water Framework Directive assessment. However, it is a general pollution parameter which is monitored in the final effluent from wastewater treatment plants. The figure of 5 mg/l does not have any particular significance, other than being a low suspended solids level. By way of comparison, the European Communities (Quality of Salmonid Waters) Regulations, 1988, which was superseded by the Water Framework Directive, set an average standard of 25 mg/l for suspended solids in salmonid waters.

The plots show depth averaged values, being the model value that best reflects the water sampling procedure for this parameter. The plots are also 95 percentile plots, showing values which will not be exceeded 95% of the time.

The plots reflect the detail contained in Table 4-5, showing a reduction in the daily suspended solids load discharged though the final effluent, notwithstanding the increase in the discharge volume.

Appendix 4A shows some additional model runs, with estimated peak suspended solids values, rather than averages. These additional plots allow an assessment of the potential variation around the average discharge on any given day, and demonstrate the impact from the more consistent performance that is achievable from the AGS process, which varies less from the average than the current process.

The plots shown here have been selected for inclusion in this section, as they show the least improvement between the existing and the future scenarios, and are thus most relevant to the worst case impact assessment. The plots based on the peak values show a greater improvement from the current to the future situation, and are consequently less interesting from the worst-case perspective.

In conclusion there will be a positive imperceptible effect in respect of the suspended solids parameter.

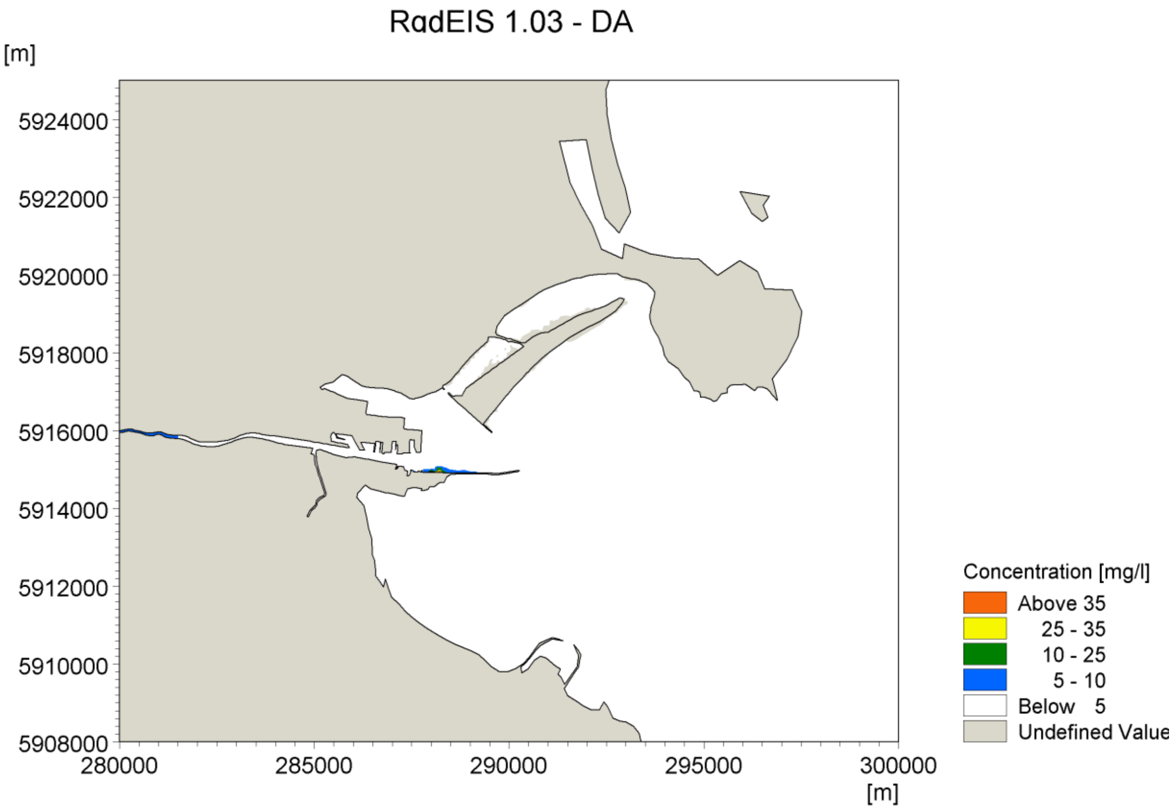


Figure 4-13: Existing Average Suspended Solids Discharge (depth averaged 95%ile)

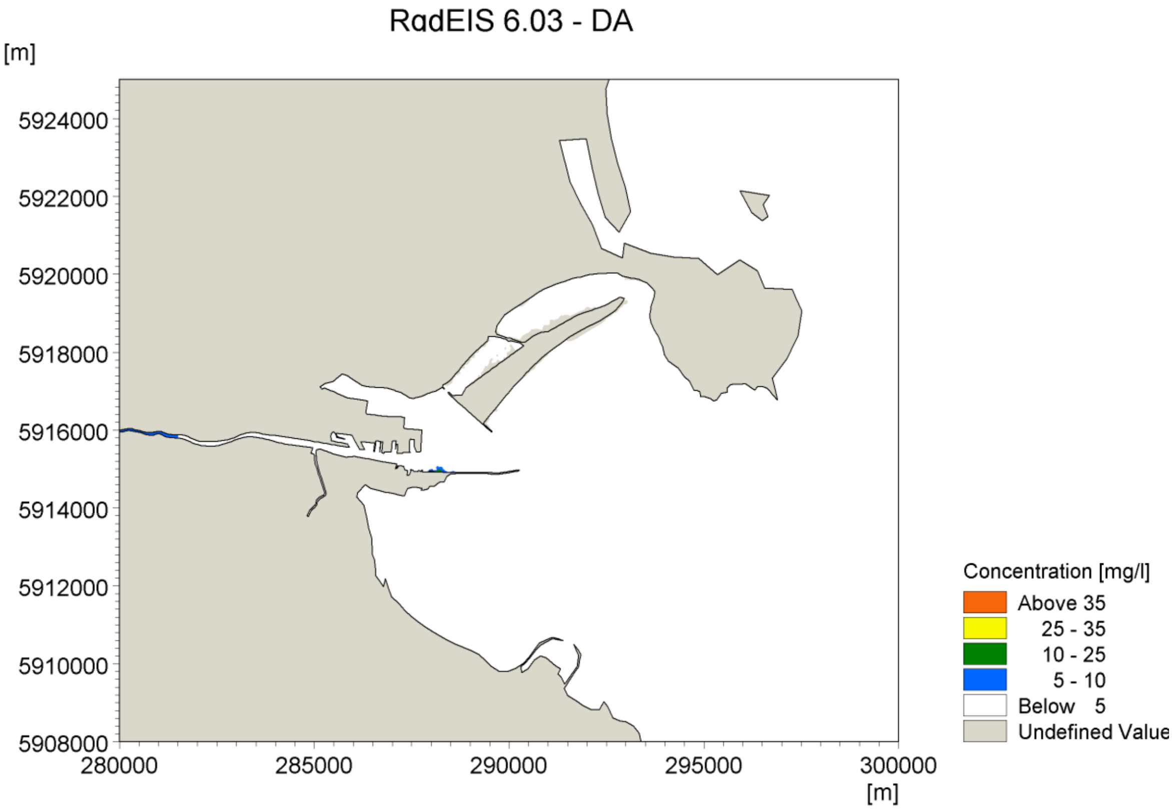


Figure 4-14: Future Average Suspended Solids Discharge (depth averaged 95%ile)

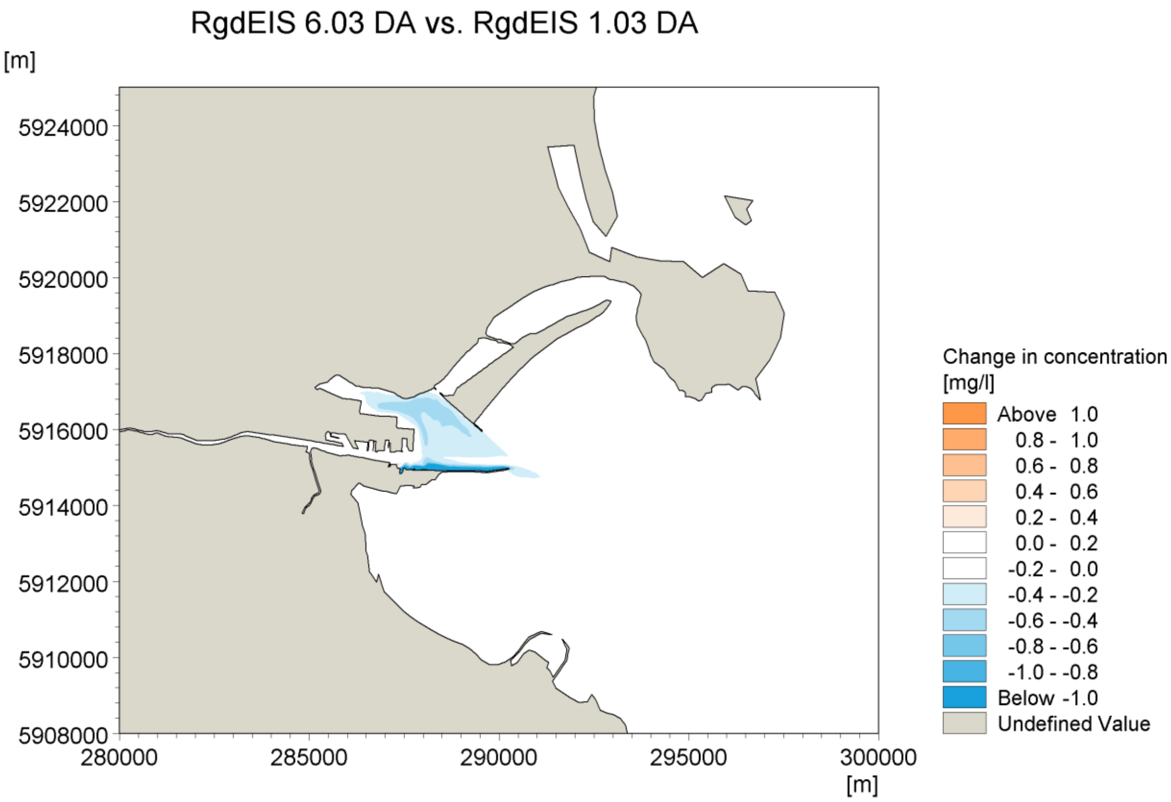


Figure 4-15: Future Change in Average Suspended Solids Discharge (depth averaged 95%ile)

4.6.3 Ammonia

The environmental impact from ammonia has been initially assessed by comparing the average amount of ammonia currently discharged in the final effluent against the average amount to be discharged when the plant reaches its future design load, as set out in Table 4-6 below.

Table 4-6: Final Effluent Discharge – Ammonia – Estimated Average

Suspended Solids	Flow	Concentration	Load
Current	4.91 m3/s	10.3 mg/l	4,370 kg/day
Future	6.95 m3/s	1 mg/l	600 kg/day

The improvement in effluent quality achieved by the Proposed WwTP Component thus compensates for the increase in flow through the plant and results in an 86.3% overall reduction in the average daily load of ammonia discharged to the environment. These figures indicate that there will be a positive effect on the receiving water environment in respect of ammonia.

The environmental impact is then further assessed using the Mike 3 Model, by comparing the impact of the existing average ammonia discharge against the future average ammonia discharge, as shown in the figures below (see Figure 4-16, Figure 4-17 and Figure 4-18). The plots show that the existing discharge, which is not fully nitrified and is modelled with a concentration of 10.3 mg N / l, results in modelled concentrations in the Tolka Estuary in excess of 0.28 mg/l. Ammonia levels in excess of 0.09 mg N / l are also observed in the Lower Liffey Estuary, however the main impact of the discharge is observed in the Tolka Estuary.

The future discharge, which is fully nitrified and is modelled with a concentration of 1 mg N / l, shows much lower concentrations in the receiving water, and with the exception of a local mixing area adjacent to the discharge point, the total ammonia concentration quickly drops to below 0.09 mg N/l, which is the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI 272 of 2009) (WFD Regulations), high status objective for rivers and lakes, there being no objective for transitional or coastal waters.

Ammonia in water exists in two forms, an ionised fraction (NH_4^+) and an unionised fraction (NH_3), which is harmful to fish. The relationship between the two forms is complex and varies with pH and temperature. Consequently, and notwithstanding the fact that there is no EQS for ammonia in transitional or coastal water, an 86.3% reduction in the ammonia discharge to the modelled levels is a positive environmental impact.

The plots show depth averaged values, being the model value that best reflects the water sampling procedure for this parameter. The plots are also 95 percentile plots, showing values which will not be exceeded 95% of the time.

The plots reflect that while the future volumes discharged from the plant will increase with increasing loading to the WwTP, an improvement in the quality of the final effluent will result in a significant overall reduction in the daily ammonia load discharged though the final effluent.

In conclusion there will be a positive moderate effect in respect of the ammonia parameter.

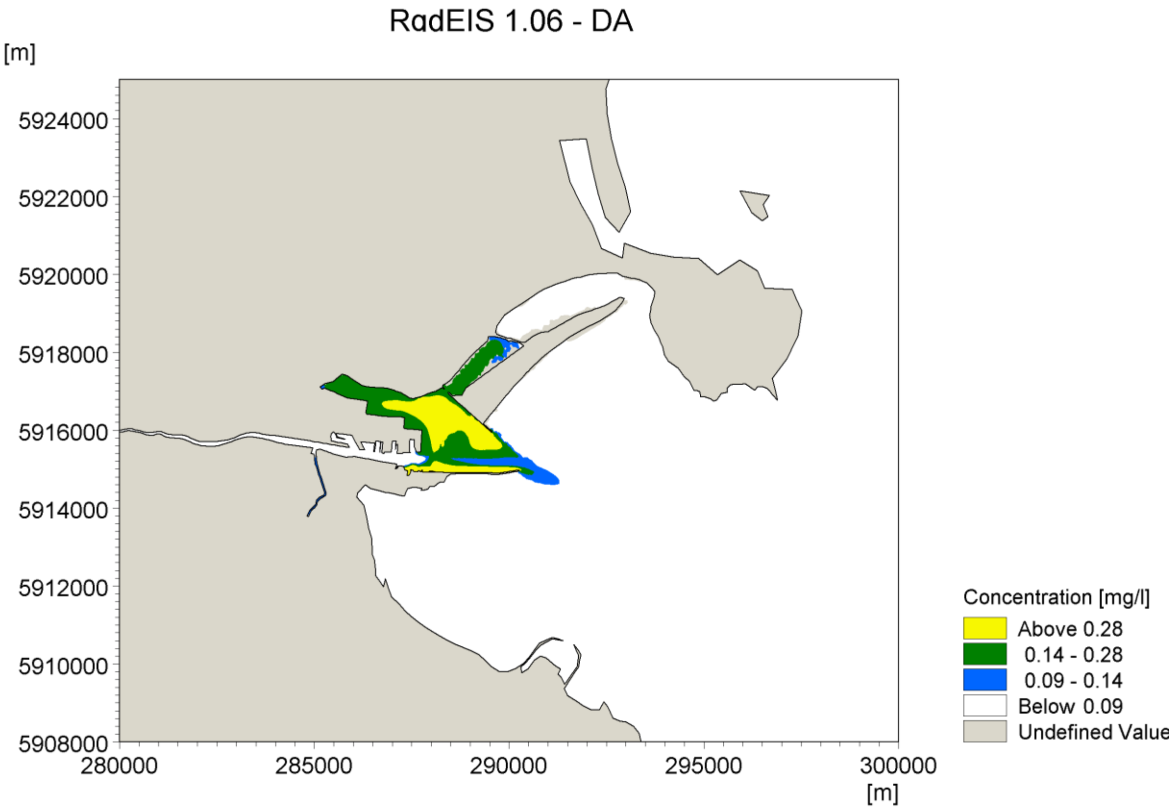


Figure 4-16: Existing Average Ammonia Discharge (depth averaged 95%ile)

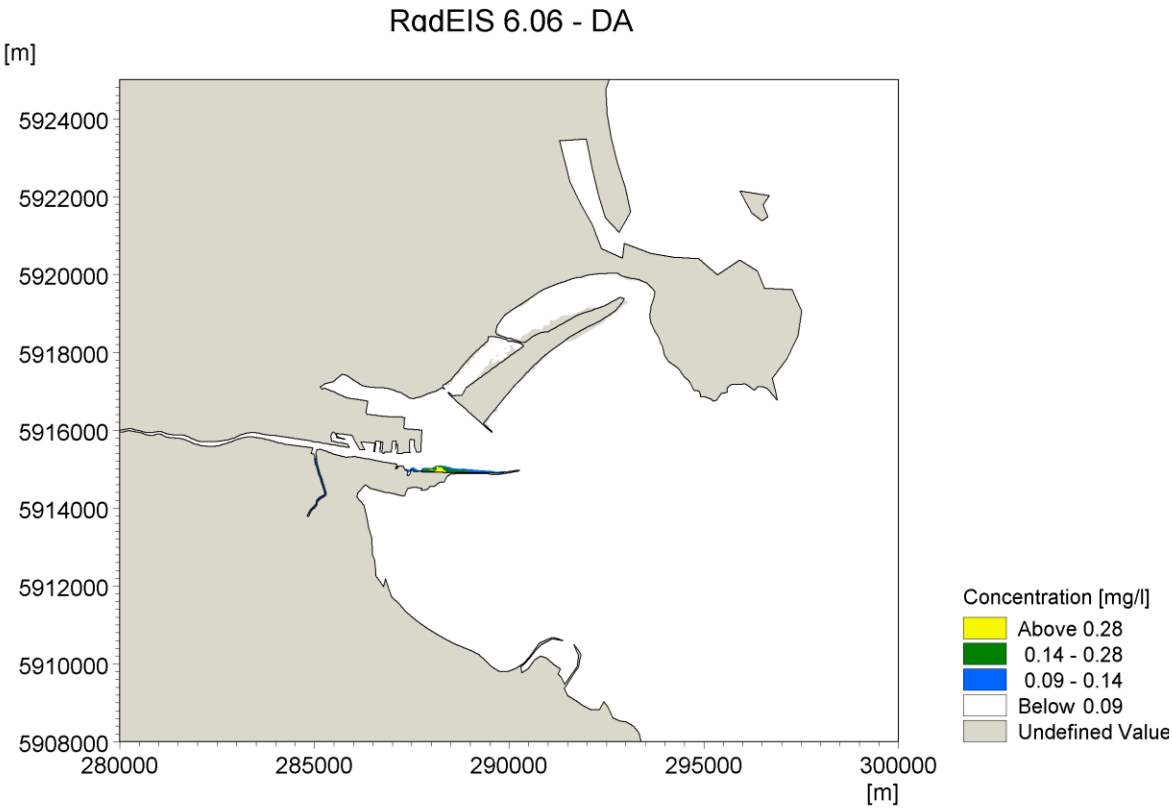


Figure 4-17: Future Average Ammonia Discharge (depth averaged 95%ile)

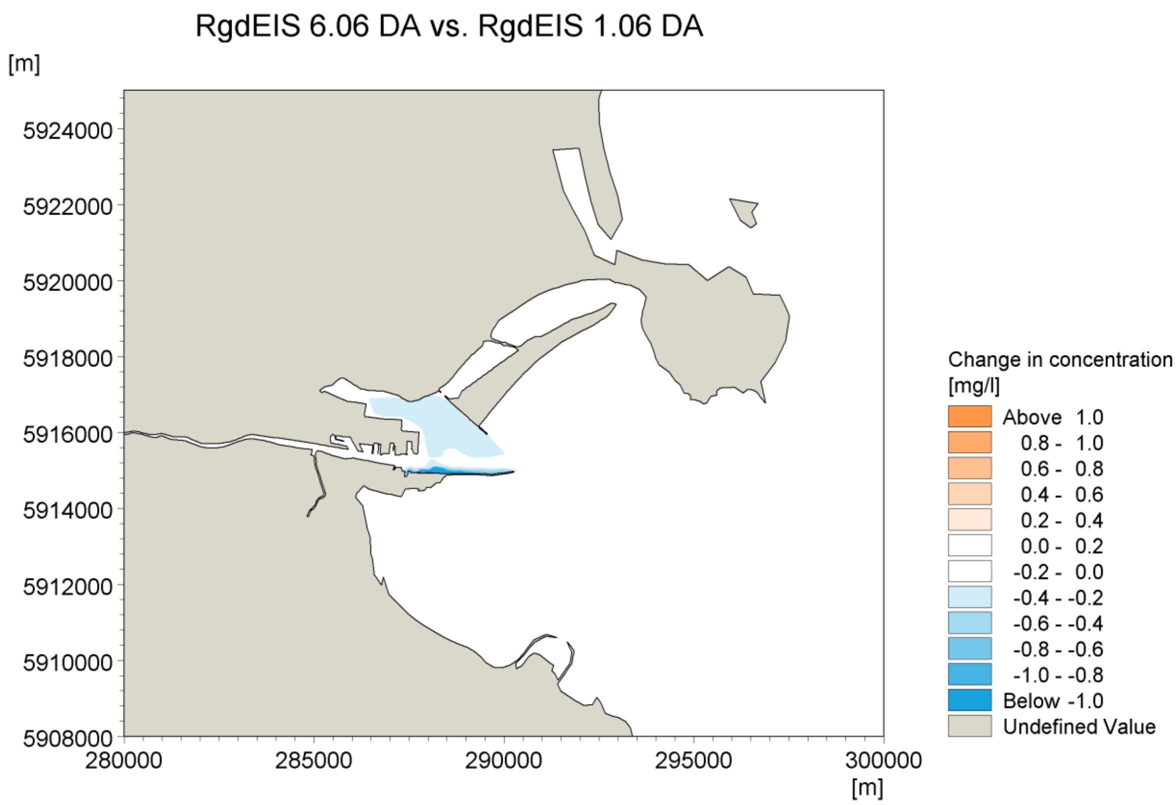


Figure 4-18: Future Change in Average Ammonia Discharge (depth averaged 95%ile)

4.6.4 Dissolved Inorganic Nitrogen (DIN)

The environmental impact from dissolved inorganic nitrogen has been initially assessed by comparing the average amount of DIN currently discharged in the final effluent against the average amount to be discharged when the plant reaches its future design load, as set out in Table 4-7 below.

Table 4-7: Final Effluent Discharge - DIN - Estimated Average

Suspended Solids	Flow	Concentration	Load
Current	4.91 m^3/s	14 mg/l	5,939 kg/day
Future	6.95 m^3/s	8 mg/l	4,803 kg/day

The improvement in effluent quality achieved by the Proposed WwTP Component thus compensates for the increase in flow through the plant and results in a 19.1% overall reduction in the average daily load of DIN discharged to the environment. These figures indicate that there will be a positive effect on the receiving water environment in respect of DIN.

The relationship between DIN and total nitrogen is noted previously within this section.

The environmental impact is then further assessed using the MIKE 3 Model, by comparing the impact of the existing average DIN discharge against the future average DIN discharge, as shown in the figures below (see Figure 4-19, Figure 4-20 and Figure 4-21). The plots, which include DIN from other sources, such as the river inputs, show that concentrations of DIN, arising from the final effluent discharge, in excess of 0.17 mg N/l are largely confined to the Tolka Estuary, with some impact also observed in the transition across the Lower Liffey Estuary. This demonstrates that the predominant impact from the final effluent discharge is experienced in the Tolka Estuary.

The European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI 272 of 2009) (WFD Regulations), does not include DIN in the parameters to be assessed when determining the status of transitional waters. However, the high-status objective for fully saline (34.5 PSU) coastal waters, is 0.17 mg N/l, which is why this concentration has been used in the legend for the plot.

The EPA do however use DIN as a parameter in their assessment of water bodies as part of the Trophic Status Assessment Scheme (TSAS). TSAS is used by the EPS to make recommendations as to whether water bodies should be designated as sensitive under the Urban Wastewater Treatment Directive. The Tolka Estuary and Lower Liffey Estuary have both been designated as sensitive and as a consequence, the final effluent discharge is required to achieve a total nitrogen concentration of 10 mg/l, measured on an annual average basis.

The plots show depth averaged values, being the model value that best reflects the water sampling procedure for this parameter. The plots are also 50 percentile plots, showing values which will not be exceeded 50% of the time.

Appendix 4A also shows some additional model runs, with winter and summer values, rather than averages. These additional plots reflect the increased concentration of DIN in the receiving water during winter, when the temperatures are lower and there is less biological uptake of the nutrient, and a reduction in the DIN concentrations, during summer in response to higher temperatures and biological uptake.

In summary:

- The Proposed WwTP Component will result in a reduction in the total DIN load discharged from the Ringsend WwTP;
- The main impact of the future DIN discharge will be experienced in the Tolka Estuary;
- DIN is not a measured parameter for the purposes of the Water Framework Directive in transitional waters, which includes the Tolka Estuary;
- The Tolka Estuary has been designated as sensitive under the Urban Wastewater Treatment Directive, as a result of monitoring as part of the TSAS; and
- The designation of the Tolka as sensitive requires the final effluent from the WwTP to achieve a total nitrogen standard, on an annual average basis, of 10 mg N / l.

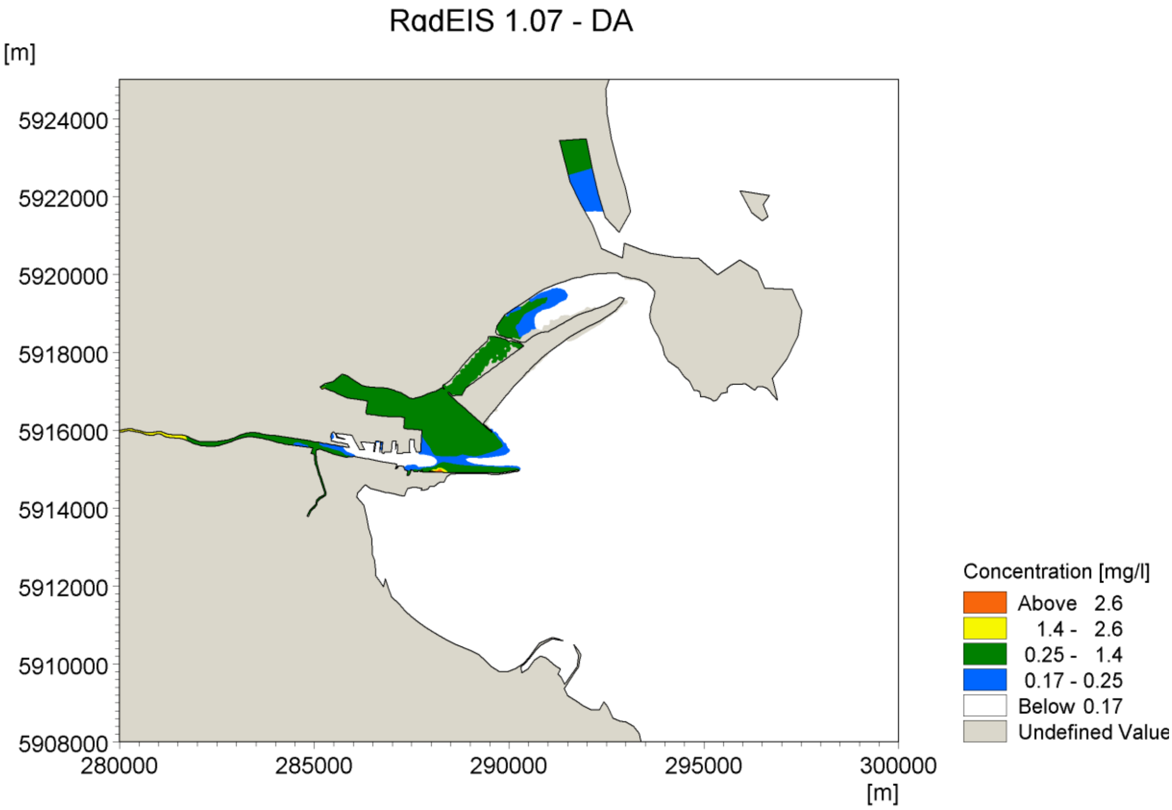


Figure 4-19: Existing Average DIN Discharge (depth averaged 50%ile)

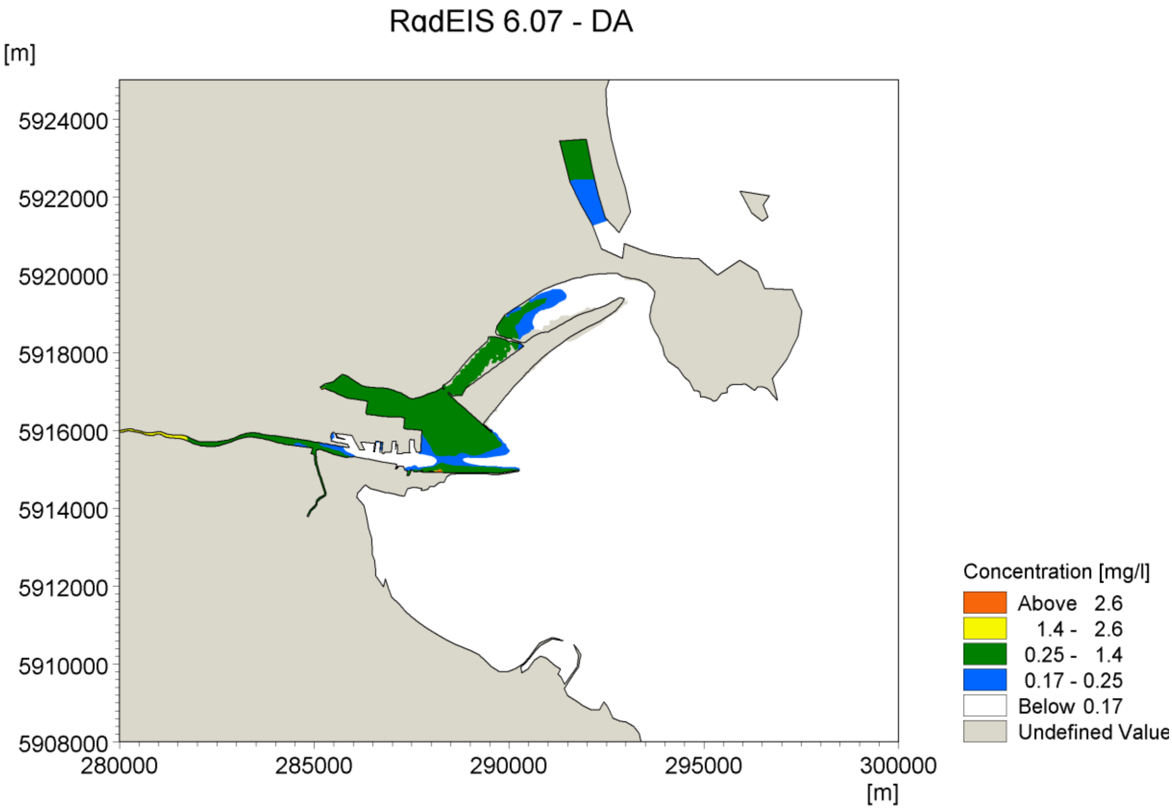


Figure 4-20: Future Average DIN Discharge (depth averaged 50%ile)

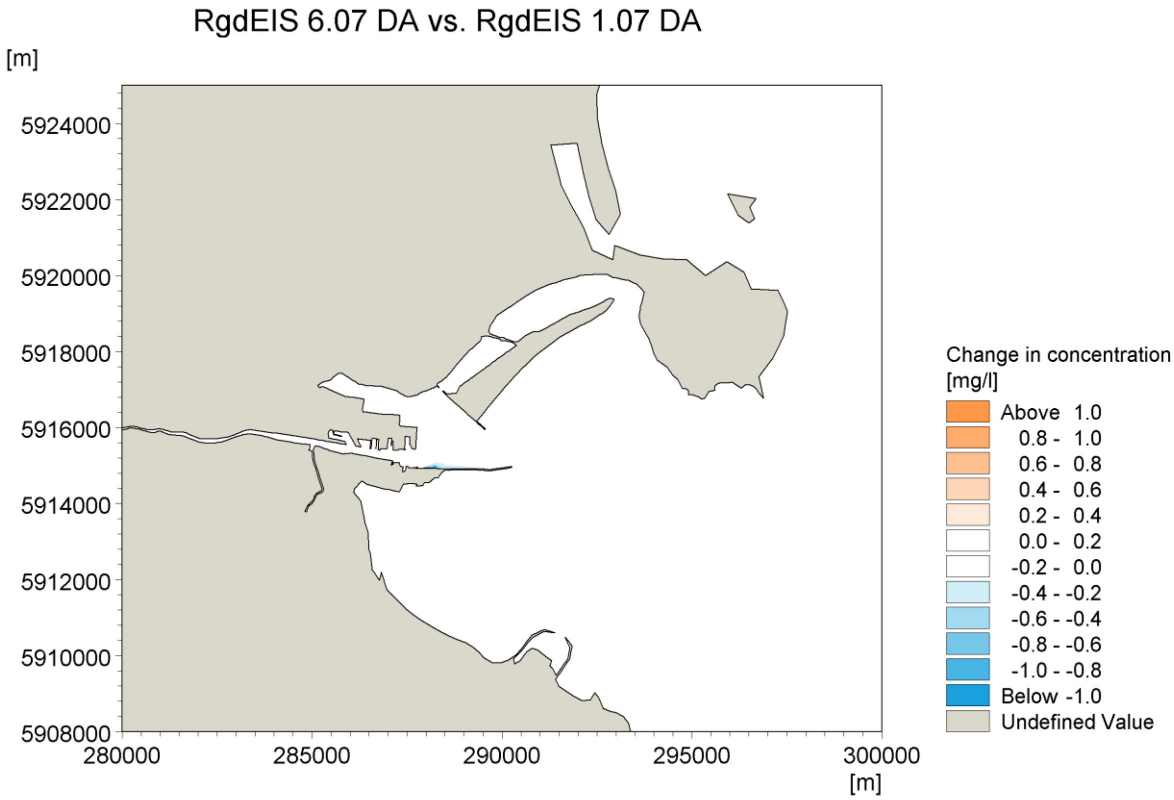


Figure 4-21: Future Change in Average DIN Discharge (depth averaged 50%ile)

The above points suggest that once the final effluent discharge standard is achieved then there are no further regulatory requirements in respect of DIN.

However, DIN is a nutrient and elicits a biological response in respect of parameters that are monitored as part of the Water Framework Directive, such as chlorophyll and macroalgae.

The impact of the DIN discharge on the Tolka Estuary was thus further analysed using the DCPM model, to assess the impact of the estimated DIN levels in the estuary on the chlorophyll and macroalgae levels. The model shows (Figure 4-22) how the existing plant, which is not designed to denitrify is dependent upon the higher summer temperatures to reduce DIN concentrations, whereas the future treatment process ensures a lower DIN concentration in the final effluent on a more consistent process.

The DCPM model also assesses the impact of the DIN concentrations on the chlorophyll and macroalgae levels and finds that there is no change in either, notwithstanding the different winter and summer DIN concentrations between existing and future (see Figure 4-23 and Figure 4-24). This analysis indicates that the DIN concentration in the WwTP discharge is not a limiting factor in the Tolka Estuary and other nutrient sources are available.

Please note that the plots show the existing and future lines on top of each other, reflecting the fact that there are no changes between the two situations.

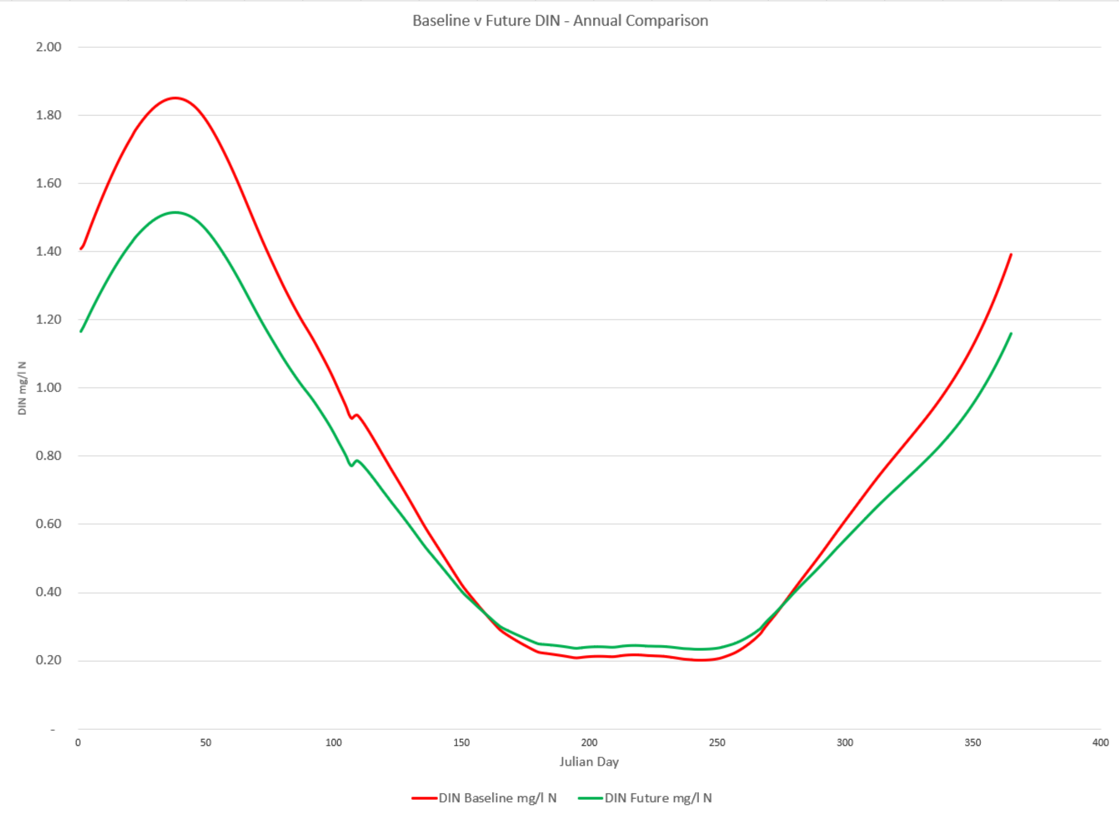


Figure 4-22: Comparison of Existing and Future DIN Concentrations in Tolka Estuary

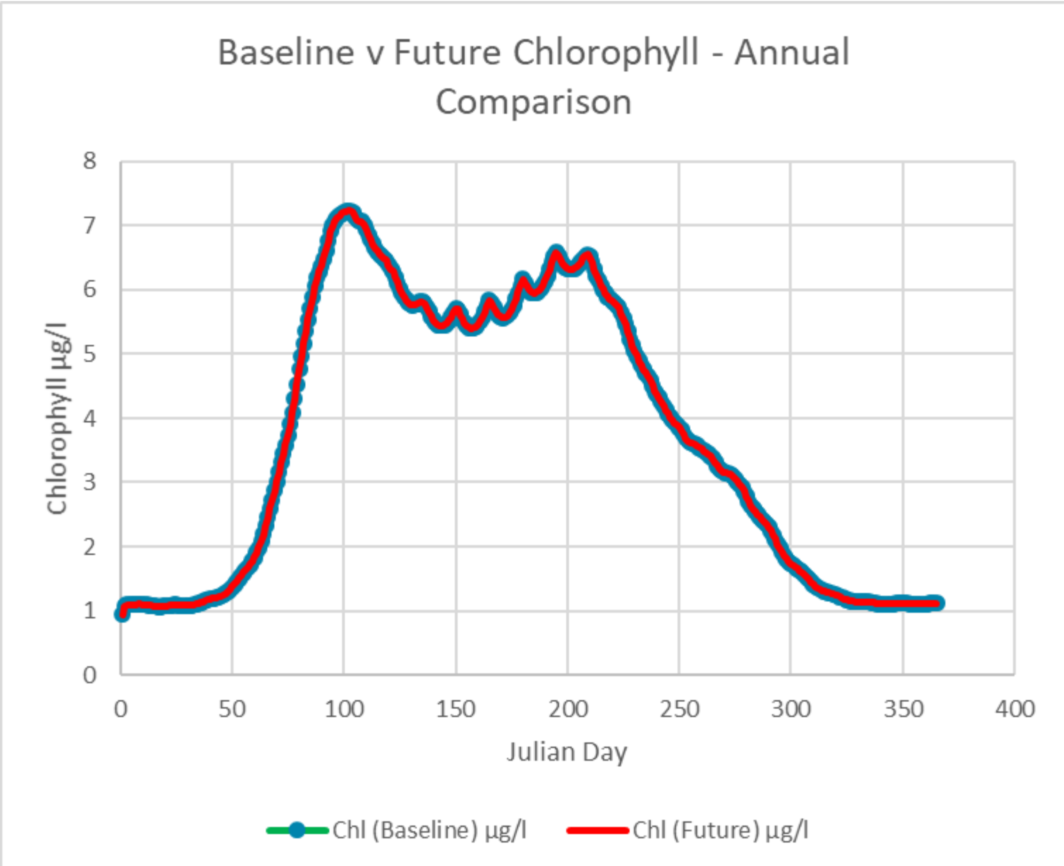
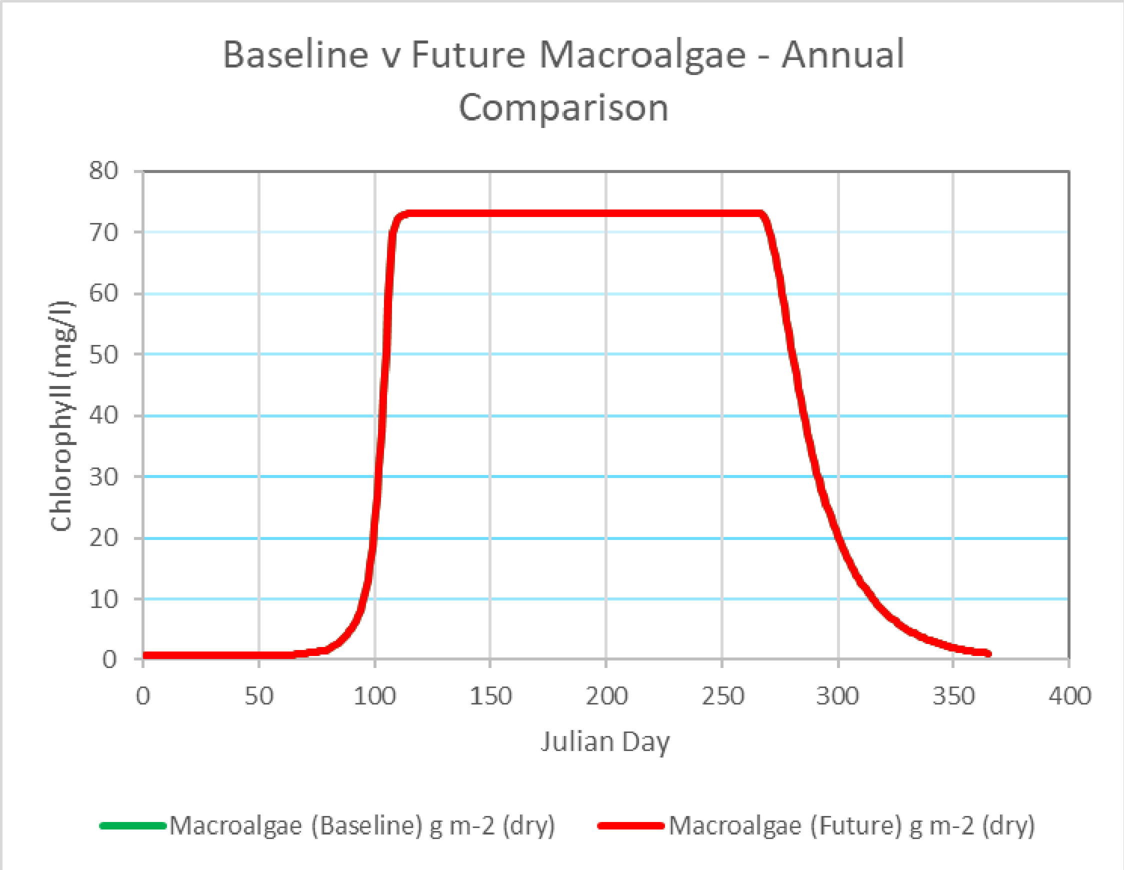


Figure 4-23: Comparison of Existing and Future Chlorophyll Concentrations in Tolka Estuary



(please note one line is directly on top of the other)

Figure 4-24: Comparison of Existing and Future Macroalgae Concentrations in Tolka Estuary

The overall conclusion in respect of the environmental impact as a result of the changes in the final effluent, in respect of the DIN parameter, is thus as follows:

- The DIN discharged in the final effluent will be reduced by the Proposed WwTP Component;
- The predominant impact of the discharge is on the Tolka Estuary;
- The receiving waters are designated as sensitive and consequently a nitrogen standard applies in the final effluent;
- There are no direct requirements to control the level of DIN in the Tolka Estuary; and
- The chlorophyll and macroalgae concentrations in the Tolka Estuary are not determined by the DIN concentrations discharged from the Ringsend WwTP.

The overall environmental impact arising from the change in the DIN discharge is thus considered to be positive and imperceptible.

4.6.5 Molybdate Reactive Phosphate (MRP)

The environmental impact from molybdate reactive phosphate has been initially assessed by comparing the average amount of MRP currently discharged in the final effluent against the average amount to be discharged when the plant reaches its future design load, as set out in Table 4-8 below.

Table 4-8: Final Effluent Discharge – MRP – Estimated Average

Suspended Solids	Flow	Concentration	Load
Current	4.91 m^3/s	2.49 mg/l	1,056 kg/day
Future	6.95 m^3/s	0.7 mg/l	420 kg/day

The improvement in effluent quality achieved by the Proposed WwTP Component thus compensates for the increase in flow through the plant and results in a 60.2% overall reduction in the average daily load of MRP discharged to the environment. These figures indicate that there will be a positive effect on the receiving water environment in respect of MRP.

The relationship between MRP and total phosphorous is noted previously within this section.

The environmental impact is then further assessed, using the Mike 3 Model, by comparing the impact of the existing average MRP discharge against the future average MRP discharge, as shown in the figures below (see Figure 4-25, Figure 4-26 and Figure 4-27). The main impact of the discharge, as previously observed under the section on DIN, is on the Tolka Estuary.

The plots show that the existing discharge, which is modelled with a concentration of 2.49 mg P/l, results in modelled concentrations in the Tolka Estuary in excess of 0.04 mg P/l, which is the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI 272 of 2009) (WFD Regulations), objective for saline transitional waters The future discharge, which is modelled with a lower discharge concentration of 0.7 mg P/l, shows significantly reduced concentrations of MRP in the Tolka Estuary.

The plots show depth averaged values, being the model value that best reflects the water sampling procedure for this parameter. The plots are also 50 percentile plots, showing values which will not be exceeded 50% of the time.

The plots reflect that while the future volumes discharged from the plant will increase with the increasing load to the WwTP, there will be an improvement in the quality of the final effluent, resulting in a reduction in the environmental impact of the discharge.

Appendix 4A also shows some additional model runs, with winter and summer values, rather than averages. These additional plots reflect the increased concentration of MRP in the receiving water during winter, when the temperatures are lower and there is less biological uptake of the nutrient, and a similar reduction in the MRP concentrations, during summer, in response to higher temperatures and biological uptake.

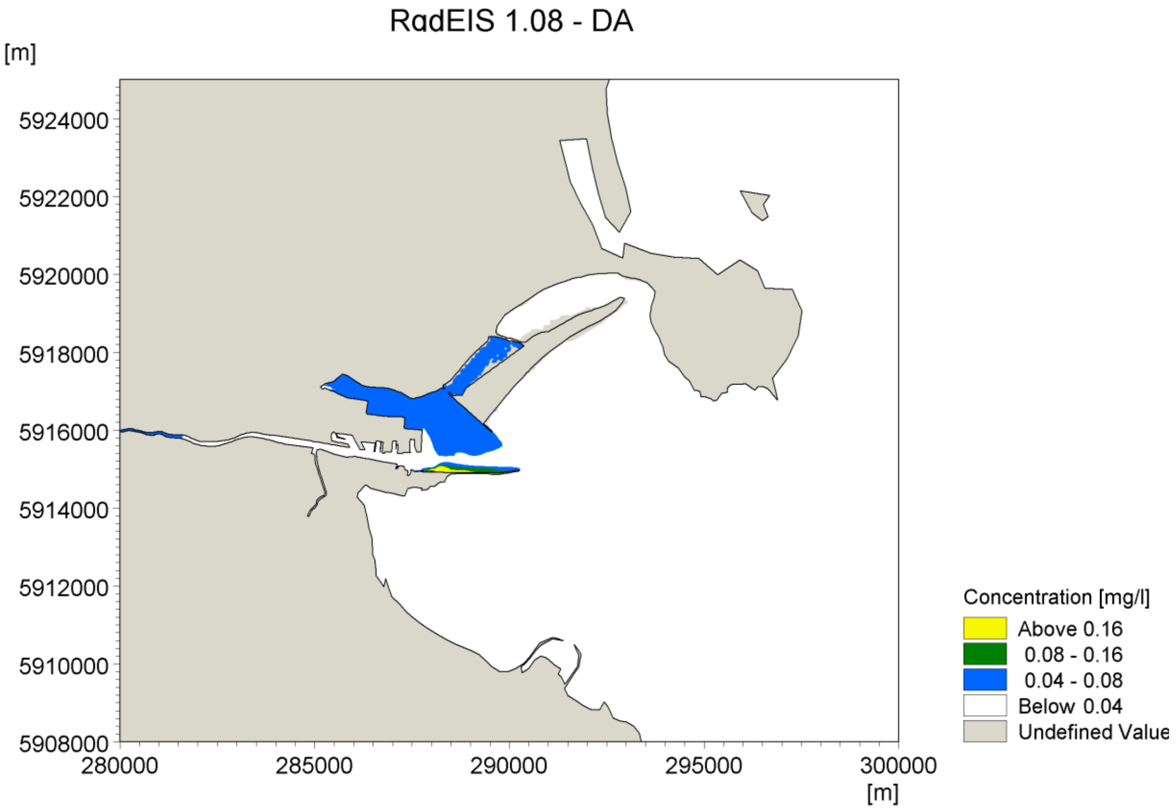


Figure 4-25: Existing Average MRP Discharge (depth averaged 50%ile)

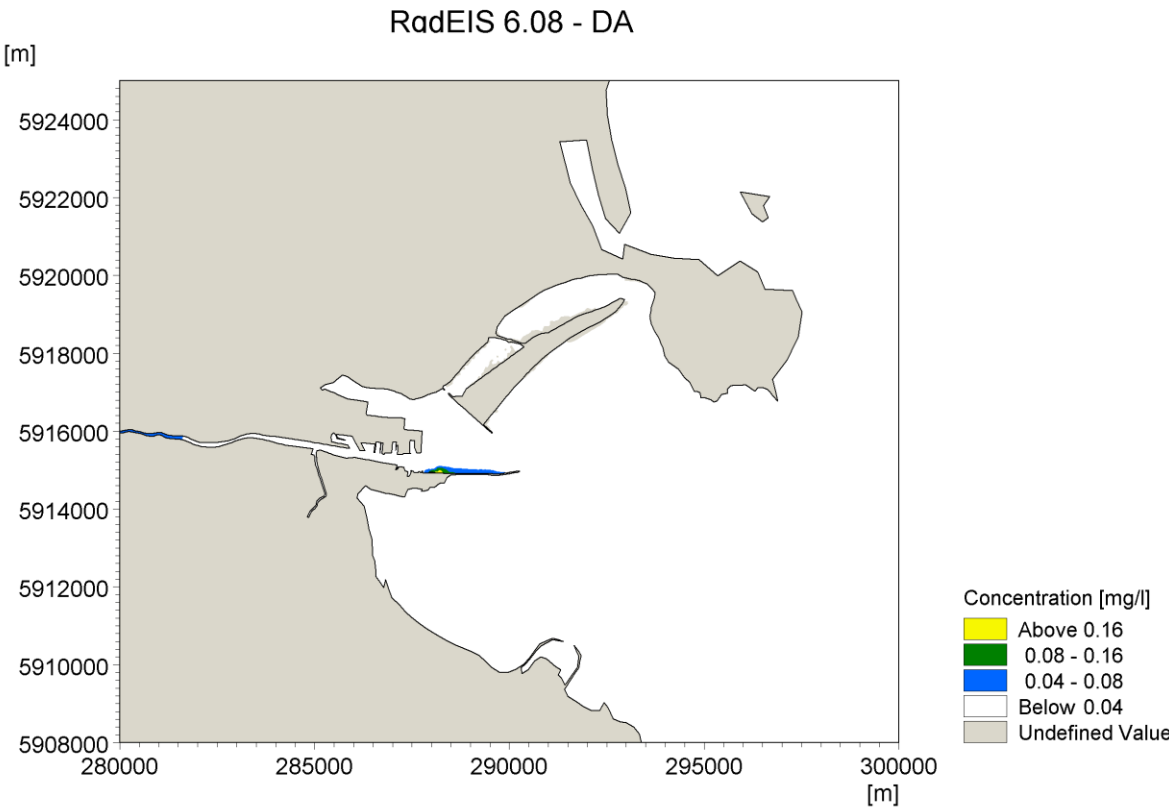


Figure 4-26: Future Average MRP Discharge (depth averaged 50%ile)

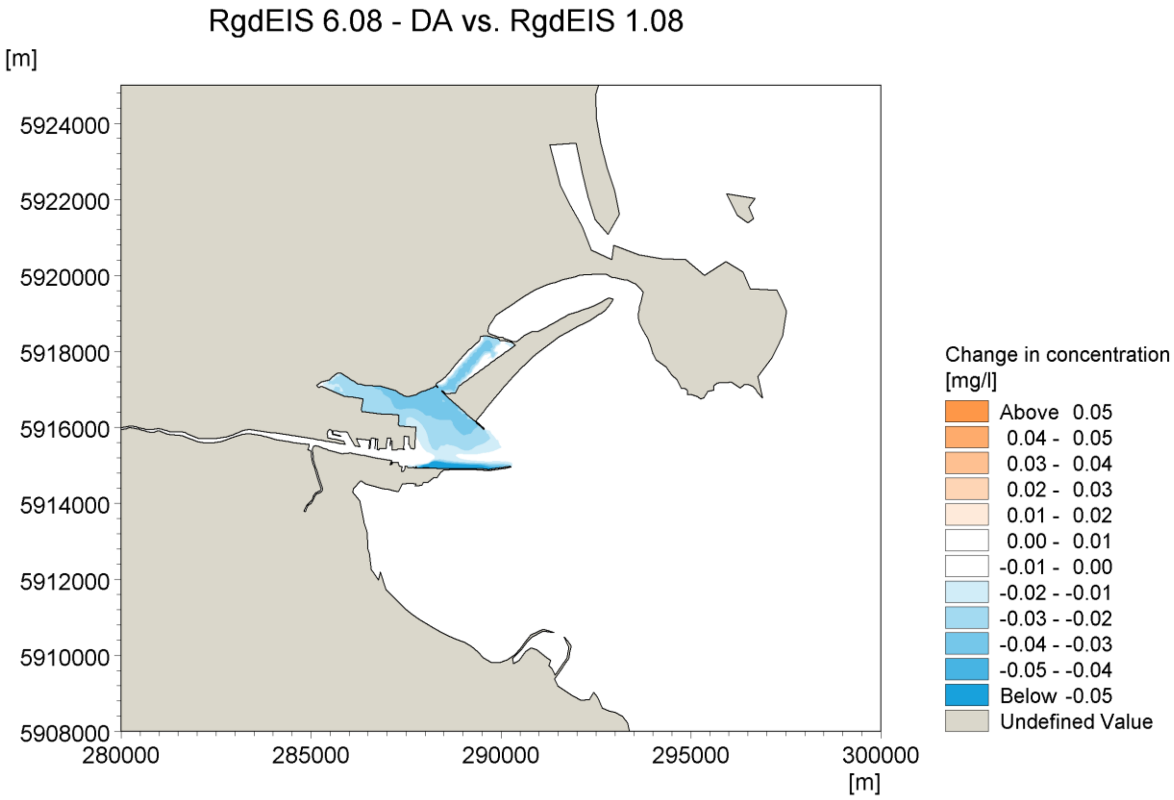


Figure 4-27: Future Change in Average MRP Discharge (depth averaged 50%ile)

Similarly to DIN, MRP is also a nutrient and elicits a biological response in respect of parameters that are monitored as part of the Water Framework Directive, such as chlorophyll and macroalgae.

The impact of the MRP discharge on the Tolka Estuary was thus further analysed using the DCPM model, to assess the impact of the estimated MRP levels in the estuary. The model confirms (Figure 4-28) the reduction in the MRP concentrations with the provision of phosphorus removal as part of the wastewater treatment process.

Additionally, it should be noted that the reduction in MRP is significant enough to make a noticeable difference in the levels of MRP observed in the Tolka Estuary, and hence assist the Tolka Estuary meet the relevant compliance objective under the Water Framework Directive.

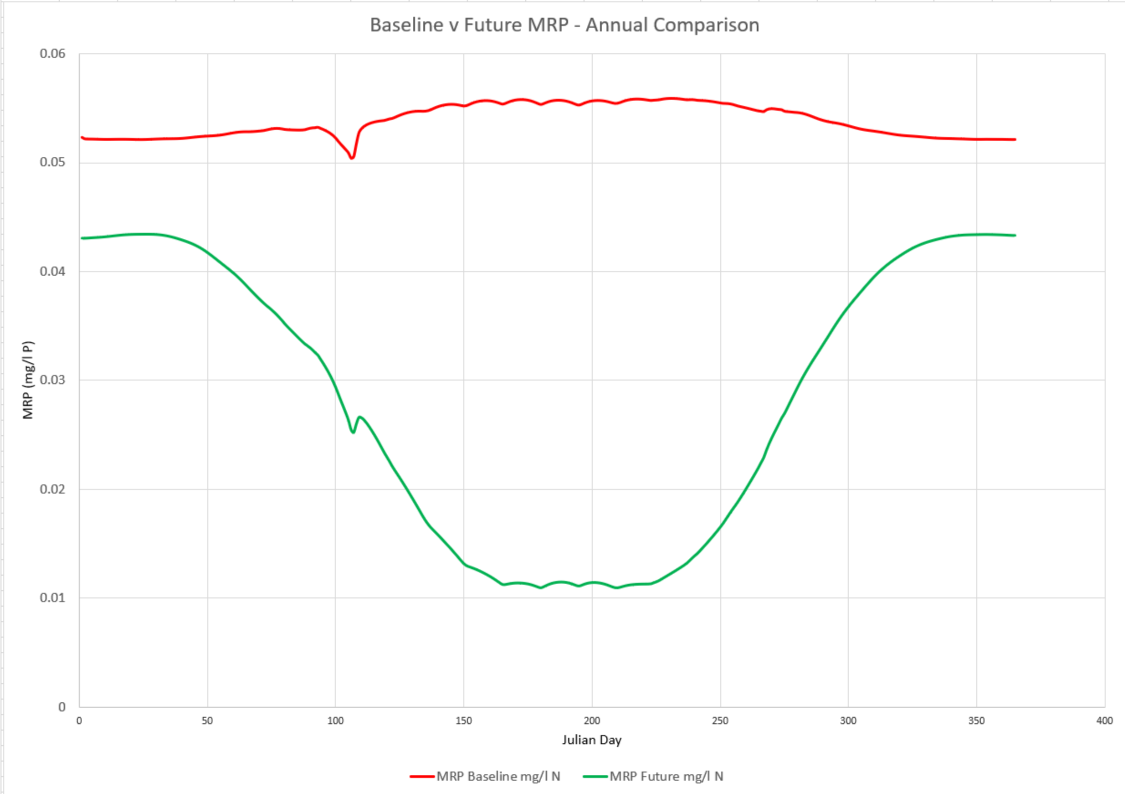


Figure 4-28: Comparison of Existing and Future MRP Concentrations in Tolka Estuary

In conclusion the impact of the Proposed WwTP Component in respect of the MRP parameter will be positive and moderate.

4.6.6 E. Coli

The environmental impact from E.Coli has been initially assessed by reference to the change in treatment process proposed at the plant. The aerobic granular sludge (AGS) process produces a final effluent with a 50% reduction in E.Coli concentrations compared to the existing biological process. This figure has been estimated by reference to monitoring of the process proving stage, which compared the two processes.

There are believed to be two reasons for the improvement in bacteriological concentrations between the two processes:

- The reduced suspended solids content and better effluent quality from the AGS process; and
- The greater treatment time provided by the AGS process.

Additionally, the final effluent from the AGS is expected to experience a higher percentage reduction through the UV disinfection process, in comparison to the existing biological process. This additional improved performance is expected due to the reduced suspended solids present in the AGS final effluent and consequently there will be a greater transmissivity of the UV light through the final effluent and a higher percentage bacteriological removal.

The improvement in the E.Coli concentrations in the final effluent will have a beneficial impact on the receiving water environment.

The impact of the final effluent discharge, in respect of E.Coli concentrations, was then further assessed using the DHI MIKE3 model, and assuming an E.Coli concentration of 100,000 E.Coli/100ml, which is equivalent to the maximum 95 %ile concentration permitted under the EPA wastewater discharge licence (see Figure 4-29, Figure 4-30 and Figure 4-31). In practice the actual E.Coli concentrations are significantly lower than the licence limits, both for the existing plant and the proposed future process. In addition, the plots assume the same level of E.Coli in the final effluent discharge, and don't make allowance for the improved performance observed during the process proving stages.

This further assessment indicates that the impact of the final effluent discharge will be largely in the Tolka Estuary and that there are no impacts on the designated bathing areas.

The plots show surface layer values, being the model value that best reflects the water sampling procedure for this parameter. The plots are also 95 percentile plots, showing values which will not be exceeded 95% of the time. The plots reflect that the designated bathing waters in Dublin Bay are not impacted by either the existing or future discharges. The plots also suggest that the water quality samples local to Clontarf and the North Bull Wall, which are not designated, but where bathing and other recreational activities take place, will be categorised as good to sufficient, in accordance with the methodology used by the EPA, in consultation with the HSE, and reported in the annual bathing water reports. These scenarios are naturally based on dry weather conditions and without any combined sewer overflows operating.

Appendix 4A also shows some additional model runs, in respect of storm events, where the analysis of the treatment plant discharge is complicated by the presence of multiple combined sewer overflows in the wider collection network. However, the plots do show a reduction in the impact in the future scenario in this instance, as the larger future capacity of the treatment plant permits treatment of a greater quantity of the storm water thus reducing the discharge from the storm tanks directly to the Liffey.

In conclusion there will be a positive and not significant impact from the Proposed WwTP Component, in respect of the E.Coli parameter, both during normal operation and during storm events. Additionally, an effluent discharge at the licence limits will not impact on any of the designated bathing areas.

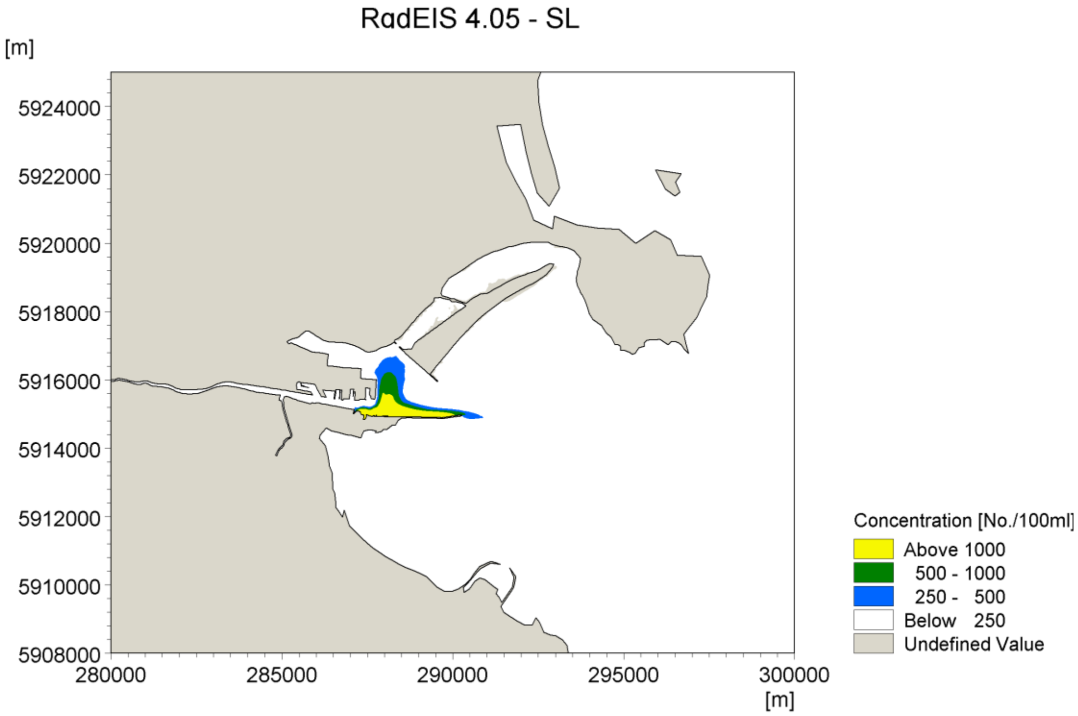


Figure 4-29: Existing Bathing Season E.Coli Discharge (surface layer 95%ile)

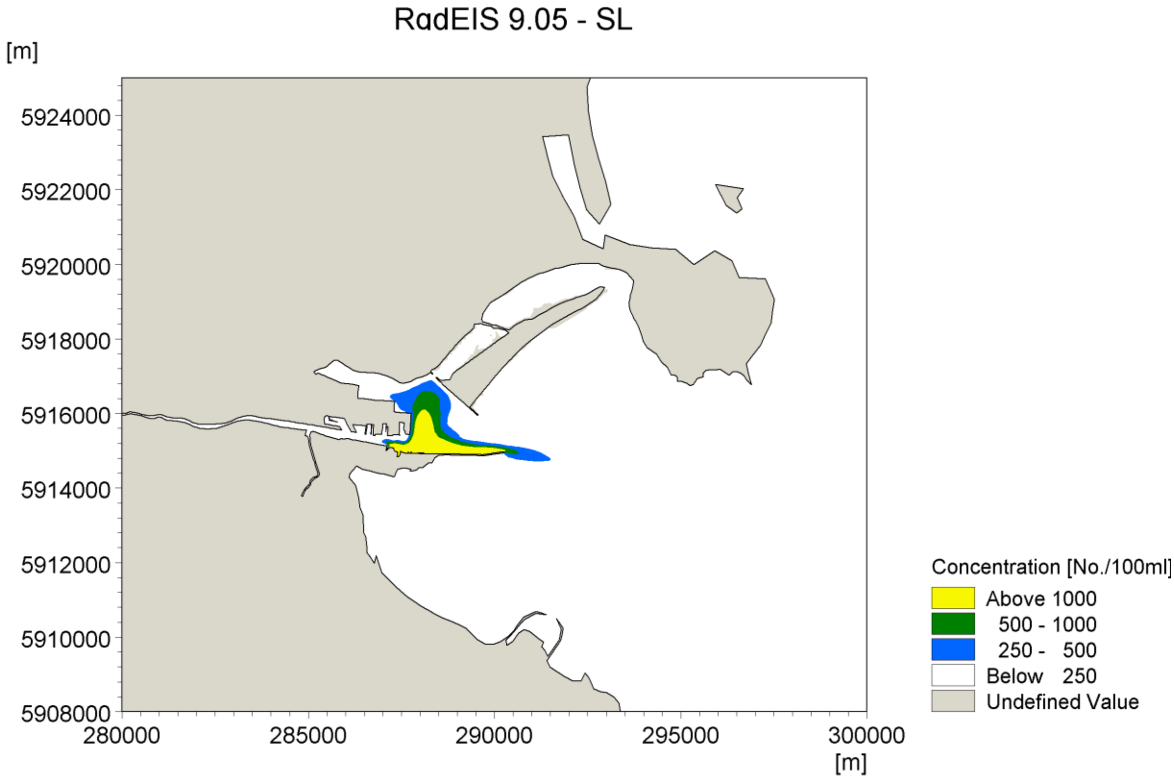


Figure 4-30: Future Bathing Season E.Coli Discharge (surface layer 95%ile)

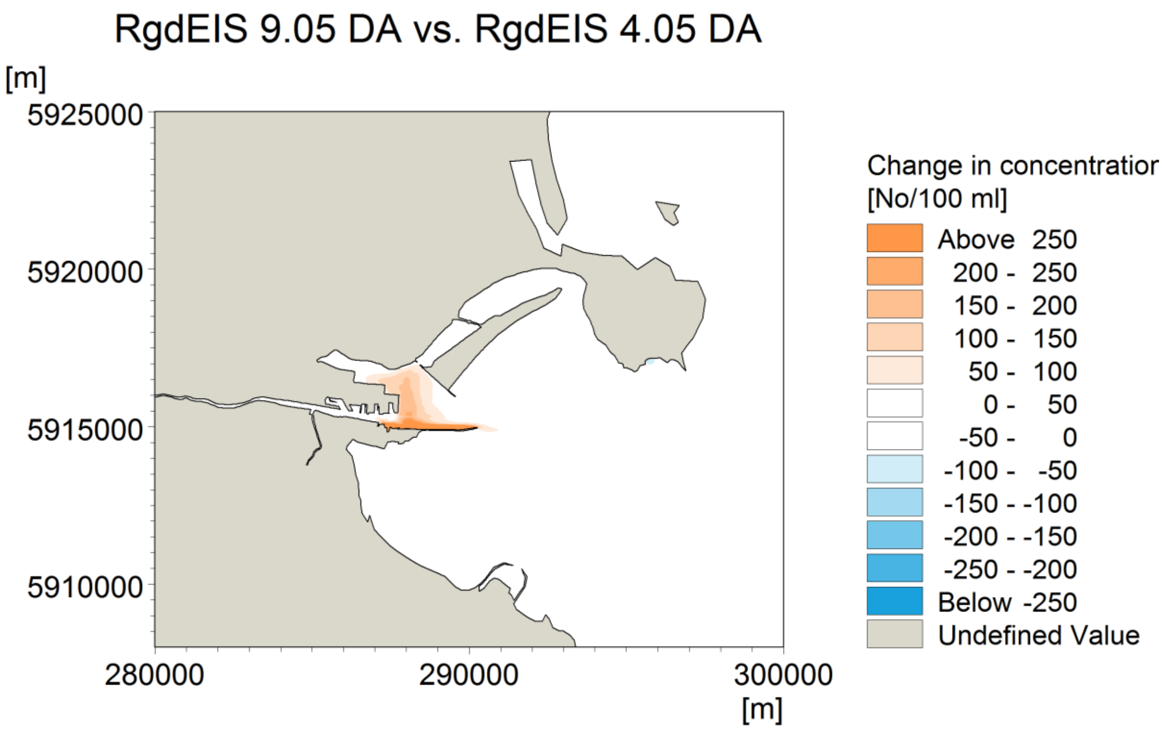


Figure 4-31: Future Change in Bathing Season E.Coli Discharge (surface layer 95%ile)

4.7 Impact Assessment – Construction Phase

The winter of 2019 / 2020 is expected to result in a reduction in the final effluent quality while the construction phase of the Proposed WwTP Component is underway, as discussed in the Proposed Upgrade Project description in Volume 2. Specifically, two construction phases will overlap, resulting in some process units being taken out of service and a reduced treatment capacity being available.

The environmental impact of this activity on the receiving water has been estimated by modelling the increased BOD and SS concentrations in the final effluent during this period. These two parameters have been chosen as the period being during winter is outside of the bathing season and additionally the nutrient (DIN and MRP) levels are not as critical during the winter months

4.7.1 Biochemical Oxygen Demand (BOD)

The environmental impact from BOD during the winter of 2019 / 2020 has been assessed, using the Mike 3 Model, by comparing the impact of the existing average BOD discharge against an existing peak BOD discharge, as shown in the figures below (see Figure 4-32, Figure 4-33 and Figure 4-34). The plots show that there will be an increase in the BOD concentration in the Tolka Estuary of up to 1.6 mg/l, but that the water quality standard will remain below the value of 4 mg/l, which is the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI 272 of 2009) (WFD Regulations), good status objective for transitional waters, for both the existing and future average discharges.

In conclusion there will be a negative imperceptible and temporary impact in respect of the BOD parameter, during this time period.

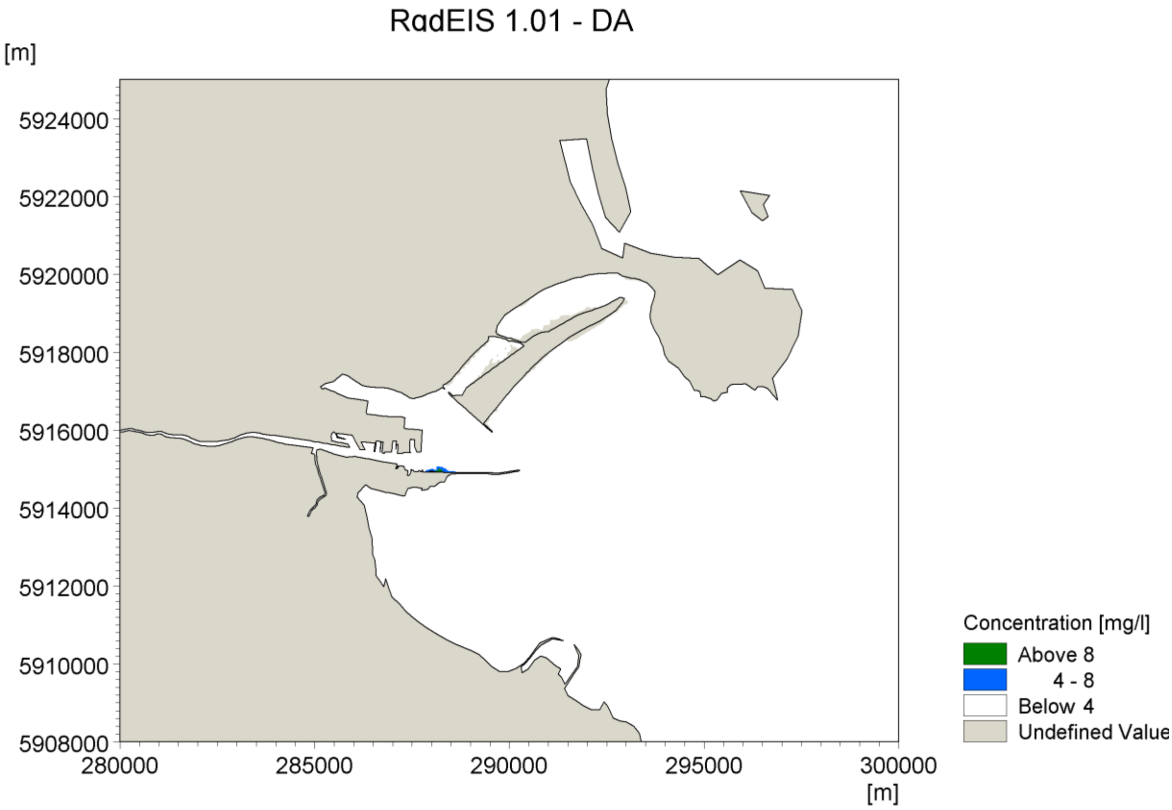


Figure 4-32: Existing Average BOD Discharge (depth averaged 95%ile)

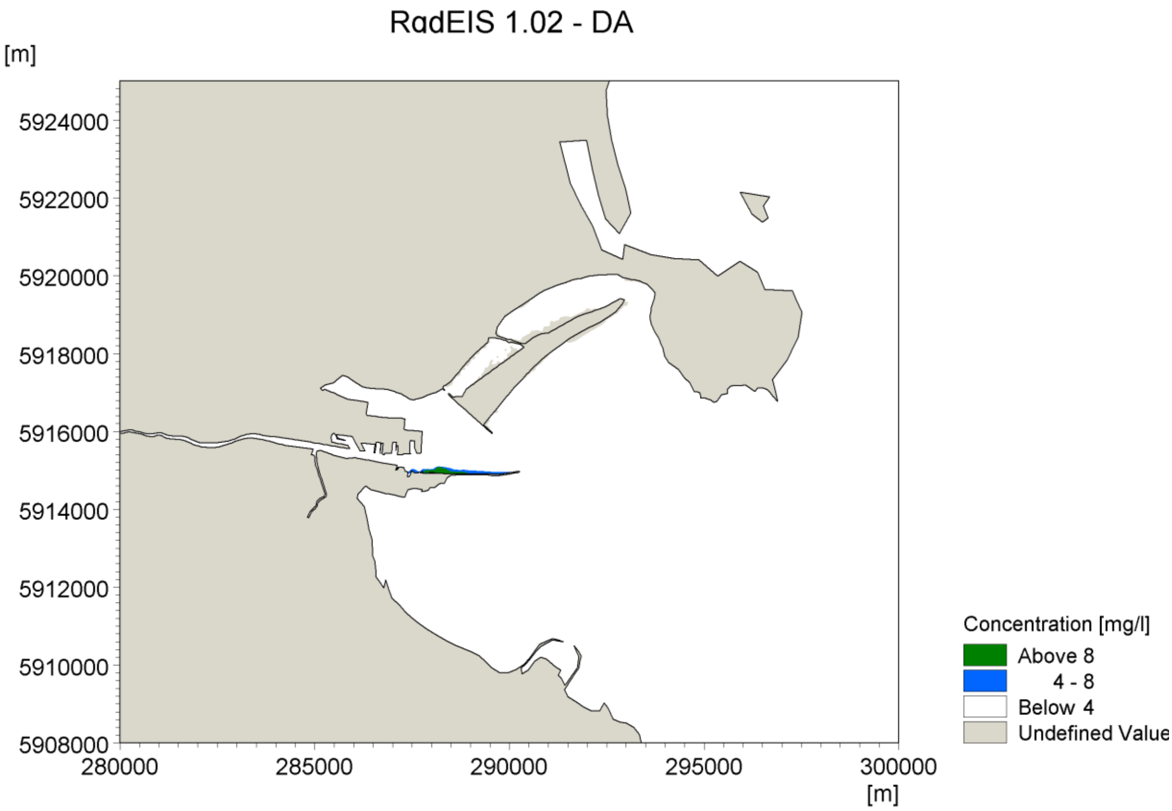


Figure 4-33: Winter 2019 / 2020 BOD Discharge (depth averaged 95%ile)

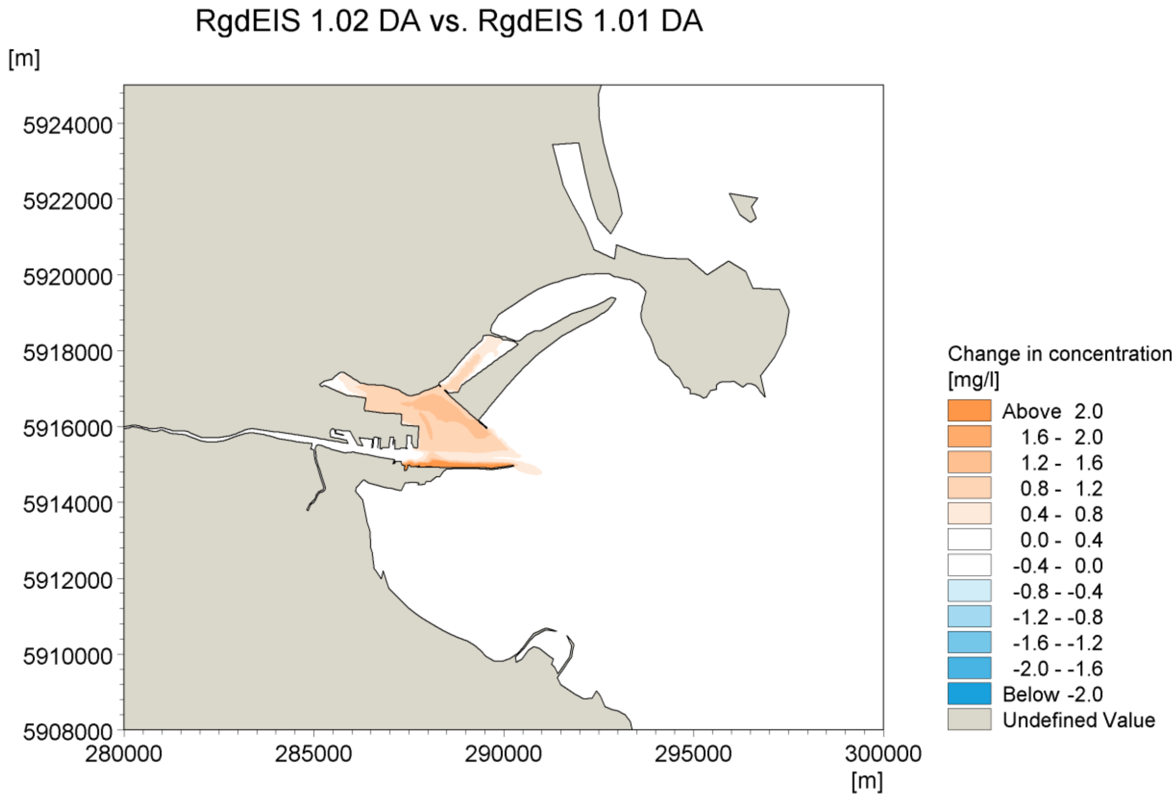


Figure 4-34: Change in BOD Discharge during Winter 2019 / 2020 (depth averaged 95%ile)

4.7.2 Suspended Solids

The environmental impact from suspended solids during the winter of 2019 / 2020 has been assessed, using the Mike 3 Model, by comparing the impact of the existing average suspended solids discharge against an existing peak suspended solids discharge, as shown in the figures below (see Figure 4-35, Figure 4-36 and Figure 4-37). The plots show that there will be an increase in the suspended solids concentration in the Tolka Estuary of up to 4 mg/l, which while a significant increase in the concentration, is still a low suspended solids concentration in an absolute sense.

In conclusion there will be a negative imperceptible and temporary impact in respect of the suspended solids parameter, during this time period.

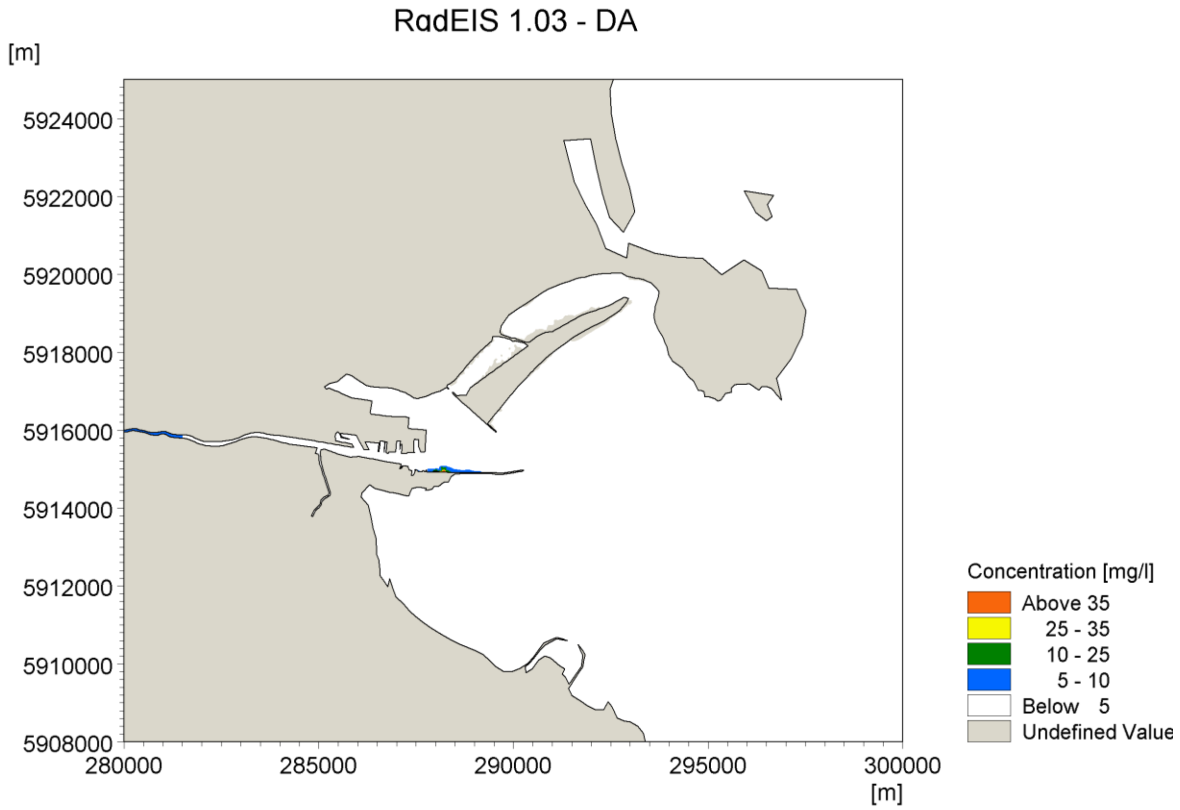


Figure 4-35: Existing Average Suspended Solids Discharge (depth averaged 95%ile)

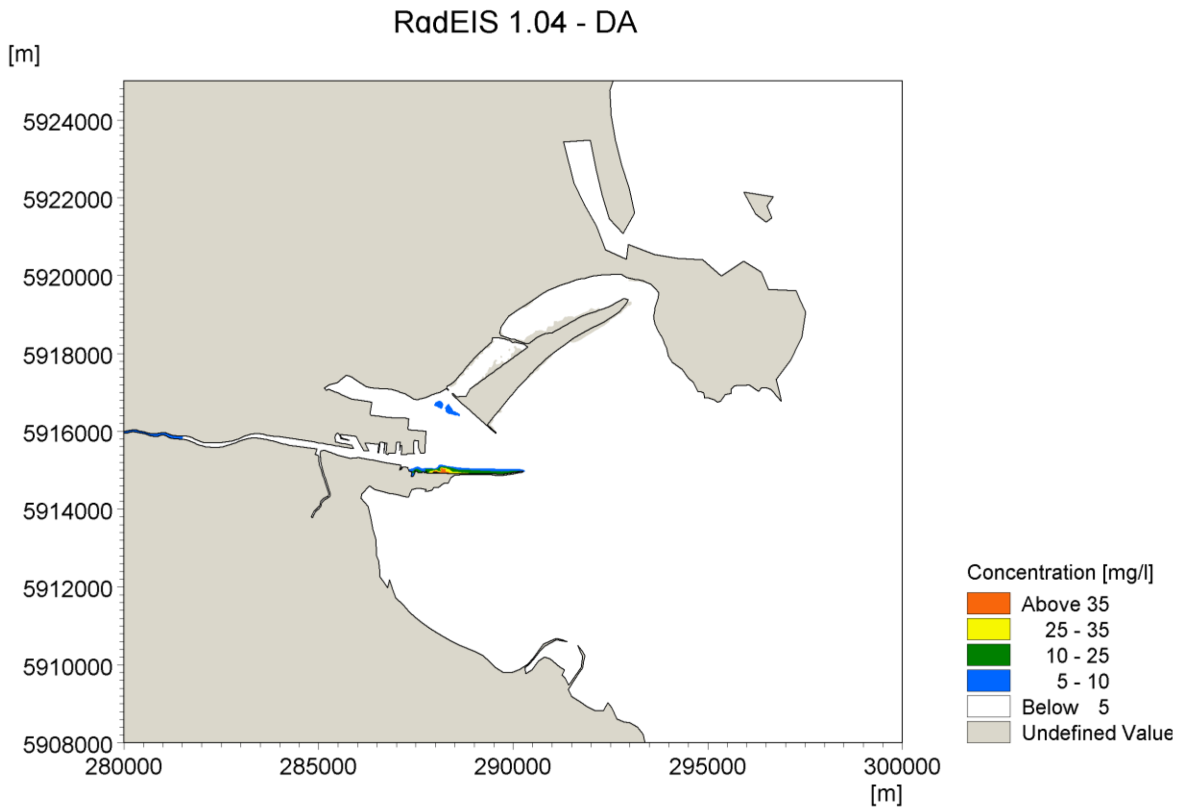


Figure 4-36: Existing Peak Suspended Solids Discharge (depth averaged 95%ile)

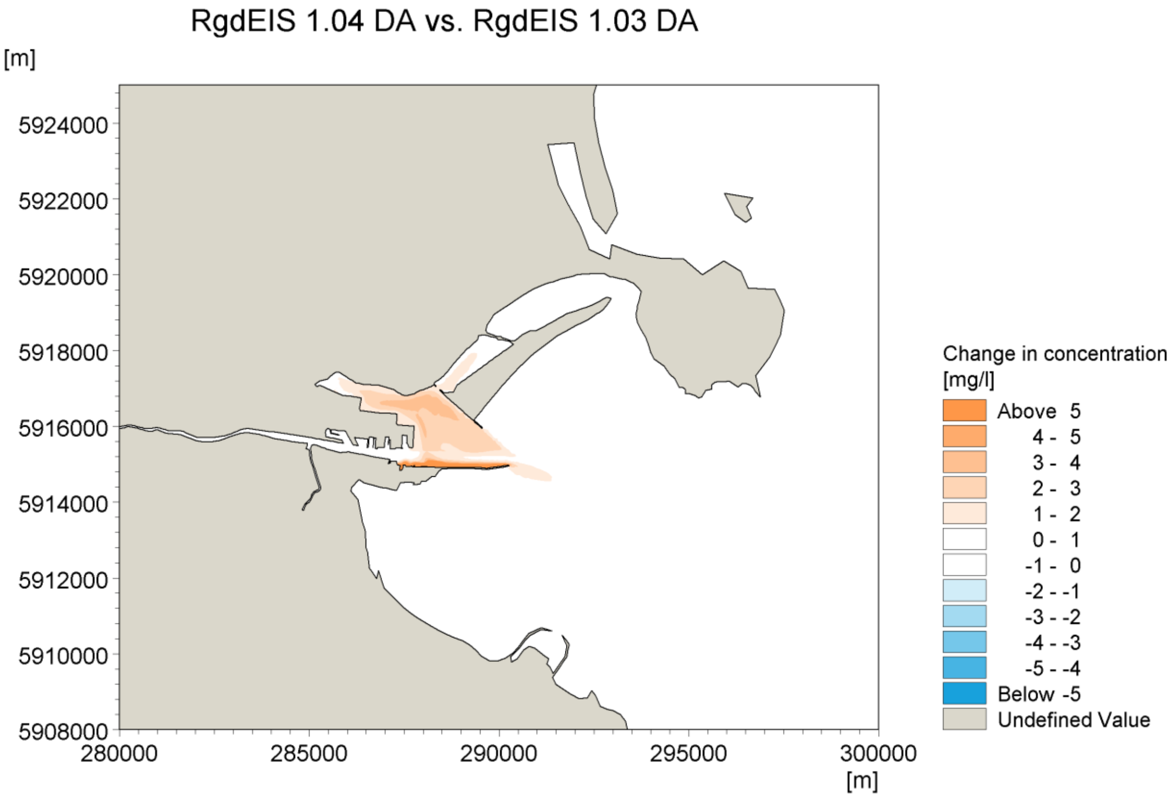


Figure 4-37: Change in Suspended Solids Discharge - Winter 2019 / 2020 (depth averaged 95%ile)

4.8 Cumulative Impacts

The March 2016 Scoping Document identified known projects, which would need to be included in the assessment for cumulative impacts. Four projects have been identified for assessment of cumulative impacts together with the wastewater discharge from the Ringsend Wastewater Treatment Plant, which are:

- Dublin Waste to Energy Plant, which has a cooling water discharge into the Lower Liffey Estuary;
- Greater Dublin Drainage Project, which is proposed to discharge another WwTP final effluent to the north-east of Ireland's Eye;
- Alexandra Basin Redevelopment, which is a redevelopment of a Dublin Port dock; and
- Poolbeg Cooling Water Channel - (Sheet-Pile Repairs), which is the discharge point for the Ringsend WwTP.

Subsequent to the Scoping document, an additional project was added for cumulative assessment of the wastewater discharge, being the operation of the Poolbeg Power Station.

The discharges from the Dublin Waste to Energy Plant and the Greater Dublin Drainage Project have been included in the MIKE 3 hydrodynamic model for the future scenario. As a consequence, the cumulative impact is included in the main impact assessment. The following additional comments can be made regarding these two projects.

Dublin Waste to Energy Project

The Dublin Waste to Energy Plant has commenced operation since the surveys used to calibrate the MIKE 3 model were carried out. As a consequence, the discharge from this facility is included in the future model scenarios and excluded from the existing model scenarios. No further cumulative impact assessment is required in respect of this project.

Greater Dublin Drainage Project

The Greater Dublin Drainage Project has been included in the future model scenarios and the model runs indicate that there is no significant interaction between the two projects at the constituent concentrations in the respective discharges. As a consequence, it was decided that there was no requirement to run the future models without the Greater Dublin Drainage Project included, and that no further cumulative impact assessment is required in respect of this project.

Alexandra Basin Redevelopment / Poolbeg Cooling Water Channel / Poolbeg Power Station

The cumulative impact assessment of the remaining three projects have each been assessed individually by the use of a model incorporating conservative tracer. The conservative tracer model run differs from the other assessments, in that it tracks individual particles over a period of two days, and thus allows a comparison of the different hydrodynamic environments.

The assessment of the 3 projects is shown at Section 7.2.4 of Appendix 4A and demonstrates that there is no significant difference between the future hydrodynamic environment as modelled and any of the 3 projects individually assessed for cumulative impacts. There is some interaction with the Poolbeg Cooling Water Channel project, whereby there appears to be an increase in the interaction with the Tolka Estuary, but it is not considered to be significant. As a consequence, the assessment concludes that there is no cumulative impact between the Proposed WwTP Component and the other three projects.

The conservative tracer model run looks significantly different to the model runs tracking the wastewater constituents. This is because the wastewater constituents experience both dilution and decay and consequently are only observed relatively close to the discharge point.

The conservative tracer on the other hand is a discrete particle, which is individually tracked for a period of two days and consequently travels much further from the discharge point.

4.9 Risk Assessment

The impact assessment considered potential significant risks to the environment arising from the Proposed WwTP Component and decided to assess the impact of a raw sewage discharge arising from the plant.

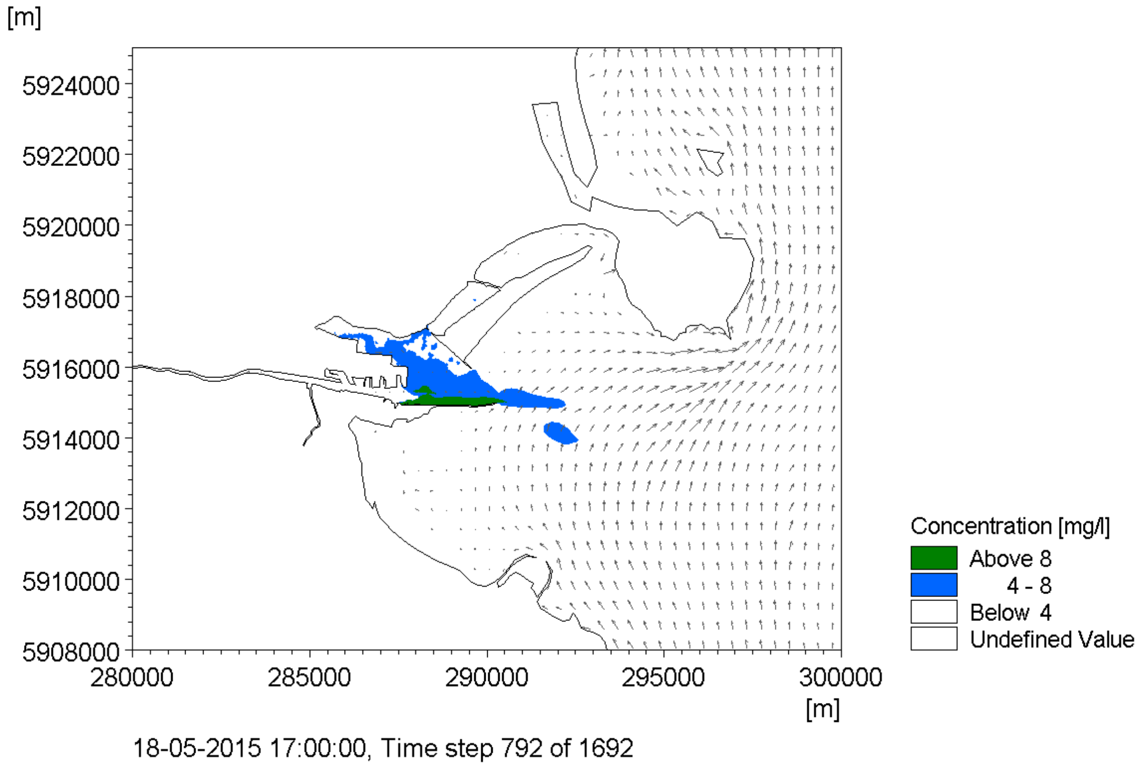


Figure 4-38: Raw Sewage Discharge - BOD - (66hrs, ebb tide)

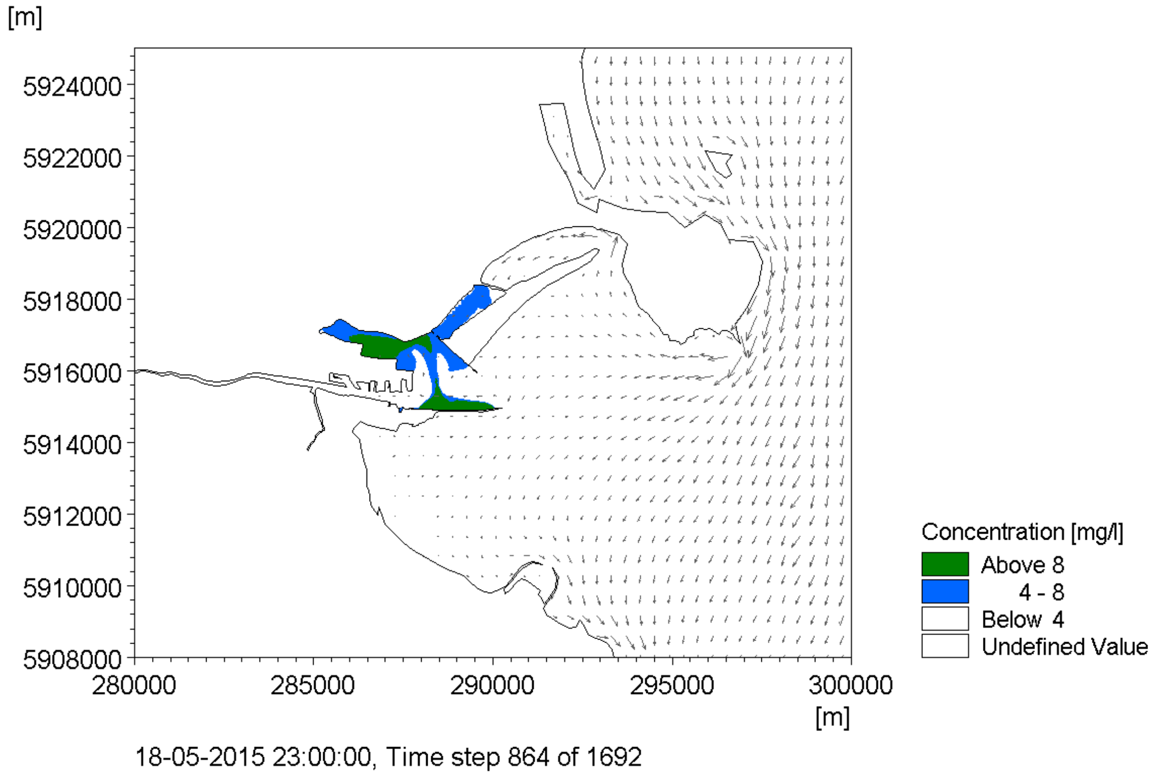


Figure 4-39: Raw Sewage Discharge - BOD - (72hrs, flood tide)

The discharge was modelled over a period of three days using BOD as the selected parameter to assess the impact and assuming a BOD concentration in the wastewater discharge of 240 mg/l.

The detail of the assessment is included in Section 7.2.3 of Appendix 4A, however by way of illustration, snapshots of the BOD concentration are shown at Figure 4-38 and Figure 4-39 for 66 hours and 72 hours after the commencement of the discharge respectively. These images show the greatest BOD concentrations during the model run, in respect of the ebb and flood tides respectively.

Once the discharge stops, the BOD concentrations return to normal values after a further three days. In conclusion, the impact of a potential raw sewage discharge is significant and short term.

Parameters such as BOD are of interest in respect of assessments such as these, as they are acute pollutants with an immediate impact, whereas parameters such as DIN and MRP do not have such an immediate impact, as they are more long term. In this context, an increase in a parameter such as DIN or MRP by a factor of 5 over three days would increase the annual average for the parameter by 3.3%, which is not significant.

4.10 Mitigation

The general effect of the Proposed WwTP Component is identified as positive and consequently no mitigation is proposed.

The impact assessment has concluded that there will be a temporary negative but not significant impact during part of the construction phase, as a result of a reduction in the effluent quality, while some construction work is ongoing.

This impact could be mitigated by carrying out the Proposed WwTP Component over a longer timescale. However, it is considered that the benefit of the positive impact that will be observed after the completion of construction outweighs the disadvantage of the negative impact that will be observed during the construction phase. Consequently, no mitigation is proposed. The risk assessment identified a potential scenario which would result in a negative temporary significant effect, however no mitigation measures have been identified which would reduce the risk of the event arising or alter the impact if the event arose. In this regard it should be noted that there are a number of features inherent in the design of the plant, including standby power generation, standby process equipment, and capacity redundancy, which significantly reduce the risk of the identified scenario arising, but are not identified as mitigation for the purposes of this EIAR.

4.11 Residual Impacts

The residual impact of the Proposed WwTP Component is the improved local water quality, arising from the improved final effluent.

4.12 Monitoring

The final effluent will be required to be monitored in accordance with the terms of the Wastewater Discharge Authorisation. No additional monitoring is proposed.

The receiving waters will continue to be monitored in accordance with the requirements of the different directive and statutory instruments, by the relevant public authorities. No additional monitoring is proposed.

4.13 Difficulties Encountered

There were no significant difficulties encountered in the preparation of this impact assessment.

4.14 Summary

The environmental impact of the Proposed WwTP Component on the local surface water environment has been the subject of a scoping process, which identified the requirement to assess the impact of the final effluent discharge from the Proposed WwTP Component on the local receiving waters.

The assessment initially considered the estimated reduction in the pollutant load contained within the final effluent discharge, which is summarised in Table 4-9 below.

Table 4-9: Final Effluent Discharge – Load Reduction Summary

Parameter	Current Average	Future Average	% Reduction
BOD (Biochemical Oxygen Demand)	8,739 kg/day	7,206 kg/day	17.5%
Suspended Solids	16,205 kg/day	10,508 kg/day	35.2%
Ammonia	4,370 kg/day	600 kg/day	86.3%
DIN (Dissolved Inorganic Nitrogen)	5,939 kg/day	4,804 kg/day	19.1%
MRP Molybdate Reactive Phosphate)	1,056 kg/day	420 kg/day	60.2%

In addition to the load reduction estimated for the above parameters, it is also estimated that the proposed AGS process will result in a 50% reduction in the bacteriological (E.Coli) content in the final effluent.

The performance of the future AGS treatment process is estimated from the results obtained during the process proving trials conducted on site during the 3 years prior to the preparation of this EIAR.

The changes to the future final effluent discharge will thus result in a positive slight effect on the receiving water environment.

The impact of the final effluent discharge was further assessed using the DHI MIKE3 model to estimate where the impact of the discharge would arise and the scale of the impact. The modelling exercise indicated in the first instance that the Tolka Estuary experienced the greatest impact.

In addition, the concentration levels, estimated by the modelling exercises in the Tolka Estuary are consistent with the legislative requirements for the water body, in respect of each of the parameters examined. Further modelling was carried out, using the CFAS DCPM model, to estimate whether the level of nutrients present would impact on the chlorophyll and macroalgae levels present in the Tolka Estuary and cause a failure to achieve the required good status under the WFD. The model estimated that the concentrations of DIN and MRP present from the final effluent discharge were not influential in the concentrations of chlorophyll and macroalgae present.

E.Coli are not relevant to the assessment of the Water Framework Directive, but are relevant to the Bathing Water Directive. The DHI model estimated the E.Coli concentrations present in the receiving water, if the final effluent concentration was at the maximum level allowed by the EPA Wastewater Discharge Licence. The model estimates that there will be no impact on the designated bathing beaches and in addition that the water quality in the Tolka Estuary, during the bathing season, would be good to sufficient. The impact of the future final effluent will be significantly less than the licence level in practice and the impact of the effluent discharge will thus be more positive than shown in the model output plots.

In summary, the change in the future final effluent discharge arising from the Proposed WwTP Component will be positive and will ensure that the upgraded plant will be consistent with the Urban Wastewater Treatment Directive.

In addition, the changes will help protect the status of the receiving waters in respect of the Water Framework Directive and the Bathing Water Directive.

The assessment of the construction phase established that there will be a reduction in effluent quality and an increase in the parameter concentrations during the winter of 2019 / 2020. BOD and suspended solids were assessed and found not to affect the Water Framework Directive objectives. The negative impact will be temporary and will allow the achievement of the Proposed WwTP Component completion and better effluent quality at an earlier stage.

There is no mitigation proposed in respect of any of the environmental impacts assessed.

Section 5: Biodiversity - Marine

5.1 Introduction

This Section describes the marine biodiversity of Dublin Bay including intertidal marine benthic assemblages, marine mammals and fisheries and the results of the intertidal benthic surveys conducted in September 2015. The Section also provides a detailed interpretation of the results of the granulometric, carbon content and taxonomical analyses of the sediment samples collected. The results of the univariate and multivariate statistical analyses are presented and discussed within the context of existing information on the benthic biodiversity of Dublin Bay.

The potential impacts (and resulting effects) that the Ringsend WwTP component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component") may have on the benthic communities and marine ecosystems of Dublin Bay are assessed and mitigating measures and residual impacts, if any, are also identified and discussed. The impacts on water birds is addressed in Section 6: Biodiversity - Terrestrial.

Full details of the Proposed Upgrade Project and the Ringsend WwTP component can be found in Volume 2, Section 3: Description of Proposed Upgrade Project.

This Section and assessment have been completed having regard to the guidance outlined in the Environmental Protection Agency documents *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (Draft, August 2017) and *Advice Notes for Preparing Environmental Impact Statements* (Draft, September 2015).

5.2 Methodology

5.2.1 Desk-based study

An in-depth review of relevant scientific publications and available data was conducted during the desk-based element of the work, which aimed at describing the existing intertidal environment in Dublin Bay and help in the assessment of the potential impacts that the Proposed WwTP Component may have on the marine ecosystems and their components. A discussion of the ecological data gathered during the field surveys was also conducted. Information on the intertidal benthic ecology of Inner Dublin Bay, especially those works published in peer-reviewed scientific journals, was overall quite limited and dated, with the main studies having been conducted in the 1970s, 80s and 90s (Jeffrey, 1977; Roth and Wilson, 1998; Walker and Rees, 1980; West, 1977; Wilson and Parkes, 1998; Wilson, 1982). A relatively recent scientific report for intertidal surveys conducted in inner Dublin Bay (AQUAFACT, 2006) was also reviewed to supplement the records from the peer-reviewed literature. Most other studies typically covered water quality and nutrient loads in Dublin Bay (Brennan *et a*l., 1994; McBreen and Wilson, 2006; O'Higgins and Wilson, 2005; Wilson, 2005), phytoplankton dynamics *(*O'Higgins *et al*., 2005; O'Higgins and Wilson, 2005) and the hydrodynamic characteristics of Dublin Bay (Bedri *et al*., 2013, 2011). Background information on sediment dynamics is from Flood (1977) and Harris (1977). A review of the existing body of research on the effects on conservation sites including Designation Objectives, Site Synopsis documents and GIS shape layers was accessed and downloaded from the website of the National Parks and Wildlife Service (www.npws.ie).

5.2.2 Field surveys

A total of 25 intertidal sediment sampling stations were surveyed within Dublin Bay on 20/21 of September 2015. The stations (see Figure 5-1 and Table 5-1) were selected because they were representative of the intertidal habitats within Dublin Bay and were included to cover the whole of the intertidal zones of the north and south areas of the bay with the aim of capturing the natural variability in sedimentary and physical parameters that can influence benthic community composition and were based on in-house knowledge of the physical oceanography of Dublin Bay. Other selection criteria were also applied, chiefly available historical data, accessibility and safety. The survey also aimed at establishing a benchmark against which to compare data that may be collected after the commissioning and implementation of the Proposed WwTP Component.

Three samples were collected for faunal analysis at each station in one of two ways:

- At low water using handheld cores (0.025 m^2 sampling area) at Stations 3, 6, 17, 18, 19, 22 and 25; or
- At high water using a small van Veen grab (0.025m^2 sampling area) operated from a Rigid Hull Inflatable boat (RHIB) at all other stations.

In addition, *c.* 200 g of sediment was collected at each station for granulometric and organic carbon content analysis. All samples were stored in pre-labelled plastic bags, kept in cold boxes and frozen at -20°C on return to the laboratory.

Figure 5-1: Locations of intertidal sites in Dublin Bay sampled for granulometric and macroinvertebrate analysis on 20 September 2015. Satellite base map © Google Inc.

Table 5-1: Locations of intertidal sites in Dublin Bay given in latitudinal and longitudinal decimal degrees (WGS84)

Station	LONG	LAT
1	-6.17272	53.3098
2	-6.17922	53.3082
3	-6.18629	53.3067
4	-6.17091	53.3281
5	-6.18606	53.3264
6	-6.20361	53.3243
7	-6.1735	53.3487
8	-6.17096	53.3526
9	-6.18428	53.3517
10	-6.18613	53.3569
11	-6.19902	53.3579
12	-6.1998	53.3547
13	-6.20767	53.3587
14	-6.20894	53.3556
15	-6.21547	53.36
16	-6.21745	53.3579
17	-6.22213	53.6303
18	-6.17311	53.3641
19	-6.14904	53.3789
20	-6.11728	53.3695
21	-6.12125	53.3724
22	-6.1255	53.3756
23	-6.14659	53.355
24	-6.15212	53.3572
25	-6.15715	53.3592

5.2.3 Granulometry

Traditional particle size analysis (PSA) techniques were used to determine the granulometric make-up of each intertidal sediment sample. The PSA analysis used involved treating *c.* 100 g of oven dried sediment with hydrogen peroxide solution to remove any organic material which could interfere with grain size determination. The residue was further treated with sodium hexametaphosphate solution to dissociate the clay particles and oven dried at 100 °C for 24 hours. The dried sediment was then passed through a Wentworth series of sieves (>2,000 µm to 63 µm; single phi units see Table 5-2). The weight of material retained in each sieve was weighed and recorded. The material that passed through the 63 µm sieve was also weighed and the value added to the value previously measured. PSA analysis was carried out in-house.

Table 5-2: Classification of sediment size particles used in the present study (adapted from Folk, 1954)

Range of particle size	Classification	Phi unit (Φ)
<63 µm	Silt/Clay	>4
63-125 µm	Very Fine Sand	4 to 3
125-250 µm	Fine Sand	3 to 2
250-500 µm	Medium Sand	2 to 1
500-1000 µm	Coarse Sand	1 to 0
1000-2000 µm	Very Coarse Sand	0 to -1
>2000 µm	Gravel	-1 to -4

5.2.4 Organic carbon content analysis

Organic carbon analysis was carried out by ALS laboratories using the Loss on Ignition (LOI) technique. This method involves oven drying the sediment sample in a muffle furnace (450 °C for a period of 6 hours) after which time the organic content of the sample is determined by expressing as a percentage of the weight of the sediment after ignition over the initial weight of the sediment.

5.2.5 Macrofaunal taxonomy

All samples were gently washed at sea through a 1 mm mesh sieve into a 5 litre plastic bucket, stained with Rhodamine dye and fixed with 10% buffered formalin.

Samples were then sorted under a microscope (x 10 magnification) into four main groups: Polychaeta, Mollusca, Crustacea and others (*e.g.* echinoderms, nematodes, nemerteans, cnidarians and other lesser phyla) and preserved in 70% ethanol. The taxa were then identified to species level where possible. All names were checked against the World Register of Marine Species (WoRMS; http://www.marinespecies.org/).

5.2.6 Data processing, GIS and statistical analyses

The faunal replicates for each station were combined to give a total abundance for each station prior to analysis. A data matrix of all the combined faunal abundance data was used for subsequent univariate and multivariate statistical analysis. The faunal analysis was carried out using PRIMER® (Plymouth Routines in Multivariate Ecological Research; Clarke and Gorley, 2006).

A suite of diversity indices were calculated on the combined replicate data for each sampling station using the DIVERSE package in Primer, including:

- Total abundance of individuals (N);
- Total number of taxa (S);
- Margalef's species richness index (d):

$$d = \frac{S-1}{\log_2 N}$$

– Shannon-Wiener diversity index (H') :

$$H' = -\sum_{i=1}^{S} p_i(\log_2 p_i)$$

where p_I is the proportion of the total count accounted for by the ith taxa

– Pielou's Evenness index (J):

$$J = \frac{H'_{observed}}{H'_{max}}$$

where H'_{max} is the maximum possible diversity which could be achieved if all species were equally abundant (= $\log_2 S$).

Evenness is a measure of how evenly the individuals are distributed among different species, i.e. benthic assemblages with low evenness are dominated by few taxa while assemblages of high evenness are characterised by similar numbers of individuals in each taxa recorded.

PRIMER (Clarke and Gorley, 2006) was used to carry out multivariate analysis on the station-by-station faunal data. All species abundance matrix was fourth root transformed to down-weigh the importance of several taxa (some of which were up to three orders of magnitude more abundant than the rest, *e.g.* nematodes) and to allow the mid-range and rarer species to play a part in the similarity calculation. The transformed data matrix was used to prepare a Bray-Curtis similarity matrix, also in PRIMER, prior to the classification and cluster analysis. The aim of the cluster analysis was to find "natural groupings" of samples, *i.e.* samples within a group that are more similar to each other, than they are similar to samples in different groups (Clarke and Gorley, 2006). The PRIMER ® programme CLUSTER carried out this analysis by successively fusing the samples into groups and the groups into larger clusters, beginning with the highest mutual similarities then gradually reducing the similarity level at which groups are formed. The result was represented graphically in a dendrogram, the x-axis representing the full set of samples and the y-axis representing similarity levels at which two or more groups are joined.

The CLUSTER programme was set to include a series of 'similarity profile' (SIMPROF) permutation tests to provide statistical evidence of significant clusters between samples which are *a priori* unstructured. SIMPROF performs tests at every node of a completed dendrogram to assess if the group being sub-divided has statistically significant internal structure. The test results are displayed in a colour convention on the dendrogram plot (samples connected by red lines cannot be significantly differentiated at the 5% level). Each significant SIMPROF group was tentatively assigned to the closest JNCC Marine habitats of Britain and Ireland biotope (JNCC, 2015).

The Bray-Curtis similarity matrix was also subjected to a non-metric multi-dimensional scaling (nMDS) algorithm using the PRIMER programme MDS. This routine produces an ordination whereby the placement of samples reflects the similarity of their biological communities (Clarke and Gorley, 2006). The stress values of an nMDS give an indication of how well the multi-dimensional similarity matrix is represented by the two-dimensional plot. They are calculated by comparing the interpoint distances in the similarity matrix with the corresponding interpoint distances on the 2-d plot. Perfect or near perfect matches are rare, especially in the absence of a single overriding forcing factor such as an organic enrichment gradient. Stress values increase not only with the reducing dimensionality (lack of clear forcing structure), but also with increasing quantity of data (it is a sum of the squares type regression coefficient). The reliability of the nMDS plots is based on the stress values obtained (Clarke and Gorley, 2006), whereby:

- Stress value < 0.05: Excellent representation of the data with no prospect of misinterpretation;
- Stress value < 0.10: Good representation, no real prospect of misinterpretation of overall structure, but very fine detail may be misleading in compact subgroups;
- Stress value < 0.20: This provides a useful 2-d picture, but detail may be misinterpreted particularly nearing 0.20;
- Stress value 0.20 to 0.30: This should be viewed with scepticism, particularly in the upper part of the range, and discarded for a small to moderate number of points such as < 50;
- Stress values > 0.30: The data points are close to being randomly distributed in the 2-d ordination and not representative of the underlying similarity matrix.

The use of dendrograms and MDS plots is standard practice in examining biological, chemical and granulometric data sets in order to identify biotopes.

5.3 Existing Environment

5.3.1 Conservation status and Natura 2000 sites

5.3.1.1 Special areas of conservation (SACs)

The Ringsend WwTP and its outfall are outside but adjacent to the boundaries of the South Dublin Bay and North Dublin Bay SACs and within the vicinity of 2 additional SACs (see Figure 5-2).

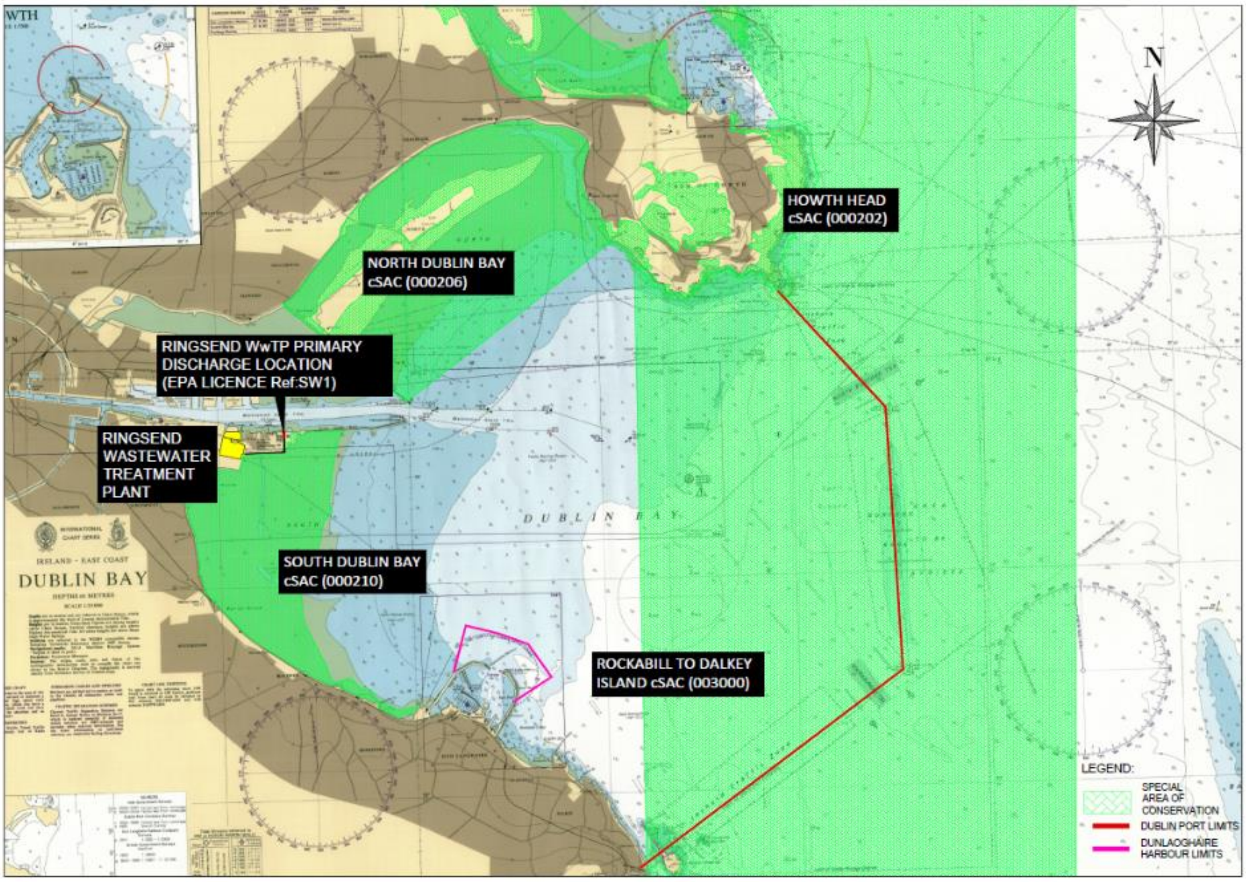


Figure 5-2: Special Areas of Conservation

Special Areas of Conservation located within Dublin Bay include:

North Dublin Bay SAC (Site code 000206)

According to the site description of the North Dublin Bay SAC (NPWS, 2013a) the site is 'an excellent example of a coastal site with all the main habitats represented'. There are nine habitats within this SAC that are listed on Annex I of the E.U. Habitats Directive including 'Tidal mudflats and sandflats' one of these ('Fixed dunes (Grey)') is listed with priority status. Several of the wintering bird species - *e.g.* light-bellied Brent goose (2,333), knot (4,423) and bar-tailed godwit (1,586) have populations of international importance within this SAC.

The Annex I habitat 'Mudflats and sandflats not covered by seawater at low tide' is a qualifying interest for the SAC and has several Conservation Objectives associated with it that are relevant within the context of this Section.

These include 'Maintain the extent and quality of the existing *Mytilus edulis* community' and 'Conserve the Fine sand to sandy mud with *Pygospio elegans* and *Crangon crangon* and Fine sand with *Spio martinensis* community in a natural condition' (see Figure 5-5 for the location and extent of those community complexes).

South Dublin Bay SAC (Site code 000210)

This site lies south of the River Liffey and extends from the Great South Wall to the west pier at Dun Laoghaire. It is an intertidal site with extensive areas of sand and mudflats. The Site Synopsis for the SAC (NPWS, 2013b) indicates that the sediments are predominantly sand grading towards sandy mud with shell near the shore at Merrion Gates. At this location, an area of dune has been evolving over the last 15 - 20 years and is now significantly vegetated. The site is a good example of a coastal system with extensive sand and mudflats, a habitat listed on Annex I of the E.U. Habitats Directive and the solely qualifying feature of interest for the SAC. South Dublin Bay is also an internationally important bird site with the most notable bird species being oystercatcher (1215), ringed plover (120), sanderling (344), dunlin (2628) and redshank (356) (NPWS, 2013b). Brent geese regularly occur in numbers of international importance (average peak 299). Bar-tailed godwit (565), a species listed on Annex I of the E.U. Birds Directive, also occurs here.

The conservation objectives for the 'Mudflats and sandflats not covered by seawater at low tides' relevant to the present study are 'Maintain the extent and high quality of the *Zostera*-dominated community' (there is a small patch of *Z. noltii* near the Merrion gates) and 'Conserve the following community type in a natural condition: Fine sands with *Angulus tenuis* community complex'.

Howth Head SAC (Site code 000202)

This SAC has been designated mainly for its terrestrial habitats and plant communities (two Annex I habitats) and it supports populations of legally protected plant species and several other scarce plants. Howth Head is of scientific importance for its seabird colonies, invertebrates and lichen (NPWS, 2013c). A census in 1985-87 recorded breeding fulmar (105 pairs), shag (25 pairs), herring gull (70 pairs), kittiwake (*c*. 1,700 pairs), guillemot (585 birds) and razorbill (280 birds). In 1990, 21 pairs of black guillemot were counted (NPWS, 2013c). The SAC does not include intertidal habitats or conservation objectives that could be directly relevant to the present study.

Rockabill to Dalkey Island SAC (Site code 003000)

This site includes a range of dynamic inshore and coastal waters in the western Irish Sea. These include sandy and muddy seabed, reefs, sandbanks and islands. The site extends southwards, in a strip approximately 7 km wide and 40 km in length, from Rockabill, running adjacent to Howth Head, and crosses Dublin Bay to Frazer Bank in south Co. Dublin. The site encompasses Dalkey, Muglins and Rockabill islands. There are 2 Qualifying Interests for this SAC and these are reefs and Harbour Porpoise.

5.3.1.2 Special Protection Areas (SPAs)

The Ringsend WwTP and outfall are located outside but adjacent to the boundaries for the South Dublin Bay and Tolka Estuary SPA and the North Bull Island SPA (see Figure 5-3 below).

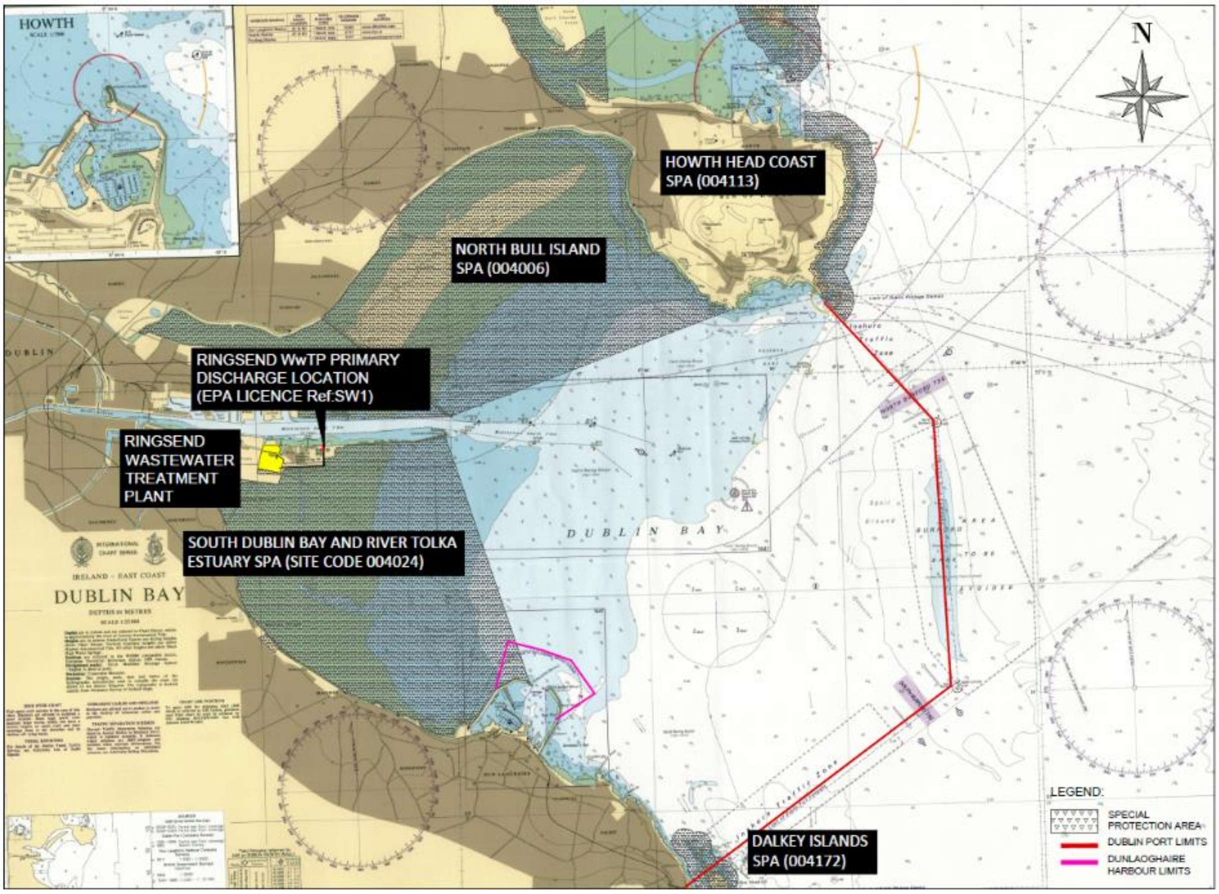


Figure 5-3: Special Protection Areas

North Bull Island SPA (Site code 004006)

The North Bull Island SPA is an excellent example of an estuarine complex and is one of the top sites in Ireland for wintering waterfowl (NPWS, 2008a). This Natura 2000 site is of international importance on account of both the total number of waterfowl and the individual populations of light-bellied Brent goose, black-tailed and bar-tailed godwit that use it.

South Dublin Bay and Tolka Estuary SPA (Site Code 004024)

The South Dublin Bay and River Tolka Estuary SPA comprises a substantial part of Dublin Bay (Figure 5-3). It includes the intertidal area between the River Liffey and Dun Laoghaire, and the estuary of the River Tolka to the north of the River Liffey, as well as Booterstown Marsh. A portion of the shallow marine waters of the bay is also included. The South Dublin Bay and River Tolka Estuary SPA is of international importance for light bellied Brent goose and of national importance for nine other waterfowl species. As an autumn tern roost, it is also of international importance. Furthermore, the SPA supports a nationally important colony of common tern. All of the tern species using the site are listed on Annex I of the E.U. Birds Directive, as are bar tailed godwit and Mediterranean gull (NPWS, 2008b).

As well as being a SAC and SPA, the North Dublin Bay Natura 2000 site is also designated as a National Nature Reserve, a Wildlife Sanctuary, a Ramsar site and a UNESCO Biosphere Reserve.

5.3.2 Study Area

The Proposed WwTP Component is located in Poolbeg, at the mouth of the Liffey Estuary, in Dublin Bay.

Dublin Bay is a shallow bay *c.* 10 km wide at its mouth and is limited to the north, west and south by the city of Dublin and its suburban areas and to the east by the Irish Sea. The bay is enclosed by two headlands *c.* 10 km apart, Howth Head in the north and Dalkey to the south, and occupies an area of about 100 km^2 (Figure 5-4).The seafloor in Dublin Bay slopes eastwards from low water to a depth of about 12 m, reaching 25 m approximately on the line between the headlands (Admiralty Chart No. 1415; UKHO, 2016; Bedri *et al.*, 2013). Composed predominantly of fine sand, the intertidal zones of the bay extend *c.* 20 km^2 (Roth and Wilson, 1998) and are occupied by extensive sandflats in the North and South Bulls (respectively known as the Dollymount and Sandymount Strand, Figure 5-4) while muddy areas are restricted to the estuaries of the Liffey and Tolka rivers (Harris, 1977). Areas of subtidal reefs occur at Howth Head and at Dalkey and Dalkey Island. A distinctive feature of the bay is North Bull Island, a sand spit c. 4.85 km long created as a result of the construction of the North Bull wall (see for example Figure 5-4). According to Wilson (1982) there are four distinct intertidal biotopes in Dublin Bay, namely: 1) the lower exposed sand dominated by tellinids, 2) the mid to upper shore silty sand typified by *Cerastoderma edule* and *Macoma balthica*, 3) muddy lagoons dominated by hydrobid gastropods and 4) the Tolka Estuary where carnivorous polychaetes are dominant. Figure 5-5 shows the marine community types within the Dublin Bay area determined by NPWS SAC surveys (NPWS, 2013).

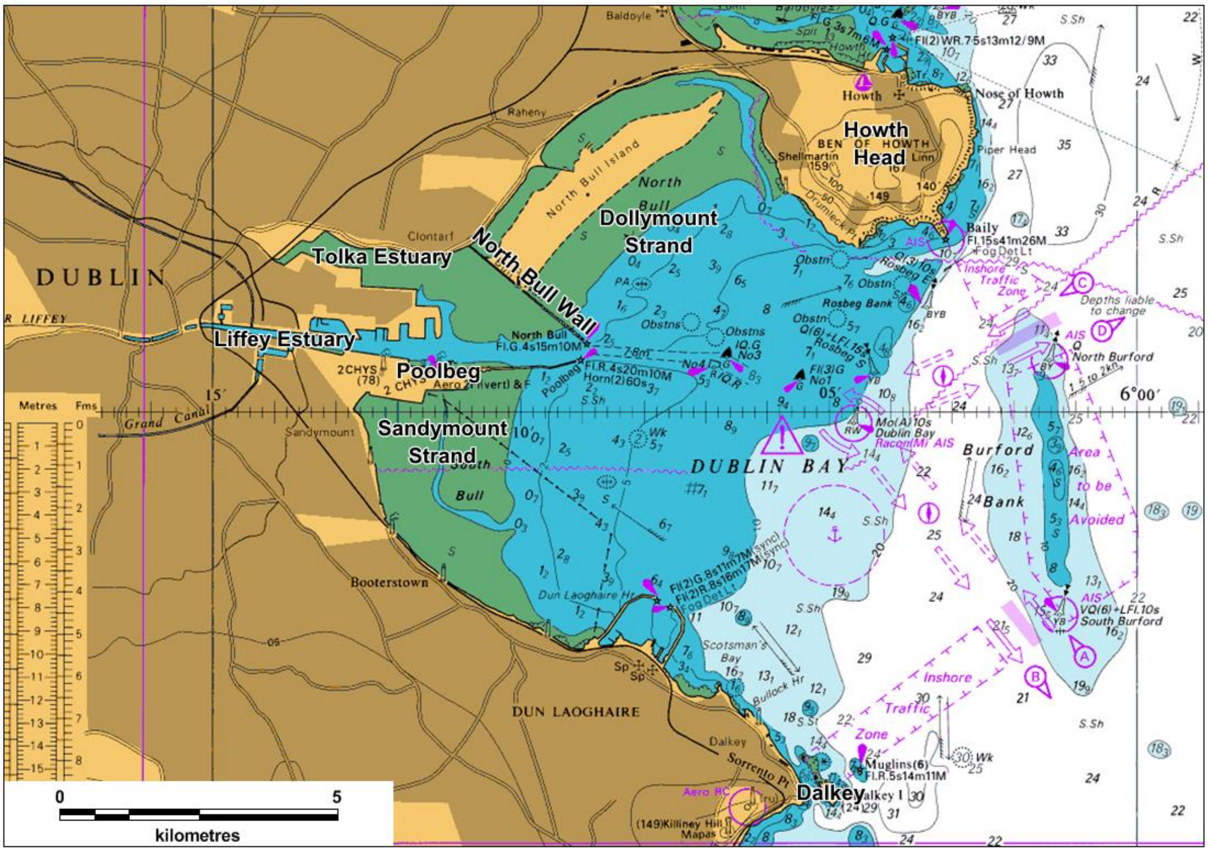


Figure 5-4: Study area

Water temperatures in Dublin Bay vary depending on season, depth, exposure and water circulation patterns, *e.g.* in the Inner Bay (Tolka Estuary), minimum water temperatures can vary from 3.6 to 5 °C in winter while in summer they can be in excess of 20 °C. In the outer bay (open to the Irish Sea), water temperatures range from 5.0 °C in winter to 17.6 °C in summer (O'Higgins and Wilson, 2005).

The estuarine (*i.e.* euhaline) nature of the inner bay, with mean salinities of 30.5 PSU (practical salinity units) and minimum salinity of 18.5 PSU, is the result of the presence of the two major influxes of freshwater within the bay, the Liffey and Tolka Rivers. In contrast, the outer bay is fully saline with mean salinity of 34.8 PSU and minimum salinity of 28.3 PSU (O'Higgins and Wilson, 2005).

According to the most recent water quality data by the EPA (19/12/2014), the waters in the Lower Liffey Estuary and Dublin Bay can be considered to be in the category of 'Good Ecological Status' while the Upper Liffey Estuary and the Tolka Estuary are classified as 'Moderate Ecological Status' (EPA, 2015). Under the Water Framework Directive (WFD) ecological status is assessed on a 'one-out-all-out' basis. Overall, ecological status of a water body is based on the biological quality element or physical and chemical standard with the lowest status. The outcome of the most recent Trophic Status Assessment (EPA, 2015) indicated that waters in the Lower Liffey Estuary (IE EA 090 0300) and Dublin Bay (IE EA 090 0000) can be regarded as 'Unpolluted' while the Upper Liffey Estuary (IE EA 090 0400) and Tolka Estuary (IE EA 090 0200) are 'Eutrophic' and 'Potentially Eutrophic', respectively. There are two main sources of nutrients into Dublin Bay. The River Liffey and, to a lesser extent, the Tolka River, account for most of the total oxidized nitrogen (TON) input to Dublin Bay while the sewage treatment plant at Ringsend is responsible for most of the phosphates and ammonia (O'Higgins and Wilson, 2005). Due to the continuous nutrient loading from the Liffey and Tolka Rivers, the main factors controlling phytoplankton levels with the inner bay are light and water retention times. However, in the outer bay, there is seasonality in nutrient and chlorophyll *a* levels leading to spring algal blooms similar to those occurring in the Irish Sea. Nonetheless, the influence of the nutrient loaded waters of the river Liffey results in summer blooms of some types of microalgae *e.g. Cryptomonas* (O'Higgins and Wilson, 2005).

The North Bull lagoon SAC area has green algal mats (*Enteromorpha* spp., *Ulva lactuca*) that cover large areas of the sand flats during Summer months (Wilson., pers. comm). These sediments have a rich macrofauna, with high densities of lugworm (*Arenicola marina*) in parts of the north lagoon. Mussels (*Mytilus edulis*) exist in places, along with bivalves such as *Cerastoderma edule*, *Macoma balthica* and *Scrobicularia plana*. The gastropod *Hydrobia ulvae* occurs in high densities in places, while the crustaceans *Corophium volutator* and *Carcinus maenas* are common. The sediments on the seaward side of North Bull Island are mostly sands. Sands to the east of Bull Island are characterised by the small tubiculous spionid, *Spio martinensis*.

South Dublin Bay SAC has similar macroalgal and macrofaunal attributes to North Dublin Bay SAC but differs from it in having eel grass (*Zostera* spp) meadows (NPWS site synopsis).

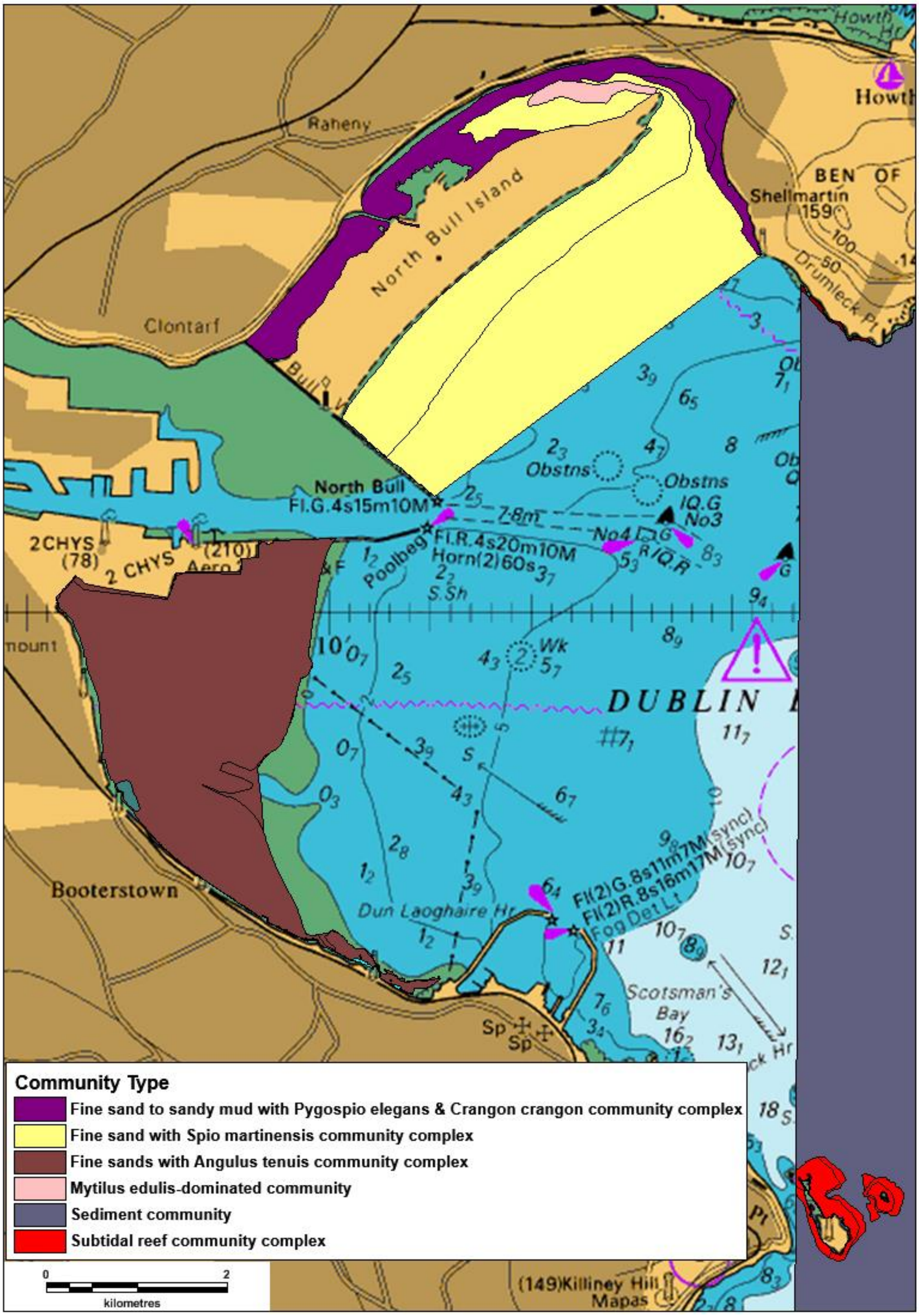


Figure 5-5: Benthic community types in the North and South Dublin Bay SACs (NPWS, 2013)

5.3.3 Marine benthos: 2015 intertidal survey results

5.3.3.1 Granulometric (PSA) analysis

The sediment sampled at the majority of the stations surveyed was classified as sand (*sensu* Folk, 1954) (see Table 5-3 and sediment composition pie charts in Figure 5-6 to Figure 5-8). These stations included all of the stations sampled at the Merrion and Dollymount Strands, the intertidal areas between Clontarf and Sutton (Stations 18 and 19) and the upper and mid littoral areas in Sandymount Strand. More specifically, the sand component at these stations was dominated by fine sand (60.6% to 88.70%) and very fine sand (varying from 8.8% to 38.2%). There was a higher component of mud (silt-clay) in Stations 18 and 19 (the mudflats to the north of North Bull Island) and the stations located within the Tolka Estuary, close to the mouth of the river, namely Station 12 and Stations 15 to 17. Some stations also had a coarser sand and gravel component, namely Station 4, located in the lower littoral zone in Sandymount Strand (slightly gravelly, muddy sand), several in the mid and outer Tolka Estuary, ranging from slightly gravelly, muddy sand (Station 11 and 16) and gravelly, muddy sand (Station 15) to gravelly sand (Station 7) and sandy gravel (Stations 9 and 13).

Table 5-3: Results of particle size analysis (PSA) for sampling stations surveyed in Dublin Bay, 20th September, 2015

Station	Fine Gravel (>4mm)	Very Fine Gravel (2-4mm)	Very Coarse Sand (1-2mm)	Coarse Sand (0.5-1mm)	Medium Sand (0.25-0.5mm)	Fine Sand (125-250mm)	Very Fine Sand (62.5-125mm)	Silt-Clay (<63mm)	Folk (1954)
1	0	0.1	0.3	0.3	1.6	75.7	21.8	0.2	Sand
2	0.00	0.10	0.20	0.10	0.80	76.60	22.00	0.20	Sand
3	0.00	0.00	0.10	0.20	0.90	88.70	9.40	0.70	Sand
4	0.2	0.8	1.4	3.9	11.6	28.1	27.5	26.6	Slightly gravelly muddy sand
5	0	0.1	0.3	0.4	0.8	75.6	22.5	0.1	Sand
6	0	0.1	0.4	0.5	2.2	83.8	11.7	1.4	Sand
7	1.5	5.8	3.7	4.2	13.1	50.6	19.6	1.5	Gravelly sand
8	0.1	0.1	0.1	0.3	1.5	62.0	35.1	0.9	Sand
9	25.1	6.8	5.1	7.5	13.2	33.8	7.7	0.7	Sandy gravel
10	0.2	0.1	0.3	0.8	4.4	78.1	15.5	0.6	Sand
11	0.5	1.3	1.5	1.6	7.3	56.9	18.6	12.3	Slightly gravelly muddy sand
12	0.3	0.3	1	1.4	3.6	25.4	44.3	23.7	Muddy sand
13	56.1	9.7	8.6	5.1	5.5	9.3	3.6	2.1	Sandy gravel
14	0.2	0.2	0.2	0.1	0.7	73	25.6	0.1	Sand
15	4.5	5.9	9.8	9.1	10	34.3	16.4	10	Gravelly muddy sand
16	0.8	0.8	0.9	3.5	8.8	23.2	30.9	31.2	Slightly gravelly muddy sand

Station	Fine Gravel (>4mm)	Very Fine Gravel (2-4mm)	Very Coarse Sand (1-2mm)	Coarse Sand (0.5-1mm)	Medium Sand (0.25-0.5mm)	Fine Sand (125-250mm)	Very Fine Sand (62.5-125mm)	Silt-Clay (<63mm)	Folk (1954)
17	0	0	0.1	0.3	9.4	17.3	22.5	50.5	Sandy mud
18	0.1	0	0.1	0.4	3.1	84.2	10.7	1.4	Sand
19	0	0	0	0.1	4.4	82.2	9	4.3	Sand
20	0	0	0	0.1	0.7	68.4	29.8	0.8	Sand
21	0.3	0.1	0.1	0.1	0.9	78.4	19.9	0.2	Sand
22	0	0.1	0.2	0.6	2.4	87.6	8.8	0.2	Sand
23	0	0.1	0.1	0.1	0.5	13.6	85	0.7	Sand
24	0	0	0	0.1	0.8	60.6	38.2	0.3	Sand
25	0	0.1	0.1	0.2	0.8	74.5	24.1	0.3	Sand

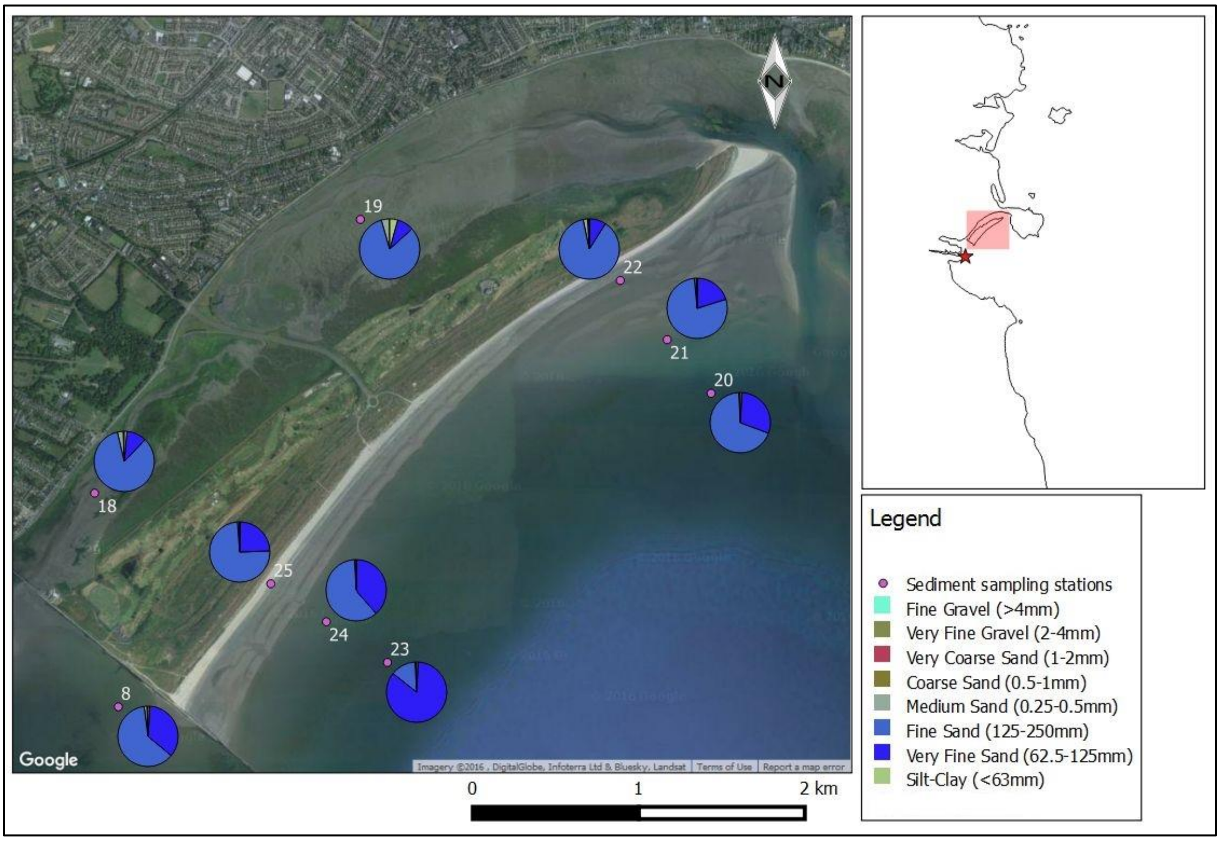


Figure 5-6: Results of particle size analysis (PSA) for sediment samples collected from intertidal sampling stations in the North Bull Island area, Dublin Bay

Figure 5-7: Results of particle size analysis for sediment samples collected from stations in the Tolka Estuary Area, Dublin Bay

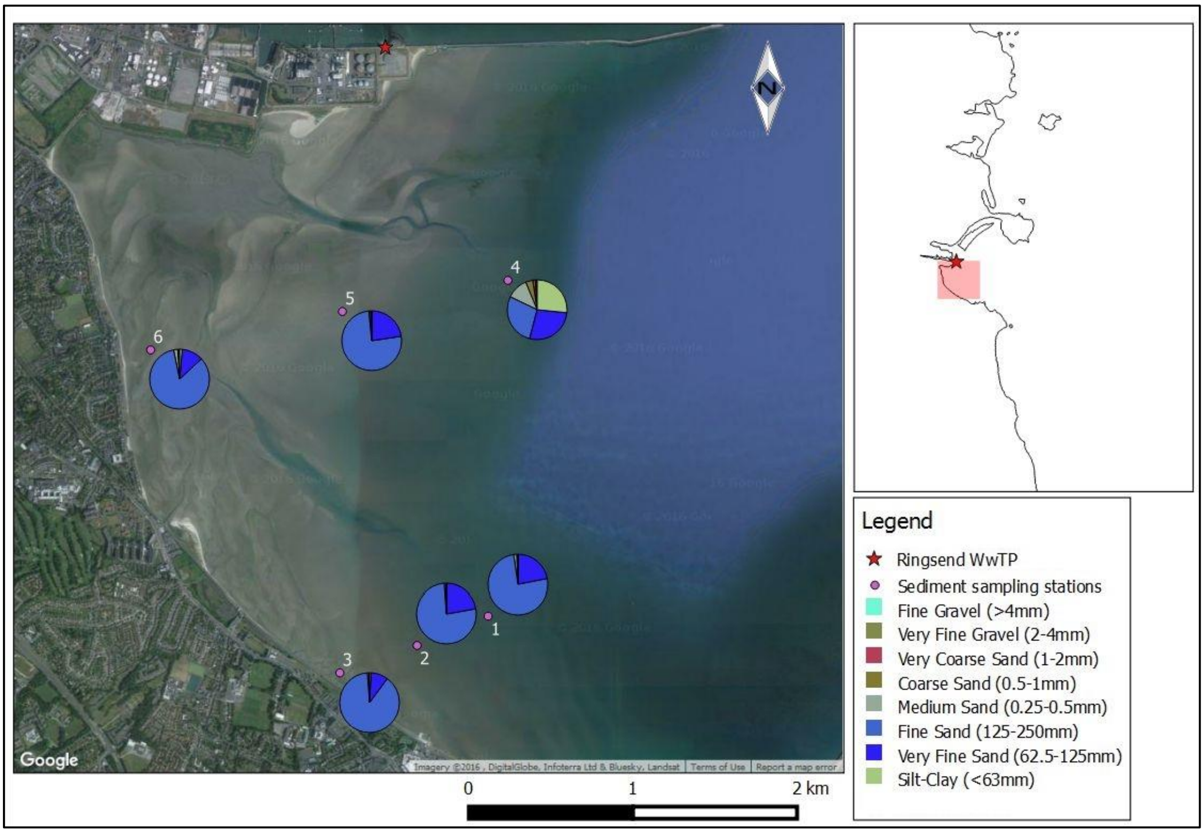


Figure 5-8: Results of granulometric (PSA) analysis for sediment samples collected from stations in South Dublin Bay

5.3.3.2 Organic carbon

Organic carbon values were generally low (see Table 5-4), even at the inner bay stations. Percentages ranged from 0.7% at Station 22, (Dollymount Strand) to 8.26% at Station 17 (Inner Tolka Estuary).

Table 5-4: Results of organic carbon analysis for sampling stations surveyed in Dublin Bay, 20 September, 2015

Station	Organic Carbon (%)
1	0.94
2	1.02
3	1.36
4	6.99
5	0.94
6	1.5
7	1.52
8	1.2
9	1.7
10	1.76
11	3.18
12	4.44
13	3.42
14	1.16
15	4.11
16	6.05
17	8.26
18	1.52
19	1.78
20	0.84
21	0.86
22	0.7
23	0.96
24	1.06
25	0.84

5.3.3.3 Intertidal benthic communities

The taxonomic identification of the benthic infauna recorded across the 25 intertidal stations sampled in Dublin Bay (Figure 5-1) yielded a total count of 107 taxa, ascribed to eight phyla. A complete listing of the taxa abundance is provided in Appendix 5A.

Of the 107 taxa enumerated, 103 were identified to species level. The remaining four taxa could not be identified to species level as they were either juveniles, partial/damaged or indeterminate.

Of the 107 taxa present, one was a cnidarian (an anemone), one was an unidentified nematode, two were nemerteans, 49 were annelids (segmented worms), 31 were crustaceans (crabs, shrimps, prawns), 22 were molluscs (mussels, cockles, snails *etc*.) and one was a chordate (*e.g.* fish).

5.3.3.4 Univariate Analysis

The results of the univariate analysis of the data are shown in Table 5-5 and Figure 5-9 to Figure 5-13. See also interpolation maps for richness (total number of taxa) and total abundance of macroinvertebrates displayed in Figure 5-14 and Figure 5-15, respectively.

Taxon numbers (S) ranged from 11 (Station 5) to 28 (Station 1). Numbers of individuals (N) ranged from 20 (Station 25) to 2500 (Station 6). Margalef's richness (d) ranged from 2.05 (Station 17) to 5.18 (Station 1). Evenness (J) ranged from 0.2 (S6) to 0.96 (S25) and Shannon's diversity (H') ranged from 0.64 (Station 6) to 2.65 (Station 21). Overall diversity was similar across all stations with highest values for S and d recorded in the Tolka Estuary. Abundance was highest in the Tolka Estuary stations with the exception of Station 6 located off the Martello Tower at Sandymount Strand where 2,500 nematodes were recorded. Shannon-Wiener's diversity was overall not very high (maximum 2.65) with highest values recorded in the Tolka and Outer North Bull (Sandymount Strand) stations in Dollymount Strand, although there were no clear trends. Evenness was highest in the stations located in the sandflats in Sandymount and Merrion Strands and Dollymount Strand where a greater spread of species existed compared to the muddy stations in the Tolka and Inner (western) North Bull where a few opportunistic species (nematodes, oligochaetes) typical of muddy brackish intertidal habitats were dominant.

Table 5-5: Macrofaunal diversity and evenness indices calculated for grab sampling stations at Dublin Bay, September 2015

Sampling station	Species Number	No. Individuals	Richness	Evenness	Diversity
1	28	183	5.18	0.79	2.62
2	17	80	3.65	0.72	2.04
3	14	65	3.11	0.73	1.92
4	16	79	3.43	0.79	2.19
5	11	31	2.91	0.77	1.84
6	27	2500	3.32	0.20	0.64
7	28	383	4.54	0.56	1.85
8	20	356	3.23	0.54	1.62
9	26	414	4.15	0.63	2.06
10	12	56	2.73	0.89	2.21
11	23	587	3.45	0.69	2.16
12	16	454	2.45	0.47	1.31
13	20	920	2.78	0.62	1.85
14	14	430	2.14	0.49	1.28
15	24	453	3.76	0.73	2.30
16	22	1257	2.94	0.62	1.92
17	13	350	2.05	0.39	1.01

Sampling station	Species Number	No. Individuals	Richness	Evenness	Diversity
18	18	175	3.29	0.64	1.86
19	17	167	3.13	0.71	2.00
20	22	111	4.46	0.71	2.19
21	17	62	3.88	0.94	2.65
22	13	58	2.96	0.66	1.69
23	13	43	3.19	0.80	2.04
24	16	76	3.46	0.74	2.04
25	11	20	3.34	0.96	2.29

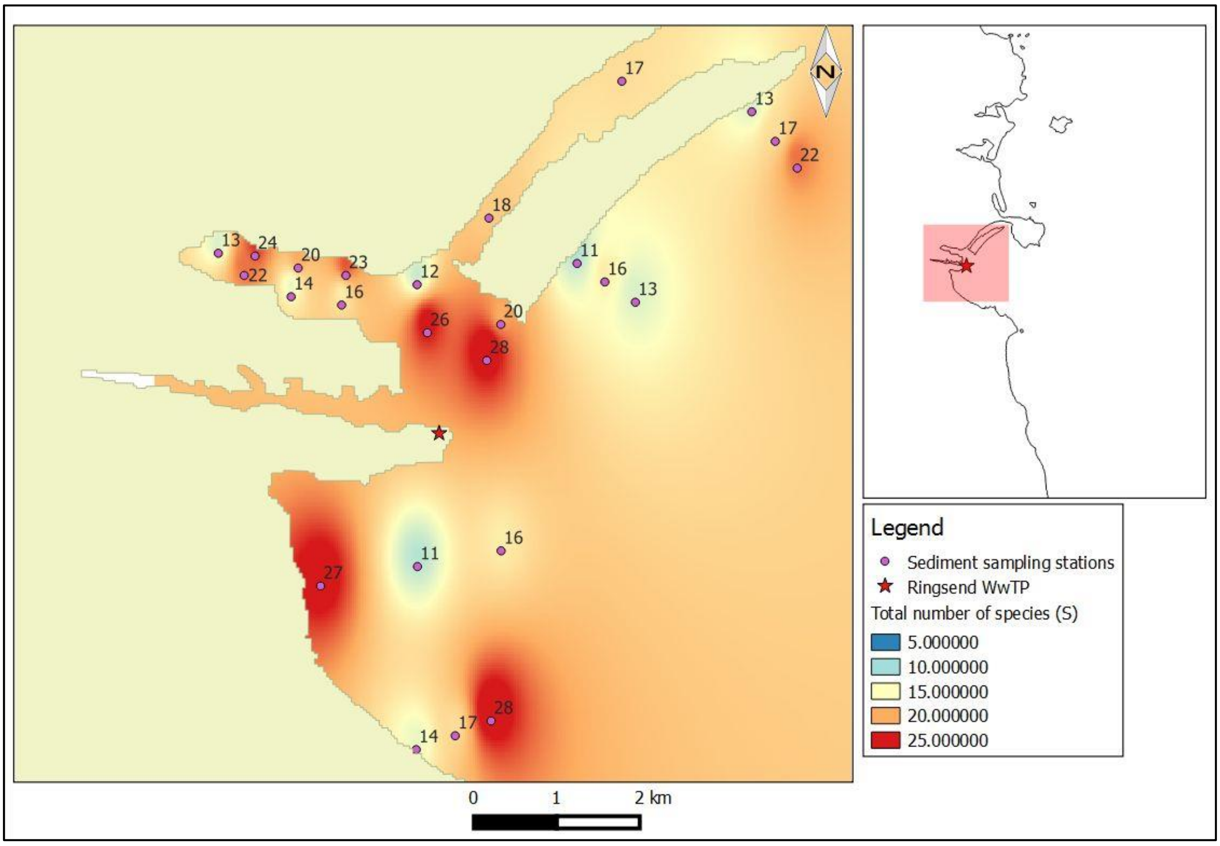


Figure 5-9: Interpolation Distance Weighing (IDW) map for species richness (number of taxa - S) recorded in 25 stations sampled in Dublin Bay on 20 September 2015. Numbers on the map represent the total number of taxa numbers recorded. Map constructed using qGIS.

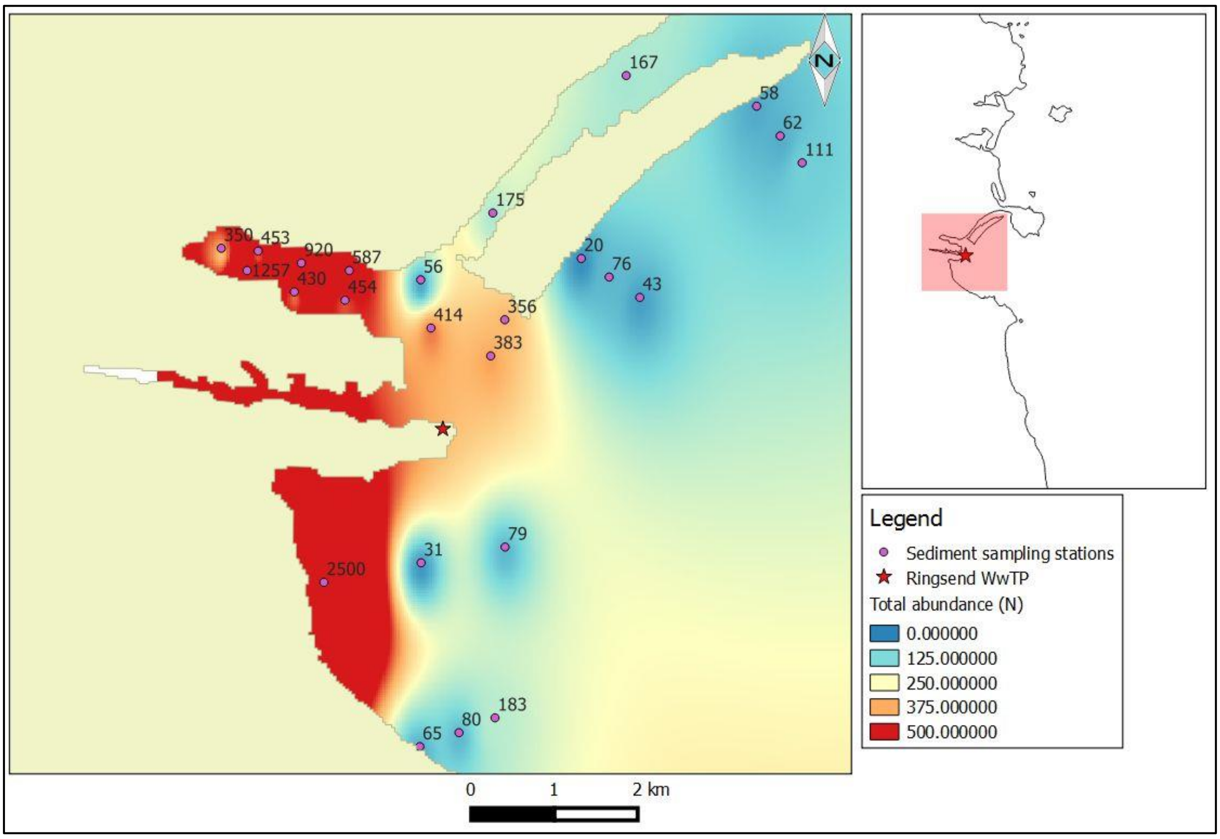


Figure 5-10: Interpolation Distance Weighing (IDW) map for total abundance of macroinvertebrate fauna (N) recorded in 25 stations sampled in Dublin Bay on 20 September 2015. Numbers on the map represent the total number of individuals recorded. Map constructed using qGIS.

5.3.3.5 Multivariate analysis

The results of the cluster analysis for the faunal samples collected at Dublin Bay clearly differentiated between two main groups: (1) all the stations sampled in muddy sand and gravelly mud in the Tolka Estuary as well as the Inner North Bull Island (along with station 6 in Sandymount Strand, located in the South Bull area); and (2) all stations in the outer North Bull Island (Dollymount Strand), Stations 4 and 5 in the medium to lower intertidal zones of Sandymount Strand and Stations 1 to 3 in Merrion Strand.

This second group was comprised of stations located in fine to muddy sand in fully marine conditions. SIMPROF analysis revealed six statistically significant (α=0.05) groupings between the 25 stations (the groupings of sampling stations joined by red lines in Figure 5-10 and Figure 5-11 could not be statistically differentiated from each other). The groupings can also be distinguished in the MDS plot. The stress value of the MDS was 0.14 which indicates the multidimensional plot provides a useful 2-d picture, but detail may be misinterpreted particularly nearing 0.20. The cluster dendrogram and the MDS plot can be seen in Figure 5-11 and Figure 5-12 below.

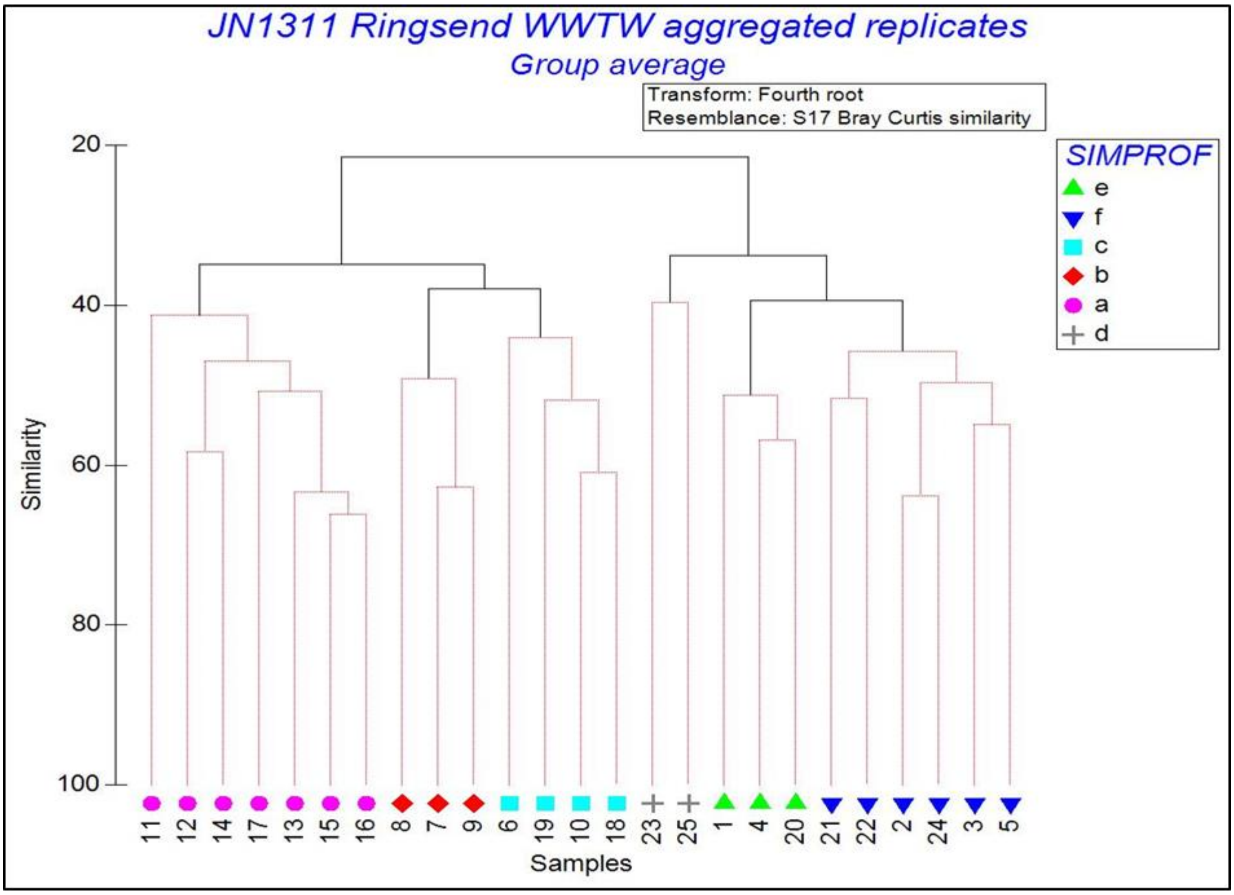


Figure 5-11: Dendrogram derived in Primer from Cluster analysis, Dublin Bay, Ringsend WwTP Upgrade Project.

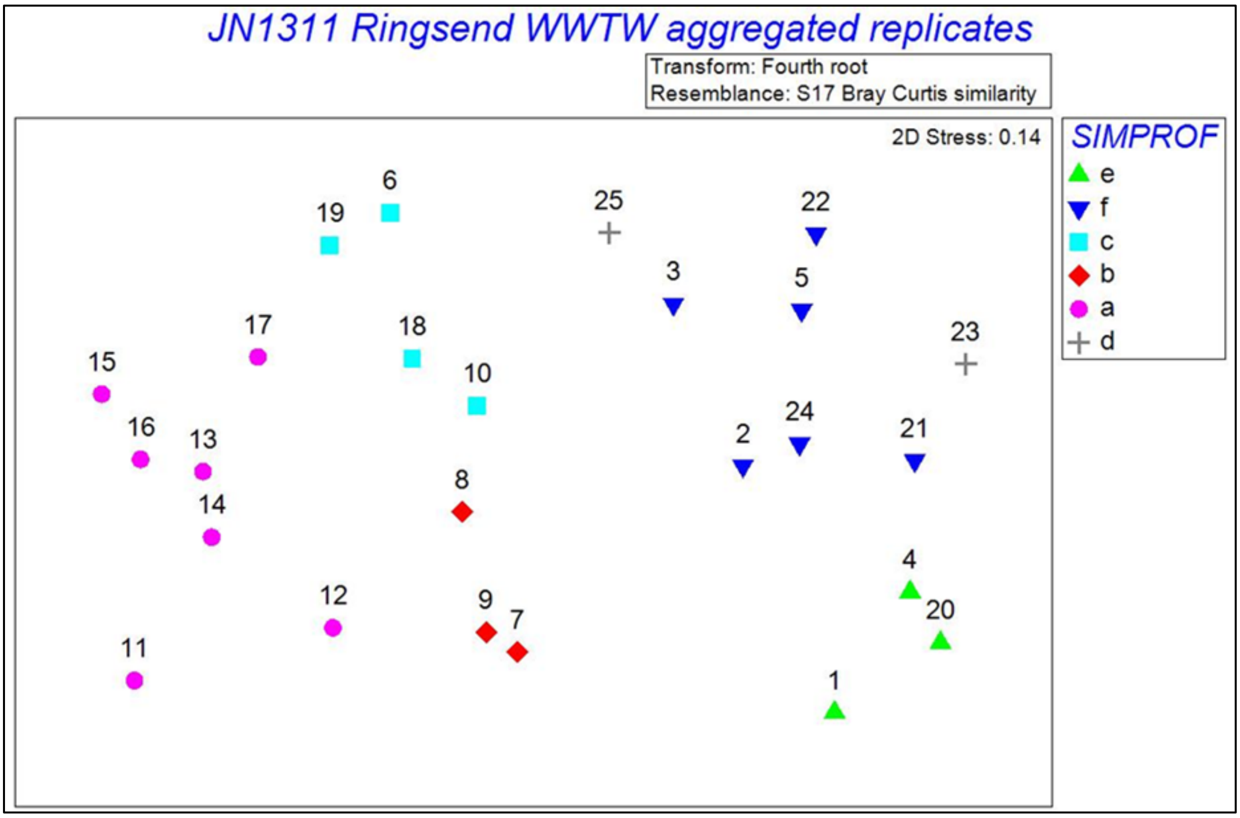


Figure 5-12: MDS plot for stations sampled at the Dublin Bay sites, Ringsend WwTP Upgrade Project

5.3.3.6 SIMPROF cluster groupings

Group a (Stations 11 to 17)

The group included all the stations sampled within the Inner Tolka Estuary (Figure 5-1). The group, along with those stations in groups b and c, separated from all other stations at 21.38% similarity and diverged from group b at 34.85% similarity. The average SIMPER similarity was 48.88% between the seven stations. Group a contained 52 taxa (of which 18 were present twice or less) comprising 4451 individuals. Three macroinvertebrate taxa accounted for just over 60% of the cumulative similarity between the stations: oligochaete annelids *Tubificoides pseudogaster* (15.09%, 843 individuals), unidentified cirratulid polychaetes (10.71%, 159 individuals), the oligochaete *T. benedii* (9.69%, 984 individuals), the cirratulid polychaete *Tharyx killariensis* (8.39%, 822 individuals), the polychaete *Hediste diversicolor* (8.26%, 300 individuals), polychaetes belonging to the *Capitella* sp. complex (7.83%, 97 individuals) and nematodes (7.57%, 246 individuals).

Tubificid oligochaetes such as *T. pseudogaster* and *T. benedii* and the polychaete *Capitella* sp. complex are first order opportunists that proliferate in oxygen-poor (reduced) sediments. The predatory polychaete *H. diversicolor* and nematodes can occur under undisturbed conditions but their populations are usually stimulated by organic enrichment. The cirratulid polychaete *T. killariensis* is a second-order, deposit feeding, opportunistic species (slight to pronounced unbalanced situations according to Borja *et al*., 2000).

Biotope assignation (JNCC, 2015):

The JNCC biotope '*Hediste diversicolor*, cirratulids and *Tubificoides* in littoral gravelly sandy mud' is a close match.

Group b (Stations 7, 8 and 9)

These stations were located in the Outer Tolka Estuary and separated from the rest at a similarity level of 39.85%. This group contained 46 taxa (of which 25 were present twice or less) comprising 1153 individuals. Seven species accounted for just over 70% of the faunal abundance in this group: *T. killariensis* (18.37%, 556 individuals), *T. pseudogaster* (5.17%, 173 specimens), the polychaete *Spio martinensis* (9.26%, 64 individuals), nematodes (9.02%, 82 individuals), *Pygospio elegans* (8.37%, 34 individuals), cirratulids (8.24%, 34 individuals) and *Capitella* sp. complex (6.22%, 57 individuals).

Nematodes, *S. martinensis* and *P. elegans* are tolerant to excess organic matter enrichment and, although they can occur under undisturbed conditions, their populations are stimulated by organic enrichment (*e.g.* caused by sewage outfalls). Tubificid oligochaetes such as *T. pseudogaster* and *T. benedii* and the polychaete *Capitella* sp. complex are first order opportunists that proliferate in reduced sediments whereas *T. killariensis* is a second-order, deposit feeding, opportunistic species that can be found under slight to pronounced unbalanced situations.

Biotope assignation (JNCC, 2015):

The JNCC biotopes '*Hediste diversicolor*, cirratulids and *Tubificoides* in littoral gravelly sandy mud' and '*Nephtys cirrosa*-dominated littoral fine sand' are the closest matches to the biotic assemblage dominated by cirratulid polychaetes and oligochaetes recorded at these stations.

Group c (stations 6, 10, 18 and 19)

Station 6 was located near the Martello Tower off Sandymount, station 10 off the Clontarf Yacht Club in the Outer Tolka Estuary and Stations 18 and 19 were within the inner section of North Bull Island.

These stations were located in sheltered, brackish areas or close to freshwater run-off. Group c contained 38 taxa (of which 16 were present twice or less) comprising 2,898 individuals. The group was part of a major cluster (along with Groups a and b) that separated from the rest of stations at 21.38% similarity. The group itself separated from Groups a and b at 37.85% similarity. The within-group SIMPER similarity was 49.45%. A total of seven species contributed to over 70% of the cumulative similarity between stations. *Pygospio elegans* (14.46%, 100 individuals), *T. benedii* (13.30%, 192 individuals), *T. pseudogaster* (11.77%, 75), *Parvicardium pinnulatum* (10.35%, 154), *Eteone longa* (9.99%, 18), *Scoloplos armiger* (9.82%, 23) and *Capitella* sp. complex (5.74%, 26).

Pygospio elegans, *Scoloplos armiger* and *Eteone longa* are tolerant to excess organic matter enrichment and they occur under undisturbed (un-impacted) conditions but their populations are stimulated by organic enrichment from anthropogenic sources. Tubificid oligochaetes such as *T. pseudogaster* and *T. benedii* and the polychaete *Capitella* sp. complex are first order opportunists that proliferate in reduced sediments. *Parvicardium pinnulatum* is regarded as sensitive to organic enrichment and is usually present only under undisturbed conditions (Borja *et al.,* 2000 based on Grall and Glémarec, 1997) (Figure 5-13).

Figure 5-13: Station 18 (Group c), intertidal sandflats east of the Bull Bridge, North Bull Island, Co. Dublin. Substrate was dominated by soft silt and very fine sand with a shallow redox layer. Green algae *Enteromorpha* spp., cockle *Cerastoderma edule* and lugworm, *Arenicola marina*

Biotope assignation (JNCC, 2015):

The most similar JNCC (2015) biotope is '*Cerastoderma edule* and polychaetes in littoral muddy sand'.

These stations are located within an area assigned by NPWS (2013a) to the 'Fine sand to sandy mud with *Pygospio elegans* and *Crangon crangon* community complex'.

Groups d, e and f

These groups separated from the remaining stations at 21.38% similarity and included all stations located in exposed areas within Dublin Bay where the seabed was dominated by sand. Group d (Stations 23 and 25) joined Groups e and f at a 33.74% similarity level (Figure 5-14). Group d had an overall within-group SIMPER similarity of 48.88% and contained 19 taxa (of which 11 were present twice or less) comprising 63 individuals. Five taxa accounted for the total (100%) similarity between stations: nematodes (23.37%, eight individuals), *Spio martinensis* (23.37%, eight individuals), *Glycera tridactyla* (23.37%, three individuals), *Scoloplos armiger* (17.76%, three individuals) and *Tellina tenuis* (17.76%, three individuals).

Nematodes, *Spio martinensis* and *Scoloplos armiger* are macroinvertebrates tolerant to excess organic matter but they also occur under 'normal' (*i.e.* not under the influence of anthropogenic disturbance) conditions. *Glycera tridactyla* is a species of predatory polychaete indifferent to organic enrichment. It is a species regarded as part of Group III (*sensu* Borja *et al*., 2000) which includes suspension feeders and less selective carnivores, taxa that are always present in low densities with non-significant variations over time. *Tellina tenuis* is a bivalve species typical of sandy substrates, part of Group I (*sensu* Borja *et al*., 2000), sensitive to organic enrichment and present only under undisturbed conditions (see also Grall and Glemarec, 1997).

Figure 5-14: Station 25 (Group d), southeaster section of Dollymount Strand, North Bull Island, Dublin

Biotope:

The JNCC (2015) biotope 'Polychaetes and *Angulus tenuis* in littoral fine sand' is a close match.

The stations are within the area assigned by NPWS (2013b) to the 'Fine sands with *Angulus tenuis* community complex' (Figure 5-5).

The stations that constitute Group e (Stations 1, 4 and 20; located on sand and mixed sediment) separated from the remaining stations along with those from Group f at a 39.32% similarity level. Group e had a within-group SIMPER similarity of 53.05% containing 39 taxa (of which 16 were present twice or less) comprising 373 individuals. Seven species accounted for over 70% of the similarity between stations belonging to this group, namely: *Donax vittatus* (15.20%, 115 individuals), nematodes. (9.05, 56 individuals), *Spio martinensis* (8.73%, 25 individuals), *Nepthys* sp. (8.42%, 18 individuals), *Nototropis swammerdamei* (8.42%, 11 individuals), *Microprotopus maculatus* (7.87%, 11 individuals), and *Pontocrates arcticus* (7.87%, nine individuals).

Populations of *S. martinensis* and nematodes are stimulated by organic enrichment (natural or from anthropogenic sources) although they can occur under 'normal' conditions (*i.e*. ambient conditions with no anthropogenic sources of pollution). *Nephtys* sp. and *P. arcticus* are taxa belonging to Group II (*sensu* Borja *et al*. 2000) indifferent to enrichment, always present in low densities with 'non-significant variations with time (from initial state to slight unbalance)'. *Donax vittatus, N. swammerdamei* and *M. maculatus* are species very sensitive to organic enrichment and present under unpolluted conditions (Borja *et al*. 2000).

Biotope:

The JNCC (2015) biotope 'Polychaetes and *Angulus tenuis* in littoral fine sand' is a close match.

These stations are within the NPW biotope 'Fine sands with *Angulus tenuis*' community complex (NPWS, 2013b).

Group f (Stations 2, 3, 5, 21, 22, and 24, all on sandy substrate) separated from the remaining stations at a 45.67% similarity level. This group contained 37 taxa (of which 18 were present twice or less) comprising 372 individuals. Seven species accounted for just over 70% of the similarity between stations belonging to this group: *S. martinensis.* (20.55%, 112individuals), *T. tenuis* (15.14%, 68 individuals), *Nephtys* sp. (11.46%, 10 individuals), nematodes 8.00%, 13 individuals), *T. benedii* (7.31%, 12 individuals), *Parvicardium pinnulatum* (5.36%, 11 individuals), and *N. cirrosa* (5.26%, 14 individuals) (Figure 5-15).

Tubificoides benedii is a deposit feeder and a first order opportunist that proliferates in reduced sediments. *Spio martinensis* and nematodes are tolerant to excess organic matter enrichment and they occur under normal conditions but their populations are stimulated by organic enrichment. *Nephtys sp., Nephtys cirrosa* and *Pontocrates arcticus* are species indifferent to enrichment, and are always present in low densities with non-significant variations with time (from initial state, to slight unbalance). *Parvicardium pinnulatum* and *Tellina tenuis* are bivalve species typical of sandy substrates, sensitive to organic enrichment and present only under undisturbed conditions (Borja *et al.,* 2000, based on Grall and Glemarec (1997)).

Biotope:

The assemblage for Group f is similar to '*Nephtys cirrosa*-dominated littoral fine sand' (JNCC 2015).

The stations belonging to Group e were located within the 'Fine sands with *Angulus tenuis*' and 'Fine sand with *Spio martinensis*' community complexes (NPWS, 2013b).

Figure 5-15: Station 22 (Group f), in the northeast section of Dollymount Strand, North Bull Island, Co. Dublin. Substrate was dominated by fine sand with a relatively deep redox layer

5.3.4 Discussion

As with many other seascapes, the sedimentology of the intertidal areas in Dublin Bay is the result of the geological history of the area and the influence of a series of contemporary factors including exposure, hydrodynamic patterns (tidal currents, freshwater influxes) or the biological communities that inhabit the sediments. In addition, anthropogenic factors are also important in determining the composition of the intertidal sediments, chiefly suspended solid inputs from agricultural, industrial and urban run offs and sewage treatment plants, dredging operations and the presence of artificial structures (*e.g.* coastal protection barriers) which in turn affect the hydrography of the area. In Dublin Bay, the north and south walls constructed in the 19th century to help maintain the navigational channel into Dublin Port, have played an important role in the current shape of the bay as their construction led to changes in the local hydrography and sediment deposition patterns. The most notable morphological changes has been the growth of the North Bull Island, from a very small sandy patch to a *c.* 5 km long island (Flood, 1977). In addition, the sand flats in South Dublin Bay are also a relatively dynamic feature, as the accretion of sand off the Merrion gates has led to the development of a vegetated embryonic dune and sand spit in the last 20 years.

The area of the Zone of Influence of the effluent from the Proposed WwTP Component is presented in Figure 5-16 below and is based on the predicted modelled output for Winter depth averaged 50%ile for Dissolved Inorganic Nitrogen (DIN). Except for an area in the inner part of Dublin Bay at Clontarf, the Blue Lagoon west of Bull Island and a small section of open sea to the south east of Bull Island, the Zone of Influence covers most of the sea water inside the retaining walls.

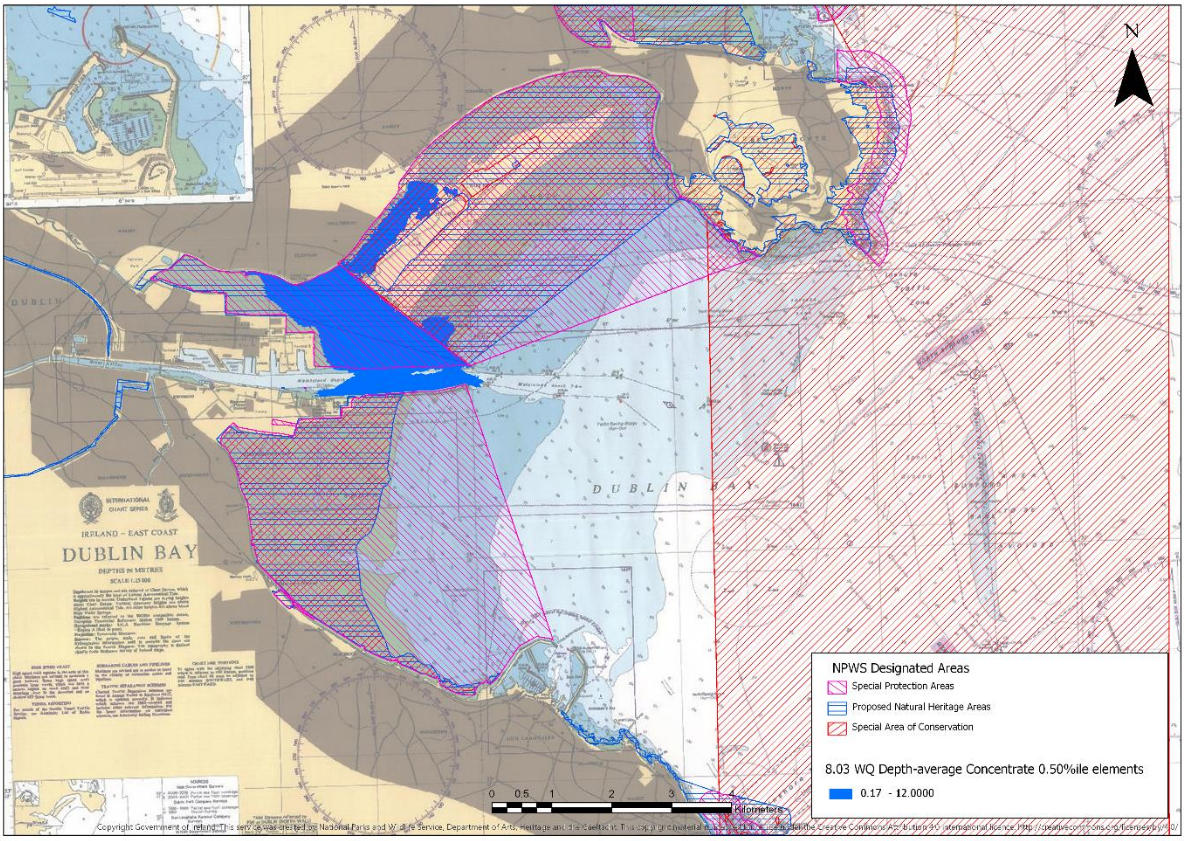


Figure 5-16: Extent of the Zone of Influence (in blue) of the effluent from the Proposed WwTP Component on the predicted modelled output for Winter depth averages 50%ile for Dissolved Inorganic Nitrogen (DIN)

The results of the biological survey undertaken in September 2015 indicate the intertidal habitats of Dublin Bay are dominated by sandflats of fine to very fine sand (Dollymount, Merrion and Sandymount Strands) with areas of soft muddy sand to the north of North Bull Island, east of the Bull Bridge and the Inner Tolka Estuary. These results match previous reports on the sedimentology of the area, for example by Harris (1977) as well as the Site Synopses for both the North and South Dublin Bay SACs. The distance gradient reported by NPWS (2013a) for the Tolka Estuary, from soft mud in the innermost section to aerated sand close to the Bull Wall was also detected. Of interest is the increase in the percentage of the gravel component in the sediments collected from the outer Tolka Estuary (this Section).

Previous intertidal biotope mapping surveys conducted in the Merrion and Sandymount Strand areas (AQUAFACT, 2006) yielded similar results to those presented in this Section. No temporal change was detected in the sediments in the mid and lower shore of Sandymount Strand which is predominantly formed by fine and very fine sands. In contrast, Station 6 (upper shore) had a coarser sand and gravel fraction in 2015 compared to 2006. There was a change in substrate composition detected at the Merrion Strand sampling sites, with mixed sand (fine to medium and very coarse) recorded in the upper littoral in 2006 compared to a higher silt fraction and no coarse sand and gravel component recorded in 2015. Fine and very fine sands were nonetheless dominant in the mid to lower littoral stations in both years.

With regard to the benthic ecology, there are no macroinvertebrate species considered to be rare or requiring conservation in Dublin Bay. There has been an apparent increase in biodiversity at the South Dublin Bay sandflats in 2015 compared to 2006 with the total number of species (S) increasing in the upper and mid shore stations (10 and 15 taxa in 2006 compared to 28 and 27 taxa in 2015). Station 4

(2015 survey) yielded similar numbers of taxa (11 compared to 13 in 2006). However, little change has occurred regarding the biotic community, described as 'Polychaetes and *Angulus tenuis* in littoral fine sand' (JNCC, 2015) in both 2006 and 2015. The species composition was roughly similar in both years, with nephtyid and spionid polychaetes, oligochaetes, amphipods and tellinid bivalves dominating the communities. This community (found in Groups d, e and f) is also similar to that reported by West (1977) and Wilson (1982) for the area (Dollymount, Sandymount and Merrion Strands) with nephtyids, *Scoloplos armiger* and their food source (spionids) along with the bivalve *Tellina tenuis* as the dominant species. All these taxa are typical of clean sands.

Wilson (1982) found that *T. tenuis* was the dominant bivalve in the mid to lower littoral zones of Dublin Bay with the exception of the muddy areas north of Bull Island, the Tolka Estuary and the inner areas of the South Bull where *Macoma balthica* dominated. The results recorded during the September 2015 survey agree with Wilson (1982) and AQUAFACT (2006), *M. balthica* only being reported from Stations 6 (upper intertidal in Sandymount Strand) and some stations in the Tolka estuary. However, for Group e (Stations 1, 4 and 20; all in located), the present study found that *Donax vittatus* has replaced *T. tenuis* as the dominant bivalve in the lower intertidal-shallow subtidal in Dollymount Strand and the South Bull. Assemblages such as those found in the lower shore in Sandymount and Dollymount where a mixture of macroinvertebrates with different feeding strategies but largely dominated by filter feeders and predators can be regarded as climax communities for this type of habitat (Borja *et al*., 2010; Roth and Wilson, 1998).

The second broad faunal assemblage identified by the cluster analysis included all the stations located within the Tolka Estuary and the tidal lagoons located between the Clontarf Road and the North Bull Island, east of the Bull Bridge. Station 6 (upper littoral zone in Sandymount Strand) was also included in this group, due to the abundance of hydrobid gastropods and nematodes, possibly due to its location close to channels carrying freshwater runoff.

These assemblages were dominated overall by opportunistic species typical of organically enriched sediments including the omnivorous nereid *Hediste diversicolor* and deposit and suspension feeders *e.g.* the spionid *Streblospio shrubsolii*, cirratulids, oligochaetes and the cockle *Parvicardium* spp.

The faunal community found in the Tolka Basin and the inner section of the North Bull Island represents a distinct biotic assemblage separated from that formed by pollution sensitive taxa such as nephtyids and tellinids that dominate the clean sands found in Dublin Bay. Although diversity measured by the Shannon-Wiener's index (H') was usually low (*i.e.* less than 2) in the innermost sections of Dublin Bay (as also found by Wilson, 1982), total abundance of individuals (N) and total richness (S) in these areas were amongst the highest among all of the stations sampled. In contrast with Wilson's (1982) observations, there was no indication of a severe reduction in richness or abundance of specimens in the Inner Tolka stations compared to the richest zones north of Bull Island. The results of the present study indicated that the Inner Tolka Basin is host to macroinvertebrate communities as rich (if not richer) than those found in the North Dublin Bay and South Dublin Bay mudflats and sandflats.

Accumulations of green algae *Enteromorpha* spp. and to a lesser extent *Ulva* spp. recorded in the mudflats north of North Bull Island during the intertidal surveys have been also reported in the past (Jeffrey, 1977; O'Higgins and Wilson, 2005). According to the 2012 Ringsend Upgrade EIS (CDM, 2102), green macroalgal biomass in the North Bull channel increased up to that period. This algal cover is the result of excess nutrient loads in the area which in turn are influenced by the reduced water circulation that the construction of the North Bull Island causeway led to (see Jeffrey, 1977). It is possible that the increased algal growth there could be having an effect in the associated macroinvertebrate communities in certain areas of the channel and thus explain the relatively low diversity and abundance of macroinvertebrates recorded in Stations 18 and 19 (Figure 5-1; Table 5-5) if compared to the Tolka Estuary and historical observations for the area by, for example, Wilson (1982).

5.4 Marine Mammals

5.4.1 Introduction

Marine mammals such as Harbour seals and Harbour porpoises can be seen in Dublin Bay and Harbour seals are regular visitors to Howth and Dun Laoghaire harbours. For this reason, a review of what species have been recorded and where they have been seen was undertaken.

5.4.2 Methodology

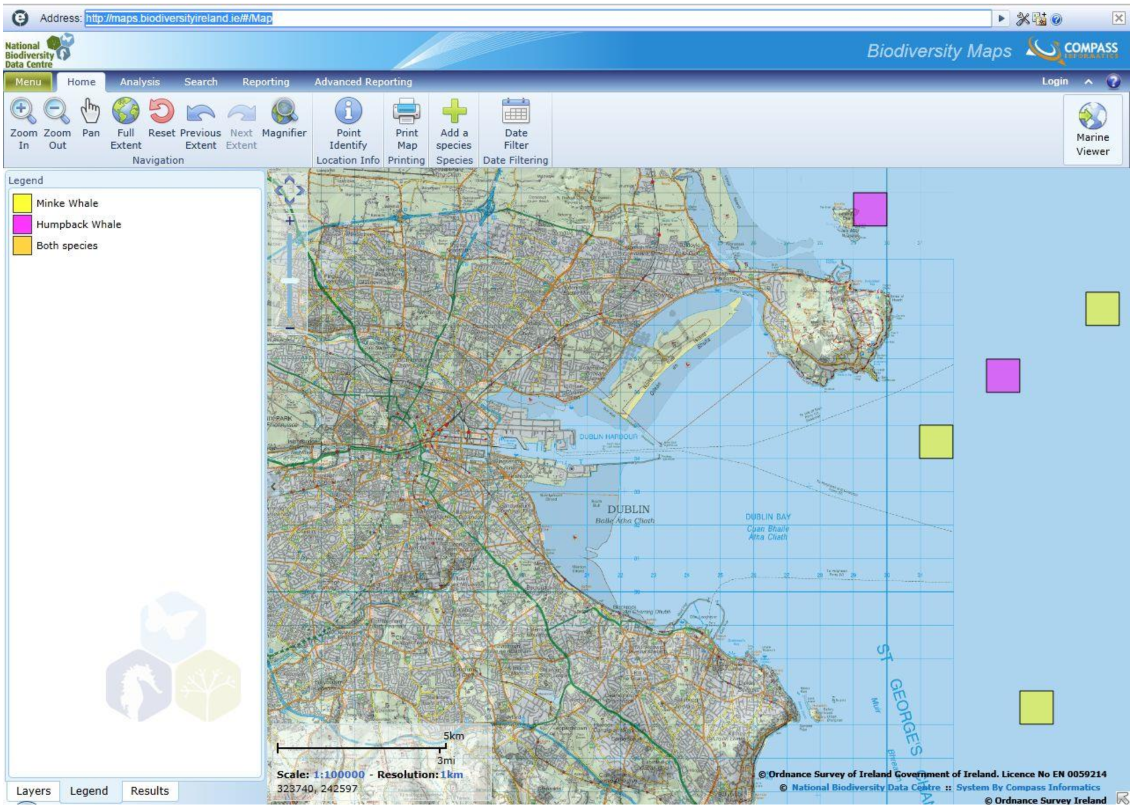
The Irish Whale and Dolphin Group (IWDG) operates an all-Ireland database of casual cetacean sightings (IWDG, 2016a) and strandings (IWDG, 2016b). Since 2001, regular monthly effort-related surveys from land-based stations have been included in the IWDG database. All records are validated and available on the National Biodiversity Mapping System (http://maps.biodiversityireland.ie). This database was used to identify species that occur in Dublin Bay and within a 20 km radius of the outfall.

5.4.3 Receiving Environment

Figure 5-17 shows the locations of all baleen whales (Mysticeti) validated records from the Dublin Bay area, within a 20 km radius of the existing outfall at Ringsend. There are no records held for baleen whales in Dublin Bay west of Howth Head.

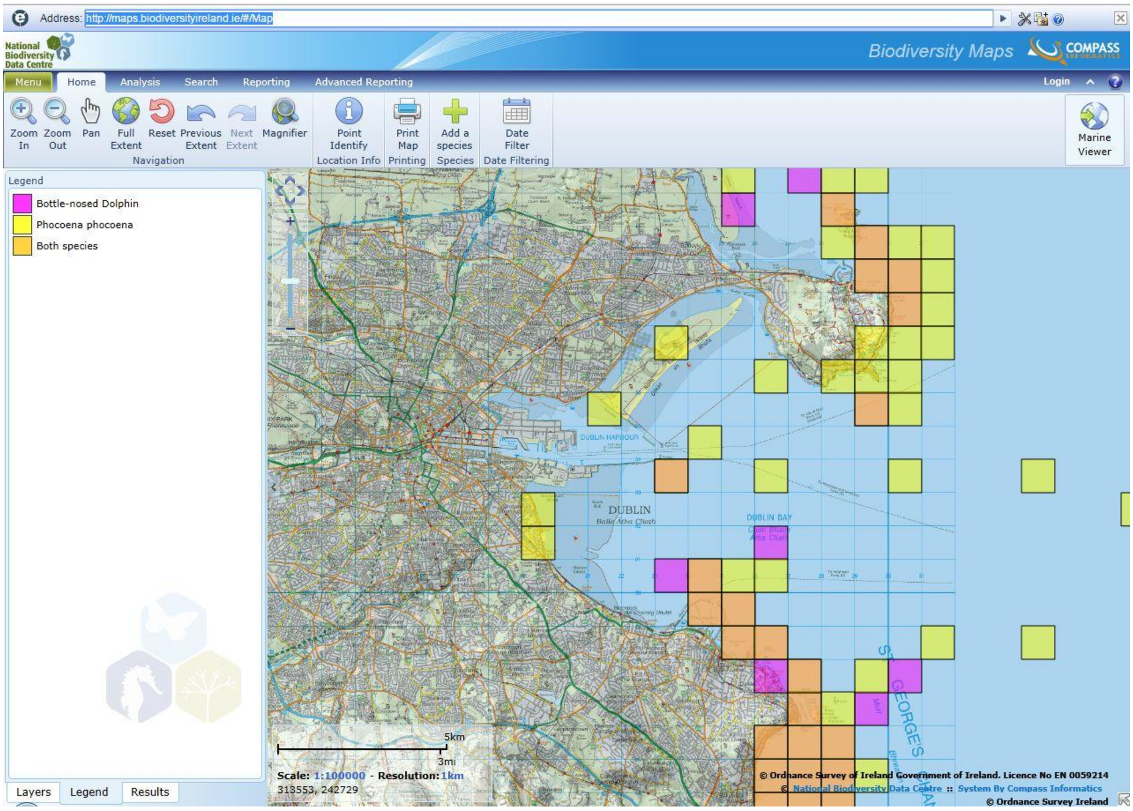
In total, only two species have been sighted in proximity to Dublin Bay, namely minke whale (two sightings, 8 km to the east of Dalkey Island and 2 km to the southeast of the Bailey lighthouse) and humpback whale (two sightings, recorded off Ireland’s Eye and 4 km to the southeast of Howth Head).

Regarding toothed whales (Odontoceti), a total of three species have been recorded within 10 km of the existing outfall, namely harbour porpoise (329 live individuals and seven strandings), bottle-nosed dolphin (118 ind.) and common dolphin (two live ind. off Killiney and two strandings in Sandymount). Outside Dublin Bay proper, killer whales have been recorded in the past off Howth and in the Kish Bank. Figure 5-17, Figure 5-18 and Figure 5-19. show the locations of the toothed whales recorded within 20 km of the existing treated sewage discharge point in Ringsend up to 2015. Overall, and notwithstanding that some records might correspond to the same individuals, harbour porpoise and bottlenose dolphin are the most commonly recorded and abundant cetaceans in Dublin Bay.



Datasets are from the casual and strandings database validated by the Irish Whale and Dolphin Group. Data visualized using the National Biodiversity Database Centre online mapping tool (http://maps.biodiversityireland.ie).

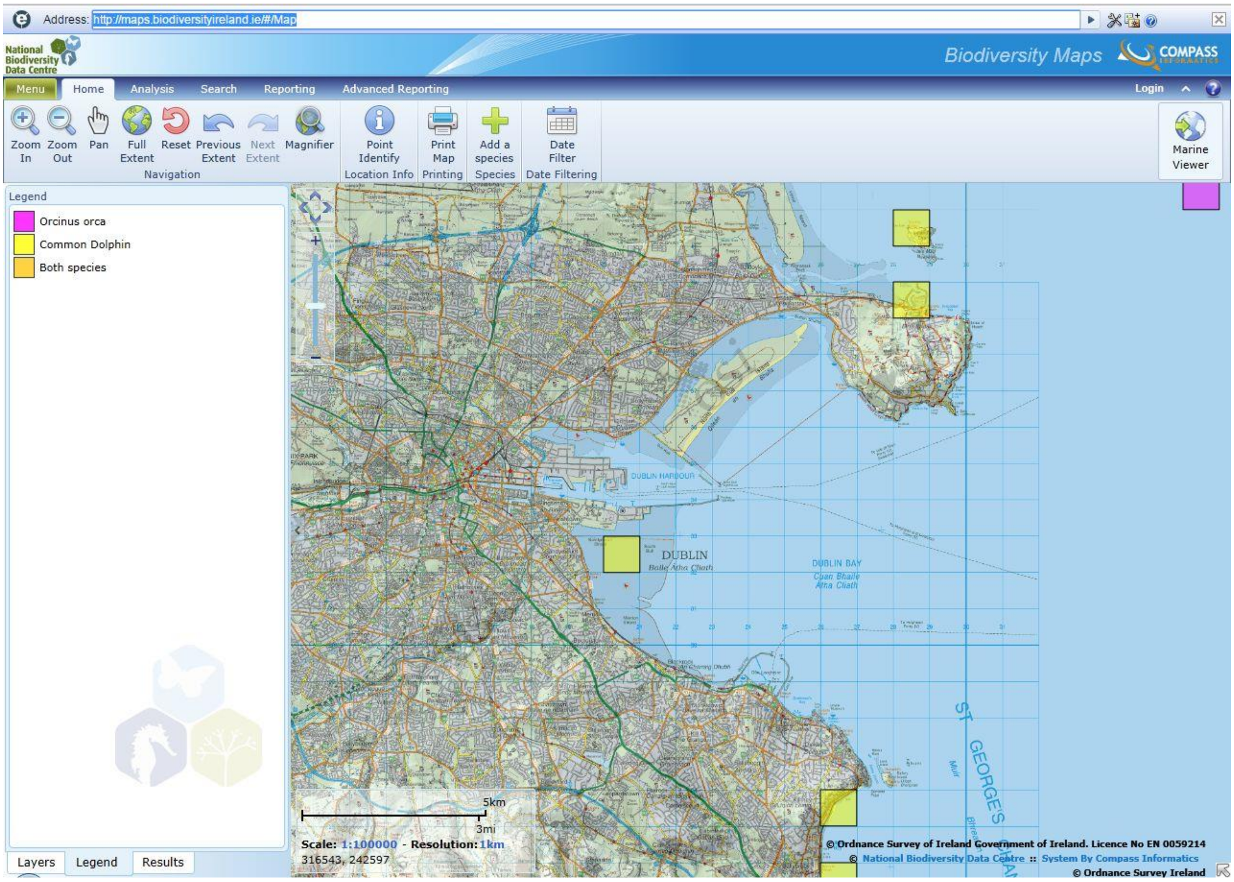
Figure 5-17: Records of baleen whales from the Dublin Bay area up to 2015.



Datasets are from the casual and strandings database validated by the Irish Whale and Dolphin Group. Data visualized using the National Biodiversity Database Centre Mapping tool (http://maps.biodiversityireland.ie)

Figure 5-18: Records of bottle-nosed dolphin and harbour porpoise from the Dublin Bay area up to 2015.

There are two harbour seal breeding sites in the vicinity of Dublin Bay, both located on Lambay Island, approximately 20 km northeast of the existing discharge site. There are three grey seal breeding sites in Dublin Bay and its surrounding area, namely Lambay Island (the largest population in the Irish Sea), on Ireland's Eye (*c.* 10 km northeast) and on Dalkey Island (*c.* 10 km southeast) (Cronin *et al*., 2004; Ó Cadhla *et a*l., 2013, 2007). However, due to distances involved, none of these sites can be impacted by the Proposed WwTP Component. Harbour and grey seals are commonly sighted within Dublin Bay and are known to forage around the existing discharge site at Ringsend (as indicated by the records held by the NBDC). As the Proposed WwTP Component will achieve higher water quality status, these species cannot therefore be negatively impacted.



Datasets are from the casual and strandings database validated by the Irish Whale and Dolphin Group. Data visualized using the National Biodiversity Database Centre online (http://maps.biodiversityireland.ie)

Figure 5-19: Records of common dolphin and killer whale from the Dublin Bay area up to 2015.

5.5 Fisheries

5.5.1 Introduction

Inner Dublin Bay and the River Liffey support a range of shellfish and fish and a review of these species was undertaken for inclusion in this EIAR.

5.5.2 Methodology

Fisheries surveys were undertaken, on three occasions over the last 10 years, at a number of locations and using 3 different collection techniques inside the North Bull Wall and Great South Wall. The techniques used (as required/determined by the SFPA) were beam trawl, seine net and fyke net. Figure 5-20 shows the locations where surveys were undertaken and the methods used. Table 5-6 presents the latitudes and longitudes of these sampling sites.

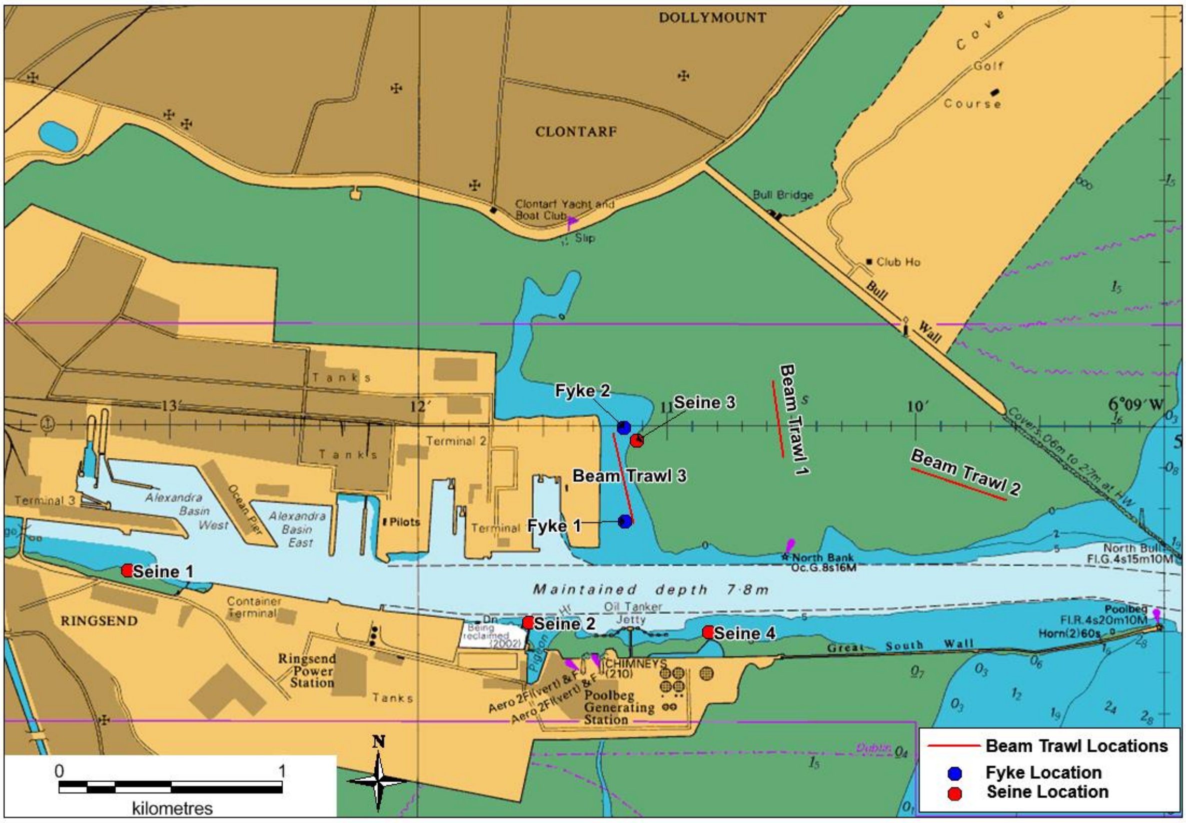


Figure 5-20: Station locations and sampling methods

Table 5-6: Sampling Locations

Station	Latitude	Longitude
Seine 1	53.3443	-6.22058
Seine 2	53.3422	-6.19362
Seine 3	53.3496	-6.18645
Seine 4	53.3418	-6.18158
Fyke 1	53.3463	-6.18722
Fyke 2	53.3501	-6.18729
Beam Trawl 1 Start	53.3472	-6.16158
Beam Trawl 1 End	53.3485	-6.16792
Beam Trawl 2 Start	53.3489	-6.17655
Beam Trawl 2 End	53.3520	-6.17730
Beam Trawl 3 Start	53.3462	-6.18668
Beam Trawl 3 End	53.3499	-6.18808

5.5.3 Receiving Environment

5.5.3.1 Shellfish

Due to the quality of water in the inner parts of Dublin Bay and the Liffey, consumption of shellfish from the area can only occur following depuration. For this reason, no shellfish are collected in this part of Inner Dublin Bay.

5.5.3.2 Fish

The Liffey estuary is highly modified due to its location in the centre of Dublin City and its use as a major port. Consequently, channels have been deepened and concrete piers have been constructed along the river bank.

With regard to fish species, no commercial fishing activities are carried out in the area because of the significant safety issue for roll on/roll off and ferry vessels that sail in and out of Dublin Port. For this reason, no boat-based fishing is permitted by the Dublin Port Authority in that area of Dublin Bay.

A number of shallow water fish surveys have been carried out in the area of the mouth of the Liffey by AQUAFACT in the past (*e.g.* CDM, 2012). Species recorded in these surveys included Trout (*Salmo trutta),* Bass (*Dicentrarchus labrax* juv.), Sand smelt (*Atherina presbyter* juv.), Common Goby (*Pomatoschistus microps* juv), Mullet (*Mugil cephalus),* Plaice (*Pleuronectes platessa* juv.), Nilson's Pipefish (*Syngnathus rostellatus*), Sea Scorpion (*Taurulus bubalis* juv.), Lemon Sole (*Microstomus kit* juv), Pollack (*Pollachius pollachius* juv.), Spratt (*Sprattus sprattus*), Lesser Sand Eel (*Ammodytes tobianus*), Eel (*Anguilla anguilla*), Flounder (*Platichthys flesus juv.*) and Shore Rockling (*Gaidropsarus mediterraneus*).

Other species that are known to occur in the area include salmon, *Salmo salar* (and its parasite, the lamprey, *Petromyzon fluviatilis*) and mackerel, *Scomber scomber.*

5.6 Characteristics of the WwTP Component of the Proposed Upgrade Project

5.6.1 Construction Phase

If planning permission is granted for the Proposed WwTP Component, there will be some reduction in treatment capacity at the plant in the Winter of 2019/2020 during the construction process during parallel construction activities on the site. This relates to an approximate nine month overlap between the construction of the AGS structures and the SBR retrofit. The reduction in the effluent quality will arise from the increased flow through the remaining 5 blocks when one block is out of operation. There will also be an increase in the number of storm water overflows.

No marine works are proposed or required for the Proposed WwTP Component. The same outfall will be used following the proposed upgrades to the WwTP. The Proposed WwTP Component will not result in direct physical disturbance of the seabed.

5.6.2 Operational Phase

The Proposed WwTP Component will result in an increase in the plant capacity and also an improvement in the final effluent quality. The improved final effluent quality will result in a reduction in the licensed parameters discharged into the receiving water, with significantly reduced quantities in respect of ammonia and phosphorus.

5.7 Potential Impacts

5.7.1 Do-Nothing Impacts

If the Proposed WwTP Component is not constructed, the nutrient and suspended solid loads from the plant into Dublin Bay will continue at the same levels and the impact of these loadings should maintain the same level of effects on marine biodiversity. The nutrient enrichment in the Liffey Estuary is regarded to be moderate to low compared to other estuarine systems in the Irish Sea where levels of magnitude up to two times higher are the norm (O'Higgins and Wilson, 2005 and references therein). The Ringsend WwTP does not currently possess the necessary nutrient reduction treatment facilities to meet the standards set under EPA Wastewater Discharge Licence and the UWWTD. It is expected that, in the absence of the Proposed WwTP Component, that water quality in the receiving environment may deteriorate as wastewater volumes increase into the future.

If the *status quo* is maintained there will be little or no change in the majority of the intertidal faunal assemblages found in Dublin Bay which would likely continue to be relatively diverse and rich across the bay. Previous studies suggest that the outer and south bays are largely unaffected by the nutrient inputs from the WwTP at Ringsend and from the Liffey and Tolka rivers. Therefore, the sandy communities found in those areas will likely remain dominated by the same assemblage of *Nepthys*, tellinids and other pollution-sensitive species, albeit subjected to natural spatial and seasonal variations.

However, the areas in the Tolka Estuary and North Bull Island channel will continue to be affected by the cumulative nutrient loads from the river Liffey and Tolka and the effluent from the Ringsend WwTP. These areas will likely continue to be colonised by opportunistic taxa tolerant of organic enrichment. There is a possibility that an increase in the nutrient outputs from the plant due to the operational overload and storm water discharges could result in a decline in the biodiversity of these communities as a result of low oxygen availability caused by increased organic enrichment. Considering the existing situation, it is possible that through the future oversupply of DIN to the area impacted by the existing outfall, benthic production could be adversely impacted due to hypoxic or even anoxic conditions. An increase in the cover of opportunistic macroalgae could lead to further deterioration in the lagoons in the North Bull as they add to the organic load on the benthos and further increase the BOD. These events, although localised, could deteriorate the biological status for Dublin Bay as a whole. Nonetheless, it is unlikely, as existing historical data suggests that pollution in Dublin Bay has had little or no effect on the composition and richness of the benthic macroinvertebrate fauna. Although a localised decline could occur, it is not envisaged to be to a scale that could pose a threat to the shellfish, fish, bird or marine mammal populations that occur in the area.

5.7.2 Construction Phase

5.7.2.1 Marine Biodiversity

The Proposed WwTP Component will not result in direct physical disturbance of the seabed. The intertidal and shallow subtidal macroinvertebrate communities in Dublin Bay will therefore not experience any of the negative impacts usually associated with that type of disturbance, *e.g.* habitat destruction and/or changes in species abundance and community composition associated with abrasion, smothering or direct removal.

If planning permission is granted for the Proposed WwTP Component, there will be some reduction in treatment capacity at the plant in the Winter of 2019/2020 during the construction process during parallel construction activities on the site. This relates to an approximate nine month overlap between the construction of the AGS structures and the SBR retrofit. During this nine-month period, the estimated average effluent quality will be as shown in Table 5-7.

Table 5-7: Estimated average effluent quality during construction process.

Parameter	Unit	(Expected) Value effluent SBR
		5 blocks
BOD	mg/l	18
COD	mg/l	79
TSS	mg/l	32
NH4-N	mg/l	15
TON	mg/l	3

The reduction in the effluent quality will arise from the increased flow through the remaining 5 blocks when one block is out of operation. There will also be an increase in the number of storm water overflows from approximately 1.2% of influent to 2.5-3.3% of influent.

The impact of these temporary increases on marine aquatic and benthic ecology will not be discernible.

5.7.2.2 Marine Mammals

The same outfall will be used following the Proposed WwTP Component. No marine works are proposed or required for the Proposed WwTP Component which is the subject of this impact report.

As such, there are no construction impacts in relation to marine mammals.

5.7.3 Operational Phase

5.7.3.1 Marine biodiversity

The Proposed WwTP Component will result in an increase in the plant capacity and also an improvement in the final effluent quality. The improved final effluent quality will result in a reduction in the licensed parameters discharged into the receiving water, with significantly reduced quantities in respect of ammonia and phosphorus.

The main impact on the marine ecology will be a positive one, whereby water quality in Inner Dublin Bay will be enhanced as a result of a reduction in the nutrient load for which the existing WwTP is currently a major source, *i.e.* phosphorus and ammonia (see O'Higgins and Wilson, 2005) as well as suspended solids. Overall no significant adverse effects are foreseen and indeed, a slight positive effect is possible.

The improvements in water quality are of value to the marine environment, however and nonetheless, the Upper Liffey and Tolka Estuaries will continue to be chiefly influenced by riverine outputs as the major sources of nutrient loads. Nitrogen (as Dissolved Inorganic Nitrogen or DIN) is incorporated into the trophic pathways in an estuary as it is absorbed by phytoplankton and phytobenthos as well as by opportunistic macroalgae that thrive in enriched environments (*e.g.* those belonging to the genera *Ectocarpus*, *Entromorpha* and *Ulva*) and used for growth when sea temperature and light conditions are suitable. During the nutrient cycling process, phytoplankton is eaten by zooplankton thus enhancing secondary benthic production by faecal pellets, phytodetritus and macroinvertebrate larvae settling onto the seabed. Phytoplankton also enhances secondary production by benthic suspension and filter feeding macroinvertebrate species, including shellfish. Zooplankton and benthic macroinvertebrates are food resources for pelagic and benthic fish species while birds can potentially feed both macroinvertebrates and fish.

Therefore, a decrease in nitrogen loads could lead to a reduction in biochemical oxygen demand (BOD) and, as a result, an increase in oxygen availability in areas of Dublin Bay where eutrophication usually occurs, *e.g.* the Tolka Estuary and Bull Island lagoons where organic enrichment is also apparent based on the abundance of macroalgal mats. The oxygenation of the superficial sediments will, in turn, result in the substitution of the opportunistic species that are usually found in organically enriched, hypoxic environments by a more biologically diverse assemblage. Nonetheless, those areas would remain under the influence of the riverine nutrient fluxes from the Tolka and Liffey.

There are concerns that an enhancement in the water quality and biological status of estuaries following the implementation of EU legislation could have knock on effects on the trophic chain, affecting infaunal invertebrates and ultimately, bird species. This possible impact is of particular concern for Dublin Bay, an important wintering area for a variety of bird species some of which are recorded in internationally important numbers, particularly within the North Bull Island SPA (Wilson, 1982).

According to the benthic succession paradigm of Pearson and Rosenberg (1978), the cessation or reduction of the intensity of anthropogenic stressors operating at a site influences the composition of the macroinvertebrate assemblages found in the sedimentary sea beds. Benthic communities found in areas subjected to high levels of organic enrichment and low sediment oxygen are usually species-poor and dominated by high numbers of individuals of a few opportunistic taxa, largely detritus feeders *e.g. Corophium* spp., *Hydrobia* spp., *Capitella* spp. complex, *Eteone* spp., *etc*., whereas those communities that live in areas which do not receive high levels of organic matter are typically diverse in species numbers with a variety of feeding strategies (*e.g.* suspension feeders, filter feeders, predators) but no one species is highly dominant. These communities usually include species that burrow into the sediment allowing oxygen-rich sea water to penetrate into the sea floor allowing aerobic bacterial activity that uses up organic matter. In turn, higher bioturbation rates contribute to further improvements in the conditions thus increasing the abundance and diversity of other pollution sensitive species (Borja *et al*., 2000). For example, Essink and Beukema (1986) studied a benthic community in the Dutch Wadensee close to a discharge pipe that began delivering organically enriched wastewater to the sea in 1969. Examination of species density data over time for *Macoma balthica, Eteone longa* and *Nephtys hombergii* showed a significant increase in the eleven-year period between 1974 and 1985. In a long-term study in southern California (USA) 24 years after the implementation of sewage treatment plans, species richness had increased several-fold throughout the monitored area to resemble ambient conditions. However, multivariate indices (*i.e.* Benthic Response Index or BRI) indicated that for some sites total recovery had not yet occurred (Stein and Cadien, 2009).

Previous modelling work has shown that the concentration of suspended solids that originates from the existing WwTP outfall at Ringsend is largely contained within the North Bull wall and South Great Wall (CDM/DHI, 2009). Results of the new model study show a high level of differences in ammonia (see Figure 4-17 above) and MRP (see Figure 4-26 above) levels but only minor reductions in levels of suspended solids (see Figure 4-14 above) and DIN (see Figure 4-20 above). Nonetheless, the reduction in the nutrient loads into Dublin Bay as a result of the Proposed WwTP Component will affect the development of algal blooms which are a source of organic matter to the benthic ecosystems. However, the development of these sporadic blooms is limited to the northern sections of Dublin Bay south of the North Bull Wall (O'Higgins and Wilson, 2005). It is therefore unlikely that the faunal communities that characterise the sandflats of the South Dublin Bay SAC (Sandymount and Merrion Strands) and North Bull Island (Dollymount Strand) will be negatively affected by a reduction in nutrient loads following the implementation of the Proposed WwTP Component.

Based on the modelled output for suspended solids, a reduction in suspended solids following the implementation of the Proposed WwTP Component is very unlikely to have any effect in south Dublin Bay, in Dollymount Strand, the intertidal mudflats to the north and west of Bull Island or the outer bay, which are currently not affected by the effluent, due to the rapid mixing and dilution.

In Dublin Bay, the Tolka Estuary has been traditionally regarded as being dominated by an impoverished community where no benthic macrofauna or one species system of nereids at very low abundance were the norm (Roth and Wilson, 1998; Wilson, 1982). These studies are in contrast with the results presented here which suggest that the benthic assemblage found in the Tolka Estuary has experienced an increase in species diversity and abundance. It is possible that this recovery could be linked to an improvement in water quality conditions in inner Dublin Bay since the Ringsend WwTP became fully operational in 2003 (DKM, 2012). Although the assemblage in the Tolka Estuary will continue to be affected by some level of organic enrichment from the Liffey and Tolka rivers (which are major sources of nutrients (TON, DIN and P) into the bay ecosystem), it is predicted that this same recovery direction, *i.e.* towards a more diverse and richer stage in the faunal succession will continue as a result of the Proposed WwTP Component and nutrient discharges are reduced. It is therefore unlikely that the food resource of wintering waders and other wildfowl in the Tolka Estuary will be negatively affected. Opportunistic species could give way to a wider array of sediment ingesters and filter feeders that would in turn attract predators including a range of crustaceans. It is predicted that total abundance of benthic macroinvertebrates might decrease but diversity will likely increase allowing birds to diversify their diet. Nonetheless, these changes will be slow and difficult to establish in the short term.

The present study found the highest diversity and richness of macroinvertebrates was in the Sandymount sampling stations, south of the South Great Wall, where water quality and benthic conditions are not impacted by organic enrichment. It can be inferred then that a reduction in the nitrate load in other areas of the bay is unlikely to lead to changes in the benthic communities that could negatively affect bird populations. The impact would therefore be neutral or positive.

Overall, the results of the survey conducted in September 2015 agree (with some exceptions already discussed) with historical observations by Wilson (1982) and AQUAFACT (2006) indicating the presence of relatively rich faunal assemblages across the bay suggesting no major negative impacts of anthropogenic origin or otherwise. Of note are the increases in biodiversity and total abundance of macroinvertebrates observed in the innermost sections of the bay, especially in the Tolka Estuary (regarded as species-poor compared to the North Bull Island lagoonal habitats) suggesting an improvement in the conditions recorded by Wilson (1982).

According to the EU Habitats Directive *Favourable Conservation Status* of an Annex I habitat is achieved when 'The specific structures and functions which are necessary for its long-term maintenance exist and are likely to continue in the foreseeable future' and for an Annex II species when 'There is, and probably will continue to be, a sufficiently large habitat to maintain its population'. The work of O'Higgins and Wilson (2005) suggested that nutrient inputs from the River Liffey (TON) and the Ringsend WwTP (PO_4; $NH4^+$) affect chlorophyll a levels within the walled parts of Dublin Bay, especially in the northern section. Results of the new model study show significant differences in levels of ammonia (see Figure 4-18 above) and MRP (see Figure 4-27 above) levels but only minor reductions in levels of DIN (see Figure 4-21 above).

However, considering that the development of these sporadic blooms is limited to the northern sections of Dublin Bay south of the North Bull Wall (O'Higgins and Wilson, 2005,), it is unlikely that the faunal communities (including shellfish and fish) that characterise the sandflats of the South Dublin Bay SAC

(Sandymount and Merrion Strands) and North Bull Island (Dollymount Strand) will be affected by a reduction in nutrient loads following the implementation of the Proposed WwTP Component.

The effect of the reduced nutrient load is likely to be positive and limited to the communities in the Tolka Estuary and the lagoons and intertidal mudflats of North Bull Island where an increase in macroinvertebrate diversity and richness could be expected. Any reduction in the abundance of opportunistic, pollution tolerant species will be compensated by an increase in the abundance of other species less tolerant to nutrient enrichment and the development of an overall more diverse assemblage. In addition to an improvement in the overall water quality for the bay, it is possible that a reduction in the nutrient levels could lead to a reduction in the green algal cover in the channels between the Clontarf Road and North Bull Island. This effect could in turn result in reduction in BOD and the development of a richer faunal community as a result. However, it is likely that these changes will be slow as these areas will continue to be subjected to nutrient loads from the Liffey and Tolka rivers.

5.7.3.2 Marine Mammals

Underwater noise during the operational phase will be limited to diffusion through the outfall which is regarded as negligible and will not affect the two cetaceans most likely to be in the vicinity, *e.g.* bottle-nosed dolphin or harbour porpoises. Seals will continue to forage in the vicinity, possibly benefiting from an increase in fish life in Inner Dublin Bay as a result of the enhanced water and benthic quality conditions.

5.7.3.3 Fisheries

The water quality model predicts that the plume will disperse away from the site and dilution will occur within short distances of the outfall. The reduction in nutrient levels predicted by the model (see Figure 4-18 and Figure 4-27 above) are too low to have any negative impact on fish or shellfish species in the area outside the North and South Walls.

5.8 Mitigation Measures

5.8.1 Construction Phase

As the only impact in relation to the construction phase (relating to temporary reduction in the effluent quality and increase in the number of storm water overflows during the winter of 2019/2020) is considered to be not discernible, no mitigation measures are proposed.

5.8.2 Operational Phase

As the effect of the reduced nutrient load resulting from the Proposed WwTP Component is likely to be positive, no mitigation measures are proposed for the operational phase.

5.9 Residual Impacts

5.9.1 Construction Phase

There will be a residual impact in relation to the temporary reduction in effluent quality during a short period of the construction phase which will arise from the increased flow through the remaining 5 blocks when one block is out of operation.

The impact of this on marine aquatic and benthic ecology will not be discernible.

5.9.2 Operational Phase

Residual impacts after the implementation of the Proposed WwTP Component will be positive and related to an improvement in sea water quality in parts of inner Dublin Bay, namely the mouth of the Liffey, the Tolka estuary and the lagoons off North Bull Island, improvements in sediment quality and, as a result, benthic diversity. Bird and marine mammals that forage within Dublin Bay would likely to be positively impacted by those changes. Residual impacts for the outer bay, the sandflats off Bull Island and those areas south of the South Great Wall will be negligible and the habitats there will remain unaffected by the Proposed WwTP Component.

5.9.3 Interactions

The main interaction between the marine biodiversity environment and other environmental disciplines is the quality of the water discharging from the WwTP both during construction and operation of the Proposed WwTP Component. Water quality models, as described in Volume 3, Section 4: Water has been used in this assessment to account for this interaction.

5.9.4 Cumulative Impacts

The water quality modelling, which forms the main potential impact on marine biodiversity considers cumulative impacts as part of their model, including DIN from other sources, such as the river inputs. Details of the cumulative impact assessment on water quality is provided in Section 4.9.4 of this EIAR.

No other plans or projects have been identified with the potential to give rise to cumulative or in combination impacts with the proposed Ringsend WwTP upgrade.

5.10 Monitoring

The following monitoring proposals are recommended to verify the findings of this assessment.

- Post-construction monitoring of macroinvertebrate communities is recommended to detect any changes in the composition and abundance of the constituent taxa; and
- Post-construction water quality surveys are recommended to validate the model output.

5.11 Difficulties Encountered

No difficulties were encountered in preparing this Section.

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Section 6: Biodiversity - Terrestrial

6.1 Introduction

This Section provides an assessment of the impacts (and resulting effects) of the Ringsend WwTP component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component") on terrestrial biodiversity, including birds, in the receiving environment. Volume 3, Section 5: Biodiversity - Marine covers marine biodiversity (below high water mark).

Full details of the Proposed Upgrade Project and the Ringsend WwTP component can be found in Volume 2, Section 3: Description of Proposed Upgrade Project.

This Section describes the existing flora and fauna in the vicinity of the Ringsend WwTP site and surrounding area, reviews the likely significant impacts and proposes measures for the mitigation of these impacts, where appropriate.

This Section of the report follows the Environmental Protection Agency's *Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports* (EPA, 2017). It also takes account of the draft *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment* (Department of Environment, Community and Local Government, July 2012). This Section also takes account of the Chartered Institute of Ecology and Environmental Management *Guidelines on Ecological Impact Assessment in the UK and Ireland*, 2nd edition (CIEEM 2016).

The Proposed WwTP Component may result in potential impacts on the designated European Sites within Dublin Bay and vicinity. Therefore, an Appropriate Assessment (Natura Impact Statement) is provided as a standalone document. This follows *Appropriate Assessment of Plans and Projects in Ireland. Guidance for Planning Authorities* (Department of the Environment, Heritage and Local Government, 2010).

The potential impacts on terrestrial biodiversity in this Section should be read in conjunction with the sections on Water (Volume 3, Section 4) and Marine Biodiversity (Volume 3, Section 5).

Relevant Legislation

Flora and fauna in Ireland are protected at a national level by the Wildlife Acts, 1976 to 2000 and the European Communities (Birds and Natural Habitats) Regulations 2011. They are also protected at a European level by the EU Habitats Directive (92/43/EEC) and the EU Birds Directive (79/409/EEC) amended in 2009 as the Directive 2009/147/EC.

Under this legislation, sites of nature conservation importance are then designated in order to legally protect faunal and floral species and important/vulnerable habitats. The categories of designation are as follows:

- Special Areas of Conservation (SAC) are designated under the European Communities (Birds and Natural Habitats) Regulations 2011 to comply with the EU Habitats Directive (92/43/EEC);
- Special Protection Areas (SPAs) and designated under the EU Birds Directive (79/409/EEC) amended in 2009 as the Directive 2009/147/EC; and

Proposed Natural Heritage Areas (pNHA) are listed under the Wildlife (Amendment) Act, 2000. They have limited legal protection under Local Authority Development Plans. There are no designated Natural Heritage Areas (NHA) in the Dublin area.

6.2 Methodology

6.2.1 Relevant Guidance

This Section followed the *Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports* (Environmental Protection Agency, 2017).

It also took account of the *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal*, 2nd edition (CIEEM, 2016).

6.2.2 Desk based study

A desk study was carried out to collate the available information on the local ecological environment. The study area is shown in Figure 6-4. The database (http://www.npws.ie) of the National Parks and Wildlife Service (NPWS) of the Department of Culture, Heritage and the Gaeltacht was consulted in relation to designated areas and records of rare plants and protected species in the vicinity of the Proposed WwTP Component site. Databases of the National Biodiversity Data Centre were also searched for records of species occurring in the immediate vicinity of the Ringsend WwTP.

Desk-based analysis of several large datasets on the bird populations of Dublin Bay was carried out. This principally concerned the intertidal areas of Dublin Bay which hold the highest diversity and numbers of waterbirds. The long-term trends of bird populations in Ireland are monitored through the Irish Wetland Bird Survey (I-WeBS) which has collected consistent data on peak numbers of all non-breeding waterbirds in Dublin Bay since 1994/95. The most recent data available is for the winter 2013/14 (BirdWatch Ireland website www.birdwatchireland.ie). Data was also analysed from the Dublin Bay Birds Project carried out by BirdWatch Ireland with support from Dublin Port Company. Dublin Bay Birds Project collected data on low tide and high tide numbers, and the distribution of all waterbirds in Dublin Bay in all months of the year from July 2013 to June 2016. The results of monitoring of tern colonies in Dublin Port, as part of the Dublin Bay Birds Project carried out by BirdWatch Ireland, were also reviewed.

6.2.3 Field surveys

Field surveys of the habitats on the construction site and immediate surround were undertaken in June 2016 to describe and evaluate the terrestrial habitats (including flora and fauna) in the vicinity of the WwTP, following the methodology of Smith *et al*. (2011). Impacts on terrestrial flora and fauna are likely to be limited to the area within the WwTP site and within 50 m of its boundary. There are no pathways for other impacts. However, as the existing and Proposed WwTP Component discharges treated effluent to Dublin Bay, the impacts on bird populations in this area have also been considered here as birds move regularly between the intertidal area and terrestrial habitats. Habitats were classified in accordance with the Heritage Council scheme (Fossitt, 2000). Information and datasets used to inform the previous Environmental Impact Assessment (Dublin City Council, 2012), was taken into account in this assessment. Terrestrial flora and habitats at proposed construction sites and in their vicinity were surveyed, and previous records of birds on these habitats were reviewed. The Proposed WwTP Component concerns the same site and its impacts will be broadly similar to that described in the 2012 application. The historical trends in bird populations are relevant to the assessment of impacts of any scheme. A survey of Japanese Knotweed *(Reynoutria japonica)* and any other invasive plant species was undertaken on site of the Proposed WwTP Component, including the associated construction compounds in June 2016.

6.3 Existing Environment

6.3.1 General study area

The study area for this assessment comprises the Proposed WwTP Component including the proposed construction compounds in its immediate vicinity.

It also includes those parts of Dublin Bay that are potentially affected by the effluent from the Proposed WwTP Component. Bird populations of Dublin Bay are included insofar as they are known to use the terrestrial habitats as well as marine and intertidal ecosystems.

6.3.2 Designated areas

Candidate Special Areas of Conservation (cSAC) designated under the Habitats Directive, and Special Protection Areas (SPA) designated under the Birds Directive are collectively known as European sites. The *Guidance for Planning Authorities on the Appropriate Assessment of Plans and Projects in Ireland* (Department of the Environment, Heritage and Local Government, 2010), recommends that European sites within a 15 km distance of the location of a plan should be considered in the Stage 1 Appropriate Assessment Screening. For projects, such as the Proposed WwTP Component, the Guidance states “the distance could be much less than 15 km and, in some cases, less than 100 m, but this must be evaluated on a case-by-case basis with reference to the nature, size and location of the project, and the sensitivities of the ecological receptors, and the potential for in-combination effects”. This assessment considers any European sites whose Conservation Objectives may be affected, either directly or indirectly by the construction and operation of the Proposed WwTP Component. It is considered that there is no potential for SPAs and cSACs outside Dublin Bay to be affected by the Proposed WwTP Component as the effluent from the treatment works cannot be detected outside this area. The assessment of likely impacts on designated areas is confined to those European sites within Dublin Bay, the seaward limit of which extends from the Baily Lighthouse to Dalkey Island (Figure 6-1 and Figure 6-2).

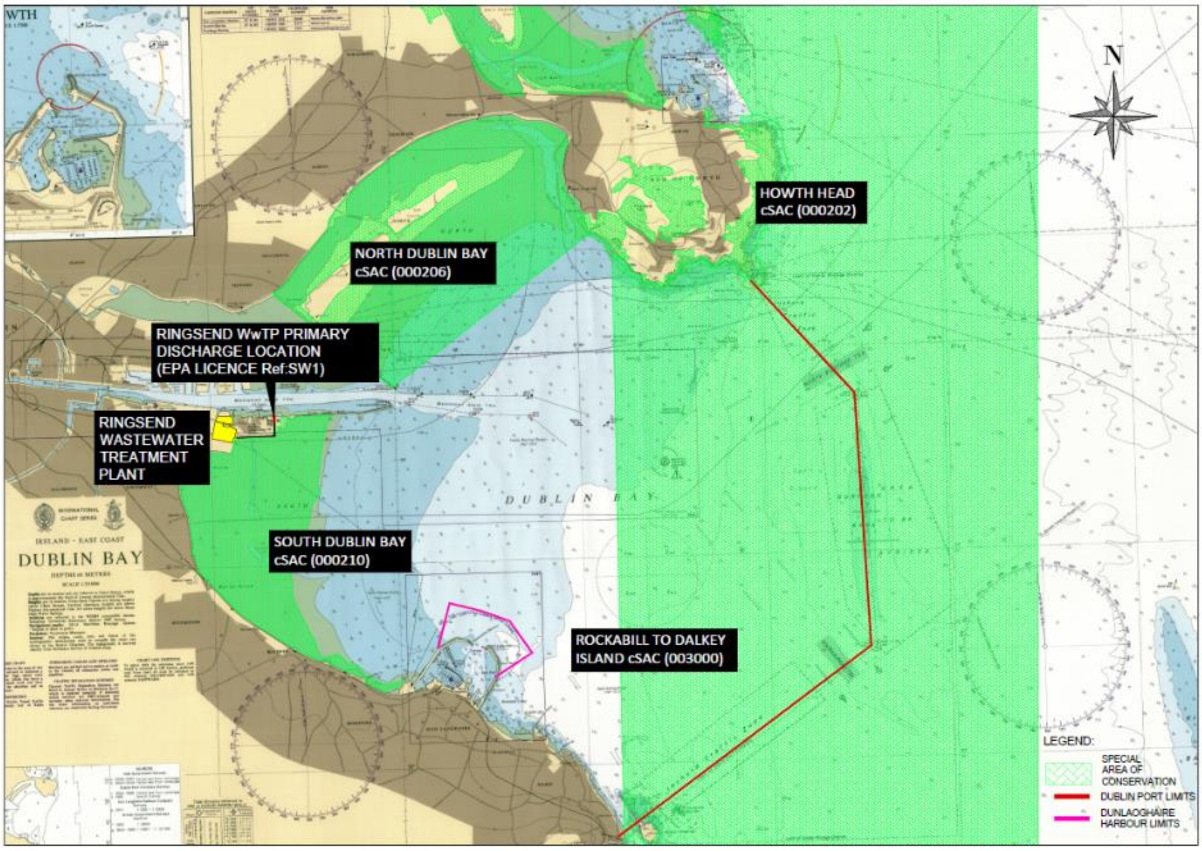

Figure 6-1: SAC European sites in Dublin Bay

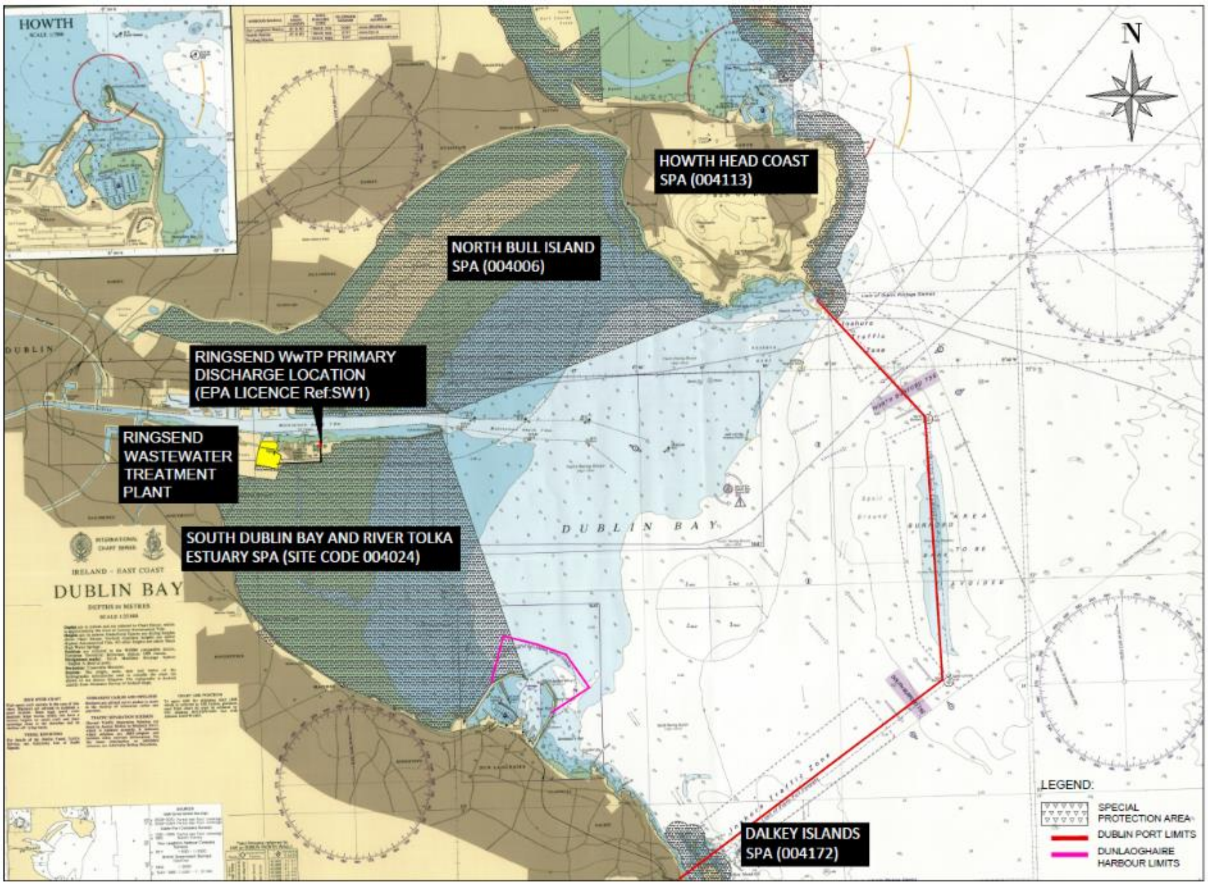

Figure 6-2: SPA European sites in Dublin Bay

6.3.3 Description of European sites

There are eight European sites which, due to their proximity to the Proposed WwTP Component site, have the potential to be adversely affected by the Proposed WwTP Component (Figure 6-1 and Figure 6-2). They are all located either wholly or partly within Dublin Bay. These are:

- South Dublin Bay and River Tolka Estuary SPA (site code 004024);
- South Dublin Bay cSAC (000210);
- North Bull Island SPA (004006);
- North Dublin Bay cSAC (000206);
- Howth Head Coast SPA (004113);
- Howth Head cSAC (000202);
- Dalkey Islands SPA (004172); and
- Rockabill to Dalkey Island cSAC (003000).

These European sites are described in the Natura Impact Statement that accompanies this Planning Application.

6.3.4 Intertidal habitats

Intertidal habitats are included in this Section because they are used by important bird populations that move regularly between the intertidal and terrestrial habitats. For example, Oystercatchers roost on saltmarsh, sand dune spits and rock armoury, but feed in the intertidal area and on terrestrial grassland. Saltmarshes are strictly intertidal but are often treated as terrestrial habits.

Sand dunes depend on the interchange of sediment with intertidal beaches and subtidal benthic habitats. Therefore, for the purposes of this assessment, Dublin Bay is treated here as one interconnected ecosystem. Cross-reference is made where appropriate to other Sections of this EIAR.

Dublin Bay is a shallow sandy bay, in which the Liffey, Tolka and Dodder rivers are the major inflowing rivers. The nomenclature for different areas of Dublin Bay used in this study follows Jeffrey *et al* (1992). The total intertidal area is currently estimated at approximately 2,000 hectares (ha), and includes the following areas (areas are approximate and are quoted from Jeffrey *et al* (1992)):

- South Dublin Bay 840 ha
- Liffey Estuary (including the Tolka Basin and Bull Wall Sands) 288 ha
- South Bull Lagoon 75 ha
- North Bull Lagoon 310 ha
- Dollymount Strand 470 ha

The upper shore has been reduced and modified by centuries of land reclamation, the construction of sea walls and rock-armoured embankments around the bay, and the construction of the North and South Bull Harbour Walls. Natural shoreline occurs mainly at Bull Island in North Dublin Bay, with small but increasing areas of beach exposed at high tide at Sutton, and between Booterstown and Poolbeg in the western part of South Dublin Bay.

The sand dunes on North Bull Island (including the habitats listed in Annex I of the EU Habitats Directive under codes 2110, 2120, 2130 and 2190) are backed by saltmarsh habitats, of which salt meadows are inundated during spring high tides. Habitats Directive Annex I listed Salicornia flats (1310), Atlantic salt meadow (1330) and Mediterranean salt meadow (1410) occur here are listed among the conservation interests of North Dublin Bay SAC, as are the sand dune and strandline habitat Annual vegetation of driftlines (1210) present. Some natural erosion of salt meadow habitat has been noted in recent years (McCorry and Ryle 2009). The salt meadow and *Salicornia* flat habitats are separated from the mainland by the North Bull Lagoon lying to the north of the causeway and extending to Sutton, and the South Bull Lagoon which extends from the causeway south to the wooden bridge. These are intertidal areas corresponding to the Annex 1 listed habitat mudflats and sandflats not covered by sea water at low tide (1140).

The main intertidal habitats present in Dublin Bay are indicated in Figure 6-3. The intertidal area in Dublin Bay is mostly sandy (refer to Section 5: Biodiversity - Marine). Variations in substrate type and granulometry arise due to the inflowing rivers, tidal currents, the degree of exposure and, more recently due to morphological change such as the build-up of supratidal sand dunes.

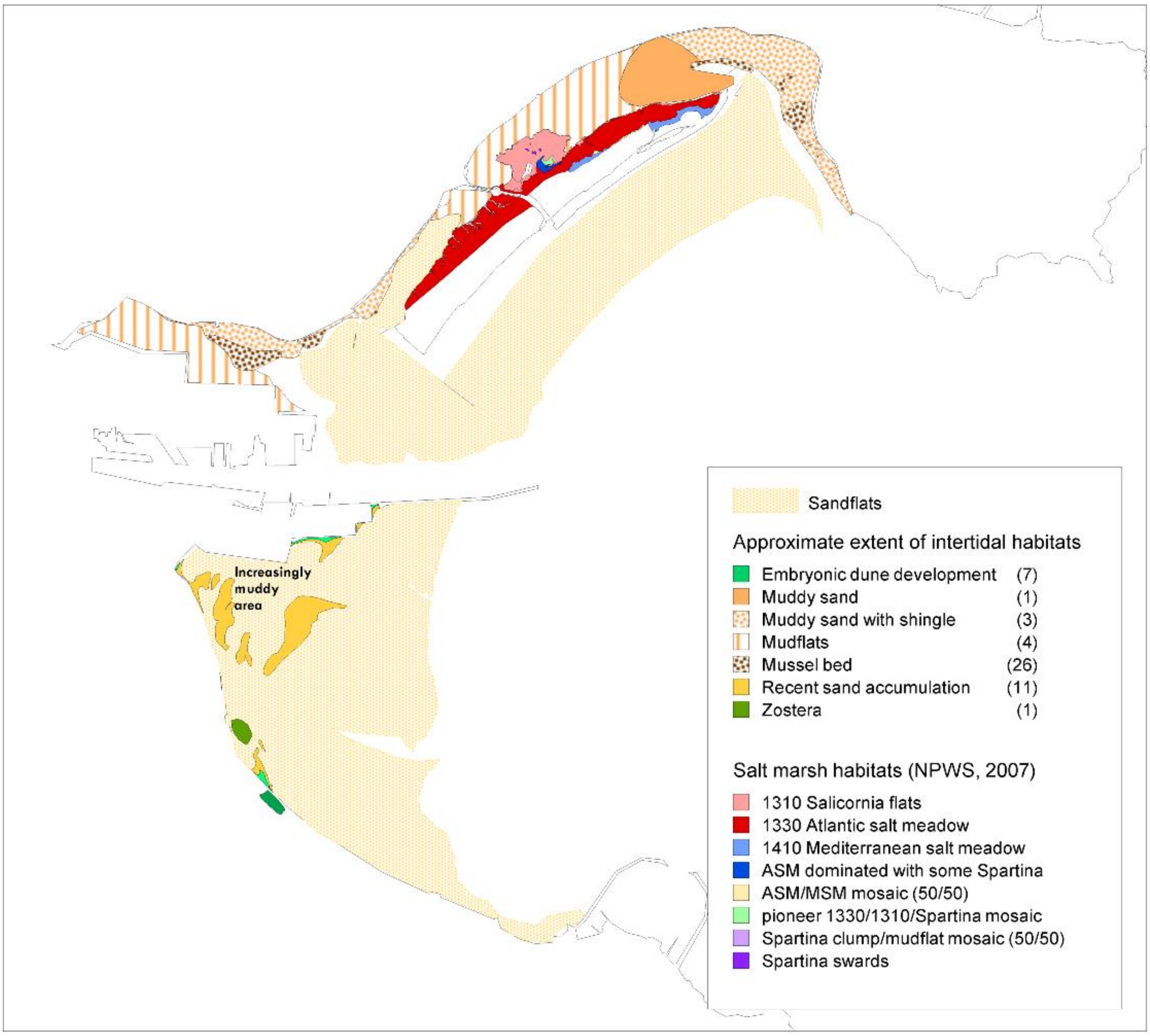

Figure 6-3: Intertidal habitats in Dublin Bay

Soft muddy mudflats are confined to the western part of the Tolka Basin, this area tends to act as a sediment trap and accumulates fine sediments and organic particulates. Soft muds also occur in the North Bull Lagoon close to the causeway, with a small area of mudflat in the South Lagoon, also close to the causeway; however, sediments are accumulating slowly in these areas as noted further below. Muddy sand with shingle areas occur along the base of the sea wall in the Tolka Basin and South Bull

Lagoon, and in the Sutton area of the North Bull Lagoon. Mussel beds *Mytilus edulis* occur in the Tolka Basin and at Sutton (Figure 6-3).

The relatively sheltered mudflats and sandflats in the Bull lagoons, together with moderate nutrient levels, provide conditions in which green macroalgal mats of *Enteromorpha* species develop during the spring and summer. Green algal mats were particularly pronounced in the Bull Island Lagoons, (Jeffrey et al, 1992). In the Tolka Basin, South Bull Lagoon and North Bull Lagoon, green algae grow on muddy sand with shingle. The exposed sands of Dollymount Strand do not develop green algal mats, but green algae occur on the western part of Sandymount Strand near Irishtown/Ringsend, in low tide channels in the western part of South Dublin Bay, and on the sheltered western side of the developing dune habitat between Booterstown and Merrion Gates.

Green macroalgae are considered as indicating nutrient enrichment, and are monitored under the Water Framework Directive (WFD) by the EPA as a key quality element under Annex V of WFD and as part of the Trophic Status Assessment Scheme.

In June 1989, a large mass of brown material (subsequently identified as the alga *Ectocarpus*) drifted ashore from the deeper water. It covered most of the 5.5 kilometres of Dollymount Strand, up to 30 cms deep and several metres wide. The nutrients, mainly nitrogen, promoting this algal production came from the Sand Mason Worm *Lanice concilega* which consumes protein-rich organic matter for its own needs. Each worm liberates an ammonium-rich “urine”, which is an ideal nitrogen source for *Ectocarpus*. There was a further minor outbreak in 1990, but on the whole this nuisance has not recurred and it seems to be a feature of very calm and warm spring periods (Jeffrey *et al.* 1992, Nairn *et al.* 2017). A more recent review of the nitrogen sources for the macroalga Ectocarpus in Dublin Bay found that there was no evidence of a direct link between the nitrogen sources and the WwTP at Ringsend as both the rivers and tides bring in more nutrients to Dublin Bay than are released by the treatment plant (Wilson and Jackson, 2011).

The North Bull lagoon intertidal area covers an area of 310 ha, extending from the causeway to the rocky shore at Sutton Martello Tower. The Santry River flows into the lagoon near the causeway, so that some water is always present in the channel that flows northwards into Sutton Creek. The substrate close to the causeway is soft mud, with a high content of fine organic material derived from inputs from the Santry River, Dublin Bay and decomposed algae (Jeffrey *et al*, 1992). Sediment is accumulating slowly in this area, and there has been some recent development of saltmarsh vegetation near the causeway (McCorry and Ryle, 2009). Extensive mats of green algae grow on soft muds lower on the shore in this area, and are dominated by *Enteromorpha ramulosa*, with *E. intestinalis* and *E. prolifera*). The *Salicornia* flats are on muddy sand, the annual glasswort plants *Salicornia dolichostachya* and *S. europaea* grow here, with the cord grass *Spartina anglica, Ruppia maritima*, green algae, and the brown alga *Fucus ceranoides*. There has been some recent development of *Salicornia* flat habitat in the South Bull Lagoon near the causeway, where there is also a slow accumulation of sediment (McCorry and Ryle 2009).

To the north of the *Salicornia* flat in the North Bull Lagoon, the substrate is increasingly sandy, but there is an area of soft muddy shore between the Howth Road and Kilbarrack Road junctions where the green alga *Vaucheria* was recorded by Jeffrey *et al* (1992). Mussel beds occur along the landward edge of the main channel in the north lagoon, from Kilbarrack around to Sutton Creek. The mussel beds vary in width and serve as attachment points for macroalgae. Towards Sutton Creek, the sandflats on the landward side of the channel include gravel and stone, and like the mussel beds, the stones provide attachment points for algae. The algal species which grow on stones and on the mussel beds include the green algae *E. compressa, E. intestinalis, E. ramulosa* and sea lettuce *Ulva lactuca*, and brown algae *Fucus vesiculosus, F. spiralis* and *F. serratus.* In the South Lagoon, the substrate includes muddy sand with shingle along the base of the sea wall, with sparse mussel bed near the wooden bridge, and sandflats adjoining the saltmarsh habitats.

The intertidal area of South Dublin Bay covers 840 ha. The muddy sands near Merrion Gates in South Dublin Bay support an eelgrass (*Zostera noltii)* bed on which Brent Geese feed on arrival in Dublin Bay in the autumn (O'Briain, 1991). This habitat is still present and used by geese each year (personal observations). Significant sand deposition has occurred in South Dublin Bay since the late 1990s. A sand bar between Merrion Gates and Booterstown DART Station has developed and accumulated a significant amount of sand.

This area now supports embryonic dune and strandline vegetation, with some marram dune, and more recently, the early stages of salt marsh development on the western, sheltered side, near Merrion Gates. Areas of *Salicornia* flat habitat are developing here. The beach at Poolbeg has also accumulated sand, and marram dune vegetation is now well established with more recent development of embryonic dune and strandline vegetation (Nairn *et al.* 2017). Sand bars that cover with sea water on the higher stages of the tide are developing across South Dublin Bay between these two developing dune systems. These are used as roosts by waders, gulls and terns as the tide rises and falls in the south bay, with birds moving to higher sandbars between Merrion Gates and Booterstown at high tide (Nairn, 2017). Waterbird use of intertidal habitats, and of shallow transitional and coastal waters in Dublin Bay, is considered below.

Rock exposure occurs at Sutton and in South Dublin Bay between Blackrock and Dun Laoghaire. There is a flora of brown and green macroalgae attached to outcropping rocks from Blackrock eastwards (Jeffrey *et al,* 1992).

6.3.5 Terrestrial Habitats Close to Ringsend WwTP

6.3.5.1 Construction access road

The proposed construction access road at the south-east corner of the existing Ringsend WwTP lies in an area of tree and shrub planting carried out as part of the completion works for the existing WwTP. This has some small patches of grassland, but none of this area is of significant ecological value nor does it contain any habitats listed in the EU Habitats Directive. Tree and shrub planting, partly on an earth mound, is classifiable as Immature woodland (Fossitt category WS2 as shown in Figure 6-4) and Ornamental shrub (WS3), includes cultivars of Alder, Birch, and Willow, with some Pine, and self-sown Butterfly Bush *Buddleia davidii*. This includes the introduced species Sea Buckthorn *Hippophoe rhamnoides*, which has been planted beside Pigeon House Road. The invasive species Japanese Knotweed *Reynoutria japonica* also occurs in the area of the construction access road and on the eastern boundary of the existing WwTP. This species is listed in the Third Schedule Part 1 as a non-native species subject to restrictions under Regulations 49 and 50 of the European Communities (Birds and Natural Habitats) Regulations SI No. 477 of 2011.

This tree and shrub planting on the berm is immature and does not contain suitable habitat for bat roosts because of the absence of mature trees or other shelter. It is not suitable for breeding birds because of the limited canopy and the general absence of ground cover. Field surveys in this area did not record any signs of large mammals (droppings, burrows or foraging signs) probably due to the fact that it is surrounded by a high security fence.

Coarse grassland, classified as a species-poor dry meadows and grassy verges habitat (GS2), adjoining the tree and shrub planting includes the grass species Red Fescue *Festuca rubra*, False Oatgrass *Arrhenatherum elatius*, Crested dog's-tail *Cynosurus cristatus*, Creeping Bent-grass *Agrostis stolonifera*, and Yorkshire Fog *Holcus lanatus*. Herbaceous dicotyledons present include Winter Heliotrope *Petasites fragrans*, Alexanders *Smyrnium olusatrum*, Colt'sfoot *Tussilago farfara*, Dandelion *Taraxacum* agg., Yarrow *Achillea millefolium*, Common Ragwort *Senecio jacobaea*, and Oxford Ragwort *S. squalidus*. *Melilot* species also occur here. This coarse grassland extends on both sides of the footpath, and merges into Marram dune to the south of the footpath.

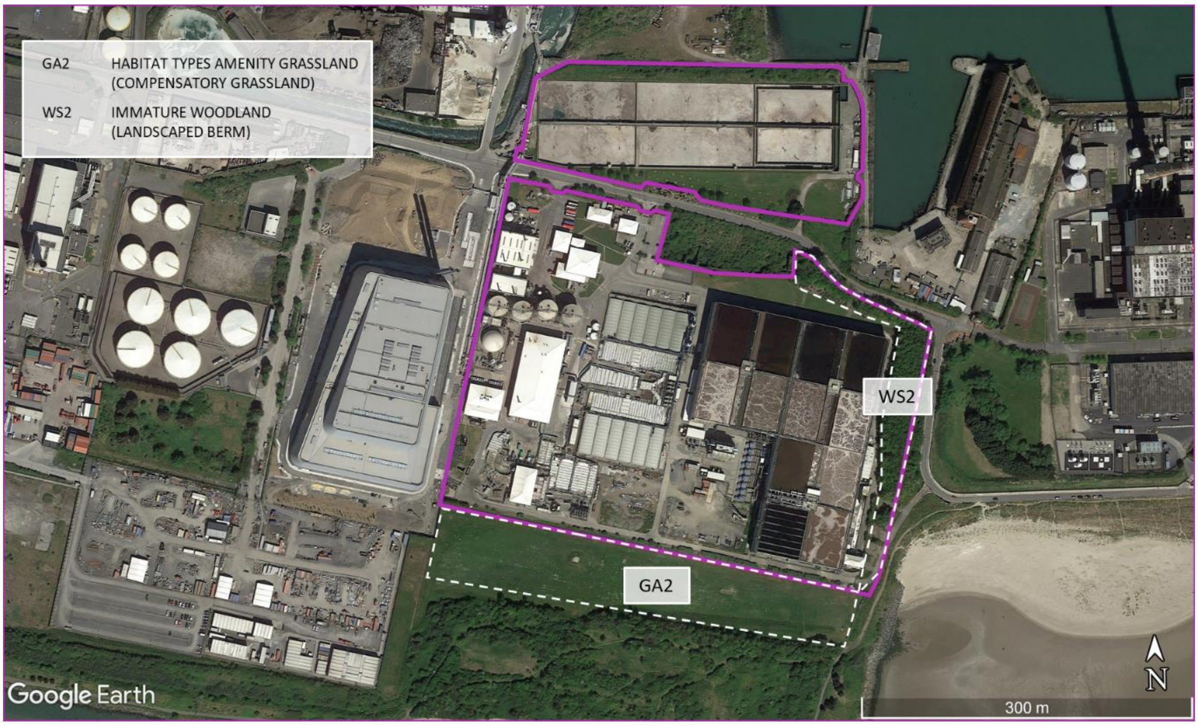

Figure 6-4: Terrestrial habitats in the vicinity of the WwTP site

6.3.5.2 Amenity grassland

An amenity grassland area (GA2) shown in Figure 6-4 was provided as a winter feeding area for Light-bellied Brent Geese *Branta bernicla hrota*, under condition No. 10 of the 1997 certification for the Dublin Bay Project extension to Ringsend WwTP. It lies immediately to the south of the Proposed WwTP Component, and to the north of Irishtown Nature Park. The grassland is included within the South Dublin Bay and River Tolka Estuary SPA (Site Code 004024).

The amenity grassland was completed in 2003, and seeded with a recommended grass mix for Brent geese with Perennial Ryegrass *Lolium perenne*, White Clover *Trifolium repens*, and Timothy Grass *Phleum pratense*. A field survey in 2015 showed that the flora remains dominated by Ryegrass. Red Fescue and Creeping Bent-grass are abundant. There is increasing cover of broad-leaved herbs: Ribwort Plantain *Plantago lanceolata* is now dominant in a small area, and Red Bartia *Odontites verna*, Red Clover, *Trifolium pretense*, Lesser trefoil *T. dubium*, Creeping Buttercup *Ranunculus repens*, Daisy *Bellis perennis*, and Great Plantain *Plantago major*, also occur (Mayes, 2015).

The grassland is maintained by Dublin City Council Parks Department, with regular mowing during the summer months, and autumn application of fertiliser. Additional management work by Dublin City Council Parks Department has included management of vegetation on sloping ground between the amenity grassland and Irishtown Nature Park, and the provision of fencing and signage, with the aim of reducing disturbance by pedestrians and dogs to geese using the grassland.

Use of the amenity grassland by Light-bellied Brent Geese was monitored as a condition of the 1997 certification for the Dublin Bay Project extension to Ringsend Wastewater Treatment Plant until the winter season of 2005/06.

A comparable programme of waterbird monitoring has been carried out since the winter of 2007/08 under Condition 13 (b) of the planning approval for the Dublin Waste to Energy Facility (WtE), granted by An Bord Pleanála in November 2007. Both monitoring programmes have included direct counts of waterbirds, and counts of goose droppings along transects. Counts of droppings along transects allows detailed comparison of the use made of different areas of the grassland by geese (Mayes, 2015).

Table 6-1: Annual Peak Counts of Brent Geese on the amenity grassland 2007/08 to 2014/15 (Mayes, 2015)

Winter	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Peak Count	34	440	349	410	336	351	411	331

Brent Geese normally occur on the amenity grassland from November to April each year. Peak numbers have varied between 34 and 411 over the eight winters 2007/08 to 2014/15 (Table 6-1). The grassland was checked on 11 dates between 26 November 2014 and 10 April 2015; geese were recorded feeding on the grassland on all dates. Average flock size through the winter was 120 geese. Flocks of 151 and 87 were recorded feeding on the grassland during the week in January when the eastern end of the temporary Dublin WtE construction compound was being enclosed (Mayes, 2015). This confirms that the geese are habituated to human disturbance on the edges of the grassland, provided that this is non-threatening. Use of the amenity grassland was higher in 2014/15 than in the previous four seasons, and also higher than the monitoring programme average use of this site (Mayes, 2015).

The grassland is used by small numbers of waders, with peak counts in winter 2014/2015 of 44 Oystercatcher, 3 Black-tailed Godwit, 1 Curlew, 2 Redshank and 3 Black-headed Gull (Mayes, 2015). Occasionally large flocks of Black-headed Gulls and Herring Gulls are recorded on the grassland (personal observations).

6.3.6 Non-breeding waterbirds in Dublin Bay

Dublin Bay is internationally important for wintering waterbirds, as well as supporting internationally important numbers of individual waterbird species (Crowe, 2000 and Tierney *et al.* 2017). Dublin Bay holds internationally important numbers of Light-bellied Brent Goose, Knot, Black-tailed Godwit and Bar-tailed Godwit as well as 19 other species in nationally important numbers. While peak numbers generally occur in the winter months many of the species are present throughout the year (BirdWatch Ireland, Dublin Bay Birds Project). Most of the waterbirds feed in the intertidal area but a small number of species (notably Light-bellied Brent Goose, Oystercatcher, Redshank, Black-tailed Godwit and Black-headed Gull) also feed on terrestrial grassland around the bay and further inland. Several species of waterbirds including Cormorant, Red-breasted Merganser and Great Crested Grebe are confined to feeding in shallow water areas of the bay.

6.3.6.1 Waterbird Population Trends in Dublin Bay

Population trends in waterbirds can vary depending on a large number of variables including: climate change (range shifts, breeding population changes); weather conditions (e.g. severe weather causing mass movement of birds); changes in prey populations (e.g. overfishing, natural fluctuations in prey); habitat changes on breeding grounds, migration areas and wintering sites; disturbance (direct and indirect, on all parts of the migration flyway routes); hunting (direct loss of individuals from the populations); food availability; and water quality and nutrient levels in the substrate. The trends observed by monitoring numbers in the non-breeding area are due to a combination of these factors (Crowe, 2005 and Boland and Crowe 2012). It should be noted that background levels of annual variation in recorded water bird numbers are generally high, due to both annual variation in absolute population size and the inherent error rate in counting waterbirds in a large and complex site. The minimum error level in large-scale water bird monitoring is considered to be around 5% (Hale, 1974; Prater, 1979; Rappoldt, 1985). Therefore, any population change of less than 5% is unlikely to be detectable.

Population trends in non-breeding waterbirds are normally calculated based on mean peak counts for 5-year periods. The most recent long-term data available for the Dublin Bay area is from the Irish Wetland Bird Survey (this data is given in the website https://www.birdwatchireland.ie/?tabid=111). The trends identified for those species where more than 100 individuals were observed are given in Table 6-2. Comparing the period 2004/05 to 2008/09 with the period 2009/10 to 2013/14 there have been increases in 11 species, decreases in 9 species and approximately stable numbers in 5 species. National trends in the same species for the 20-year period from 1994 to 2013 are also given in Table 6-2 (Boland and Crowe 2012, Tierney et al. 2017).

Table 6-2: Overall trends in populations of common[1] non-breeding waterbirds in Dublin Bay from 2004/05 to 2013/14 (Data from the Irish Wetland Bird Survey[2])

Species[3]	Peak 2004/05 to 2013/14	Mean Peak 2004/05 to 2008/09	Mean Peak 2009/10 to 2013/14	% change in Mean Peak between 5-year periods	Trend in Dublin Bay between 5-year periods	Long-term trend in Republic of Ireland 1994-2013
Light-bellied Brent Goose	6134	3866	4556	18	Increase	Increase
Shelduck	2129	873	1085	24	Increase	Stable
Wigeon	1911	694	968	40	Increase	Decrease
Teal	2275	978	1301	33	Increase	Stable
Pintail	347	133	211	58	Increase	Stable
Shoveler	249	101	130	29	Increase	Stable
Great Crested Grebe	930	108	526	386	Increase	Stable
Cormorant	211	202	142	-30	Decrease	Stable
Oystercatcher	5326	3171	3777	19	Increase	Increase
Ringed Plover	314	365	228	-37	Decrease	Stable
Golden Plover	1360	1748	733	-58	Decrease	Decrease
Grey Plover	394	376	313	-17	Decrease	Decrease
Knot	6260	4713	3924	-17	Decrease	Stable
Sanderling	683	583	495	-15	Decrease	Increase
Dunlin	9231	5593	5543	-1	Stable	Decrease

Species[3]	Peak 2004/05 to 2013/14	Mean Peak 2004/05 to 2008/09	Mean Peak 2009/10 to 2013/14	% change in Mean Peak between 5-year periods	Trend in Dublin Bay between 5-year periods	Long-term trend in Republic of Ireland 1994-2013
Black-tailed Godwit	1769	782	1376	76	Increase	Increase
Bar-tailed Godwit	3489	1732	2166	25	Increase	Stable
Curlew	1252	1002	1045	4	Stable	Decrease
Redshank	2790	2306	2557	11	Increase	Stable
Turnstone	633	398	386	-3	Stable	Increase
Black-headed Gull	3112	3672	2376	-35	Decrease	No data
Common Gull	985	550	571	4	Stable	No data
Lesser Black-backed Gull	195	236	54	-77	Decrease	No data
Herring Gull	490	352	348	-1	Stable	No data
Great Black-backed Gull	358	317	174	-45	Decrease	No data

1.Common species are those with mean peak populations of greater than 100 individuals. Less common species may frequently be overlooked in I-WeBS counts and are not reliable estimates.
2.Data were supplied by the Irish Wetland Bird Survey (I-WeBS), a joint scheme of BirdWatch Ireland and the National Parks and Wildlife Service of the Department of Culture, Heritage & the Gaeltacht".
3.Boland & Crowe 2012; Crowe & Holt 2013.

6.3.6.2 Feeding Distribution of Waterbirds in Dublin Bay

During the years 2013/14 and 2014/15, waterbirds have been monitored in all months of the year throughout Dublin Bay as part of the Dublin Bay Birds Project (Tierney *et al.* 2017). Table 6-3 gives the peak numbers of each species recorded at low tide and high tide. For most species the numbers counted are generally greater at low tide as the birds are distributed across the intertidal area. This represents the most accurate estimate of population size and illustrates the relative importance of different parts of the feeding area.

Table 6-3: Comparison between peak number of common[1] non-breeding waterbirds recorded at low tide and during rising or high tides in Dublin Bay over two full years 2013/14 and 2014/15 (Data from the Dublin Bay Birds Survey; BirdWatch Ireland[2])

Species	Peak counts 2013/14		Peak counts 2014/15	
	Low tide	Rising and high tide	Low tide	Rising and high tide
Light-bellied Brent Goose	3605	2761	3974	2713
Shelduck	746	783	1114	1013
Wigeon	968	243	1009	603
Teal	1487	909	2760	972
Pintail	148	363	334	54
Shoveler	319	152	216	115
Great Crested Grebe	423	565	726	753
Cormorant	104	68	86	107
Oystercatcher	2037	2841	5772	3231
Ringed Plover	186	105	258	134

Species	Peak counts 2013/14		Peak counts 2014/15	
	Low tide	Rising and high tide	Low tide	Rising and high tide
Golden Plover	745	240	1072	880
Grey Plover	150	535	178	176
Knot	4124	2840	9040	5321
Sanderling	613	374	454	424
Dunlin	7940	4460	6034	2782
Black-tailed Godwit	1754	1649	1779	1410
Bar-tailed Godwit	1555	2286	2252	3178
Whimbrel	145	97	78	118
Curlew	1056	774	1310	1265
Redshank	1349	1454	2302	2001
Turnstone	144	231	486	252
Black-headed Gull	7006	1781	8708	3548
Common Gull	1009	901	1008	535
Herring Gull	2908	658	4087	403

1.Common species are those with mean peak populations of greater than 100 individuals. Less common species may frequently be overlooked in I-WeBS counts and are not reliable estimates.
2.Data were supplied by BirdWatch Ireland from the datasets of the Dublin Bay Birds Project. See also *Lewis et al.* (2016).

The main area of dispersal of the treated effluent from Ringsend WwTP is in the Tolka Basin and around the North Bull Island. South Dublin Bay is unaffected by the effluent. Peak numbers counted in each of these three parts of Dublin Bay in the full year 2014/15 are shown in Table 6-4. This table shows that North Bull Island holds the highest numbers of several duck species notably Shelduck, Shoveler, Pintail, Teal and Wigeon. Brent Geese are mainly concentrated in North Bull Island and the Tolka Basin. South Dublin Bay is the most important area for Bar-tailed Godwit while Black-tailed Godwit are mainly concentrated in North Bull Island and Tolka Basin. Other species are widely distributed throughout the bay.

Table 6-4: Peak numbers of regularly occurring waterbirds in three parts of Dublin Bay in 2014/15 (data from Dublin Bay Birds Project; BirdWatch Ireland[1])

Species	North Bull Island	Tolka Basin	South Dublin Bay
Bar-tailed Godwit	651	782	1046
Black-headed Gull	2221	2397	2076
Black-tailed Godwit	891	987	394
Cormorant	23	46	41
Common Gull	309	158	286
Curlew	434	369	144
Dunlin	2876	1186	1907
Great Black-backed Gull	119	37	34
Great Crested Grebe	10	14	723
Greenshank	39	3	12

Species	North Bull Island	Tolka Basin	South Dublin Bay
Golden Plover	86	1003	69
Grey Plover	101	28	15
Grey Heron	28	20	10
Herring Gull	1276	2337	968
Knot	1351	2700	1668
Lapwing	70	0	0
Lesser Black-backed Gull	59	20	64
Light-bellied Brent Goose	2450	2183	300
Little Egret	62	9	14
Mallard	33	0	0
Oystercatcher	1426	417	1585
Pintail	167	0	0
Redshank	926	561	486
Red-breasted Merganser	38	44	50
Ringed Plover	84	11	174
Sanderling	161	35	350
Shelduck	746	5	24
Shoveler	108	0	0
Teal	1367	34	81
Turnstone	180	92	44
Wigeon	1009	63	15

1.Data were supplied by BirdWatch Ireland from the datasets of the Dublin Bay Birds Project. See also *Lewis et al.* (2016).

6.3.7 Breeding seabirds

Seabirds are potentially impacted by the treated effluent from Ringsend WwTP as they feed mainly on fish throughout Dublin Bay. The greatest numbers and diversity of seabirds are present during the breeding season. Both Common Tern *Sterna hirundo* and Arctic Tern *Sterna paradisaea* breed in Dublin Port on a variety of artificial structures including mooring dolphins and specially designed pontoons. Populations of these species have been monitored annually since 1995 and the total estimated number of nests in the four years 2013-2016 are given in Table 6-5 (Tierney *et al*. 2016). This shows that the number of Common Tern nests has increased steadily over this period. Arctic Tern numbers are more variable as the nests are located on a single mooring structure which does not provide optimum nesting habitat, and which is subject to occasional disturbance from shipping during the breeding season. These reasons are thought to have caused the failure in breeding in 2016 but this was partly compensated for by the presence of 105 nests of Arctic Tern on Dalkey Island (also in Dublin Bay) during 2016 (Newton, 2016).

Table 6-5: Total number of tern nests in Dublin Port in 2013 to 2017 (data from Dublin Bay Birds Project; BirdWatch Ireland[1])

Species	2013	2014	2015	2016	2017[2]
Common Tern	420	477	490	503	(403)
Arctic Tern	25	76	58	0	(13)
Total both species	445	553	548	503	(416)

1.Data were supplied by BirdWatch Ireland from the datasets of the Dublin Bay Birds Project
2.In 2017 a full census was not possible because access to one of the sites was not permitted.

In late summer and autumn large numbers of post-breeding terns congregate in South Dublin Bay. These originate from a wide area including colonies throughout Ireland. Peak counts of over 10,000 terns have been recorded on the sandbanks of Merrion Strand and Sandymount Strand (Merne *et al.* 2008). Total numbers peaked at 3518 in 2013, 2264 in 2014, 4035 in 2015 and 17,404 in 2016 (BirdWatch Ireland, Dublin Bay Birds Project). These populations are of international importance and represent the largest single aggregation of terns in Ireland (Tierney *et al.* 2016). The terns forage in Dublin Bay including in the area potentially affected by the treated effluent from Ringsend WwTP.

A colony of Black Guillemot also breeds in the quaysides of Dublin Port and in the tidal stretches of the River Liffey. This has varied from 56 to 82 individuals during the years 2013 to 2017 (Dublin Port Company, unpublished data). These birds forage in Dublin Bay including in the area potentially affected by the treated effluent from Ringsend WwTP.

6.4 Characteristics of the WwTP Component of the Proposed Upgrade Project

The Proposed WwTP Component will involve a number of elements of work relevant to terrestrial biodiversity and these are described in full in Volume 2, Section 3: Description of Proposed Upgrade Project. Characteristics of the Proposed WwTP Component specifically relevant to terrestrial biodiversity include the removal of the berm at the eastern end of the site during construction; dust, noise and air emissions during construction and nutrient discharge from the WwTP during the operational phase.

6.5 Potential Impacts

Annex III of the amended Directive 2104/52/EU requires that the EIAR should assess:

a) The magnitude and spatial extent of the impact (for example geographical area and size of the population likely to be affected);
b) The nature of the impact;
c) The transboundary nature of the impact;
d) The intensity and complexity of the impact;
e) The probability of the impact;
f) The expected onset, duration, frequency and reversibility of the impact;
g) The cumulation of the impact with the impacts of other existing and/or approved projects; and
h) The possibility of effectively reducing the impact.

The potential impacts of the Proposed WwTP Component on terrestrial biodiversity include:

- Direct impacts on terrestrial habitats through removal of the berm at the eastern end of the site during construction;
- Indirect impacts through disturbance of waterbirds on the amenity grassland at the southern side of the site during construction;
- Indirect impacts of construction noise on wintering and breeding waterbirds;
- Indirect effects of dust deposition on habitats and species during construction;
- Indirect effects of air emissions on waterbirds during construction;
- Indirect impacts of nutrient discharge on intertidal habitats in Dublin Bay during operation;
- Indirect impacts on intertidal habitats in Dublin Bay during operation; and
- Indirect impacts on waterbird populations within Dublin Bay during operation.

6.5.1 Do-Nothing Impacts

If there is no change to the treatment process at Ringsend WwTP then the terrestrial environment adjacent to the site will remain largely unchanged. If the Proposed WwTP Component is not implemented, and no control measures are taken, then it is likely that Japanese Knotweed will spread further on the eastern margins of the site.

If the Proposed WwTP Component is not implemented, there will be little or no change in the majority of the intertidal faunal assemblages found in Dublin Bay which would likely continue to be relatively diverse and rich across the bay, as discussed in Volume 3, Section 5: Biodiversity - Marine. The sandy communities found in South Dublin Bay will likely remain dominated by the same assemblage of the polychaete worm *Nepthys caeca*, Cockle *Cerastoderma edula,* tellinids and other pollution-sensitive species, albeit subjected to natural spatial and seasonal variations. Bird populations in these areas will be unaffected by the discharge from the WwTP.

If the Proposed WwTP Component is not implemented, there is a possibility that an increase in the nutrient outputs from the plant due to operational overload and storm water discharges could result in a decline in the biodiversity of invertebrate communities in the Tolka Estuary and North Bull Island channel as a result of low oxygen availability caused by increased organic enrichment. An increase in the cover of opportunistic macroalgae could lead to further deterioration in the lagoons in the North Bull as they add to the organic load on the benthos and further increase the BOD. These events, although localised, could deteriorate the biological status for Dublin Bay as a whole. It is unlikely that they would have any significant impact on the waterbird populations that forage on invertebrates in Dublin Bay.

6.5.2 Construction Phase

6.5.2.1 Direct Impacts on terrestrial habitats adjacent to the Proposed WwTP Component

The construction of the Proposed WwTP Component is described in Volume 2 Section 3: Description of Proposed Upgrade Project. The programme for the development of the Proposed WwTP Component is also contained therein. It will make provision for additional capacity for AGS treatment and new access roads within the existing Ringsend WwTP site. These works will require the removal of a bund at the eastern end of the site. The area of the bund is as follows: Large Bund: 0.395 ha (northern element); Small Bund: 0.0543 ha (southern element).

This contains an area of immature woodland and ornamental shrub which is of no conservation value. The habitat has been surveyed on several dates over the period 2011 to 2016. It contains immature woodland (planted as landscaping in 2003) with very little ground cover. It is unsuitable for large mammals, bats or breeding birds. These surveys demonstrate that the distribution does not change significantly from year to year. The removal of the bund will be certain and irreversible but will have no significant ecological impacts.

It also contains Japanese Knotweed which will be subject to special control methods in accordance with an Invasive Species Management Plan. An Outline Invasive Species Management Plan is contained in Appendix 6A. Section A and B of the bund will be removed as part of the advanced works as shown in Figure 6-5. Advanced works are those covered under the 2012 permission. Section C at the proposed entrance at the north-eastern side of the site does not contain Knotweed therefore no special measures will be required for this area. The removal of the remaining portion of this bund (Section D) to the northeast will not be undertaken until 2023. This area will be treated *in situ* using chemicals to kill the vegetative and root parts of the plants.

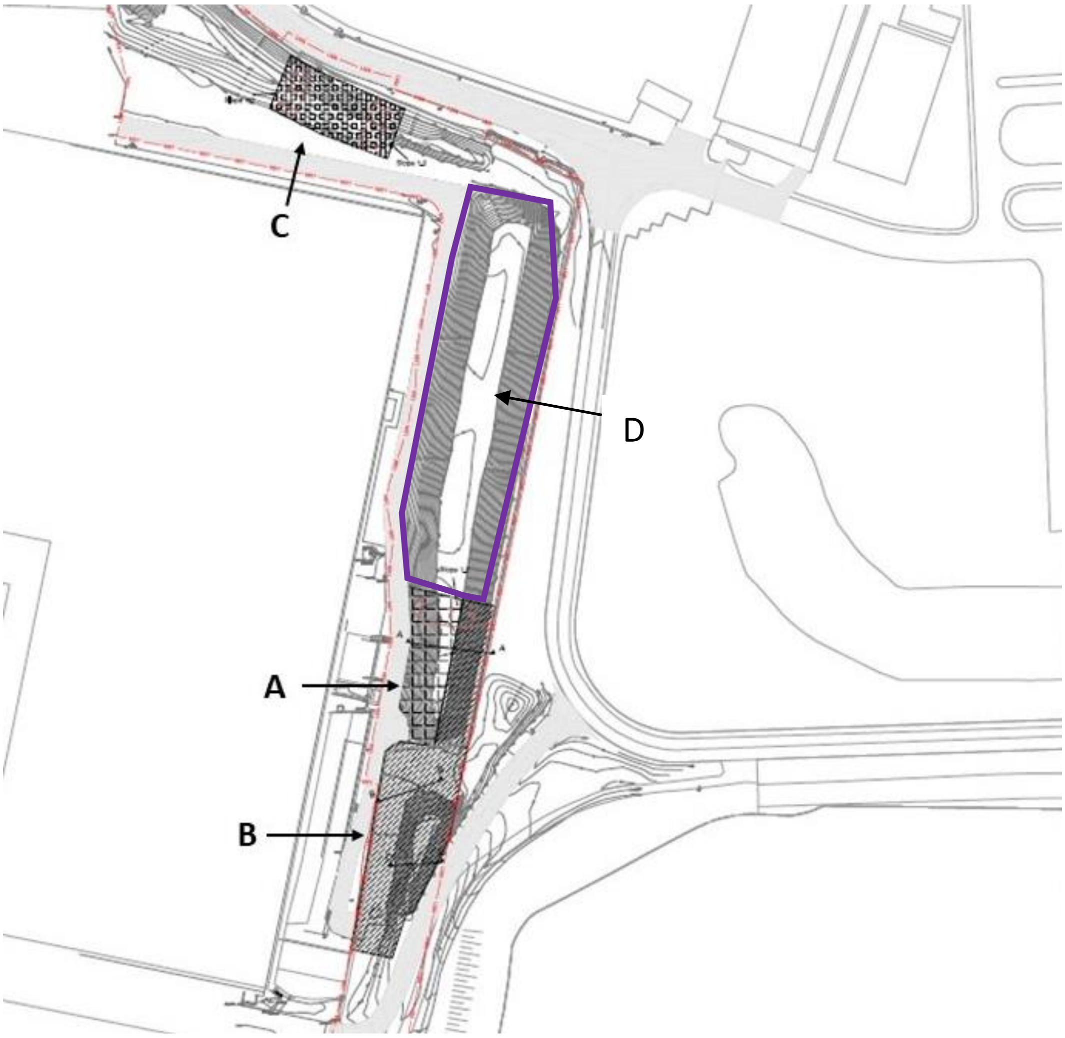

Figure 6-5: Treatment of soil and vegetation at the eastern end of the WwTP site

Given the presence of invasive plant species and the absence of roosting bats, nesting birds or large mammals, this area of the bund is considered to be of negligible ecological value. The removal of these small sections of habitat (none of which is of high ecological value) will have a slight temporary local impact on flora and fauna.

6.5.2.2 Indirect disturbance to waterbirds using the amenity grassland

The area of grassland immediately to the south of the Proposed WwTP Component is used by a number of species of waterbirds in winter including Brent Goose, Oystercatcher, Black-tailed Godwit, Curlew, Redshank, Black-headed Gull and Herring Gull. The Brent Goose is of particular note as the grassland was created specifically to provide this species with additional habitat.

There is a potential for indirect disturbance from construction works to Brent Geese and other waterbirds using this area of amenity grassland. This would have significant effects without mitigation as the area is part of South Dublin Bay and the River Tolka Estuary SPA and the species concerned are qualifying interests of this SPA.

6.5.2.3 Indirect impacts of construction noise on wintering and breeding waterbirds

Temporary construction noise during the construction phase of the Proposed WwTP Component has the potential to cause disturbance to wintering waterbirds and nesting terns within the vicinity of the site as an indirect effect. This is because the Proposed WwTP Component is immediately adjacent to the grassland used by wintering waterbirds and is within 400 m of the nearest tern colony. The terns are present from May to August each year. The potential airborne construction noise levels arising at the nearby tern colony to the north of the site and the area located to the south which is occasionally frequented by wintering waterbirds, including Brent Geese, are expected to fall in the following ranges: Tern Colony: 40 to 45 dB LA_{eq}; and grassland area: 65 to 80 dB LA_{eq}. On average, birds hear less well than many mammals, including humans. Acoustic deterrents or 'scarecrow' devices are not generally effective because birds habituate to them and eventually ignore them completely. Devices that purport to use sound frequencies outside the hearing range of humans are most certainly inaudible to birds as well because birds have a narrower range of hearing than humans do (Birkhead, 2012). Dooling (2002) reviewed the literature on how well birds can hear in noisy (windy) conditions and suggested that birds cannot hear certain mechanical noises as well as humans can in these conditions.

The sounds that birds hear could be divided into threatening and non-threatening sounds. Examples of non-threatening sounds are wave noise on a beach or constant traffic noise from a road. Threatening sounds would include impulsive sounds such as gunfire, explosions or the barking of a dog. The sound of construction is not impulsive (sudden, loud or shocking) but tends to be continuous and low frequency noise such as that made by machinery and vehicular traffic. Although the predicted level of noise at this location of the grassland is expected to fall in the range of 45 to 80 dB LA_{eq}, it is important to note that the additional construction noise arising within this area would not vary significantly in character from that previously generated by the adjacent DWtE construction works as well as certain maintenance activities onsite.

Waterbirds in Dublin Bay are habituated to construction noise. This is common in estuarine areas close to urban conurbations. For example, waders using a high tide roost within 150-200 m of the construction site for a major sewage treatment works in Galway Bay showed no negative effects of disturbance during construction which involved blasting and pile-driving (Nairn, 2005). Hence there will be no significant effects on wintering waterbirds on the grassland adjacent to the Proposed WwTP Component.

The Common tern *(Sterna hirundo)* colony at Poolbeg (which is part of South Dublin Bay and River Tolka Estuary SPA) is located approximately 380 m from the nearest part of the Proposed WwTP Component. The tern colony itself generates noise up to 70 to 80 dB(A) through the continuous calling of over 1,000 terns during the breeding season (trial measurements carried out 09 June 2015). This would far exceed the audible construction noise from the construction site at 380 m distance. The level of operational noise arising at this location would therefore be significantly below the level of noise generated by the terns themselves. Results of a trial for a colony of another species, the Crested Tern *(Sterna bergii)* in

Australia, found that the maximum responses observed, preparing to fly or flying off, were restricted to exposures to simulated aircraft noise levels of greater than 85 dB(A).

It was suggested that visual stimulus is likely to be an important component of aircraft noise disturbance (Brown 1990). The Proposed WwTP Component will not be visible from the tern colony.

It is therefore concluded that construction noise from the Proposed WwTP Component site will not be threatening to birds (in particular, waterbirds and terns which are qualifying interests of the European sites in Dublin Bay) and that there will be no significant impacts on these species.

6.5.2.4 Indirect effects of dust deposition on habitats and species

There is a potential for dust deposition to impact flora and fauna in the vicinity of the site during construction. Unusually high levels of dust deposition, such as that from quarrying and opencast mining, can have negative effects on vegetation. Dust may affect photosynthesis, respiration, transpiration and allow the penetration of phytotoxic gaseous pollutants (Farmer, 1991). Dust is constantly present in the urban air as particulate matter generated by road traffic, port activities, factory emissions and burning of fossil fuels. Birds breeding in urban areas such as gardens, hedgerows and treelines are habituated to normal levels of dust in the air and there is no evidence of any negative impacts on their breeding success. Any dust is normally washed off vegetation during heavy rainfall and has no permanent effects on the nesting success of birds.

The movement of excavated earth will be the most significant potential sources of dust generation from the Proposed WwTP Component. Excavated material will be transported by dump trucks along the site roads. Un-cleaned vehicles leaving the site also have the potential to deposit mud and dirt along the access road and public highway. This has the potential to generate fugitive dust. There is the potential for roadways, stockpiles and other un-vegetated surfaces to produce dust emissions during dry, windy conditions. However, the levels of dust generated during construction will not be high enough to cause any adverse impacts on flora and fauna in the vicinity of the site. The effects of dust deposition on flora and fauna in the vicinity of the Proposed WwTP Component will be imperceptible.

6.5.2.5 Indirect effects of air emissions on waterbirds during construction

The impacts of the Proposed WwTP Component on air quality is dealt with in Volume 3, Section 8: Air and Climate. The predicted annual average NOx level in South Dublin Bay near the construction access road exceeds the limit value for the protection of vegetation (Air Quality Standards Regulations SI 180 of 2011) of 30 μg/m^3 for the “Do-nothing” scenario, with NOx concentrations reaching 146% of this limit. Levels with construction taking place will be higher, reaching 152% of the limit value for the period during peak construction. The impact of the construction traffic will lead to an increase in NOx concentrations of at most 4.54 μg/m^3 within the South Dublin Bay and the River Tolka Estuary SPA. Appendix 9 of the *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (NRA, 2011) state that where the scheme or development is expected to cause an increase of more than 2 μg/m^3 and the predicted concentrations (including background) are close to, or exceed the standard, then the sensitivity of the habitat to NO_X should be assessed by the project ecologist.

In light of the air quality impact predictions, the potential for any indirect impact on sensitive ecological receptors (waterbirds on the amenity grassland in particular) was assessed. This level of deposition of NO_x will have no significant effect on the habitat (improved grassland) or on the bird species that use the amenity grassland adjacent to the WwTP site. The maximum increase in the NO_2 dry deposition rate is 0.22 kg(N)/ha/yr during the peak construction period.

This reaches only 4.4% of the critical load for inland and surface water habitats of 5-10 kg(N)/ha/yr. Brent Geese, wader and gull species are not sensitive to this compound and will continue to use the grassland habitat and intertidal areas during construction.

6.5.3 Operational Phase

6.5.3.1 Indirect impacts of nutrient discharge on intertidal habitats in Dublin Bay

The existing Ringsend WwTP treated effluent discharge location is such that the effluent plume extends over intertidal areas, including the Annex 1 listed habitat *Mudflats and sandflats not covered by seawater at low tide* (1140), which are listed as a special conservation interest for North Dublin Bay SAC. During high water Spring tides, the effluent plume extends marginally over saltmarsh habitats that are listed as a special conservation interest for North Dublin Bay cSAC. This area is submerged for a limited time, therefore, baseline and proposed changes in water quality parameters cannot be modelled for saltmarsh habitats. It is unlikely that a reduction in nutrients from the Proposed WwTP Component will have any effects on these habitats. The effluent plume also extends over intertidal habitats in the Tolka Estuary (also part of South Dublin Bay and Tolka Estuary SPA) and over intertidal habitats and over shallow water in North Bull Island SPA (see Volume 3, Section 4: Water). The predicted reduction in nutrients will have no significant negative effects on these habitats, either in Dublin Bay or in the wider coastal and marine area. The potential impact will be neutral or possibly somewhat positive in respect of the marine and intertidal habitats in vicinity of the existing discharge location (North Dublin Bay cSAC and South Dublin Bay cSAC).

6.5.3.2 Indirect impacts on waterbird populations in Dublin Bay - Operational Phase

This Section considers whether the Proposed WwTP Component could have any significant indirect impacts on waterbird populations within Dublin Bay during the operational phase. Only positive impacts are predicted on water quality resulting from the construction of the Proposed WwTP Component as outlined in Volume 3, Section 4: Water.

6.5.3.3 Historical changes in the Dublin Bay environment

From 2003 on, the introduction of biological treatment at Ringsend, where previously only primary treatment was in place, led to a large reduction in the quantities of suspended solids being discharged into the Lower Liffey Estuary. This marked a major change in the response of the Bay to the wastewater treatment plant discharges. While the effluents were still high in nutrients, the highly mineralised effluent now has a much-reduced suspended solids fraction. Particulate nitrogen from poorly treated sewage (pre-2003) was linked to unusually dense beds of a tube-dwelling polychaete worm with which the macroalgae *Ectocarpus* was associated (Jeffrey *et al*. 1995; O'Higgins and Wilson 2005). This algal species was frequently deposited along the beaches of Dublin Bay causing odour problems as it rotted. This problem has largely disappeared since the plant was commissioned in 2003 and residual deposits were mineralised. Particulate nitrogen was also shown to enhance the growth of macroalgae such as *Enteromorpha* and *Ulva* (Jennings and Jeffrey 2005; Wilson *et al.* 2002). These authors showed evidence of anoxic or reducing conditions in the sediments underlying macroalgae with very significant releases of ammonia from these sediments. This situation has improved significantly since the supply of particulate matter has been reduced to its current level.

Thus, an important change occurred in the post-2003 period, due primarily to the reduction in the quantity of particulate matter discharged from the WwTP and the consequent change in the pathways by which nitrogen, phosphorus and carbon flow through the ecosystem. The change in speciation of nutrients, and in particular the dissolved/particulate balance was emphasized by Wilson in a 2003 paper (Wilson 2003).

6.5.3.4 Predicted impacts of the Proposed WwTP Component on water quality and habitats

Reduction of the Ringsend WwTP's emissions from the current values of approximately 13.6 mg/l N and 3.9 mg/l P to the licence ELVs of 10 mg/l N and 1 mg/l P respectively will reduce the nutrient loading further - with a significant reduction in the phosphorus loading to Dublin Bay generally, by more than 60% and for nitrogen by more than 20%. This will push the ecosystems in the Dublin Bay area, whether intertidal, estuarine or marine closer to their ideal 'reference condition' state as per the concept central to the Water Framework Directive's definition of ecological status - the closer an ecosystem is to its ideal 'reference condition' the closer it is achieving to high ecological status. Much of Dublin Bay already achieves good ecological status, and indeed some quality elements already achieve high status, especially in the outer Dublin Bay water body. Closer to Dublin City, however, the upper Liffey Estuary does not achieve good status and the Tolka Estuary water body is at moderate ecological status due to an over-abundance of opportunistic macroalgae.

The Proposed WwTP Component will bring Dublin Bay generally closer to good or high ecological status - the ultimate aim of the Water Framework Directive. Benthic marine macroinvertebrates, an important source of food for many ducks and waders will not be adversely impacted. An improvement in diversity has already occurred in localised areas due to the reduction in particulates and further reduction in total nutrient loads will lead to further improvements. The evidence to date is that bird populations in Dublin Bay are generally stable or increasing following the commissioning of the current Ringsend WwTP in 2003 (section 6.3.6). Modelling and historical information suggests that geese will still have sufficient quantities of intertidal macroalgae even with the reduction in nutrient loading. Water quality modelling also suggests that the nutrient reductions predicted following the Proposed WwTP Component are unlikely to give rise to any change in phytoplankton abundance as measured by chlorophyll concentrations. Changes in the ratio of N to P may cause some changes in species but as this ratio shifts towards a more natural one (the ideal being the Redfield ratio of approximately 16:1) these changes are also likely to push the system closer to its reference condition.

Therefore, the Proposed WwTP Component will not have any detrimental impacts on the aquatic food chain in the bay. Benthic macroinvertebrates will become more diverse, phytoplankton will remain abundant, and perhaps more diverse, and the conservation status of bird populations, whether dependent on aquatic plants or infaunal macroinvertebrates, will not be negatively impacted.

6.5.3.5 Predicted impacts of the Proposed WwTP Component on waterbird populations

It has been suggested that reductions in nutrient discharges from the WwTP could have a negative impact on the food resources of waterbirds in Dublin Bay. The potential for such changes in the populations of infaunal invertebrates and macroalgae to have negative impacts on the waterbird populations which depend on these food resources is reviewed below.

The ecological modelling of opportunistic macroalgae in the Tolka Estuary suggests that the nutrient reduction predicted to result from the Proposed WwTP Component would not reduce the biomass of macroalgae significantly due to the relatively high 'background' nutrients in Dublin Bay and the Irish Sea (McGarrigle, 2016).

Burton *et al.* (2002) carried out an extensive review of relevant literature, across a range of discharge types and sites, principally in the UK. Studies were carried out prior to the implementation of the Urban Waste Water Treatment (UWWT) Directive.

The studies in the UK investigated whether, in addition to physical, climatic and geographic variables, wader communities on British estuaries could be determined directly by water quality variables, and found associations with salinity, ammoniacal nitrogen concentration in the water, percentage dissolved oxygen, and BOD. In spite of these relationships, changes in the wader communities recorded over a 16-year study period were not related to any aspect of the nutrient status of estuaries. Burton *et al.* (2002) noted in this regard that this result may have been because their study investigated these relationships only prior to the implementation of the UWWT Directive, when the nutrient status of estuaries may have been such that food resources for waterbirds were less limited than they perhaps have been since. The fact that the study did find links between the composition of wader communities and water quality variables would suggest that large changes in the nutrient status of estuaries could affect the numbers of some species. The wildfowl and wader species that the various studies suggested might decline as a result of implementation of the UWWT Directive include Brent Goose, Shelduck, Wigeon, Teal, Pintail, Oystercatcher, Avocet, Grey Plover, Lapwing, Knot, Purple Sandpiper, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Spotted Redshank, Redshank, and Turnstone (Burton *et al.*, 2002).

In the second phase of the UK studies, 12 Special Protection Areas in the UK were identified where past changes in wastewater treatment over the period 1990 to 2000 could have impacted on waterbird populations. The results of this analysis indicated that there were declines in waterbird indices on all of the study sites but that there was no consistent pattern of decline following improvements to wastewater discharges. Initial analyses investigated whether waterbird indices might be positively related to the concentrations of BOD and other variables in the effluent at sites only affected by one main discharge. Results for the three sites where analysis was possible indicated no consistent relationship between waterbird numbers and these variables (Burton *et al.*, 2003).

It is likely that even in cases where improvements to wastewater discharges do have an impact on waterbird numbers, it might not be possible to detect them at the estuary or SPA level, perhaps because other factors operating at site level are masking them - evidence of impacts on waterbirds may be apparent at a finer, within-site scale (Burton *et al.*, 2003). These authors also note that many improvements to wastewater treatment are relatively recent, and that impacts of changes may take time to become apparent. Medium and long-term changes may become more difficult to discern, as they may become part of cumulative changes arising from other factors such as disturbance or climate change.

Section 4.5.2 of this Volume of the EIAR confirms that the concentration of suspended solids that originates from the existing WwTP outfall at Ringsend is largely contained within the North Bull Wall and Great South Wall. Therefore, a reduction of suspended solids following the implementation of the Proposed WwTP Component is very unlikely to have an effect in South Dublin Bay, in Dollymount Strand, the intertidal mudflats to the north and west of Bull Island or the outer bay, which are currently not affected by the effluent due to the rapid mixing and dilution.

The results presented in this Volume under Marine Biodiversity (Section 5) suggest that the benthic assemblage found in the Tolka Estuary has experienced an increase in species diversity and abundance. It is possible that this recovery could be linked to an improvement in water quality conditions in inner Dublin Bay since the Ringsend WwTP became fully operational in 2003.

Although the assemblage in the Tolka Estuary will continue to be affected by some level of organic enrichment from the Liffey and Tolka rivers (which are major sources of nutrients (TON, DIN and P) into the bay ecosystem), it is predicted that this same recovery direction, *i.e.* towards a more diverse and richer stage in the faunal succession will continue if the Proposed WwTP Component goes ahead and nutrient discharges are reduced. Therefore, the food resource of waterbirds in the Tolka Estuary will not be negatively affected. Opportunistic species will give way to a wider array of sediment ingesters and filter feeders that would in turn attract predators including a range of crustaceans. It is predicted that diversity of benthic macroinvertebrates will increase allowing birds to diversify their diet. Nonetheless, these changes will be slow and difficult to confirm in the short term (see Volume 3, Section 5: Biodiversity - Marine).

6.5.3.6 Summary of impacts on waterbird populations

The effect of the reduced nutrient load, if any, is likely to be positive and limited to the invertebrate communities in the Tolka Estuary and the lagoons and intertidal mudflats of North Bull Island where an increase in macroinvertebrate diversity and richness could be expected. Any reduction in the abundance of opportunistic, pollution tolerant species will be compensated by an increase in the abundance of other species less tolerant to nutrient enrichment and the development of an overall more diverse macroinvertebrate assemblage. This will be of benefit to waterbirds by ensuring a more sustainable ecosystem in Dublin Bay. The ecological modelling of opportunistic macroalgae in the Tolka Estuary suggests that the nutrient reduction predicted to result from the Proposed WwTP Component would not reduce the biomass of macroalgae significantly due to the relatively high 'background' nutrients in Dublin Bay and the Irish Sea (McGarrigle, 2016). Consequently, it is predicted that there will be no significant indirect effects on the waterbirds such as Light-bellied Brent Geese and Wigeon that forage on these macroalgae.

Therefore, the Proposed WwTP Component is unlikely to have any detrimental impacts on the aquatic food chain in the bay. Benthic macroinvertebrates are likely to become more diverse and phytoplankton is unlikely to become less abundant, but perhaps more diverse. Hence the bird populations, whether dependent on aquatic plants or infaunal macroinvertebrates, are not expected to be impacted by the Proposed WwTP Component.

6.6 Mitigation Measures

6.6.1 Construction Phase

6.6.1.1 Mitigation for potential visual disturbance of waterbirds

During the construction phase of the Proposed WwTP Component, there is a potential for indirect visual disturbance from construction workers to Brent Geese and other waterbirds using the amenity grassland, immediately to the south of the WwTP. To mitigate against such disturbance, solid screening will be erected prior to construction to reduce or eliminate any visual disturbance (this is already in place as part of the capacity upgrade contract). No screening will be necessary in relation to the tern colony in Dublin Port as the WwTP is not visible from this location. Since these waterbirds are habituated to traffic and machinery noise within Dublin Port and on the Tolka Estuary, they will not be disturbed by construction noise on the site of the Proposed WwTP Component. Similarly, nesting terns within Dublin Port are habituated to industrial noise and construction noise at the WwTP will not be audible within the colony due to the high levels of noise that the birds themselves produce.

It should be noted that during the construction of a major sewage treatment plant at Mutton Island in Inner Galway Bay, the numbers and diversity of wader species roosting in close proximity to the construction site remained stable or slightly increased (Nairn, 2005). No mitigation is thus required for impacts on the tern colony.

6.6.1.2 Mitigation for the removal of invasive species

Specific control measures have been recommended to prevent the spread of Japanese Knotweed. An Outline Invasive Species Management Plan has been prepared for this purpose (Appendix 6A).

6.6.1.3 Mitigation of dust deposition

Mitigation measures will be implemented to reduce or eliminate the creation and release of dust within the site. A Dust Management Plan will be implemented by the contractors, details of dust mitigation measures are detailed in Volume 3, Section 8: Air and Climate.

The potential for nuisance dust impacts is considered to be negligible at the nearest sensitive receptors and dust deposition rates will be in accordance with relevant guideline limits assuming the recommended construction mitigation measures are adhered to. There will be no significant air quality and dust impacts from the operation of the Proposed WwTP Component so there will be no significant effects on flora and fauna in the vicinity of the construction site.

As no other significant effects of the Proposed WwTP Component are likely on terrestrial flora and fauna, including waterbird populations, no other mitigation measures are required.

6.6.2 Operational Phase

No mitigation measures are required for the operational phase of the Proposed WwTP Component.

6.7 Residual Impacts

6.7.1 Construction Phase

As no significant adverse impacts due to the construction of the Proposed WwTP Component are predicted on terrestrial flora or fauna (including birds), following the mitigation described above, no residual impacts are likely.

6.7.2 Operational Phase

As no significant adverse impacts due to the operation of the Proposed WwTP Component are predicted on terrestrial flora or fauna (including birds), no residual impacts are likely.

6.7.3 Interactions

As no significant adverse impacts due to the construction or operation of the Proposed WwTP Component on terrestrial flora or fauna (including birds) are predicted (following the mitigation during construction described above) no interactions with other impacts are predicted.

6.7.4 Cumulative Impacts

The Biodiversity Terrestrial assessment considers potential direct and indirect impacts resulting from the Proposed WwTP Component. There are no direct cumulative impacts associated with the Proposed WwTP Component. The assessment also considers potential effects resulting from Dust, Water Quality, Traffic - all of which have a cumulative impact integrated into the assessment.

The assessment does confirm that the Proposed WwTP Component will not give rise to impacts on water populations, however cumulative medium and long-term changes to waterbird numbers may become more difficult to discern, as they may become part of cumulative changes arising from other factors such as disturbance from non-related projects or climate change.

6.8 Monitoring

6.8.1 Monitoring for disturbance to waterbirds

A series of monthly surveys of waterbirds on the grassland, immediately south of the Proposed WwTP Component, will be carried out each winter between October and April for the period of construction and for one year following completion of the Proposed WwTP Component. When compared with the baseline period (data given above) and general population trends, this will allow assessment of the efficacy of the mitigation measures on potential disturbance. A record will be maintained of any disturbance incidents to the waterbirds on this site where these are connected with the construction works.

6.8.2 Monitoring of potential changes in waterbird population related to effluent discharge

A comprehensive monitoring programme currently being undertaken by BirdWatch Ireland for all of Dublin Bay, which can be used to allow assessment of the efficacy of potential changes in waterbird populations related to effluent discharge.

6.8.3 Monitoring of invasive plant species

Annual monitoring of potentially invasive plant species in the immediate vicinity of the Proposed WwTP Component will be undertaken to assess the efficacy of control measures proposed in the Invasive Species Management Plan. Where necessary, further control measures may be required.

6.9 Difficulties Encountered

No difficulties were encountered with this Section of the assessment.

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Section 7: Land and Soils

7.1 Introduction

This Section of the EIAR assesses the potential impacts (and resulting effects) likely to occur as a result of the Ringsend WwTP component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component") on the Land and Soils environment (including Hydrogeology). The issues associated with the disposal of contaminated soil are also dealt with in this Section. It should be noted that Land Utilisation is assessed in Volume 3, Section 12: Material Assets.

Full details of the Proposed Upgrade Project and the Ringsend WwTP component can be found in Volume 2, Section 3: Description of Proposed Upgrade Project.

This Section and assessment have been completed having regard to the guidance outlined in the Environmental Protection Agency documents *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (Draft, August 2017) and *Advice Notes for Preparing Environmental Impact Statements* (Draft, September 2015).

7.2 Methodology

This Section assesses the effects of the Proposed WwTP Component on the Land and Soils environment in terms of Quality, Significance, Magnitude, Probability, Duration and Types as detailed in Volume 2, Section 2: The EIA Process.

A desk study and site-specific investigations were undertaken to provide the data to compile the description of the existing land and soils environment.

The likely significant effects of the Proposed WwTP Component on soils, geology and hydrogeology are discussed, and the measures to mitigate adverse impacts are described. Adverse impacts are those that result in a detrimental effect to the current environment, e.g. deterioration in groundwater quality.

This Section also discusses the management and disposal of contaminated/waste soils and excavated soil infested with invasive species.

Information on the soils, geology and hydrogeology has been obtained from the following sources:

- Arup Consulting Engineers (Arup) - Dublin Waste to Energy Project, Ringsend, Dublin (June 2008);
- Causeway Geotech Ltd (Causeway) - Ringsend Wastewater Treatment Works (October 2012);
- Causeway Geotech Ltd (Causeway) - Ringsend Wastewater Treatment Works Site Investigation (January 2016);
- CDM - Constraint Mapping of Dublin Bay (February 2010);
- CDM - Overview of Geology of Dublin Bay (March 2010);
- Dublin City Council (DCC) - Ringsend WwTP Extension Project - Testing of Groundwater Samples (2013);
- EPA (2006), Subsoil Mapping;
- Geological Survey of Ireland (GSI) 1:100,000 scale Bedrock Geology Map, Sheet 16 (Kildare-Wicklow);
- GSI Bedrock Geological Map of Ireland;
- GSI Groundwater Mapping Databases;

- GSI Quaternary Geology Map of Ireland;
- IGI 2002 Geology in Environmental Impact Statements - a Guide;
- Irish Geotechnical Service Ltd (IGSL) - Ringsend Wastewater Treatment Works Effluent Outfall Extension (June 2013);
- Irish Geotechnical Services (IGSL) Ltd - Poolbeg Generating Station Site Investigation (1992);
- Norwest Holst - Ringsend Wastewater Treatment Works Investigation (1997);
- RPS – Dublin Waste to Energy Site Soil and Groundwater Investigation (2005);
- WYG / Causeway Geotech - Waste Classification Assessment (June 2016);
- WYG / Causeway Geotech - Waste Classification Assessment (February 2017);
- JBB - Soil Assessment and Removal Associated with the Construction of the EFS at Ringsend WwTW (July 2012);
- Natura - Survey of Japanese Knotweed (June 2016); and
- Ringsend Wastewater Treatment Works Extension - EIS (2012).

7.2.1 Site Investigations

Several detailed site-specific investigations have been carried out to establish subsurface conditions at the site and these are summarised below in Table 7-1. The various site investigation reports were reviewed and used to develop a conceptual model of the subsurface conditions.

Table 7-1: Site investigation summary

Contractor	Description of Investigation	Details of Investigation	Date of Works
Norwest Holst	Ringsend Wastewater Treatment Works Investigation	125 Trial pits 144 Percussive boreholes 35 Rotary cored holes 59 Dynamic cone probe tests 36 Static cone probe tests	1997
Causeway Geotech Ltd	Ringsend Wastewater Treatment Works	6 Cable percussion boreholes 3 Deep rotary cored holes 1 Permanent standpipe 2 Vibrating wire piezometers Groundwater sampling	October 2012
IGSL	Ringsend Wastewater Treatment Works Effluent Outfall Extension	1 Deep Rotary Cored Borehole 3 Shallow Boreholes 26 Slit Trenches 3 Plate Bearing Tests 1 Infiltration Test	June 2013
Causeway Geotech Ltd	Ringsend Wastewater Treatment Works Site Investigation	34 Trial pits and 2 Slit trenches 12 Percussive boreholes 4 Rotary cored holes 5 Rotary open bores with rotary coring follow on 55 Cone penetration tests 6 Seismic cone penetration tests 5 Groundwater monitoring standpipes 4 Vibrating wire piezometers Downhole and crosshole seismic mapping Geotechnical and environmental soil testing. Waste Assessment report	January 2016

7.3 Existing Environment

7.3.1 Site Description

The Proposed WwTP Component comprises both the permanent site (the WwTP) and a number of sites which will be utilised as temporary construction compounds. The site is located within an area known as the Poolbeg Peninsula which forms the southern boundary to the entrance to Dublin Port. The permanent site is divided into a northern and southern section by Pigeon House Road, which traverses the site (see Figure 7-4 and Figure 7-5).

A historical review of the site indicates that the site has been progressively infilled between the early 1700's up to the 1970's prior to the construction of the WwTP circa 1976. The site was infilled with a mixture of glass, rubble, concrete, ash, domestic waste, bricks, dredge material, gravel and clay. Information from site investigations undertaken were used to provide an understanding of the existing subsurface strata and composition.

7.3.2 Bedrock Geology

7.3.2.1 Regional Bedrock Geology

Most of Dublin City is underlain by Carboniferous Limestones, notably the Calp limestone. The Bay itself is shaped by Howth Head in the north, which comprises rocks of the Cambrian-age Bray Group, and the Dalkey Headland in the south, which comprises rocks of the Leinster Granite.

The Calp limestone, identified as underlying the majority of Dublin, comprises varied dark grey to black basinal limestone and shale in several different formations. The southern margin of the limestones in the Dublin Bay area is fault-controlled.

7.3.2.2 Encountered Bedrock Geology

Rock was encountered at depths ranging from approximately 41.3 m to 47.1 m bgl. Bedrock typically comprised interbedded limestone and siltstone/mudstone. Limestone is described as weak to medium strong, grey, fine grained, carboniferous limestone with bands of very weak to weak, dark grey limestone and brecciated zones. Brecciated zones may be indicative of bedrock faulting at the site location. Siltstone and mudstone are described as very weak to moderately weak, grey and brown. Discontinuity sets within the limestone bedrock are described as closely to medium spaced sub-horizontal, planar, rough and stepped to sub-vertical planar, undulating to rough. Fracture planes are frequently described as clay smeared and infilled with staining and discolouration observed on fracture surfaces. Large infilled karst features comprising firm to stiff, orange/brown gravelly sandy clay with low to medium cobble and boulder content were encountered at depth in the three-deep rotary cored holes carried out in 2012 (Causeway, Ringsend Wastewater Treatment Works, October 2012).

7.3.3 Quaternary Deposits

The GSI Quaternary Geology Map of Ireland indicates that the northern portion of the site is underlain by made ground and indicates that no information is available for the southern portion of the site. However, a historical review of the site indicates the site was infilled with a mixture of dredge material and made ground containing glass, rubble, concrete, ash, bricks, gravel and clay.

7.3.3.1 Made Ground

Made Ground was encountered in all investigation locations on site to depths ranging from 6.3 m to 10.4 m bgl. The made ground is variable in composition, typically comprising brown and grey sand, gravel, clay and silt. The gravel consists of angular to sub-angular, fine to coarse, dark grey to black carbonaceous limestone and fine grained igneous rock. Sand was fine to coarse grained. Large proportions of anthropogenic (manmade) waste (e.g., building waste, cinders, tyres, metal and plastic) was observed in made ground as well as some asbestos and/or asbestos containing material. White Young Green (WYG) carried out a waste classification assessment in June 2016 (WYG, Ringsend WwTW Waste Classification, June 2016) for the capacity upgrade area and in December 2016 (WYG, Ringsend WwTW Waste Classification, February 2017) for the area in the vicinity of the eastern boundary. It should be noted that soil containing asbestos is only classified as hazardous when the asbestos content exceeds 0.1%. Of the 66 samples analysed for asbestos, ten indicated the presence of asbestos, only two of which exceeded the hazardous waste threshold. More detail on the waste composition and type is provided later in this section (sub-section 7.4.6.2: Waste Classification).

7.3.3.2 Marine Sediments

Marine sediments can be subcategorised into two distinct units; granular marine sediments and cohesive marine sediments.

Granular marine sediments comprised a mixture of grey coloured silty, gravelly sand and fine to coarse grained gravel with occasional cobbles. Cobbles, if present, are described as being sub-angular to sub-rounded. Gravels are described as being sub-angular to sub-rounded in shape. Sand is described as fine to medium grained in most samples. Layers of sandy gravel are also described as containing occasional pockets (<60 mm) of a dark grey silty clay. Shell fragments were occasionally present in the sand layers.

A layer of cohesive marine sediments was identified at depths ranging from approximately 10 m to 14.7 m bgl and typically comprised soft to firm, grey, slightly gravelly silts, slightly sandy silts, sandy clays and silty clays.

7.3.3.3 Glacio-Marine Deposits

The glacio-marine deposits typically comprised clay with interbedded layers of sands, clay, gravels, cobbles and boulders. The glacial boulder clay is described as firm to very stiff, grey sandy clay with occasional cobbles and boulders of limestone at the base of the unit.

7.3.4 Summary of Ground Conditions

Using the subsurface information from geotechnical investigations and published data, our inferred conceptual site model has been developed to characterise the soil and rock strata and is presented in Figure 7-1 and Table 7-2.

Table 7-2: Conceptual Site Model

Unit	Material	Description	Depth to Top of Unit (m bgl)	Range of Unit Thickness (m)[3]
1	Made Ground	Made Ground: SAND, CLAY, GRAVEL with anthropogenic inclusions (construction and demolition waste, cinders and plastic)	0.0	6.3 to 10.4
2a	Marine Sediments	Upper Marine Sediments: Typically comprising loose to dense sandy GRAVEL/gravelly SAND (not present in all locations)	6.3 to 10.4	0.5 to 4.5
2b		Typically comprising soft to firm sandy SILT and sandy CLAY	10.0 to 14.7	0.5 to 7.3
2c		Lower Marine Sediments: Typically comprising medium dense to dense sandy GRAVEL/gravelly SAND present in an upper and lower stratum	6.8 to 11.7	5.8 to 14.5
3	Glacio-Marine Deposits	Typically comprising firm to very stiff sandy SILT and sandy CLAY	19.0 to 22.8	12.0 to >19.5
4	Bedrock[4]	Typically comprising very weak to medium strong, grey, slightly weathered, fine grained LIMESTONE with interbedded very weak to moderately weak, brown and grey SILTSTONE and MUDSTONE. Evidence of karstification observed in BH01, BH02 and BH06.	41.3 to 47.1	Unproven

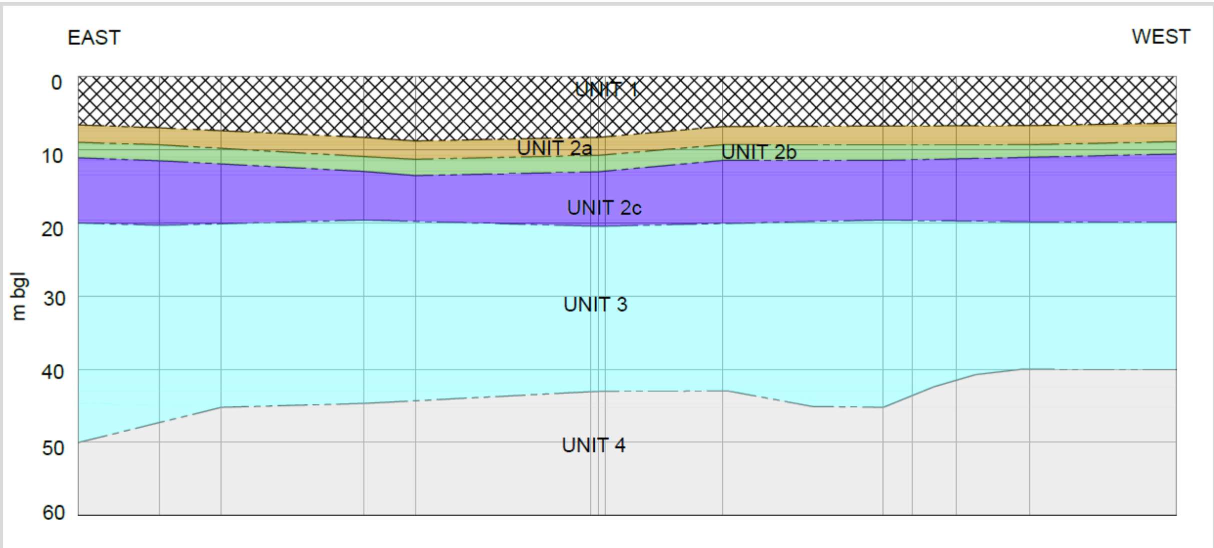

Figure 7-1: Conceptual Site Model

[3] *The depths and unit thicknesses are based on borehole locations and may not represent the maximum or minimum depths and thicknesses across the site.*

[4] *Bedrock not proven in all locations.*

7.3.5 Geological Heritage

There are no geological heritage sites within the Proposed WwTP Component area. The nearest geological heritage site is the North Bull Island. The construction and operational effects will not interact with the geological qualifying interests of any Geological Heritage Sites.

7.3.6 Hydrogeology

Aquifer classification and groundwater vulnerability classifications are sourced from the Geological Survey of Ireland (GSI) Ground Water Protection Scheme (GWPS) mapping program.

7.3.6.1 Aquifer Classification

The GSI mapping indicates that the Ringsend WwTP site is underlain by Calp Limestone, the overall GSI classification for this formation is Li (locally important aquifer unproductive except for local zones). However, due to the proximity to the bay and estuary (saline) and the fact that the site is underlain by made ground, the aquifer is not considered suitable as a groundwater supply source.

The low permeability glacio-marine deposits above bedrock represent “aquitards” which limit infiltration and restrict percolating water from reaching the bedrock aquifer. The overlying granular marine sediments have a much higher permeability and consequently a greater potential recharge and storage capacity. However, given the proximity to the sea, these deposits do not represent a potable source of groundwater.

7.3.6.2 Groundwater Vulnerability

Groundwater vulnerability provides an indication of the ease at which potential contaminants can migrate downwards from the surface to the underlying aquifer. There is no detailed vulnerability classification available from the GSI database for the site, as such vulnerability is classified as being low to high. However, based on the subsurface conditions encountered on site, a more accurate vulnerability assessment can be made by applying the GSI vulnerability mapping guidelines as shown in Table 7-3. The shallow groundwater vulnerability at the site is assessed as ‘high’. However, the deeper bedrock aquifer is protected by an aquitard >10 metres thick of marine clays and the vulnerability relating to the bedrock aquifer is therefore assessed as “low”.

Table 7-3: GSI Vulnerability Mapping Guidelines

Vulnerability Classification	Subsoil Permeability (Type and Thickness)			Unsaturated Zone	Karst Features
	High permeability (sand/gravel)	Moderate permeability (e.g. sandy subsoil)	Low permeability (e.g. clayey subsoil, clay, peat)	(Sand / Gravel Aquifers only)	(<30 m radius)
Extreme (E)	0 – 3.0 m	0 – 3.0 m	0 – 3.0 m	0 – 3.0 m	-
High (H)	>3.0 m	3.0 - 10.0 m	3.0 – 5.0 m	>3.0 m	N/A
Moderate (M)	N/A	>10.0 m	5.0 – 10.0 m	N/A	N/A
Low (L)	N/A	N/A	>10.0 m	N/A	N/A

7.3.6.3 Groundwater Use

There are no known groundwater users in the vicinity of the Proposed WwTP Component. Groundwater analysis carried out by DCC in 2013 (DCC, WwTP Extension Project, Testing of Groundwater Samples, 2013) indicates underlying groundwater is brackish and saline in nature. The groundwater underlying the site is therefore not considered suitable for potable supply and does not constitute a groundwater resource.

7.3.6.4 Groundwater Levels and Flow

The Poolbeg Peninsula consists of made ground. Original ground level would have been below sea level. Groundwater flow through made ground and underlying sands and gravels will flow towards the Liffey where it will discharge as baseflow.

As shown in Figure 7-2 below, groundwater monitoring results indicate that groundwater levels typically respond to tidal fluctuations. Where response zones of installed monitoring wells are within the overburden, a strong correlation between groundwater levels and tidal fluctuations was observed. Where response zones are within the underlying bedrock, response to tidal variation is less pronounced.

Anomalous readings (BH101, BH102B and BH103) are likely attributable to the heterogeneous nature of the overlying made ground and are not considered to be representative of underlying groundwater levels.

Groundwater underlying the site is hydraulically connected to Dublin Bay. Groundwater response to tidal variations within the site locality is approximately ± 0.7 m with an approximate mean groundwater level slightly greater than 0.0 m OD.

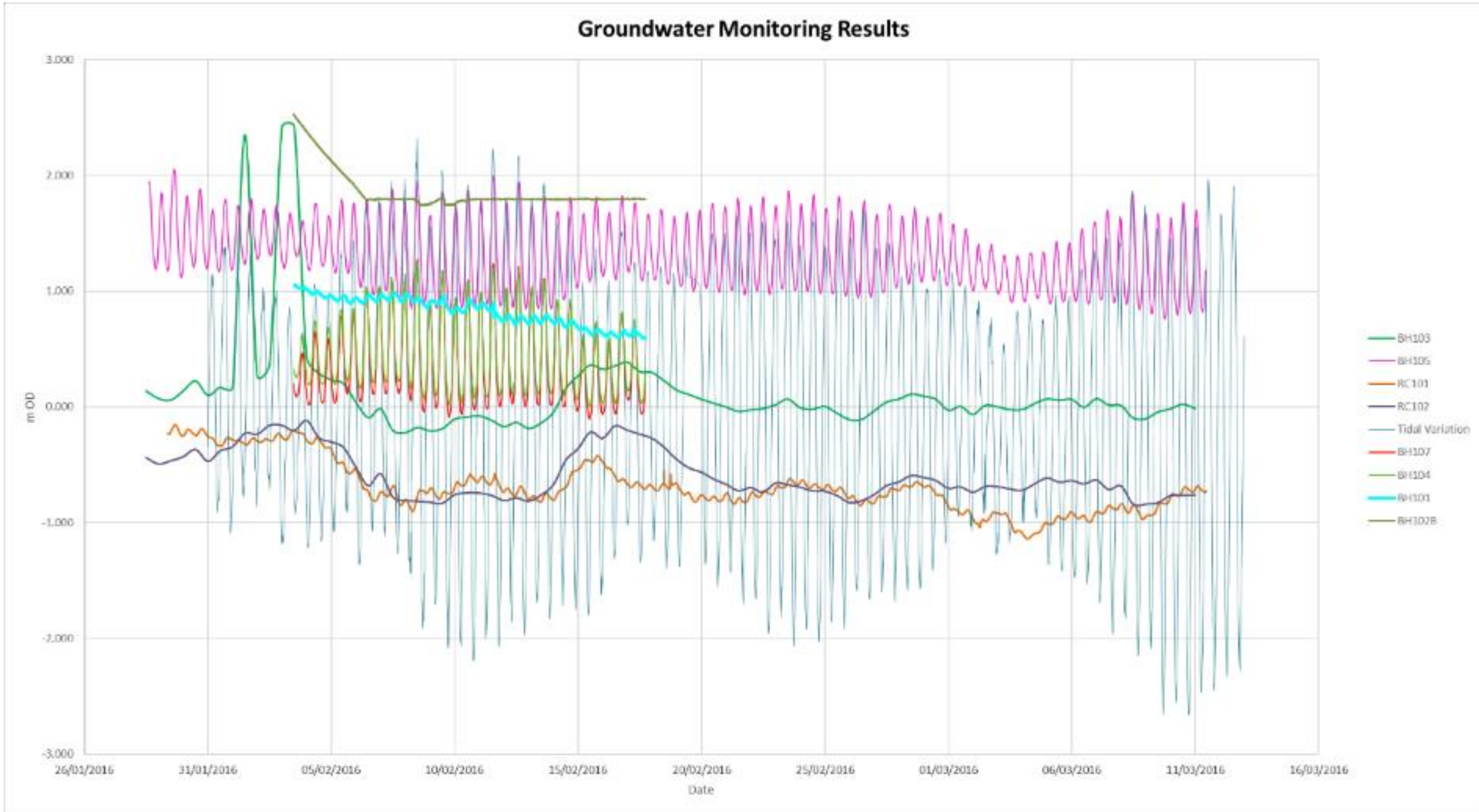

Figure 7-2: Groundwater Monitoring Results

7.3.6.5 Permeability

Variable head tests were carried out in five of the installed standpipes. Variable head tests were carried out in made ground, granular marine deposits and cohesive marine deposits. Results for permeability within the made ground ranged from 1.5 x 10^{-9} m/s to 2.4 x 10^{-2} m/s (Causeway, 2012 and 2016). The large range in permeability is likely attributable to the variable nature of ground conditions at the site.

7.3.6.6 Groundwater Quality

Groundwater sampling has been carried out on site by DCC (Ringsend WwTP Extension Project - Testing of Groundwater Samples, 2013) and analysed for a limited chemical suite. Some elevated concentrations of ammonia, barium, benzene, chromium, chloride and zinc were observed. Elevated chloride concentrations indicate that the underlying groundwater is saline in nature.

Historical groundwater sampling carried out on adjacent sites were analysed for a broader chemical suite (RPS, Soil and Groundwater Investigation at the Proposed Dublin Waste to Energy site in Ringsend, Dublin, May 2005). Results indicated some trace concentrations of Total Petroleum Hydrocarbons (TPH) and Polycyclic Aromatic Hydrocarbons (PAH) and slightly elevated concentrations of heavy metals, most notable boron, nickel and zinc in groundwater samples. Elevated concentrations of TPH, PAH and heavy metals is attributable to the industrial nature of the site and surrounding land use and is not unusual. The groundwater present beneath the site is unsuitable for human consumption and saline in nature.

7.3.7 Invasive Species

An invasive species survey of the site was undertaken March and September 2013 and again in June 2016. The presence of Japanese Knotweed was identified at four locations (Figure 7-3) along the eastern site boundary (Invasive Species, Ringsend Wastewater Treatment Works Extension Survey of Japanese Knotweed, September 2013, Survey of Japanese Knotweed, June 2016). Some plants have spread through the security fence and established on the pathway within the treatment works site adjacent to the bund. While no specimens of Japanese Knotweed were found on the bund itself, it is understood the plant roots may extend up to 7 m from any surface stems (Kelly et al. 2008). The presence of the invasive species Japanese Knotweed will result in a proportion of the excavated soil containing rhizomes which has implications for disposal. In areas where there is no excavation proposed, the Japanese Knotweed will be treated in-situ with herbicide by an invasive species specialist. The bund in the north eastern corner of the WwTP site will be removed to facilitate the construction of the effluent fine screens. These works are not proposed to take place till 2023. Therefore, it proposed to treat the Japanese Knotweed in-situ using herbicides in advance of the earthworks.

Irish Water has produced a guidance document. *"Irish Water Information and Guidance Document on Japanese Knotweed*". Japanese Knotweed Management on the Proposed WwTP Component shall follow these guidelines and those produced by Invasive Species Ireland (Best Practice Management Guidelines - Japanese Knotweed).

Figure 7-3: Locations of Japanese Knotweed

While the Irish Water Japanese Knotweed guidelines recommend that Japanese Knotweed should be managed on site, it is not feasible for areas of the Proposed WwTP Component which will be excavated at an early date. Southern parts of the bund on the eastern boundary of the WwTP will be removed to facilitate the construction of the access road. In these areas, the only option available is excavation and offsite disposal to a licenced facility. It is proposed to chemically treat the Japanese Knotweed plants on site prior to excavation as a precautionary measure. Disposal of Japanese Knotweed impacted material requires a licence from the National Parks and Wildlife Service in advance of any removal, in accordance with the European Communities (Birds and Natural Habitats) Regulations 2011 (SI 477). Monitoring and further treatment will be undertaken on completion of the disposal.

7.4 Characteristics of the WwTP Component of the Proposed Upgrade Project

As discussed in Volume 2, Section 3: Description of Proposed Upgrade Project, the Proposed WwTP Component comprises several different project elements including modifications and retrofitting to existing plant in addition to the construction of new facilities.

Aspects of the Proposed WwTP Component that will impact on the land, soils, geology and hydrogeology environments at Ringsend are discussed in the following sections.

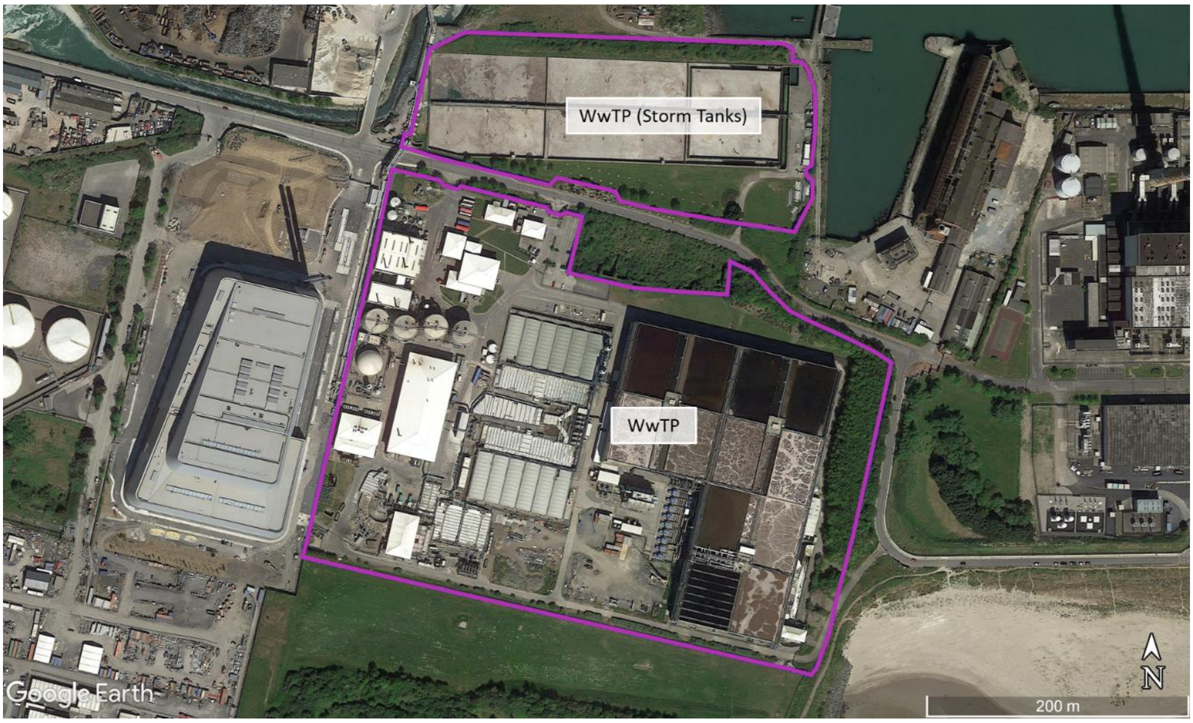

Figure 7-4: Ringsend WwTP Site Location

7.4.1 Capacity Upgrade and Expansion Lift Pumping Station (ELPS)

To accommodate the tanks associated with the capacity upgrade, bulk excavation of approximately 0.5 ha to an average depth of approximately 2 m below ground level (bgl) will be required. Bulk excavations for the capacity upgrade are unlikely to extend below groundwater levels.

The Expansion Lift Pumping Station (ELPS) will involve localised excavation to approximately 6 m bgl. Excavations for ELPS will extend approximately 2-3 m below measured groundwater levels and will require temporary dewatering to facilitate excavation.

It is proposed to utilise a piled foundation for the capacity upgrade structures. Associated works include:

- Excavations above groundwater;
- Excavations below groundwater;
- Waste soil generation and disposal;
- Dewatering and groundwater discharge; and
- Piling.

7.4.2 New Builds

The Proposed WwTP Component will comprise the construction of a number of additional new buildings including the phosphorus recovery facility, anaerobic digester, pasteurisation facility and sludge digestion facility.

Piled foundations are proposed for all new structures. Associated works include:

- Excavations above groundwater;
- Waste generation (soil contaminated with waste) and disposal; and
- Piling.

7.4.3 Site Access, Link Road and Stormwater By-Pass Culvert (Eastern Site Boundary)

It is proposed to construct a new site entrance from Pigeon House Road at the northeast site boundary and a link road to the southeast site corner. A stormwater bypass connection involving the installation of a subsurface pipeline to a depth of approximately 3 m bgl is also proposed. These works are undertaken in made ground and excavated material must be disposed of as waste.

As part of these works, the bund in the south-eastern corner of the site will be removed to accommodate the route of the link road. A portion of the bund is infested with the invasive species Japanese Knotweed. Due to space restrictions on site and the composition of the bund material, the excavated spoil contaminated with Japanese knotweed will require offsite disposal. The bund is also composed of imported fill material that will require removal to a suitable landfill. Associated works include:

- Excavation;
- Disposal of invasive species impacted material; and
- Waste generation (soil contaminated with waste) and disposal.

7.4.4 Effluent Fine Screens (if required)

The Effluent Fine Screens will be located on the north eastern corner of the site. These works are not proposed, at present, to be undertaken until 2023. The construction will require the removal of the northern bund on the eastern boundary. The bund is composed of construction and demolition waste and manmade fill. The contaminated soil will require off-site disposal to a suitable landfill. A portion of the bund is infested with the invasive species Japanese Knotweed. It is proposed to treat and eradicate the Japanese Knotweed in-situ with herbicides in advance of the construction in 2023. Associated works include:

- Excavation;
- In-situ advance herbicide treatment of Japanese Knotweed; and
- Waste generation (soil contaminated with waste) and disposal.

7.4.5 Temporary Construction Compounds

The locations of the temporary construction compounds (Figure 7-5) are discussed in Volume 2, Section 3: Description of Proposed Upgrade Project. They will be used as a store for dry materials (steel, cladding, precast concrete etc.) and potentially as a staging area for the works and car parking areas.

7.4.5.1 C1: Temporary Construction Compound

Associated land and soils related works include:

- No site preparation required.

7.4.5.2 C2: Temporary Construction Compound

Associated land and soils related works include:

- Minor site preparation required (stripping topsoil).

7.4.5.3 C3: Temporary Construction Compound

Associated land and soils related works include:

- No site preparation required.

Figure 7-5: Construction Compound Areas

7.4.6 Waste Classification, Disposal and Approximate Earthwork Quantities

For the purposes of this assessment and based on the conceptual model, it is assumed that there is at least 6 metres of made ground throughout the site and that all excavated material will require disposal as a waste to a licenced waste disposal facility. This is the worst-case scenario in respect of excavated material.

7.4.6.1 Spoil Disposal Options

In the context of the spoil generated as a result of the construction activities, the waste hierarchy as outlined in the European Communities (Waste Directive) Regulations SI 126 of 2011 will be applied.

The waste hierarchy shall apply as a priority order in waste prevention and management legislation and policy.

- Prevention;
- Preparing for re-use;
- Recycling;
- Other recovery; and
- Disposal.

All material requiring disposal will be handled in accordance with the Waste Management (Collection Permit) Regulations, 2007 and the Waste Management (Collection Permit) (Amendment) Regulations, 2008. As much material as possible will be re-used as an infill material for engineering projects and quarry restoration. Material that cannot be re-used will be treated in accordance with the Landfill Directive (2003/33/EC).

7.4.6.2 Waste Classification

The characterisation and classification of wastes in Ireland is governed by comprehensive waste management legislation primarily informed by EU Directives including the Landfill Directive, Hazardous Waste Directive and Waste Framework Directive. Waste classification is based on:

- Commission Decision of 18 December 2014, amending Decision 2000/532/EC on the list of waste pursuant to Directive 2008/98/EC of the European parliament and of the Council (2014/955/EEC); and
- Commission Regulation (EU) No 1357/2014 of 18 December 2014, replacing Annex III to Directive 2008/98/EC of the European Parliament and of the Council on waste and repealing certain Directives.

Disposal of waste to waste management facilities is governed by the Landfill Directive Council Directive 1999/31/EC on the landfill of waste, which classifies landfills by waste type:

- Inert;
- Non- Hazardous; and
- Hazardous.

Some hazardous wastes are also suitable for disposal within appropriately licenced non-hazardous facilities where it can be demonstrated they are stable, non-reactive hazardous waste.

White Young Green (WYG) carried out a waste classification assessment in June 2016 (WYG, Ringsend WwTW Waste Classification, June 2016) for the capacity upgrade area and in December 2016 (WYG, Ringsend WwTW Waste Classification, February 2017) for the area in the vicinity of the eastern boundary. The waste classification assessment indicated low level hydrocarbon and heavy metal contamination. In general, samples meet the waste acceptance criteria for non-hazardous waste.

Some small quantities of asbestos were identified at a number of locations across the site. In accordance with the EPA guidance, where the proportion of asbestos fibres by mass is below the carcinogenic hazardous waste property threshold (0.1% by mass), the sample is classified as non-hazardous. Where the proportion of asbestos fibres exceeds the hazardous waste threshold, the sample classifies as hazardous.

Excavated material will require segregation prior to disposal, a portion of which will be categorised as hazardous waste. It is acknowledged that there are currently no hazardous waste facilities in operation in Ireland and hazardous waste will likely require export and disposal at a licensed hazardous waste facility abroad.

7.4.6.3 Invasive Species

Excavations within the vicinity of identified areas affected by Japanese Knotweed shall be extended to 7 m beyond identified surface stems. Excavated spoil within this radius can contain rhizomes and shall be disposed of offsite to a licensed landfill. It should be noted that soils containing Japanese Knotweed roots can also be contaminated.

7.4.6.4 Approximate Earthwork Quantities

The estimated spoil volumes and waste categories generated are listed in Table 7-4. As detailed design is yet to be finalised, quantities should be considered as estimates based on preliminary design. The Ringsend site is underlain by made ground comprising construction and demolition waste. A conservative '*worst case*' scenario approach to the estimate of waste volumes was adopted and it is assumed that all the material to be excavated on the site will be made ground and will require disposal at a licenced non-hazardous or hazardous waste facility. The exception is the spoil from piling in the deeper marine sediments (below the made ground) which are naturally occurring. Actual quantities of the respective material types encountered will vary. A monitoring and sampling programme for waste segregation will be in place both prior to and during construction.

Table 7-4: Spoil Waste Classification and Approximate Volumes for Disposal

Upgrade Element	Estimated Spoil Volume (m^3)	Estimated Volume of Inert Waste (m^3)	Estimated Volume of Non-Hazardous Waste (m^3)	Estimated Volume of Non-Hazardous Waste (control measures - contains low level asbestos) (m^3)	Estimated Volume of Hazardous Waste (m^3)
Capacity Upgrade (0.8 Ha site)	10,000	-	8,466	928	606
Expansion Lift Pumping Station (ELPS)	2,000	-	1,000	900	100
South Eastern Bund Removal/Link Road	2,820	470	1,500	850	140
North eastern Bund Removal/Effluent Fine Screens	9,579	0	7,222	1,308	1,049
Storm Bypass Culvert	2,250		1,667	448	135
Temporary Site Compounds	0	-	-		-
Total volume (m^3)	28,309	1,270	20,575	4,434	2,030

7.4.6.5 EPA Licensed Facilities

Waste facilities that are potentially available as destinations for the excavated spoil are listed below. Whether a facility will accept the excavated soil will depended on the waste classification of the material and the waste acceptance criteria of the facility. These are facilities licensed for acceptance of non-hazardous waste. The hazardous fractions will require export overseas.

Waste facilities with operational licences to accept non-hazardous waste include:

- W0146-01 Greenstar's Knockharley Landfill, Knockharley, Navan, County Meath;
- W0015-01 Ballyogan Landfill Facility, Jamestown Townland, Carrickmines, Dublin 18; and
- W0201-03 Drehid Waste Management Facility, Kildare.

The capacities of the above soil waste licensed facilities are summarised in the following Table 7-5.

Table 7-5: Licensed Waste Facilities

Facility	Capacity (tonnes/year)
Greenstar's Knockharley	175,000
Ballyogan Landfill Facility	400,000
Drehid Waste Management Facility	120,000
Total	695,000

If there is an insufficient number of suitable land based licensed facilities available to accept the waste material generated from the Proposed WwTP Component, then exportation of waste/excavated material must be considered. The fact that the some of the soil will contain Japanese Knotweed rhizomes may complicate matters regarding acceptance. Many non-hazardous landfills are reluctant to take soils that contain Japanese Knotweed. The indications are that spoil containing Japanese Knotweed rhizomes will need to be exported. Should trans-frontier shipment of waste be required, it shall be carried out in accordance with Waste Management (Shipments of Waste) Regulations, 2007. This will apply to the export of hazardous waste also.

7.5 Potential Impacts

7.5.1 Do-Nothing Impacts

The 'Do-nothing' alternative describes the circumstance where the Proposed WwTP Component is not developed. A Do-nothing approach to Japanese Knotweed would result in a significant permanent negative impact, because control of the Japanese Knotweed will need to be addressed regardless of whether the Proposed WwTP Component proceeds. Otherwise, there will be no impact on the land, soils, geology and hydrogeology if the Do-nothing scenario is followed.

7.5.2 Construction Phase

There are a number of elements associated with the Proposed WwTP Component which have the potential to impact the land, soils, geological and hydrogeological environments.

Excavated material from the site will predominantly comprise made ground with the exception of piling spoil. Where Continuous Flight Auger (CFA) piling is adopted, additional excavated spoil volumes will comprise both made ground and marine sediments.

Based on the WYG Waste Classification Assessment carried out in May 2016, spoil from excavation works within the made ground will be generally classified as non-hazardous waste (with some localised areas of hazardous waste) for disposal in accordance with the relevant Waste Management Regulations. The disposal of this material shall be the responsibility of the contractor (subject to compliance with Waste Management (Collection Permit) Regulations, 2007 and the Waste Management (Collection Permit) (Amendment) Regulations, 2008. There is no impact predicted associated with waste disposal.

The impacts of the disposal of the excavated soil on traffic is addressed in Volume 3, Section 13: Traffic.

7.5.2.1 Construction Induced Ground Movements

Deep foundations will be required to support the main structures. The underlying glacio-marine sediments are cohesive in nature and will be subject to consolidation settlement post construction.

7.5.2.2 Piling

Deep foundations will be required to support the proposed capacity upgrade tanks. Where CFA piling is adopted, spoil volumes will comprise made ground and marine sediments. The disposal of this material shall be in accordance with the Waste Management (Collection Permit) Regulations, 2007 and 2008. All piling spoil shall be disposed of at suitably licensed facilities.

The piling works also have the potential to create vertical pathways in which potentially contaminated soils/sediment and/or groundwater can migrate downwards. However, due to the proximity to the bay and the underlying made ground, the aquifer is not considered to be a potable groundwater resource.

The proposed piling works are not considered likely to result in significant effects on the hydrogeological environment.

7.5.2.3 Temporary Construction Dewatering

Earthworks for the majority of the Proposed WwTP Component will comprise excavations (above measured groundwater levels) to approximately 2 m bgl and is unlikely to require dewatering. Laboratory analyses of groundwater carried out to date (RPS, Dublin Waste to Energy Site Soil and Groundwater Investigation, 2005 and DCC, Ringsend WwTP Extension Project - Testing of Groundwater Samples, 2013) indicate some elevated concentrations of ammonia and chloride indicating groundwater was saline/brackish. Trace benzene, PAH, TPH and heavy metals and evidence of free-product was also noted during groundwater sampling in 2005. The groundwater is saline. This groundwater discharges naturally to the River Liffey as baseflow. Consequently, the groundwater underlying the site is considered an attribute of very low importance.

Localised excavations for the ELPS pumping station will extend below measured groundwater levels to approximately 6 m bgl which will require temporary construction dewatering. Due the nature and variability of the permeability of the made ground and the response of groundwater levels to the tides (fluctuations of up to 3 metres can occur with the water level rising to 2.0 mOD), it is difficult to predict the rate of inflow. Dewatering will require sheet piling to prevent groundwater inflows during excavation. Consequently, the only the groundwater contained within the sheet piling will need to be pumped.

Due to the required groundwater drawdown (approximately 6 m bgl, i.e. an approximate drawdown of 3 m) and the use of sheet piling, no significant volumes of water will be abstracted during dewatering operations. The abstracted groundwater will be groundwater that currently discharges to the Liffey as baseflow. The proposed dewatering exercise is not considered likely to result in significant effects on the hydrogeological environment.

The contractor will be required to apply for a Section 16 wastewater discharge licence for the disposal of groundwater to a sewer. The impact on the water quality of the River Liffey will be negligible in magnitude and imperceptible in significance. Dewatering abstractions will be temporary in nature.

As contaminated soil will be removed from site, the contaminant flux to groundwater will be reduced. As such, the predicted impact on the hydrogeological environment is permanent and positive and imperceptible.

7.5.2.4 Invasive Species

Excavation of Japanese Knotweed impacted material has the potential to cause the spread of invasive plant materials. Japanese Knotweed has been identified at four locations along the eastern site boundary in small localised areas. While Japanese Knotweed has not been identified elsewhere on site, there is a possibility that it could become established between the time of the site surveys and construction commencing. In the absence of mitigation, where invasive species are disturbed during construction activities, they have the potential to spread to surrounding sites and/or into the receiving water environment. This would be considered a permanent, moderate impact.

7.5.2.5 Temporary Site Compounds

A number of potential locations have been identified (see Figure 7-5) as temporary construction compounds which will be made available during the construction works. They will be used as a store for dry materials (steel, cladding, precast concrete, etc.) and potentially as a staging area for the works. There are no groundworks required in these areas with the exception of minor site clearance (topsoil stripping where required). It is not proposed to remove any significant volumes of soil from these sites. The proposed construction compound sites activities have low likelihood for significant impact/interaction with the land, soils and hydrogeological environment.

7.5.2.6 Accidental Spillages

Potential impacts during the construction phase include the potential for leakage or spillage of construction related materials on site. For example, raw or uncured concrete and grouts, wash down water from exposed aggregate surfaces, cast-in-place concrete from concrete trucks, fuels, lubricants and hydraulic fluids for equipment used on the development site, bitumen and sealants used for waterproofing concrete surfaces can all potentially impact on soils and groundwater during the construction stage. Impacts on water quality and soils would be negative, short term in duration and imperceptible in significance.

7.5.3 Operational Phase

There will be no direct discharges to the soil and hydrogeological environment during the operational phase. Therefore, no significant impacts are anticipated. The operation of the Proposed WwTP Component will not give rise to indirect or in-combination impacts.

7.6 Mitigation Measures

7.6.1 Construction Phase

The construction contracts will require that the contractor produce a contract specific Construction Environmental Management Plan (CEMP) and waste and invasive species management plans will form part of this document. An Outline Waste Management Plan has been produced and is contained in Appendix 7A. An Outline Invasive Species Management Plan has been produced and is contained in Appendix 6A.

7.6.1.1 Excavation and Waste Disposal

In order to mitigate potential impacts associated with contaminated material and spoil disposal, the contract documents for the Proposed WwTP Component will include the following provisions:

- The contractor will be required to produce a project specific Waste Management Plan addressing inter alia the disposal of contaminated soil;
- All unsuitable (contaminated) material shall be disposed of in accordance with all relevant legislation including the Department of the Environment and Local Government (DoELG) (1996 to 2008), Waste Management Acts, the DoELG (1998) Waste Management (Permit) Regulations

and the NRA (2008) Guidelines for the Management of Waste from National Road Construction Projects. Material that cannot be re-used will be handled in accordance with the Landfill Directive (2003/33/EC);

- All waste shall be removed by waste contractors authorised under the Waste Management (Collection Permit) Regulations, 2007 and the Waste Management (Collection Permit) (Amendment) Regulations, 2008;
- The waste collected shall be delivered to authorised waste facilities in accordance with the Waste Management Acts 1996-2010;
- The contractor is required to prepare a contract specific Waste Management Plan for the Proposed WwTP Component in accordance with "Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects". This will provide details of the exact methods it is proposed to employ to manage excavated soil on site and to remove spoil from the site and will include details of the location and end use of the spoil;
- As soil characteristics will vary during the construction operations, the contractor will be required to implement, prior to the commencement of construction works, and thereafter maintain throughout the construction phase, a comprehensive environmental monitoring programme in respect of the soil characteristics. If necessary, disposal outlets will be modified to ensure continuous compliance with all relevant regulations and with this EIAR; and
- A Project Waste Manager will be appointed by the contractor to oversee the implementation and adherence to the plan during the construction phase of the Proposed WwTP Component.

7.6.1.2 Management of Construction Induced Ground Movements

Management of construction induced settlement will be required for the Proposed WwTP Component. In order to mitigate potential impacts associated with construction induced settlement, the contract documents for the Proposed WwTP Component will include the following provisions:

- Condition surveys of the adjacent structures will be carried out prior to construction to provide a baseline for excavation monitoring and piling works;
- Appropriate batters or appropriate temporary works solutions such as sheet piling and trench boxes will be adopted during excavations above groundwater to ensure cut face stability;
- Where excavations extend below groundwater, appropriate retention and construction dewatering systems will be adopted to mitigate the potential effects of drawdown on nearby structures, roads and major services;
- Appropriate foundation construction techniques will be adopted to ensure settlements are within tolerable limits; and
- Settlement monitoring will be carried out during construction to ensure settlements are within tolerable limits.

There are no mitigation measures proposed in relation to piling as there are no adverse significant impacts predicted.

7.6.1.3 Construction Dewatering

Management of temporary construction dewatering and abstracted groundwater discharge will be required for the Proposed WwTP Component. Sheet piling will be required to seal out groundwater inflows from excavations below the groundwater table.

The contractor will be required to provide a method statement for the dewatering of excavations below the water table.

Where construction dewatering is undertaken, a consent/licence issued under Section 16 of the Local Government (Water Pollution) Acts and Regulations must be obtained by the contractor. The discharge licence is likely to be subject to conditions governing: the measurement of flow; effluent quality prior to discharge; pre-treatment (e.g. settlement/filtration, hydrocarbon separation, pH adjustment, etc.); rates of discharge and permitted volumes; provisions for monitoring, and the requirement and frequency of sampling. All groundwater discharges shall strictly comply with all conditions, constraints and requirements imposed under the discharge licence.

In order to mitigate potential impacts associated with the management of groundwater and water the contract documents for the Proposed WwTP Component will include the following provisions:

- Discharge control will be modified as necessary to ensure continuous compliance with all relevant regulations and with this EIAR;
- All discharges arising from the construction phase shall incorporate silt removal and hydrocarbon removal using a hydrocarbon interceptor (which will comply with current European Standard EN858);
- If required, some on-site storage can be provided to allow discharge to sewer over non-peak times each day; and
- If required, some on-site storage can be provided to allow discharge to sewer over non-peak times each day.

7.6.1.4 Management of Invasive Species

Treatment of the Japanese Knotweed will be undertaken in-situ for the bund in the northeast corner of the site.

In order to mitigate potential impacts associated with spread of invasive species, the contract documents for the Proposed WwTP Component will include the following provisions:

- The contractor will employ a qualified ecologist or botanist or horticulturalist to verify if Japanese Knotweed is present prior to carrying out any earthworks. A method statement and contract specific Invasive Species Management Plan will be prepared for the control of disturbance to soils containing Japanese Knotweed and the movement and disposal of soils and vegetation from the site. The method statement shall follow the "Irish Water Information and Guidance Document on Japanese Knotweed";
- A suitably qualified ecologist will oversee the implementation of the Invasive Species Management Plan and monitor the success of the mitigation measures post-construction;
- The area affected by the Japanese Knotweed will be marked with a temporary exclusion zone and there will be no working of vehicles with caterpillar tracks within this exclusion zone;
- The removal of soil or vegetation from the area affected by the Japanese Knotweed will be carried out separately from other site clearance. Soil and vegetation removed will be stockpiled in a separate bunded area, at least 50 meters from high water mark and where there is no risk of accidental transfer or spreading of vegetation or soil onto adjacent areas;
- The soil or vegetation removed from the affected area will be transported to a suitably licensed Landfill Facility for 'deep burial' which comprises immediate cover of 1 m to 2 m with final burial/cover of a minimum of 5 m within 2-4 weeks of initial placement. The full depth of cover will comprise material which is not infected with Japanese Knotweed. These burial/cover requirements are strict and not achievable at all licensed landfill facilities and each Landfill Operator's attention must be drawn to them prior to determining whether the waste can be accepted at any individual facility; and

- Material infected with Japanese Knotweed is deemed to be 'non-hazardous waste' during transportation to a licensed landfill facility and therefore, is subject to the Waste Management Acts and Regulations. The classification of the material at the Landfill Facility is determined by the Landfill Operator.

Note: Where Japanese Knotweed is present but is greater than 7 metres from any area to be excavated, in-situ treatment using herbicides will be undertaken.

7.6.1.5 Accidental Spillage

Measures set out in the Construction Industry Research and Information Association (CIRIA) on the control and management of water pollution from construction sites shall be adhered to by the contractor. Good construction management practices will be employed. During the construction stage, all potentially harmful substances (e.g. oils, diesel, herbicides, pesticides, concrete etc.) will be stored in accordance with the manufacturer's guidelines regarding safe and secure buildings/compounds. The contractor will ensure that adequate means to absorb or contain any spillages of these chemicals are available at all times. Suitable measures will be taken to minimise the potential for pollution arising from accidental spillage.

7.6.2 Operational Phase

No operational mitigation is proposed (apart from measures that will be put in place during the operational phase for the storage of potentially harmful substances). All chemicals will either be stored in a designated area on hardstanding, under cover in a bunded area or will be stored outside in sealed tanks which will be bunded.

7.7 Residual Impacts

7.7.1 Construction Phase

The predicted overall residual impact of the Proposed WwTP Component on land, soils, geology and hydrogeology during the construction stage will be neutral or positive.

As contaminated soils will be removed from site, the risk to the environment will be reduced. As such, the predicted impact on the land and soils environment is permanent and slightly positive.

The removal and control of Japanese Knotweed on the site will result in a slight positive permanent impact.

7.7.2 Operational Phase

The predicted overall residual impact of the Proposed WwTP Component on land, soils, geology and hydrogeology during the operational stages will be neutral.

7.7.3 Interactions

The principal interactions requiring information exchange between the Land and Soils Specialist and other environmental specialists and the design team are summarised below.

The earthworks associated with the construction of the Proposed WwTP Component interacts with several disciplines.

7.7.3.1 Biodiversity

The ecological survey of the site established the presence of the invasive species Japanese Knotweed. Section 7: Land and Soils addresses the disposal of contaminated soils. Interaction between the Land and Soils specialist and the Biodiversity specialist was required to determine the location and volumes of soils contaminated with Japanese Knotweed and the disposal route and methodology. The removal of Japanese Knotweed will result in slight permanent positive impact.

7.7.3.2 Traffic

The volume of contaminated soil (including Japanese Knotweed infested soil) to be disposed of offsite will influence traffic volume prediction by the traffic specialist and the consequent impacts. The potential impacts and mitigation measures relating to traffic are addressed in Section 13: Traffic.

7.7.3.3 Landscape and Visual

The removal of existing bunds and soils can remove screening properties and influence the visual impact of the Proposed WwTP Component. The impact of this has been assessed in Section 14: Landscape and Visual. Mitigation in the form of planting on the boundary is proposed and the long-term impact is predicted to be imperceptible.

7.7.3.4 Air and Climate

The construction activities will generate dust. Impacts and mitigation of dust generation are addressed in Section 8: Air and Climate. The impacts of dust associated with the construction phase are predicted to be imperceptible following implementation of the proposed mitigation measures.

7.7.3.5 Noise and Vibration

The activities associated with the land and soils environment (earthworks and piling) will contribute to the noise emissions from the site. The noise and vibration impacts associated with earthworks and piling are addressed in Section 9: Noise and Vibration.

7.7.3.6 Cultural Heritage

Information on the depths of made ground and subsurface conditions were provided to the Cultural Heritage specialist to assist in determining the likelihood of encountering buried archaeology during earthworks and excavations. Excavations within the made ground (< 6.3 metres below ground) will have no Impact on buried cultural heritage. Monitoring will be undertaken for any excavation beyond 6.3 metres.

7.7.3.7 Population and Human Health

Details of contaminated soil and its disposal were provided to enable the assessment of impacts on human health (Section 3: Population and Human Health).

7.7.4 Cumulative Impacts

There are no cumulative impacts with other projects predicted. All residual impacts are predicted to be neutral or positive.

7.8 Monitoring

As all of the impacts are predicted to be neutral or positive, no monitoring is proposed.

7.9 Difficulties Encountered

No difficulties were encountered in compiling this Section.

7.10 References

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Section 8: Air and Climate

8.1 Introduction

This Section of the EIAR assesses the potential impacts (and resulting effects) likely to occur as a result of the WwTP component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component") on air quality and climate.

Full details of the Proposed Upgrade Project and the Ringsend WwTP component can be found in Volume 2, Section 3: Description of Proposed Upgrade Project.

This Section has been prepared in line with EPA guidance documents on the preparation of Environmental Impact Assessment Reports, *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (Draft, August 2017) and *Advice Notes for Preparing Environmental Impact Statements* (Draft, September 2015). The assessment of air quality and climate impacts associated with the Regional Biosolids Storage Facility component of the Proposed Upgrade Project is discussed in Volume 4, Section 8: Air and Climate. The assessment of Odour is addressed Volume 3, Section 10: Odour of this EIAR.

8.2 Background Information

8.2.1 Ambient Air Quality Standards

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or "Air Quality Standards" are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set (see Table 8-1 and Appendix 8A).

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the Air Quality Standards Regulations 2011, which incorporate EU Directive 2008/50/EC, which has set limit values for SO_2, NO_2, Particulate Matter < 10 µm (PM_{10}), Particulate Matter < 2.5 µm ($PM_{2.5}$, Benzene and CO (see Table 8-1). Council Directive 2008/50/EC combines the previous Air Quality Framework Directive (96/62/EC) and its subsequent daughter directives (including 1999/30/EC and 2000/69/EC). Provisions were also made for the inclusion of new ambient limit values relating to $PM_{2.5}$ (see Appendix 8A).

Table 8-1: Air Quality Standard Regulations 2011 Limit Values

Pollutant	Regulation[5]	Limit Type	Value
Nitrogen Dioxide (NO_2)	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 µg/m^3
		Annual limit for protection of human health	40 µg/m^3

[5]. *EU 2008/50/EC - Clean Air For Europe (CAFÉ) Directive replaces the previous Air Framework Directive (1996/30/EC) and daughter directives 1999/30/EC and 2000/69/EC*

Pollutant	Regulation[5]	Limit Type	Value
		Critical limit for protection of vegetation	30 µg/m³ NO + NO_2
Lead	2008/50/EC	Annual limit for protection of human health	0.5 µg/m³
Sulphur dioxide (SO_2)	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 24 times/year	350 µg/m³
		Daily limit for protection of human health - not to be exceeded more than 3 times/year	125 µg/m³
		Critical limit for the protection of ecosystems	20 µg/m³
Particulate Matter (PM_{10})	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m³
		Annual limit for protection of human health	40 µg/m³
Particulate Matter ($PM_{2.5}$)	2008/50/EC	Annual limit for protection of human health	25 µg/m³
Benzene	2008/50/EC	Annual limit for protection of human health	5 µg/m³
Carbon Monoxide (CO)	2008/50/EC	8-hour limit (on a rolling basis) for protection of human health	10 mg/m³ (8.6 ppm)

8.2.2 Climate Agreements

Ireland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in April 1994 and the Kyoto Protocol in 1997 (United Nations, 1997), (Framework Convention on Climate Change, 1999). For the purposes of the EU burden sharing agreement under Article 4 of the Kyoto Protocol, Ireland agreed to limit the net anthropogenic growth of the six greenhouse gases (GHGs) under the Kyoto Protocol to 13% above the 1990 level over the period 2008 to 2012 (Environmental Resource Management, 1998). The UNFCCC is continuing detailed negotiations in relation to GHGs reductions and in relation to technical issues such as Emission Trading and burden sharing. The most recent Conference of the Parties to the Convention (COP23) took place in Bonn, Germany from 06 to 17 November 2017 and focussed on advancing the implementation of the Paris Agreement. The Paris Agreement was established at COP21 in Paris 2015 and was an important milestone in terms of international climate change agreements. The "Paris Agreement", agreed by over 200 nations, has a stated aim of limiting global temperature increases to no more than 2 °C above pre-industrial levels with efforts to limit this rise to 1.5 °C. The aim is to limit global GHG emissions to 40 gigatonnes as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to GHG emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress was also made on elevating adaption of countries to deal with the impacts of climate change onto the same level as action to cut and curb emissions.

The EU, on the 23/24 October 2014, agreed the "2030 Climate and Energy Policy Framework" (European Union (EU), 2014). The European Council endorsed a binding EU target of at least a 40% domestic reduction in GHG emissions by 2030 compared to 1990. The target will be delivered collectively by the EU in the most cost-effective manner possible, with the reductions in the emissions-trading-system (ETS) and non-ETS sectors amounting to 43% and 30% by 2030 compared to 2005, respectively. Secondly, it was agreed that all Member States will participate in this effort, balancing considerations of fairness and solidarity. The policy also outlines, under "Renewables and Energy Efficiency", an EU binding target of at least 27% for the share of renewable energy consumed in the EU in 2030.

8.2.3 Gothenburg Protocol

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. The initial objective of the Protocol was to control and reduce emissions of Sulphur Dioxide (SO_2), Nitrogen Oxides (NO_X), Volatile Organic Compounds (VOCs) and Ammonia (NH_3).

To achieve the initial targets Ireland was obliged, by 2010, to meet national emission ceilings of 42 kt for SO_2 (67% below 2001 levels), 65 kt for NO_X (52% reduction), 55 kt for VOCs (37% reduction) and 116 kt for NH_3 (6% reduction). In 2012, the Gothenburg Protocol was revised to include national emission reduction commitments for the main air pollutants to be achieved in 2020 and beyond and to include emission reduction commitments for $PM_{2.5}$.

European Commission Directive 2001/81/EC and the National Emissions Ceiling Directive (NECD), prescribes the same emission limits as the 1999 Gothenburg Protocol. A National Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005 (Department of the Environment, Heritage and Local Government (DEHLG), 2004). Data available from the EU in 2010 indicated that Ireland complied with the emissions ceilings for SO_2, VOCs and NH_3 but failed to comply with the ceiling for NO_X (European Environment Agency (EEA), 2012). COM (2013) 920 Final is the "*Proposal for a Directive on the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC*". The proposal will apply the 2010 NECD limits until 2020 and establish new national emission reduction commitments which will be applicable from 2020 and 2030 for SO_2, NO_X, NMVOC, NH_3, $PM_{2.5}$ and CH_4. In relation to Ireland, 2020-29 and 2030 GHG emission targets are detailed in Table 8-2 below.

Table 8-2: GHG Emission Targets

Target Date	SO_2	NO_X	VOCs	NH_3	$PM_{2.5}$
2020-29	65% below 2005 levels	49% reduction	25% reduction	1% reduction	18% reduction
2030	83% below 2005 levels	75% reduction	32% reduction	7% reduction	35% reduction

8.3 Methodology

8.3.1 Air Quality Assessment Methodology

EU and Irish legislation do not identify criteria for the assessment of the significance of air quality impacts, either as a percentage of limit value or otherwise. However, the Transport Infrastructure Ireland (TII) document "*Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes*" (Transport Infrastructure Ireland (TII), 2011) details a methodology for determining air quality impact significance criteria for road schemes. Whist directly relevant to road schemes, this methodology can be applied to any assessment where there is a change in traffic, during both construction and operational phases, as is the case here (see Section 13: Traffic). Changes in traffic flows are assumed to be the primary source of air quality impacts associated with the Proposed WwTP Component. The TII methodology provides that the significance of impact is determined based on both the absolute and relative impact of the Proposed WwTP Component. The TII significance criteria have been adopted for the purposes of this assessment and are detailed in Table 8-3, Table 8-4 and Table 8-5. The significance criteria are based on PM_{10} and NO_2 as these pollutants are most likely to exceed the limit values. However, these significance criteria have also been applied to the predicted 8-hour CO, annual benzene and annual $PM_{2.5}$ concentrations for the purposes of this assessment.

Table 8-3: Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Magnitude of Change	Annual Mean NO_2 / PM_{10}	No. days with PM_{10} concentration > 50 μg/m³	Annual Mean $PM_{2.5}$
Large	Increase / decrease ≥4 μg/m³	Increase / decrease >4 days	Increase / decrease ≥2.5 μg/m³
Medium	Increase / decrease 2 - <4 μg/m³	Increase / decrease 3 or 4 days	Increase / decrease 1.25 - <2.5 μg/m³
Small	Increase / decrease 0.4 - <2 μg/m³	Increase / decrease 1 or 2 days	Increase / decrease 0.25 - <1.25 μg/m³
Imperceptible	Increase / decrease <0.4 μg/m³	Increase / decrease <1 day	Increase / decrease <0.25 μg/m³

Source: Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes - Transport Infrastructure Ireland (2011)

Table 8-4: Air Quality Impact Significance Criteria for Annual Mean Nitrogen Dioxide and PM_{10} and $PM_{2.5}$ Concentrations at a Receptor

Absolute Concentration in Relation to Objective/Limit Value	Change in Concentration[6]		
	Small	Medium	Large
Increase with Scheme			
Above Objective/Limit Value with Scheme (≥40 μg/m³ of NO_2 or PM_{10}) (≥25 μg/m³ of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value with Scheme (36 - <40 μg/m³ of NO_2 or PM_{10}) (22.5 - <25 μg/m³ of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value with Scheme (30 - <36 μg/m³ of NO_2 or PM_{10}) (18.75 - <22.5 μg/m³ of $PM_{2.5}$)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value with Scheme (<30 μg/m³ of NO_2 or PM_{10}) (<18.75 μg/m³ of $PM_{2.5}$)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value with Scheme (≥40 μg/m³ of NO_2 or PM_{10}) (≥25 μg/m³ of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value with Scheme (36 - <40 μg/m³ of NO_2 or PM_{10}) (22.5 - <25 μg/m³ of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value with Scheme (30 - <36 μg/m³ of NO_2 or PM_{10}) (18.75 - <22.5 μg/m³ of $PM_{2.5}$)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value with Scheme (<30 μg/m³ of NO_2 or PM_{10}) (<18.75 μg/m³ of $PM_{2.5}$)	Negligible	Negligible	Slight Beneficial

[6] *Well Below Standard = <75% of limit value.*

Source: Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes - Transport Infrastructure Ireland (2011)

Table 8-5: Air Quality Impact Significance Criteria for Changes to Number of Days with PM_{10} Concentration Greater than 50 µg/m³ at a Receptor

Absolute Concentration in Relation to Objective / Limit Value	Change in Concentration[7]		
	Small	Medium	Large
Increase with Scheme			
Above Objective/Limit Value with Scheme (≥35 days)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value with Scheme (32 - <35 days)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value with Scheme (26 - <32 days)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value with Scheme (<26 days)	Negligible	Negligible	Slight Adverse
Decrease with Scheme			
Above Objective/Limit Value with Scheme (≥35 days)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value with Scheme (32 - <35 days)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value with Scheme (26 - <32 days)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value with Scheme (<26 days)	Negligible	Negligible	Slight Beneficial

The air quality assessment has been carried out in accordance with the procedures described in the publications by the EPA (EPA 2002, 2003, 2015 and 2017) and using the methodology outlined in the guidance documents published by the TII (Transport Infrastructure Ireland (TII), 2011) and UK DEFRA (UK DETR (1998), UK DEFRA (2000), UK DEFRA (2001), UK Highways Agency (2007), UK DEFRA (2016), UK DEFRA (2016a), UK DEFRA (2016b)). The use of UK DEFRA guidance is recommended by TII in its guidance document "*Guidelines on the Treatment of Air Quality During the Planning and Construction of National Road Schemes*" (TII, 2011). The air quality assessment is carried out using a phased approach as recommended by the UK DEFRA (UK DEFRA, 2016b). The phased approach recommends that the complexity of an air quality assessment be consistent with the risk of failing to achieve the air quality standards. For this assessment, a desk-based scoping exercise was undertaken to identify the potential key pollutants and the identification of likely air pollution "*hot-spot*" locations. An examination of recent EPA and Local Authority data in Ireland (Environmental Protection Agency, 2017b) has indicated that SO_2 and smoke are unlikely to be exceeded at the Proposed WwTP Component site and therefore it is considered that these pollutants do not require further assessment and have been scoped out of this assessment. The analysis did indicate potential impacts arising from nitrogen dioxide (NO_2), PM_{10} and $PM_{2.5}$ at busy junctions in urban centres (EPA 2017a, EPA 2017b). Benzene, although previously reported at quite high levels in urban centres, has recently been measured at several city centre locations to be well below the EU limit value (EPA 2017a, EPA 2017b).

[7] *Where the Impact Magnitude is Imperceptible, then the Impact Description is Negligible*

Source: Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes - Transport Infrastructure Ireland (2011)

Historically, CO levels in urban areas were a cause for concern. However, CO concentrations have decreased significantly over the past number of years and are now measured to be well below the limits even in urban centres (EPA 2017a, 2017b). The key pollutants considered as part of this assessment are NO_2, PM_{10}, $PM_{2.5}$, benzene and CO, with particular focus on NO_2 and PM_{10}.

Key pollutant concentrations were predicted for nearby sensitive receptors within these hot-spots for the following scenarios:

- The Existing scenario (2017), for model verification;
- Opening Year Do-nothing scenario (DN), which assumes no development in place (2028);
- Opening Year Do-something scenario (DS), which assumes the Proposed WwTP Component is in place (2028);
- Design Year DN scenario, which assumes no Proposed WwTP Component in place (2040); and
- Design Year DS scenario, which assumes the Proposed WwTP Component in place (2040).

The air quality assessment methodology involved air dispersion modelling using the UK DMRB (Design Manual for Roads and Bridges) Screening Model (Version 1.03c, July 2007) (UK Highways Agency, 2007) ("the DMRB Model") the NO_X to NO_2 Conversion Spreadsheet (UK DEFRA, 2016) (Version 5.1), and following guidance issued by Transport Infrastructure Ireland (Transport Infrastructure Ireland, 2011), the UK Highways Agency (UK Highways Agency, 2007), UK DEFRA (UK DEFRA, 2000 and 2016) and the EPA (EPA 2002, 2003, 2015 and 2017). The use of the UK based air dispersion modelling methodology such as the DMRB Model is recommended by TII in the absence of relevant Irish methodology.

The TII guidance states that the assessment must progress to detailed modelling if:

- Pollutant concentrations exceed 90% of the air quality limit values when assessed by the screening method; or
- Sensitive receptors exist within 50 m of a complex road layout (e.g. grade separated junctions, hills etc.).

Additionally, the UK DMRB guidance (UK DEFRA, 2016a) states that road links meeting one or more of the following criteria can be defined as being ‘affected’ by the Proposed WwTP Component and should be included in the local air quality assessment:

- Road alignment change of 5 metres or more;
- Daily traffic flow changes by 1,000 AADT or more;
- HGV flows change by 200 vehicles per day or more;
- Daily average speed changes by 10 km/h or more; or
- Peak hour speed changes by 20 km/h or more.

The DMRB Model calculates concentrations of key pollutants at sensitive receptors which have the potential to be affected by the Proposed WwTP Component. Road links which are affected by the Proposed WwTP Component and within 200 m of the chosen sensitive receptors are required for input into the model. Other inputs into the DMRB Model include: road layouts, receptor locations, annual average daily traffic movements (AADT), percentage heavy goods vehicles, annual average traffic speeds and background concentrations. The UK DMRB guidance states that road links at a distance of greater than 200 m from a sensitive receptor will not influence pollutant concentrations at the receptor. Using this input data, the model predicts the road traffic contribution to ambient ground level pollutant concentrations at the worst-case sensitive receptors using generic meteorological data.

The DMRB model uses conservative emission factors, the formulae for which are outlined in the DMRB Volume 11, Section 3 Part 1 - HA 207/07 Annexes B3 and B4. The worst-case road contribution is then added to the existing background concentrations to give the worst-case predicted ambient concentrations. The worst-case ambient concentrations are then compared with the relevant ambient air quality standards to assess the compliance of the Proposed WwTP Component with the relevant ambient air quality standards.

The TII Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes(7) detail a methodology for determining air quality impact significance criteria for developments which involve increased traffic flows or road schemes. The degree of impact is determined based on both the absolute and relative impact of the Proposed WwTP Component. The TII significance criteria have been adopted for the Proposed WwTP Component and are detailed in Table 8-3, Table 8-4 and Table 8-5. The significance criteria are based on PM_{10} and NO_2 as these pollutants are most likely to exceed the annual mean limit values (40 µg/m^3). However, the significance criteria have also been applied to the predicted 8-hour CO, annual benzene and annual $PM_{2.5}$ concentrations for the purposes of this assessment. The outputs from the DMRB model are compared against the significance criteria and the impact of the Proposed WwTP Component is then determined.

8.3.2 Conversion of Nitrogen Oxides to Nitrogen Dioxides (NO_X to NO_2)

There are emissions associated with the various wastewater treatment processes on site, primarily nitrogen oxides (NO_X). An air dispersion model such as the USEPA's AERMOD can be used to model these emissions and assess their impact to ambient air quality. The model is a steady-state Gaussian plume model used to assess pollutant concentrations associated with industrial sources. The model is recommended as an appropriate model for assessing the impact of air emissions from industrial facilities in the EPA Guidance document "*Air Dispersion Modelling from Industrial Installations Guidance Note (AG4) (2010)*". However, the use of this model was deemed unnecessary as emissions from the Proposed Upgrade Project cannot be properly quantified but are considered to be lower than current emissions. Historical EPA monitoring of NO_2 at a site on Sean Moore Road, approximately 1km from the current WwTP site and Proposed Upgrade Project indicated that levels of NO_2 were well below the annual limit value of 40 µg/m^3 (see Section 8.4.3). This would indicate that the current WwTP was not impacting ambient air quality. As the Proposed Upgrade Project is predicted to have lower air emissions than present, impacts to air quality are not predicted and therefore air dispersion modelling of process emissions was not needed.

NO_X ($NO + NO_2$) is emitted by vehicle and diesel generators exhausts. The majority of emissions are in the form of NO, however, with increased numbers of diesel vehicles and regenerative particle traps on HGVs, the proportion of NO_X emitted as NO_2 rather than NO is increasing. With the correct conditions (presence of sunlight and O_3) emissions in the form of NO, have the potential to be converted to NO_2.

Transport Infrastructure Ireland sets out the recommended method for the conversion of NO_X to NO_2 in the TII guidelines (Transport Infrastructure Ireland, 2009). The TII guidelines recommend the use of DEFRA's NO_X to NO_2 calculator (UK DEFRA, 2016) which was originally published in 2009 and is currently on version 5.1. This calculator accounts for the predicted availability of O_3 and proportion of NO_X emitted as NO for each local authority across the UK. O_3 is a regional pollutant and therefore concentrations do not vary in the same way as concentrations of NO_2 or PM_{10}.

The calculator includes Local Authorities in Northern Ireland and the TII guidance recommends that Craigavon provides the most suitable relationship between NO_2 and NO_X for Ireland. The "All Other Urban UK Traffic" traffic mix option was used in the conversion calculations.

8.3.3 Climate Assessment

The impact of the construction phase of the Proposed WwTP Component on climate has been estimated using the UK Environment Agency's Carbon Calculator (Version 3.6, 2014). The carbon calculator measures the greenhouse gas impacts of construction activities (in terms of CO_2eq) by calculating the embodied CO_2eq of material plus the CO_2eq associated with their transportation. The model can also consider personnel travel, site energy use and waste management.

Information on the material quantities, waste product and construction traffic was obtained for this assessment. This information was input into the Carbon Calculator to determine an estimate of the GHG emissions associated with the Proposed WwTP Component.

The impact of the Proposed WwTP Component on climate at a national / international level during the operational stage is determined using the procedures given by Transport Infrastructure Ireland (Transport Infrastructure Ireland, 2011) and the methodology provided in Annex 2 in the UK Design Manual for Roads and Bridges (UK Highways Agency, 2007). The assessment uses air dispersion modelling with the DMRB Model and focuses on determining the resulting change in emissions of volatile organic compounds (VOC's), nitrogen oxides (NOx) and carbon dioxide (CO_2). The Annex provides a method for the prediction of the regional impact of emissions of these pollutants from road schemes or any development which experiences a change in traffic flows such as this one (see Section 13: Traffic). The inputs to the air dispersion model (the DMRB Model) are similar to those required for the air quality assessment and consist of information on road link lengths, AADT movements and annual average traffic speeds.

8.3.4 Ecological Sites

The TII Guidance (Transport Infrastructure Ireland, 2009) requires consultation with an ecologist on the potential air quality impacts on designated areas of conservation (both Irish and European designated sites) within 2 km of a proposed project. However, in practice the potential for impact on a designated site is highest within 200 m of the proposed project and when significant changes in AADT (Annual Average Daily Traffic) (>5%) occur.

The TII's *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (Transport Infrastructure Ireland, 2009) and *Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities* (Department of the Environment, Heritage and Local Government (DEHLG), 2010) provide details regarding the legal protection of designated conservation areas.

If a designated area of conservation is within 200 m of the Proposed WwTP Component and a significant change in AADT flows is met, an assessment of the potential for impact due to nitrogen deposition should be assessed. This is carried out by air dispersion modelling using the UK DMRB model as outlined in Section 8.2.1 and the NO_X to NO_2 conversion spreadsheet detailed in Section 8.2.2. Concentrations of NO_X (i.e. NO and NO_2) are calculated along a transect up to 200 m from the designated area.

Where any development is predicted to adversely impact concentrations of NO_X by 2 µg/m^3 or more and causing overall concentrations to be within 10% of the 30 µg/m^3 limit, then the sensitivity of the habitat to NO_X should be assessed by the project ecologist.

The Proposed WwTP Component is located within 2 km of the South Dublin Bay proposed Natural Heritage Area, Special Protected Area and Special Area of conservation (pNHA, SPA and SAC) and the

River Tolka Estuary SPA and as such the impact of nitrogen deposition has been assessed and ongoing consultation has been maintained with the project ecologist.

8.4 Existing Environment

8.4.1 Meteorological Data

A key factor in assessing temporal and spatial variations in air quality is the prevailing meteorological conditions. Depending on wind speed and direction, individual receptors may experience very significant variations in pollutant levels under the same source strength (i.e. traffic levels) (World Health Organisation, 2006). Wind is of key importance in dispersing air pollutants and for ground level sources, such as traffic emissions, pollutant concentrations are generally inversely related to wind speed. Thus, concentrations of pollutants derived from traffic sources will generally be greatest under very calm conditions and low wind speeds when the movement of air is restricted. In relation to PM_{10}, the situation is more complex due to the range of sources of this pollutant. Smaller particles (less than $PM_{2.5}$) from traffic sources will be dispersed more rapidly at higher wind speeds. However, fugitive emissions of coarse particles ($PM_{2.5}$ - PM_{10}) will actually increase at higher wind speeds. Thus, measured levels of PM_{10} will be a non-linear function of wind speed.

The nearest representative weather station collating detailed weather records is Dublin Airport, which is located approximately 10 km north of the Proposed WwTP Component. Dublin Airport met data has been examined to identify the prevailing wind direction and average wind speeds over a five-year period (see Figure 8-1). For data collated during five representative years (2012 - 2016), the predominant wind direction is westerly. The average wind speed over the period 1981 – 2010 is approximately 5.3 m/s.

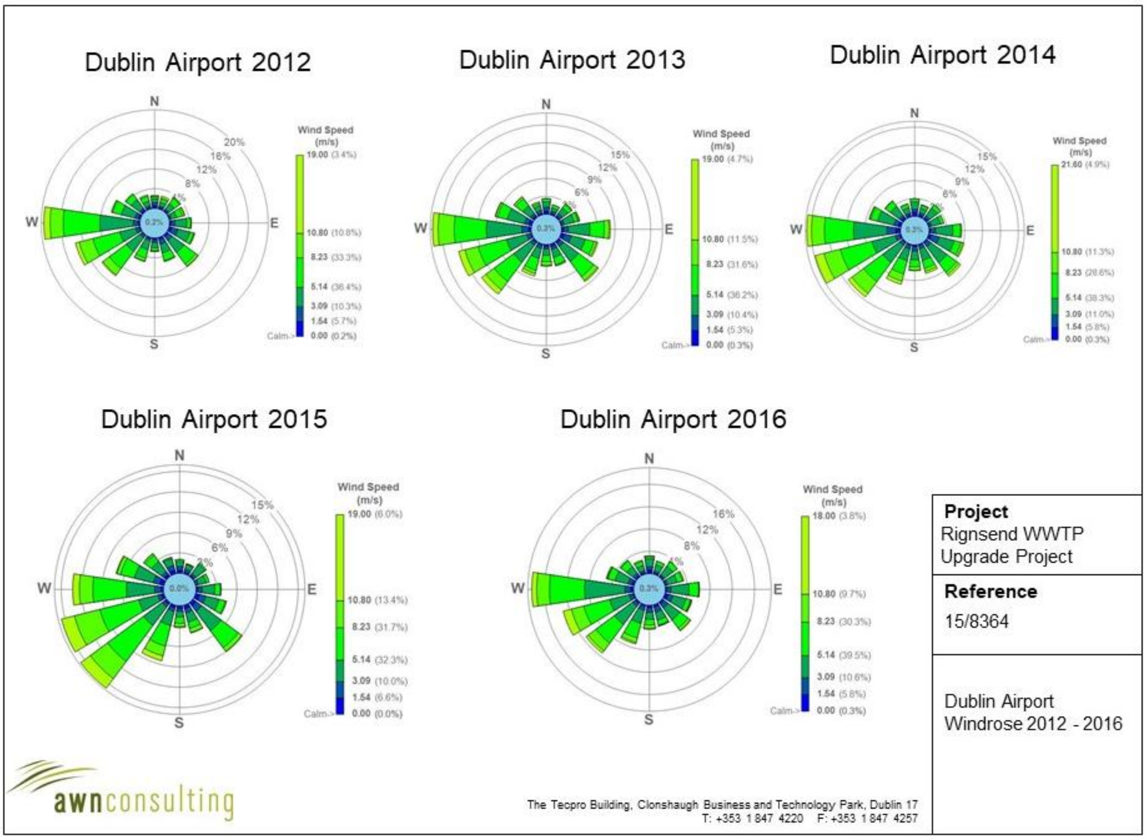

Figure 8-1: Dublin Airport Windrose 2012 – 2016

8.4.2 Trends in Air Quality

Air quality is variable and subject to both significant spatial and temporal variation. In relation to spatial variations in air quality, concentrations generally fall significantly with distance from major road sources (UK DETR, 1998). Thus, residential exposure in urban and suburban areas will be determined by the location of sensitive receptors relative to major roads sources in the area. Temporally, air quality can vary significantly by orders of magnitude due to changes in traffic volumes, meteorological conditions and wind direction.

In 2011, the UK DEFRA published research (UK DEFRA, 2011) on the long-term trends in NO_2 and NO_x for roadside monitoring sites in the UK. This study found a marked decrease in NO_2 concentrations between 1996 and 2002, after which the concentrations stabilised with little reduction between 2004 and 2010. The result of this study is that there now exists a gap between projected NO_2 concentrations which UK DEFRA previously published and monitored concentrations. The impact of this 'gap' is that the DMRB Model can under-predict NO_2 concentrations predicted for future years. Subsequently, the UK Highways Agency (HA) published Interim Advice Note (IAN 170/12) in order to correct the DMRB results for future years. Both methods have been used to assess the impact of NO_2 concentrations during both the construction and operational stages of the Proposed WwTP Component to allow for a comparison between the two methods.

8.4.3 Baseline Air Quality - Review of Available Background Data

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality in Ireland is the "*Air Quality Monitoring Annual Report 2016*" (Environmental Protection Agency, 2017b). The EPA website details the range and scope of monitoring undertaken throughout Ireland and provides both monitoring data and the results of previous air quality assessments (EPA, 2017a).

As part of the implementation of the Air Quality Standards Regulations 2002 (SI No. 271 of 2002), four air quality zones have been defined in Ireland for air quality management and assessment purposes (Environmental Protection Agency, 2017b). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D.

In terms of air monitoring and assessment, the site of the Proposed WwTP Component is within Zone A (Environmental Protection Agency, 2017b). The long-term monitoring data has been used to determine background concentrations for the key pollutants in the region of the Proposed WwTP Component. The background concentration accounts for all non-traffic derived emissions (e.g. natural sources, industry, home heating etc.).

With regard to NO_2, continuous monitoring data from the (Environmental Protection Agency, 2017b) at urban locations in Coleraine Street and Winetavern Street show that current levels of NO_2 are below both the annual and 1-hour limit values (see Table 8-6), with average levels ranging from 28 - 37 $\mu g/m^3$ in 2016. With regards to the monitoring stations in Dun Laoghaire and Rathmines, average levels ranged from 19 - 20 $\mu g/m^3$ in 2016. Sufficient data is available for these four stations to observe long-term trends over the five year period 2012 - 2016 (see Table 8-6), with results averaging between 17 - 32 $\mu g/m^3$ with no exceedances of the one-hour limit value. In addition to this, NO_2 monitoring carried out at a location on the Sean Moore Road, approximately 1 km west of the Ringsend WwTP, between 2009 – 2012 showed an average annual mean of 28 $\mu g/m^3$ which is below the limit of 40 $\mu g/m^3$.

Based on these results, the background NO_2 concentration in the vicinity of the Proposed WwTP Component in 2017 is estimated to be 32 µg/m^3.

Table 8-6: Trends in Dublin City Air Quality - Nitrogen Dioxide (NO_2)

Station	Averaging Period	Year				
		2012	2013	2014	2015	2016
Winetavern Street	Annual Mean NO_2 (µg/m^3)	29	31	31	31	37
	Max 1-hr NO_2 (µg/m^3)	136	158	188	182	194
Coleraine Street	Annual Mean NO_2 (µg/m^3)	26	26	25	25	28
	Max 1-hr NO_2 (µg/m^3)	142	118	130	157	147
Rathmines	Annual Mean NO_2 (µg/m^3)	21	19	17	18	20
	Max 1-hr NO_2 (µg/m^3)	138	107	112	106	102
Dún Laoghaire	Annual Mean NO_2 (µg/m^3)	18	16	15	16	19
	Max 1-hr NO_2 (µg/m^3)	136	123	105	103	142

Continuous PM_{10} monitoring carried out at Winetavern Street showed an average level of 14 µg/m^3 in 2016, with two exceedances of the 24-hour limit value of 50 µg/m^3 (35 exceedances are permitted per year) (Environmental Protection Agency, 2017b) (see Table 8-7). In addition, average PM_{10} levels at the monitoring location in the Phoenix Park in 2016 were 11 µg/m^3, with no exceedances of the 50 µg/m^3 limit value (Environmental Protection Agency, 2017b). The long-term data at Winetavern Street shows a general downward trend in PM_{10} concentrations (Environmental Protection Agency, 2017b). Long-term trends over the period 2012 - 2016 at all locations listed in Table 8-7 show average annual mean PM_{10} levels ranging from 12 - 15 µg/m^3 with no locations experiencing greater than 35 days exceeding the 24-hour limit value of 50 µg/m^3. In addition to this, PM_{10} monitoring carried out at a location on the Sean Moore Road between 2009 – 2012 showed an average daily value of 19.3 µg/m^3 which is below the limit of 50 µg/m^3.

Based on the EPA data (Table 8-7), the background PM_{10} concentration in the vicinity of the Proposed WwTP Component for 2017 is estimated to be 15 µg/m^3.

Table 8-7: Trends in Dublin City Air Quality - Particulate Matter < 10 µm (PM_{10})

Station	Averaging Period	Year				
		2012	2013	2014	2015	2016
Winetavern Street	Annual Mean PM10 (µg/m3)	13	14	14	14	14
	24-hr Mean > 50 µg/m3 (days)	0	3	1	4	2
Rathmines	Annual Mean PM10 (µg/m3)	14	17	14	15	15
	24-hr Mean > 50 µg/m3 (days)	2	8	3	5	3
Phoenix Park	Annual Mean PM10 (µg/m3)	11	14	12	12	11
	24-hr Mean > 50 µg/m3 (days)	0	3	0	2	0
Dún Laoghaire	Annual Mean PM10 (µg/m3)	12	17	14	13	13
	24-hr Mean > 50 µg/m3 (days)	1	5	2	3	0

The results of $PM_{2.5}$ monitoring at Rathmines in 2016 indicated an average $PM_{2.5}/PM_{10}$ ratio of 0.67. A similar result was observed in 2015; and an average ratio of 0.64 was observed in 2014.

Based on this information, a conservative ratio of 0.67 was assumed in calculating the background $PM_{2.5}$ concentration for 2017 of 10.05 µg/m^3.

In terms of benzene, Table 8-8 outlines measurements carried out in Rathmines over the period 2011 - 2016. The average concentration measured over the period was 1.10 µg/m^3, which is well below the limit value of 5 µg/m^3 (Environmental Protection Agency, 2017b). Annual average benzene levels ranged from 0.92 – 1.6 µg/m^3. Based on the EPA data, the background benzene concentration in the vicinity of the Proposed WwTP Component in 2017 is estimated to be 1 µg/m^3.

Table 8-8: Trends in Dublin City Air Quality - Benzene

Station	Averaging Period	Year					
		2011	2012	2013	2014	2015	2016
Rathmines	Annual mean (µg/m3)	1.6	1.2	0.94	0.94	0.92	1.01

With regard to CO, annual averages at the Zone A locations at Winetavern Street and Coleraine Street are low, peaking at 5% of the limit value (10 mg/m^3) in 2016 (see Table 8-9). Similarly, low levels were measured in 2012 - 2015, although trends in the data are not apparent; an average annual mean over the five year period is 0.44 µg/m^3. Based on the annual average EPA data, the background CO concentration in the vicinity of the Proposed WwTP Component in 2017 is estimated to be 0.44 mg/m^3.

Table 8-9: Trends in Dublin City Air Quality - Carbon Monoxide (CO)

Station	Averaging Period	Year				
		2012	2013	2014	2015	2016
Winetavern Street	Annual mean (mg/m^3)	0.1	0	0	0	0.1
Coleraine St.	Annual mean (mg/m^3)	0.4	0.4	0.5	0.4	0.5

Background concentrations for the peak construction year, Opening Year 2028 and Design Year 2040 have been calculated. These have used 2017 background concentrations and the year on year reduction factors provided by Transport Infrastructure Ireland in the *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (Transport Infrastructure Ireland, 2011) and the UK Department for Environment, Food and Rural Affairs LAQM.TG(16) (UK Department of the Environment, Transport and the Regions (DETR), 1998). A summary of the background concentrations is detailed in Table 8-10.

Table 8-10: Summary of the Background Concentrations Used in the Air Dispersion Model

Nitrogen Dioxide (µg/m^3)	Particulates (PM_{10}) (µg/m^3)	Particulates ($PM_{2.5}$) (µg/m^3)	Benzene (µg/m^3)	Carbon Monoxide (mg/m^3)
32	15	10.05	1	0.44

8.5 Characteristics of the WwTP Component of the Proposed Upgrade Project

The Proposed WwTP Component involves the upgrade of the Ringsend Wastewater Treatment Plant (WwTP) to ensure that the Greater Dublin Area has appropriate wastewater treatment to enable continued social and economic development and to safeguard human health and protect the environment.

8.6 Potential Impacts

In terms of air quality and climate, during the construction phase, dust and traffic are expected to be the dominant source of emissions as a result of the Proposed WwTP Component and thus are the focus of this assessment. During the operational phase, increased road traffic is expected to be the dominant source of emissions and thus is the focus of the operational air quality and climate assessment.

8.6.1 Do-Nothing Impacts

Under the Do-nothing Scenario the Proposed WwTP Component will not occur and the site will remain as present. In this scenario, ambient air quality at the site will remain as per the baseline and will change in accordance with trends within the wider area (including influences from any potential new developments in the surrounding areas, changes in road traffic, etc).

8.6.2 Construction Phase - Air Quality

Construction dust has the potential to cause temporary, slight and local impacts through dust nuisance at the nearest houses as shown in Figure 8-2. The Proposed WwTP Component is approximately 1 km to the east of the nearest residential dwellings, on Sean Moore Road. Construction activities such as excavation, earth moving and backfilling may generate quantities of dust, particularly in dry and windy weather conditions. While dust from construction activities may be deposited within 200 m of a construction site, the majority of the deposition occurs within the first 50 m of the Proposed WwTP Component (as shown in Table 8-11). The extent of any dust generation depends on the nature of the dust (soils, peat, sands, gravels, silts etc.) and the nature of the construction activity. In addition, the potential for dust dispersion and deposition depends on local meteorological factors such as rainfall, wind speed and wind direction. Vehicles transporting material to and from the Proposed WwTP Component also have the potential to cause dust generation along the selected haul routes from the construction areas.

Table 8-11: Assessment Criteria for the Impact of Dust from Construction with Standard Mitigation in Practice

Source		Potential distance for significant effects (distance from source)		
Scale	Description	Soiling	PM_{10}	Vegetation effects
Major	Large construction sites, with high use of haul roads	100 m	25 m	25 m
Moderate	Moderate sized construction sites, with moderate use of haul roads	50 m	15 m	15 m
Minor	Minor construction sites, with limited use of haul roads	25 m	10 m	10 m

Source: Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes - Transport Infrastructure Ireland (2011)

Given the distance of the Proposed WwTP Component to the residences (c. 1 km) these residential receptors are unlikely to be affected by dust emissions from the main construction works. The likely source-pathway of dust emissions will be those generated by HGVs associated with the construction phase. The potential short term, reversible, impact of the dust emissions generated by HGVs is described below.

8.6.2.1 Air Quality Dispersion Modelling

Vehicles (including heavy goods vehicles (HGVs) and large goods vehicles (LGVs)) travelling to and from the Proposed WwTP Component site during the construction phase have the potential to cause dust nuisance and increased pollutant concentrations at nearby sensitive receptors. The receptors modelled represent the worst-case locations close to both the affected road links and the Proposed WwTP Component. The receptors were chosen as they are within 200 m of the road links which will be impacted by the additional construction traffic during the construction phase of the Proposed WwTP Component. The traffic data used in this assessment was provided by the traffic consultant and worst-case peak construction phase traffic data was modelled. The worst-case scenario was assessed using the four receptors described below which have been identified as most sensitive to air quality impacts.

8.6.2.2 Locations for Air Quality Modelling Assessment

Four receptors (Figure 8-2) were modelled for the construction phase of the Proposed WwTP Component and are detailed below, coordinates are given in ITM (Irish Transverse Mercator).

1. A residential receptor on the R131 near East Link Bridge (718639, 734026);
2. A residential receptor at Poolbeg Quay Apartments (718830, 733974);
3. A residential receptor (representative of SDZ) on Sean Moore Road (718863, 733535); and
4. A residential receptor located near the Sean Moore Road Roundabout (718918, 733970).

The Strategic Development and Regeneration Area (SDRA) no. 6, known as Poolbeg West (including the glass bottle site), which is adjacent to the Sean Moore Road has been identified for development as part of a Strategic Development Zone (SDZ). It is considered that Receptor 3 which is located close to the Sean Moore Road represents the worst-case scenario for air quality impacts in that immediate vicinity and would therefore apply to any potential receptor within the SDRA 6.

The modelled receptors, including their proximity to the glass bottle site, can be seen below in Figure 8-2.

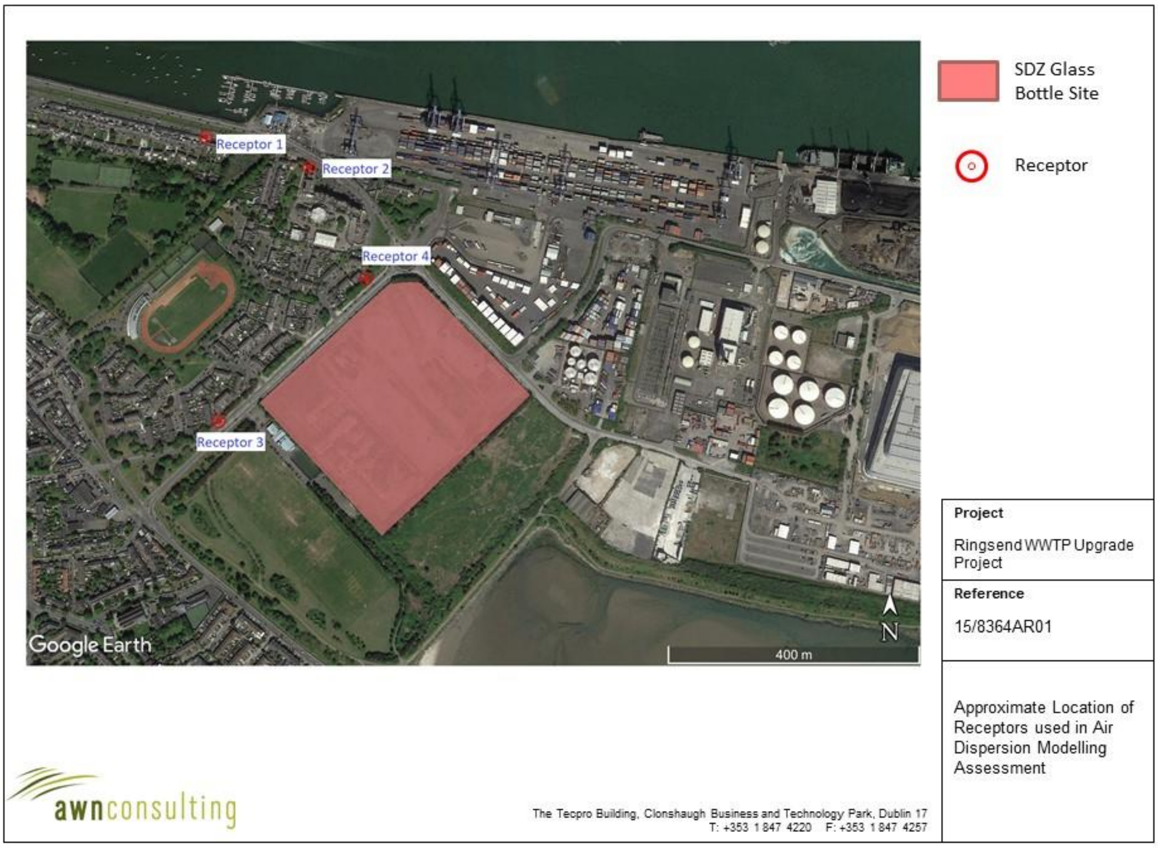

Figure 8-2: Receptors Used in the Air Dispersion Modelling Assessment

8.6.2.3 Modelled Air Quality Impact During Construction Phase

Results are reported assuming average daily speeds of approximately 60 km/hr on the R131 and 50 km/hr on Sean Moore Road. The impact of the Proposed WwTP Component during the peak construction phase was assessed by modelling the emissions from traffic generated as a result of the construction of the Proposed WwTP Component.

Nitrogen Dioxide - NO_2

The impact of the Proposed WwTP Component on concentrations of NO_2 at individual receptors is shown in Table 8-12 for the Highways Agency IAN 170/12 and Table 8-13 using the UK Department for Environment, Food and Rural Affairs technique respectively. Some small increases in NO_2 levels are predicted as a result of the Proposed WwTP Component. Levels of NO_2 reach 79% of the limit using the UK Department for Environment, Food and Rural Affairs technique and 93% of the limit using the more conservative Highways Agency IAN 170/20 technique.

The maximum adverse impact will be an increase of 4.6% of the annual limit value using the more conservative IAN 170/20 technique at Receptor 2. Using the criteria outlined in Table 8-3, this results in a slight adverse impact. The maximum 1-hour limit value is not predicted to be exceeded at any of the receptors assessed using either technique.

Thus, applying the assessment criteria outlined in Table 8-3 - Table 8-4, the potential impact of the Proposed WwTP Component during the construction phase in terms of NO_2 is reversible, short-term and insignificant at all of the receptors assessed, as the impact will decrease once construction works have ceased.

Table 8-12: DMRB Screen Air Quality Assessment, Proposed WwTP Component. Predicted Annual Mean NO_2 Concentrations (Construction Phase; using Interim Advice Note 170/12 V3 Long Term NO_2 Trend Projections)

Receptor	Location	Impact ($\mu g/m^3$)	Magnitude	Description	Increase as % of Ambient Limit Value
1	Pigeon House Road (Adjacent to R131)	1.42	Small	Small Increase	3.6%
2	Poolbeg Quay Apartments	1.82	Small	Small Increase	4.6%
3	Sean Moore Road	0.18	Imperceptible	Negligible Increase	0.4%
4	Sean Moore Road Apartments	0.80	Small	Small Increase	2.0%

Table 8-13: DMRB Screen Air Quality Assessment, Proposed WwTP Component. Predicted Annual Mean NO_2 Concentrations (Construction Phase; using DEFRA's Technical Guidance)

Receptor	Location	Impact ($\mu g/m^3$)	Magnitude	Description	Increase as % of Ambient Limit Value
1	Pigeon House Road (Adjacent to R131)	1.20	Small	Small Increase	3.0%
2	Poolbeg Quay Apartments	1.55	Small	Small Increase	3.9%
3	Sean Moore Road	0.15	Imperceptible	Negligible Increase	0.4%
4	Sean Moore Road Apartments	0.67	Small	Small Increase	1.7%

PM_{10}

The impact of the Proposed WwTP Component on concentrations of PM_{10} at individual receptors are shown in Table 8-14. Some imperceptible increases in PM_{10} levels are predicted as a result of the Proposed WwTP Component. Levels of PM_{10} are 39% of the limit value during the peak construction period.

The maximum adverse impact will be an increase of 0.35% of the annual limit value at Receptor 2. The 24-hour limit value is not exceeded at any location during this period.

Thus, applying the assessment criteria outlined in Table 8-3 - Table 8-5, the impact of the Proposed WwTP Component during the construction phase with regard to PM_{10} is imperceptible, short-term and reversible at all four of the receptors assessed as the impact will decrease once construction works have ceased.

Table 8-14: DMRB Screen Air Quality Assessment, Proposed WwTP Component. Predicted Annual Mean PM_{10} Concentrations (Construction Phase)

Receptor	Location	Impact (µg/m³)	Magnitude	Description	Increase as % of Ambient Limit Value
1	Pigeon House Road (Adjacent to R131)	0.107	Imperceptible	Negligible Increase	0.27%
2	Poolbeg Quay Apartments	0.140	Imperceptible	Negligible Increase	0.35%
3	Sean Moore Road	0.035	Imperceptible	Negligible Increase	0.09%
4	Sean Moore Road Apartments	0.089	Imperceptible	Negligible Increase	0.22%

$PM_{2.5}$

The impact of the Proposed WwTP Component on concentrations of $PM_{2.5}$ at individual receptors can be seen in Table 8-15. Some imperceptible increases in $PM_{2.5}$ levels are predicted as a result of the Proposed WwTP Component. Levels of $PM_{2.5}$ are 41% of the limit value during the peak construction year (2020). The maximum adverse impact will be an increase of 0.4% of the annual limit value at Receptor 2.

Thus, applying the assessment criteria outlined in Table 8-3 and Table 8-4, the impact of the Proposed WwTP Component during the construction phase with regard to $PM_{2.5}$ is short-term, imperceptible and reversible at all of the receptors assessed, as the impact will decrease once construction works have ceased.

Table 8-15: DMRB Screen Air Quality Assessment, Proposed WwTP Component. Predicted Annual Mean $PM_{2.5}$ Concentrations (Construction Phase)

Receptor	Location	Impact (µg/m³)	Magnitude	Description	Increase as % of Ambient Limit Value
1	Pigeon House Road (Adjacent to R131)	0.07	Imperceptible	Negligible Increase	0.3%
2	Poolbeg Quay Apartments	0.09	Imperceptible	Negligible Increase	0.4%
3	Sean Moore Road	0.02	Imperceptible	Negligible Increase	0.1%
4	Sean Moore Road Apartments	0.06	Imperceptible	Negligible Increase	0.2%

CO and Benzene

The impact of the Proposed WwTP Component on concentrations of CO and Benzene at individual receptors are outlined in Table 8-16 and Table 8-17. Some imperceptible increases in pollutant levels are predicted as a result of the Proposed WwTP Component Levels of CO are expected to increase to 28% of the limit value in the peak construction year (2020); with levels of benzene increasing to 32% of the limit value.

The maximum adverse impacts will be an increase of 0.19% of the limit value for CO at Receptor 4 and 0.18% of the limit value for benzene at Receptor 3.

Thus, applying the assessment criteria for NO_2 and PM_{10} outlined in Table 8-3 and Table 8-4, the potential local impacts of the Proposed WwTP Component during the construction phase in terms of CO and benzene are expected to be short-term, imperceptible and reversible, as the impact will decrease once construction works have ceased.

Table 8-16: DMRB Screen Air Quality Assessment, Proposed WwTP Component. Predicted Maximum 8-Hour CO Concentrations (Construction Phase)

Receptor	Location	Impact (mg/m^3)	Magnitude	Description	Increase as % of Ambient Limit Value
1	Pigeon House Road (Adjacent to R131)	0.011	Imperceptible	Negligible Increase	0.11%
2	Poolbeg Quay Apartments	0.014	Imperceptible	Negligible Increase	0.14%
3	Sean Moore Road	0.012	Imperceptible	Negligible Increase	0.12%
4	Sean Moore Road Apartments	0.019	Imperceptible	Negligible Increase	0.19%

Table 8-17: DMRB Screen Air Quality Assessment, Proposed WwTP Component. Predicted Annual Mean Benzene Concentrations (Construction Phase)

Receptor	Location	Impact ($\mu g/m^3$)	Magnitude	Description	Increase as % of Ambient Limit Value
1	Pigeon House Road (Adjacent to R131)	0.005	Imperceptible	Negligible Increase	0.11%
2	Poolbeg Quay Apartments	0.007	Imperceptible	Negligible Increase	0.14%
3	Sean Moore Road	0.009	Imperceptible	Negligible Increase	0.18%
4	Sean Moore Road Apartments	0.008	Imperceptible	Negligible Increase	0.16%

8.6.3 Construction Phase - Climate

The estimated GHG emissions arising as a result of the Proposed WwTP Component are outlined in Table 8-18.

Table 8-18: Greenhouse Gas Emissions Associated with the Proposed WwTP Component

Sub-Totals	Tonnage of Materials	CO_2eq / tonne	CO_2eq (Tonnes)	%
Quarried Material	4,300	0.005	21.5	0%
Timber	1,400	0.45	630	4%
Concrete, Mortars and Cement	24,570	0.11	2629	18%
Metals	3,824	1.45	9830.9	69%
Plastics	0	3.31	0	0%
Glass	0	0.91	0	0%

Sub-Totals	Tonnage of Materials	CO_2eq / tonne	CO_2eq (Tonnes)	%
Miscellaneous	0	n/a	0	0%
Finishings, coatings and adhesives	0	2.91	0	0%
Plant and equipment emissions	0	n/a	0	0%
Waste Removal	36,700	n/a	226.3	2%
Portable site accommodation	0	n/a	0	0%
Material transport	n/a	n/a	210.3	1%
Personnel travel	n/a	3,497 kgCO_2eq/week	727	5%
Total	70,794	n/a	13,548	100%

As shown in Table 8-18, the major source of GHG emissions associated with the construction phase of the Proposed WwTP Component is the use of metals, equating to approximately 69% of the total anticipated emissions. Other sources include concrete, mortars and cement emissions and timber material emissions. The GHG emissions produced during the construction phase of the Proposed WwTP Component are expected to account for 0.03% of Ireland's EU 2020 target and therefore the impacts on climate are considered to be not significant.

8.6.4 Operational Phase - Air Quality

There is the potential for a number of emissions to atmosphere as a result of the Operational Phase of the Proposed WwTP Component. Emissions of NOx (NO + N2O) from the nitrifying and denitrifying cycles within the plant could cause an impact to local air quality. However, these emissions currently occur at the site with no issue as a result of the SBR process; with improved systems implemented with the Proposed WwTP Component, such as the proposed AGS process, future processes are likely to be improved and offer more efficient process control and abatement thus limiting the volume of NOx released, if any.

There will be a number of back-up generators on site to provide power generation in the event of a power failure to site. These have the potential to release NOx during operation. However, the back-up generators are unlikely to cause a significant impact to air quality due to their infrequent use as they will only be in operation in the event of a power failure to site. As a result, it is unlikely that emissions of NOx as a result of the Proposed WwTP Component will have a significant impact on air quality in the long-term. One of the aims of the Proposed WwTP Component is to enhance processes and to reduce overall emissions to air in the long-term. Therefore, as previously mentioned, the primary impact to air quality as a result of the operation of the Proposed WwTP Component is as a result of increased traffic volumes generating increased quantities of air pollutants such as NO_2, CO, benzene and PM10. This impact is discussed in the following section.

8.6.4.1 Air Quality Dispersion Modelling

There is the potential for a number of emissions to the atmosphere during the operational phase of the Proposed WwTP Component. In particular, the increased levels of traffic may generate quantities of air pollutants such as NO_2, CO, benzene and PM_{10}.

Traffic flow information was obtained from the traffic consultant and has been used to model pollutant levels under various traffic scenarios and under sufficient spatial resolution to assess whether any significant air quality impact may occur.

Cumulative effects have been assessed, as recommended in the EU Directive on EIA (Council Directive 2014/52/EU) and using the methodology of the UK DEFRA (UK DEFRA, 2016a, 2016b). Background concentrations (UK DEFRA, 2016a) have been included in the modelling study. These background concentrations are year-specific and account for non-localised sources of the pollutants of concern (UK DEFRA, 2016a). Appropriate background levels were selected based on the available monitoring data provided by the EPA and Local Authorities (EPA, 2017a and 2017b) (see Table 8-10).

The impact of the Proposed WwTP Component has been assessed by modelling emissions from the traffic generated as a result of the development. This traffic data is in the form of Annual Average Daily Traffic (AADT). The assessment methodology involves air dispersion modelling using the UK DMRB Screening Model (Version 1.03c) (UK Highways Agency, 2007). This model requires data in annual average daily traffic (AADT) format. The impact of CO, benzene, NO_2, PM_{10} and $PM_{2.5}$ for the opening year and design year was predicted at the nearest sensitive receptors to the Proposed WwTP Component. This assessment allows the significance of the Proposed WwTP Component, with respect to both relative and absolute impact, to be determined.

8.6.4.2 Modelled Air Quality Impact for the Proposed WwTP Component Once Operational

NO_2

The results of the modelled impact of the Proposed WwTP Component for NO_2 in the opening and design years of the operational phase are shown Table 8-19 for the Highways Agency IAN 170/12 and Table 8-20 using the UK Department for Environment, Food and Rural Affairs technique respectively. Pollutant concentrations during the operational phase of the Proposed WwTP Component are predicted to be below the ambient standards at all locations. Levels of NO_2 are anticipated to increase to 86% and 88% of the annual limit value in 2028 and 2040 using the IAN technique, while concentrations are 65% and 66% of the annual limit value in 2028 and 2040 using the UK Department for Environment, Food and Rural Affairs technique. Maximum one-hour NO_2 levels with the Proposed WwTP Component in place are not predicted to be exceeded using either technique.

The impact of the Proposed WwTP Component during the operational phase has been assessed relative to "Do-nothing" levels in 2028 and 2040. Some small increases in NO_2 are predicted as a result of the Proposed WwTP Component. The maximum adverse impact will be a 3.5% increase in concentrations at Receptor 4 in 2028. Thus, applying the assessment criteria outlined in Table 8-3 to Table 8-4, the impact of the Proposed WwTP Component during the operational stage in terms of NO_2 is long-term and imperceptible and therefore not considered to be significant.

The hourly limit value for NO_2 is 200 µg/m^3 expressed as a 99.8th percentile (i.e. it must not be exceeded more than 18 times per year). The maximum 1-hour NO_2 concentrations are not predicted to be exceeded in 2028 or 2040 for either the "Do-nothing" (DN) or the "Do-something" (DS) scenarios (see Table 8-21).

PM_{10}

The results of the modelled impact of the Proposed WwTP Component for PM_{10} in the opening and design years of the operational phase are shown in Table 8-22. Pollutant concentrations during the operational phase of the Proposed WwTP Component are predicted to be at most 40% of the limit value in 2028 or 2040. In addition, the 24-hour limit value is not exceeded at any location in either 2028 or 2040.

The impact of the Proposed WwTP Component during the operational phase has been assessed relative to "Do-Nothing" levels in 2028 and 2040 (see Table 8-22). Some imperceptible increases in PM_{10} are predicted as a result of the Proposed WwTP Component. The maximum adverse impact will be an increase of 0.6% of the limit value at Receptor 4 in 2028 or 2040. Thus, the magnitude of the changes in air quality during the operational phase of the Proposed WwTP Component are long-term and imperceptible at all receptors based on the criteria outlined in Table 8-3 to Table 8-5 and is therefore not considered to be significant.

$PM_{2.5}$

The results of the modelled impact of the Proposed WwTP Component for $PM_{2.5}$ in the opening and design years of the operational phase are shown in Table 8-23. Pollutant concentrations during the operational phase of the Proposed WwTP Component are predicted to be 41% of the limit value in 2028 at all locations. Future trends with the development in place indicate similarly low levels of $PM_{2.5}$. Annual average $PM_{2.5}$ concentrations are also 44% of the limit in 2040.

The impact of the Proposed WwTP Component during the operational phase can be assessed relative to "Do-nothing" levels in 2028 and 2040 (Table 8-23). Some imperceptible increases in $PM_{2.5}$ concentrations are predicted as a result of the Proposed WwTP Component. The maximum adverse will be an increase of 0.6% of pollutant concentrations at Receptor 4 in 2028. Therefore, applying the assessment criteria outlined in Table 8-3 and Table 8-4, the impact of the Proposed WwTP Component with regard to $PM_{2.5}$ during the operational phase is considered long-term and imperceptible and is therefore not considered to be significant.

CO and Benzene

The results of the modelled impact of CO and benzene in the opening and design years of the operational phase are shown in Table 8-24 and Table 8-25. Pollutant concentrations during the operational phase of the Proposed WwTP Component are predicted to be below the ambient standards at all locations. Levels of CO are anticipated to increase to 29% of the limit value in 2028; with levels of benzene reaching 33% of the limit value in the same year. Future trends indicate similarly low levels of both pollutants. Levels of both pollutants are expected to remain below their respective limit values, with CO reaching 28% of the limit and benzene reaching 35% in 2040. Given the expected increases in traffic flows between 2028 and 2040, any reduction in concentrations is due to reduced background concentrations and greater efficiencies predicted in engines.

The impact of the Proposed WwTP Component during the operational phase has been assessed relative to "Do-nothing" levels in 2028 and 2040. Some imperceptible increases in pollutant levels are predicted as a result of the Proposed WwTP Component. The maximum adverse impact in terms of CO will be an increase of 0.7% of the CO limit value at Receptors 3 and 4. The maximum adverse impact in terms of Benzene concentrations in either 2028 or 2040 will be an increase of 1.2% of the limit value at Receptor 3.

Thus, applying the assessment criteria for NO_2 and PM_{10} outlined in Table 8-3 and Table 8-4 and applying these criteria to CO and benzene, the potential impact of the Proposed WwTP Component in terms of CO and benzene during the operational phase is expected to be long-term and imperceptible and is therefore not considered to be significant.

Table 8-19: DMRB Screen Air Quality Assessment, Proposed WwTP Component. Predicted Annual Mean NO_2 Concentrations (using Interim Advice Note 170/12 V3 Long Term NO_2 Trend Projections)

Receptor	Location	Impact 2028 (µg/m³)	Magnitude	Description	Increase as % of Ambient Limit Value	Impact 2040 (µg/m³)	Magnitude	Description	Increase as % of Ambient Limit Value
1	Pigeon House Road (Adjacent to R131)	1.01	Small	Small Increase	2.5%	0.01	Imperceptible	Negligible Increase	0.034%
2	Poolbeg Quay Apartments	1.28	Small	Small Increase	3.2%	0.01	Imperceptible	Negligible Increase	0.033%
3	Sean Moore Road	0.92	Small	Small Increase	2.3%	0.00	Imperceptible	No Change	0.000%
4	Sean Moore Road Apartments	1.38	Small	Small Increase	3.5%	0.00	Imperceptible	No Change	0.000%

Table 8-20: DMRB Screen Air Quality Assessment, Proposed WwTP Component. Predicted Annual Mean NO_2 Concentrations (using DEFRA's Technical Guidance)

Receptor	Location	Impact 2028 (µg/m³)	Magnitude	Description	Increase as % of Ambient Limit Value	Impact 2040 (µg/m³)	Magnitude	Description	Increase as % of Ambient Limit Value
1	Pigeon House Road (Adjacent to R131)	0.75	Small	Small Increase	1.9%	0.01	Imperceptible	Negligible Increase	0.025%
2	Poolbeg Quay Apartments	0.96	Small	Small Increase	2.4%	0.01	Imperceptible	Negligible Increase	0.025%
3	Sean Moore Road	0.68	Small	Small Increase	1.7%	0.00	Imperceptible	No Change	0.000%
4	Sean Moore Road Apartments	1.01	Small	Small Increase	2.5%	0.00	Imperceptible	No Change	0.000%

Table 8-21: DMRB Screen Air Quality Assessment, Proposed WwTP Component. 1 Hour 99.8th%ile NO_2 Concentrations (µg/m^3)

	IAN 170/12 V3 Long Term NO_2 Trend Projections Technique				Defra's Technical Guidance Technique			
Receptor	Opening Year (2028)		Design Year (2040)		Opening Year (2028)		Design Year (2040)	
	DN	DS	DN	DS	DN	DS	DN	DS
1	112.2	115.8	117	117.1	112.2	115.8	117	117.1
2	116.9	121.4	123.4	123.5	116.9	121.4	123.4	123.5
3	110.6	113.9	113.8	113.8	110.6	113.9	113.8	113.8
4	107.4	112.2	112.5	112.5	107.4	112.2	112.5	112.5

Table 8-22: DMRB Screen Air Quality Assessment, Proposed WwTP Component. Predicted Annual Mean PM10 Concentrations

Receptor	Location	Impact 2028 (µg/m3)	Magnitude	Description	Increase as % of Ambient Limit Value	Impact 2040 (µg/m3)	Magnitude	Description	Increase as % of Ambient Limit Value
1	Pigeon House Road (Adjacent to R131)	0.128	Imperceptible	Negligible Increase	0.3%	0.0011	Imperceptible	Negligible Increase	0.003%
2	Poolbeg Quay Apartments	0.168	Imperceptible	Negligible Increase	0.4%	0.0014	Imperceptible	Negligible Increase	0.004%
3	Sean Moore Road	0.195	Imperceptible	Negligible Increase	0.5%	0.0002	Imperceptible	Negligible Increase	0.0005%
4	Sean Moore Road Apartments	0.223	Imperceptible	Negligible Increase	0.6%	0.0013	Imperceptible	Negligible Increase	0.003%

Table 8-23: DMRB Screen Air Quality Assessment, Proposed WwTP Component. Predicted Annual Mean PM2.5 Concentrations

Receptor	Location	Impact 2028 (µg/m³)	Magnitude	Description	Increase as % of Ambient Limit Value	Impact 2040 (µg/m³)	Magnitude	Description	Increase as % of Ambient Limit Value
1	Pigeon House Road (Adjacent to R131)	0.08	Imperceptible	Negligible Increase	0.3%	0.0007	Imperceptible	Negligible Increase	0.003%
2	Poolbeg Quay Apartments	0.11	Imperceptible	Negligible Increase	0.4%	0.0009	Imperceptible	Negligible Increase	0.004%
3	Sean Moore Road	0.13	Imperceptible	Negligible Increase	0.5%	0.0001	Imperceptible	Negligible Increase	0.0005%
4	Sean Moore Road Apartments	0.14	Imperceptible	Negligible Increase	0.6%	0.0008	Imperceptible	Negligible Increase	0.003%

Table 8-24: DMRB Screen Air Quality Assessment, Proposed WwTP Component. Predicted Maximum 8-Hour CO Concentrations

Receptor	Location	Impact 2028 (mg/m³)	Magnitude	Description	Increase as % of Ambient Limit Value	Impact 2040 (mg/m³)	Magnitude	Description	Increase as % of Ambient Limit Value
1	Pigeon House Road (Adjacent to R131)	0.034	Imperceptible	Negligible Increase	0.3%	0.0003	Imperceptible	Negligible Increase	0.003%
2	Poolbeg Quay Apartments	0.045	Imperceptible	Negligible Increase	0.4%	0.0004	Imperceptible	Negligible Increase	0.004%
3	Sean Moore Road	0.068	Imperceptible	Negligible Increase	0.7%	0.0001	Imperceptible	Negligible Increase	0.001%
4	Sean Moore Road Apartments	0.070	Imperceptible	Negligible Increase	0.7%	0.0003	Imperceptible	Negligible Increase	0.003%

Table 8-25: DMRB Screen Air Quality Assessment, Proposed WwTP Component. Predicted Annual Mean Benzene Concentrations

Receptor	Location	Impact 2028 (µg/m³)	Magnitude	Description	Increase as % of Ambient Limit Value	Impact 2040 (µg/m³)	Magnitude	Description	Increase as % of Ambient Limit Value
1	Pigeon House Road (Adjacent to R131)	0.028	Imperceptible	Negligible Increase	0.6%	0.0003	Imperceptible	Negligible Increase	0.005%
2	Poolbeg Quay Apartments	0.036	Imperceptible	Negligible Increase	0.7%	0.0003	Imperceptible	Negligible Increase	0.007%
3	Sean Moore Road	0.061	Imperceptible	Negligible Increase	1.2%	0.0001	Imperceptible	Negligible Increase	0.001%
4	Sean Moore Road Apartments	0.047	Imperceptible	Negligible Increase	0.9%	0.0001	Imperceptible	Negligible Increase	0.002%

Table 8-26: DMRB Screen Regional Climate Assessment, Proposed WwTP Component

Year	Scenario	VOC	NOX	CO2
		(kg/annum)	(kg/annum)	(tonnes/annum)
2028	Do-Nothing	2698	10256	5156
	Do-Something	2735	10514	5242
2040	Do-Nothing	2999	11995	5811
	Do-Something	3035	12234	5890
Increment in 2020		37.9 kg	257.7 kg	85.7 Tonnes
Increment in 2035		35.5 kg	238.6 kg	79.7 Tonnes
Emission Ceiling (kilo Tonnes) 2020 Note 1		46.5	56.1	42100
Emission Ceiling (kilo Tonnes) 2035 Note 2		42.16	27.5	42100
Impact in 2020 (%)		0.0000815 %	0.000459 %	0.000203 %
Impact in 2035 (%)		0.0000842 %	0.000868 %	0.000189 %

Note 1 Targets under the “Proposal for a Directive on the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC”

Note 2 20-20-20 Climate and Energy Package

8.6.4.3 Modelled Air Quality Impact on Sensitive Ecosystems

The TII Guidelines (Transport Infrastructure Ireland, 2011) state that as the potential impact of a development is limited to a local level, detailed consideration need only be given to roads where there is a significant change to traffic flows (>5%) and the designated site lies within 200 m of the road centre line.

The impact of NOx (i.e. NO and NO_2) emissions resulting from the proposed construction access road adjacent to the South Dublin Bay and the River Tolka Estuary SPA was assessed. This section of the access road runs adjacent to the South Dublin Bay SPA as can be seen in Figure 8-3. Dispersion modelling and prediction was carried out at typical construction traffic speeds at both of these locations. Ambient NOx concentrations predicted for the peak construction traffic along a transect of up to 200 m within the South Dublin Bay and the River Tolka Estuary SPA is presented in Table 8-27: Air Quality Impact on South Dublin Bay SPA. The road contribution to dry deposition along the transect is also presented and was calculated using the methodology of the TII (Transport Infrastructure Ireland, 2011).

Figure 8-3: Construction Access Route in Relation to Site and Dublin Bay SPA

The predicted annual average NOx level in the South Dublin Bay and the River Tolka Estuary SPA near the construction access road exceed the limit value of 30 µg/m^3 for the "Do-nothing" scenario, with NOx concentrations reaching 146% of this limit. Pollutant concentrations during the peak construction period are higher than in the "Do-nothing" scenario, reaching 152% of the limit value.

During the peak construction period, the predicted annual average NOx levels at the South Dublin Bay and the River Tolka Estuary SPA near the construction access road are predicted to exceed the limit value of 30 µg/m^3 for the "Do-something" scenario.

The impact of the construction traffic leads to an increase in NOx concentrations of at most 1.88 µg/m^3 within the South Dublin Bay SPA. Appendix 9 of the TII Guidelines (Transport Infrastructure Ireland, 2011) state that where the scheme or development is expected to cause an increase of more than 2 µg/m^3 and the predicted concentrations (including background) are close to, or exceed the standard, then the sensitivity of the habitat to NO_X should be assessed by the project ecologist.

In the light of the above air quality impact predictions (even though impact was predicted to be less than 2 µg/m^3) the project ecologist was consulted and assessed the potential impact on sensitive ecological receptors (e.g. Brent Geese). The indirect impact on the ecological receptors was assessed and the project ecologist concluded that:

"This level of deposition of NO_2 will have no significant effect on the habitat (improved grassland) or on the bird species that use the South Dublin Bay and the River Tolka Estuary SPA. Brent Geese, wader and gull species are not sensitive to this compound and will continue to use the grassland habitat during construction. Consequently, no mitigation measures are required for this potential impact."

The rate of NO_2 dry deposition within the road corridor, known as the road contribution, was calculated along the 200 m transect within the South Dublin Bay and the River Tolka Estuary SPA. This is detailed in Table 8-27. The maximum predicted increase in the NO_2 dry deposition rate is 0.22 kg(N)/ha/yr during the peak construction period. This reaches only 4.4% of the critical load for inland and surface water habitats of 5-10 kg(N)/ha/yr, Transport Infrastructure Ireland (2011).

Table 8-27: Air Quality Impact on South Dublin Bay SPA

Dist. To Road (m)	NO_x Conc. (µg/m^3)			NO_2 Dry Deposition Rate Impact (Kg(N) /ha/yr)
	Do-Nothing	Do-Something	Impact	
9	43.76	45.64	1.88	0.096
19	43.11	44.54	1.43	0.073
29	42.64	43.73	1.09	0.056
39	42.30	43.15	0.85	0.044
49	42.04	42.71	0.67	0.034
59	41.84	42.37	0.53	0.027
69	41.68	42.10	0.41	0.022
79	41.56	41.89	0.33	0.017
89	41.46	41.72	0.26	0.013
99	41.38	41.58	0.20	0.01
109	41.32	41.47	0.16	0.008
119	41.27	41.39	0.12	0.006
129	41.23	41.33	0.10	0.005
139	41.21	41.29	0.08	0.004
149	41.19	41.26	0.06	0.003
159	41.18	41.24	0.06	0.003
169	41.18	41.23	0.06	0.003
179	41.17	41.21	0.05	0.003

Dist. To Road (m)	NO_x Conc. ($\mu g/m^3$)			NO_2 Dry Deposition Rate Impact (Kg(N) /ha/yr)
	Do-Nothing	Do-Something	Impact	
189	41.15	41.19	0.04	0.002
199	41.14	41.17	0.03	0.002
Standards	30 $\mu g/m^3$	30 $\mu g/m^3$	-	5 - 10 Kg(N)/ha/yr

8.6.5 Operational Phase - Climate

There is the potential for a number of GHG emissions to the atmosphere during the operational phase of the Proposed WwTP Component. Road traffic and space heating of buildings may give rise to CO_2 and N_2O emissions. However, due to the size of the Proposed WwTP Component the potential impacts on national GHG emissions is considered to be insignificant in terms of Ireland's obligations under the EU 2020 target.

The impact of the Proposed WwTP Component on emissions of NO_x and VOCs has been assessed using the procedures of Transport Infrastructure Ireland (Transport Infrastructure Ireland, 2011) and the UK Department for Environment, Food and Rural Affairs (UK DEFRA, 2016b). The results (see Table 8-26) show that the likely impact of the Proposed WwTP Component on Ireland's obligations under the Targets set out by "*Proposal for a Directive on the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC*" are imperceptible and long-term. For the assessment year of 2028, the predicted impact of the changes in AADT is to increase NO_x levels by 257.7 kg which is 0.000459% of the NO_x emissions ceiling (56.1 kt) and increase VOC levels by 37.9 kg which is 0.0000815% of the VOC emissions ceiling (45.6 kt) to be complied with in 2020. For the assessment year of 2040, the predicted impact of the changes in AADT is to increase NO_x levels by 238.6 kg which is 0.000868% of the NO_x emissions ceiling (27.5 kt) and increase VOC levels by 35.5 which is 0.0000842% of the VOC emissions ceiling (42.2 kt) to be complied with in 2035. Therefore, impacts on climate during the operational phase of the Proposed WwTP Component can be deemed long-term and imperceptible and are not considered significant.

8.6.5.1 Regional Climate Impacts

The impact of the Proposed WwTP Component on emissions of CO_2 was also assessed using the DMRB Model (see Table 8-26). The results show that the potential impact of the Proposed WwTP Component in 2028 will be to increase CO_2 emissions by 85.7 tonnes which is 0.000203% of Ireland's EU 2020 Target of 42,100 kt. In the design year of 2040, the Proposed WwTP Component will increase CO_2 emissions by 79.7 tonnes which is 0.000189% of EU 2020 Target. Thus, the potential impact of the Proposed WwTP Component on national GHG emissions is considered to be not significant (European Union, 2017).

Emissions from power generation on site may also cause an impact to climate during the operational phase of the Proposed WwTP Component. Emissions of NOx and CO2 may be released during various processes occurring on site, including heating and drying processes and from the infrequent use of back-up generators to provide power in the event of a power failure to site. With the Proposed WwTP Component, the load to be treated will increase, causing an increase in the power consumption at the site. However, the improved and higher efficiency processes and systems that will be put in place as a result of the Proposed WwTP Component will lead to a lower volume of emissions due to greater efficiency of the processes. It is proposed to increase the amount of biogas used for power generation as this is already generated on site and will be generated in greater quantities once the Proposed WwTP

Component is in operation. This will decrease the reliance on fossil fuel derived power obtained from the national grid and thus overall, reduce any potential impact to climate.

The back-up generators on site are unlikely to cause a significant impact to climate due to their infrequent use as they will only be in operation in the result of a power failure to site.

The magnitude of the likely impacts on climate during the operational phase of the Proposed WwTP Component is expected to be imperceptible, long-term and therefore not significant.

8.7 Mitigation Measures

8.7.1 Construction Phase - Air Quality

The greatest potential impact on air quality during the construction phase of the Proposed WwTP Component is from construction dust emissions and the potential for nuisance dust.

The dust minimisation measures specified in Appendix 8B will be incorporated into a contract-specific CEMP and implemented during the construction phase of the Proposed WwTP Component and thus, fugitive emissions of dust from the site are expected to be insignificant and will not pose a nuisance at nearby receptors.

8.7.2 Construction Phase - Climate

CO_2 and NO_2 emissions during construction are anticipated to have an imperceptible impact on climate, therefore no mitigation measures are considered necessary.

8.7.3 Operational Phase - Air Quality

The results of the dispersion modelling study indicate that no site-specific mitigation measures are required during the operational phase of the Proposed WwTP Component.

8.7.4 Operational Phase - Climate

The impact of the Proposed WwTP Component on climate will be imperceptible. Thus, no site-specific mitigation measures are required.

8.8 Residual Impacts

8.8.1 Construction Phase

If the dust minimisation measures specified in Appendix 8B are implemented, fugitive emissions of dust from the site will be insignificant and pose no nuisance at nearby receptors. There are no statutory limits for dust deposition in Ireland. However, the German Technical Guidelines on Air Quality, known as the TA Luft standards, have set an emission level for dust deposition (non-hazardous dust). An emission level is defined in the TA Luft as a mass concentration or deposition level of an air pollutant. The maximum permissible emission level for dust deposition over a one-year period is 350 $mg/m^2/day$ at any receptors outside the site boundary. A recent report from the Department of Environment, Heritage and Local Government entitled *“Quarries and Ancillary Activities, Guidelines for Planning Authorities”* applies the TA Luft limit for dust deposition at the boundary of quarries. This limit can also be applied at construction sites.

In relation to traffic emissions during the construction phase of the Proposed WwTP Component, the air quality dispersion modelling has found that there will be an imperceptible impact for all pollutants at all receptors assessed. Therefore, residual impacts are not anticipated as a result of the construction phase of the Proposed WwTP Component.

8.8.2 Operational Phase

As can be seen from the air quality dispersion modelling assessment detailed in Section 8.6.4, there will be an imperceptible impact for all pollutants at all receptors assessed. As a result, there are no residual impacts anticipated due to the operational phase of the Proposed WwTP Component.

8.8.3 Interactions

Air Quality does not have a significant number of interactions with other topics. The most significant interactions are between human beings and air quality. An adverse impact due to air quality in either the construction or operational phase has the potential to cause health and dust nuisance issues. The mitigation measures that will be put in place at the site will ensure that the impact of the Proposed WwTP Component complies with all ambient air quality legislative limits and therefore the predicted impact is long term and neutral with respect to human beings.

Interactions between air quality and traffic are significant. With increased traffic movements and reduced engine efficiency, i.e. due to congestion, the emissions of vehicles increase. The impacts of the Proposed WwTP Component on air quality are assessed by reviewing the change in annual average daily traffic on roads close to the site. In this assessment, the impact of the interactions between traffic and air quality are considered to be not significant.

The construction and operation of the Proposed WwTP Component will lead to emissions to the atmosphere which have the potential to impact on sensitive flora, fauna and water, in particular with respect to the Dublin Bay SPA. However, the effect of these emissions is predicted to be neutral for both the construction and operational phases. Construction phase mitigation measures will be implemented to minimise dust emissions which could impact on flora, fauna and water. In the operational phase, impacts meet the criteria set down for ecologically sensitive sites and therefore the interactions between air quality and flora, fauna and water are neutral for both the construction and operational phases.

With the appropriate mitigation measures to prevent fugitive dust emissions, it is predicted that there will be no significant interactions between Air Quality and Soil, Geology. No other significant interactions with Air Quality have been identified.

8.8.4 Cumulative Impacts

There are a number of other significant developments in the vicinity of the Proposed WwTP Component which have been granted planning permission. These include large scale developments such as Dublin Port, Dublin Waste to Energy (complete), Alexandra Basin Re-development and the Poolbeg West Strategic Development Zone. Further detail on the Cumulative Impacts are provided in Section 19 of this Volume of the EIAR.

Should the construction phases of the Proposed WwTP Component overlap with these permitted developments, there is the potential for cumulative construction dust impacts at nearby sensitive receptors. However, it is predicted that appropriate mitigation measures can be put in place to reduce any potential impacts such that they are considered to be not significant.

Cumulative effects of the operational phase have been assessed, as recommended in the EU Directive on EIA (Council Directive 97/11/EC) and using the methodology of the UK DEFRA. Any schemes that are predicted to be in place during the future year have been included in future traffic increases, as significant increases in vehicle emissions due to other developments have the potential to increase background concentrations and therefore raise the significance of impact due to the Proposed WwTP Component. The cumulative effect of the operational phase was found to be long-term, negative and not significant in terms of air quality and climate impacts.

8.9 Monitoring

During the construction phase, dust deposition monitoring will be put in place to ensure dust mitigation measures are adequately controlling emissions. Dust monitoring will be conducted using the Bergerhoff method in accordance with the requirements of the German Standard VDI 2119. The Bergerhoff Gauge consists of a collecting vessel and a stand with a protecting gauge. The collecting vessel is secured to the stand with the opening of the collecting vessel located approximately 2 m above ground level. The TA Luft limit value is 350 mg/(m^2*day) during the monitoring period which is between 28 - 32 days.

There is no monitoring proposed for the operational phase.

8.10 Difficulties Encountered

There were difficulties encountered in quantifying the emissions associated with the processes in the Proposed Upgrade Project, primarily emissions of NO_X and CO_2. Accurate details of process emissions could not be obtained and therefore their impact to ambient air quality and climate could not be quantified through air dispersion modelling. However, historical EPA monitoring data of NO_2 at a site on Sean Moore Road, approximately 1km from the current WwTP site and Proposed Upgrade Project indicated that levels of NO_2 were well below the annual limit value of 40 µg/m^3 (see Section 8.4.3). This would indicate that the current WwTP was not impacting ambient air quality. As the Proposed Upgrade Project is predicted to have lower air emissions than present due to increased process efficiency and greater process control, impacts to air quality and climate are not predicted and the lack of data on emissions did not hinder the assessment.

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Section 9: Noise and Vibration

9.1 Introduction

This Section of the EIAR assesses the potential noise and vibration impacts (and resulting effects) likely to occur as a result of the WwTP component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component") in the context of current relevant standards and guidance and identifies any requirements or possibilities for mitigation. The Ringsend WwTP facility is herein referenced to as the "site".

Full details of the Proposed Upgrade Project and the Ringsend WwTP component can be found in Volume 2, Section 3: Description of Proposed Upgrade Project.

This Section and assessment have been completed having regard to the guidance outlined in the Environmental Protection Agency documents *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (Draft, August 2017) and *Advice Notes for Preparing Environmental Impact Statements* (Draft, September 2015).

In the first instance, it is beneficial to provide an outline of the fundamentals of Noise and Vibration against which the more technical elements of the Section can be put into context. In addition, a Glossary of Acoustic Terminology has been prepared and included in Appendix 9A for reference.

9.1.1 Fundamentals of Noise

A sound wave travelling through the air is a regular disturbance of the atmospheric pressure. These pressure fluctuations are detected by the human ear, producing the sensation of hearing. In order to take account of the vast range of pressure levels that can be detected by the ear, it is convenient to measure sound in terms of a logarithmic ratio of sound pressures. These values are expressed as Sound Pressure Levels in decibels (dB).

The audible range of sounds expressed in terms of Sound Pressure Levels is 0 dB (nominally, the threshold of hearing) to 120 dB (for the threshold of pain). In general, a subjective impression of doubling of loudness corresponds to a tenfold increase in sound energy which conveniently equates to a 10 dB increase in Sound Pressure Level. It should be noted that a doubling in sound energy (such as may be caused by a doubling of traffic flows) increases the Sound Pressure Level by 3 dB.

The frequency of sound is the rate at which a sound wave oscillates and is expressed in Hertz (Hz). The sensitivity of the human ear to different frequencies in the audible range is not uniform. For example, hearing sensitivity decreases markedly as frequency falls below 250 Hz. In order to rank the Sound Pressure Level of various noise sources, the measured level has to be adjusted to give comparatively more weight to the frequencies that are readily detected by the human ear. Several weighting mechanisms have been proposed but the 'A-weighting' system has been found to provide one of the best correlations with perceived loudness. Sound Pressure Level's measured using 'A weighting' are expressed in terms of dB(A).

An indication of the level of some common sounds on the dBA scale is presented in Figure 9-1, which shows a quiet bedroom at around 35 dBA, a nearby noisy heavy goods vehicle at 7 m at 90 dBA and a pneumatic drill at 7 m at about 100 dBA.

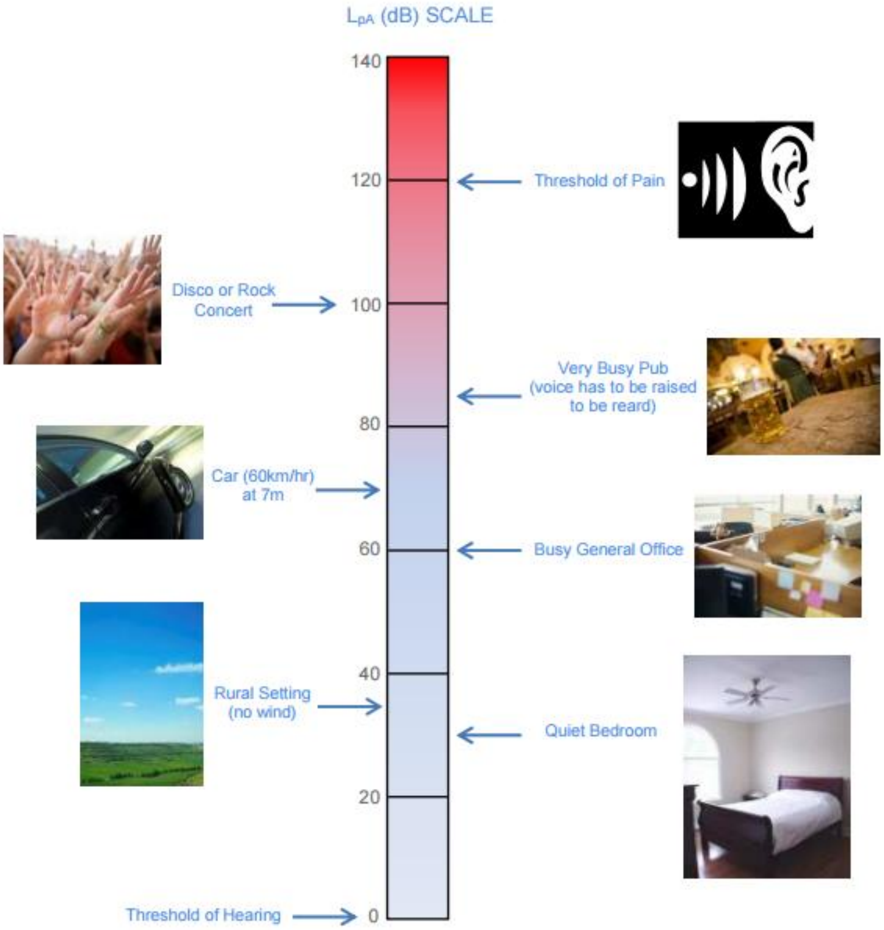


Figure 9-1: Typical Common Sounds on the dBA Scale (Environmental Protection Agency)

9.1.2 Fundamentals of Vibration

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. In both instances, it is appropriate to consider the magnitude of vibration in terms of Peak Particle Velocity.

Peak Particle Velocity is defined in BS 5228-2:2009+A1:2014 *Code of Practice for Noise and Vibration Control on Construction and Open Sites – Vibration* as the:

> *'Instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position.'*

The unit of measurement of Peak Particle Velocity is most commonly millimetres per second, mm/s. However, when dealing with human perception to vibration and the tolerances of sensitive equipment, the unit of measurement of micrometres per second, µm/s, may be used. It is also important to take account of the frequency at which the vibration occurs, which similar to sound, is expressed in Hertz (Hz). Buildings are sensitive to vibration at very low frequencies, i.e. less than 10 Hz, and are more resistant to vibration at higher frequencies, i.e. above 50 Hz.

It is acknowledged, however, that humans are sensitive to vibration stimuli at much lower magnitudes than those likely to cause damage to buildings. Vibration typically becomes perceptible at around 150 to 300 µm/s PPV and may become disturbing or annoying at higher magnitudes.

However, higher levels of vibration are typically tolerated for single events or events of short term duration, particularly during construction projects and when the origin of vibration is known.

9.2 Methodology

This Section and assessment has been completed having regard to the guidance outlined in the Environmental Protection Agencies documents:

- Guidelines on the information to be contained in Environmental Impact Assessment Reports (Draft, August 2017); and
- Advice Notes for Preparing Environmental Impact Statements (Draft, September 2015).

In assessing the noise and vibration impacts the following methodology has been adopted:

- Characterise the receiving environment through a series of baseline surveys;
- Determine appropriate criteria for evaluating the significance of noise and vibration impacts through reference to local guidance documents where applicable and international best practice;
- Calculate the potential noise and vibration impacts using industry standardised calculation methods;
- Assess the impact by comparing the calculated levels against the adopted criteria;
- Where necessary specify mitigation measures to control the impacts to be within the adopted criteria; and
- Present the residual predicted impact of the Proposed Upgrade Project with mitigation measures in place.

9.2.1 Assessment Criteria - Construction Phase

9.2.2 Noise

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Dublin City Council typically controls construction activities by imposing limits on the hours of operation and consider noise limits at their discretion and refer to British Standard *BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control On Construction and Open Sites - Noise* for the control of construction noise impacts.

The approach in this standard calls for the designation of a noise sensitive receptor into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded at this location, indicates a significant noise impact is associated with the construction activities.

BS 5228-1:2009+A1:2014 sets out guidance on permissible noise levels relative to the existing noise environment. Table 9-1 sets out the values which, when exceeded, signify a significant effect at the facades of residential receptors.

Table 9-1: Example Threshold of Significant Effect at Dwellings

Assessment category and threshold value period (LAeq)	Threshold value, in decibels (dB)		
	Category A[8]	Category B[9]	Category C[10]
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and weekends[11]	55	60	65

For the appropriate periods (i.e. daytime) the ambient noise level is determined and rounded to the nearest 5 dB. Baseline monitoring carried out as part of this assessment (section 9.3.1) would indicate that the categories detailed in Table 9-2 are appropriate in terms of the nearest noise sensitive receptors being considered in this instance.

Table 9-2: Rounded Baseline Noise Levels and Associated Categories

Period as defined in BS 5228-1:2009+A1:2014[12]	Rounded Baseline Noise Level L_{Aeq} (dB)	Category	Suggested Limit
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	B	70
Evening (19:00 to 23:00hrs)	65	C	65
Night time (23:00 to 07:00hrs)	55	C	55

If the construction noise exceeds the appropriate category value, then a significant effect is deemed to occur.

9.2.3 Vibration

Vibration standards are generally split into two categories, those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. In both instances, in terms of construction vibration, it is appropriate to consider the magnitude of vibration in terms of Peak Particle Velocity (PPV).

Human Comfort

It is acknowledged that humans are particularly sensitive to vibration stimuli and that any perception of vibration may lead to concern. In the case of road traffic, vibration is perceptible at around 0.5 mm/s

[8] threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.

[9] threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.

[10] threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.

[11] 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

[12] Not proposed construction hours

and may become disturbing or annoying at higher magnitudes. However, higher levels of vibration are typically tolerated for single events or events of short duration.

For example, rock breaking and piling, two of the primary sources of vibration during construction, are typically tolerated at vibration levels up to 12 mm/s and 5 mm/s respectively (BS 5228-1:2009+A1:2014). This guidance is applicable to the daytime only; it is unreasonable to expect people to be tolerant of such activities during the night.

Cosmetic Damage

It is noted that in the absence of specific guidance relevant to the nature of the development proposed, guidance for acceptable vibration within buildings during the construction phase of a development is provided in the following documents:

- British Standard BS 7385-2:1993 Evaluation and Measurement for Vibration in Buildings - Guide to Damage Levels from Ground Borne Vibration (BS7385-2:1993); and
- British Standard BS 5228-2:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Vibration (BS5228-2:2009+A1:2014)

BS 7385-2:1993 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at low frequencies rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above. These guidelines relate to relatively modern buildings and should be reduced to 50% or less for more critical buildings that may be prone to dynamic magnification due to resonance (tall lightweight structures).

BS5228-2:2009+A1:2014 recommends that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak component particle velocity (in frequency range of predominant pulse) of 15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above. Below these values, minor damage is unlikely. Where continuous vibration is such as to give rise to dynamic magnification due to resonance, the guide values may need to be reduced by up to 50%. BS5228-2:2009+A1:2014 also comments that important buildings which are difficult to repair might require special consideration on a case by case basis.

Table 9-3 presents the vibration criteria to be adopted during construction at nearby soundly constructed residential properties and similar structures that are generally in good repair. These limit values have been selected to avoid cosmetic (i.e. non-structural) damage. Please note that the potential for vibration induced damage is greater at lower frequencies of vibration. Therefore, the limit values proposed are related to the frequency range of the vibration. To put this into context, most building damage from man-made sources (construction traffic, etc.) occurs in the frequency range of 1 Hz to 150 Hz.

Table 9-3: Allowable vibration during construction phase for soundly constructed buildings

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of:		
Less than 10 Hz	**10 to 50 Hz**	**50 to 100 Hz (and above)**
15 mm/s	20 mm/s	50 mm/s

The nearest properties where the above vibration limits are applied are the residential dwellings at Locations R01 to R08 and R11 (as shown in Figure 9-2).

Figure 9-2: Vibration Sensitive Receptors

Protected Structures

In the case of the Proposed WwTP Component, it is acknowledged that an existing protected structure (Ringsend Fort) is situated immediately adjacent the site. The old Pigeon House Hotel is located further north of the site, as outlined in Figure 9-3.

Figure 9-3: Vibration Receptor (Lower Limits)

In this instance, it is therefore proposed to apply the lower limits listed in Table 9-4 to these buildings, for which the appropriate threshold is the provided in the following German Standard:

- DIN 4150-3 (1999-02) Structural Vibration - Effects of Vibration on Structures.

Table 9-4: Allowable vibration during construction phase for sensitive buildings

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of:		
Less than 10 Hz	**10 to 50 Hz**	**50 to 100 Hz (and above)**
3 mm/s	3 – 8 mm/s	8 – 10 mm/s

Monitoring of construction vibration in the vicinity of these locations with reference to the lower limit values (ref. Table 9-4) will also ensure that the vibration criteria for soundly constructed buildings (ref. Table 9-3) will be achieved at other nearby receptors.

Underground Services

Consideration should also be given to the potential for vibration induced damage to underground services nearby. Generally underground structures are less susceptible to damage due to vibration. Notwithstanding this, BS 5228-2:2009+A1:2014 recommends that in the absence of specific criteria from the statutory undertakers, the following criteria should be applied to underground services:

- Maximum Peak Particle Velocity for intermittent or transient vibrations - 30 mm/s; and
- Maximum Peak Particle Velocity for continuous vibrations - 15 mm/s.

These criteria should be reduced by 30% in the case where dilapidated brick sewers are encountered.

ESB Gas Turbine

Vibration levels at the turbine building foundation should be less than 6 mm/s. This is a trigger level at which action is required to reduce vibration levels. Note that the ESB turbine foundations are monitored by ESB and a trip is caused if the peak particle velocity in any of the three orthogonal directions exceeds 11 mm/s.

9.2.4 Assessment Criteria – Operational Phase

9.2.5 Noise

Dublin City Council Development Plan (2016 to 2022)

The Dublin City Council Development Plan outlines the following objectives in respect of noise:

"SIO23: *To implement the Dublin Agglomeration Environmental Noise Action Plan (2013 - 2018) in co-operation with the other local authorities in Dublin and the Irish Aviation Authority.*

SIO24: *To protect the designated 'Quiet Areas' within the city from increased exposure to noise.*

SIO25: *To support new technologies and practices as a power source in transport to reduce noise.*

SIO26: *To protect residents of mixed-use developments from noise emanating from other uses such as shops, offices, nightclubs, late night busking, public houses and other night time uses through the planning system.*

SIO27: *To give careful consideration to the location of noise-sensitive developments, including the horizontal and vertical layout of apartment schemes, so as to ensure they are protected from major noise sources where practical.*

SIO28: *To support and facilitate the monitoring and enforcement by the environmental health department of noise reduction measures in areas experiencing excess noise.*

SIO29: *To take cognisance of the Dublin Agglomeration Environmental Noise Action Plan 2013-2018 during the development and implementation of any policies for the city and before any major planning developments commence within Dublin".*

The most relevant of the objectives in relation to the Proposed WwTP Component is the implementation of the requirement to take cognisance of the Dublin Agglomeration Environmental Noise Action Plan 2013-2018 before any major planning developments commence. The Noise Action Plan states the following thresholds be applied when considering developments which introduce people to noise:

> *"Undesirable high sound levels are defined areas with a night time level greater than 55 decibels and a daytime level greater than 70 decibels"*

It is important to note that the Noise Action Plan does not recommend that residential development be restricted within areas identified as having undesirably high noise levels. Instead it recommends a range of noise mitigation measures be required for new residential developments within these areas.

Given that the guidance levels set out within the Noise Action Plan refer to external noise levels, reference has been made to BS8233:2014 – *Guidance on Sound Insulation and Noise Reduction for Buildings* in order to set appropriate internal noise levels within sensitive rooms of the developments.

On-Site Noise Sources

During the operational phase, the potential noise sources on-site are primarily related to additional mechanical plant as well as vehicular movement of biosolids from the site.

Whilst the discharge of effluent from the treatment plant is licenced by the Environmental Protection Agency under WWDL D0034-01, it is specifically stated in this licence that this legislation does not extend to include issues regarding the operation of the WwTP in relation to noise. The licence states the following:

> *"The legislation governing this licence relates specifically to, and is restricted to, the regulation and control of waste water discharges from the agglomeration. Therefore, any odour or noise issue that may be associated with the waste water works including the treatment plant cannot be addressed by this licence".*

As such, in order to set appropriate operational noise criteria for this source, guidance has been taken from the British Standard BS8233:2014.

This standard sets out recommended internal noise levels for several different building types from external noise sources. The guidance is primarily for use by designers and hence BS 8233:2014 may be used as the basis for an appropriate schedule of noise control measures. The recommended indoor ambient noise levels for residential dwellings are set out in Table 9-5.

Table 9-5: Indoor ambient noise levels for dwellings from BS8233: 2014

Activity	Location	Day 07:00 to 23:00hrs dB $L_{Aeq,16hour}$	Night 23:00 to 07:00hrs dB $L_{Aeq,8hour}$
Resting	Living room	35	-
Dining	Dining room/area	40	-
Sleeping (daytime resting)	Bedroom	35	30

It is appropriate to derive external limits based on the internal criteria noted in the paragraph above. This can be done by factoring in the degree of noise reduction afforded by a partially open window. This is nominally deemed to be 15 dB. In summary, the following criteria apply at the façades of those residential properties closest to the Proposed Upgrade Project:

- Daytime (07:00 to 23:00 hours) 55 dB LAeq,16hour, and;
- Night-time (23:00 to 07:00 hours) 45 dB $_{LAeq,8hour}$.

In addition to the application of BS8233:2014, it is also prudent to make reference to:

- British Standard - Methods for Rating and Assessing Industrial and Commercial Sound (BS4142:2014).

BS4142:2014 is considered the most appropriate guidance for setting appropriate noise levels for new plant items affecting existing residential areas. The use of this guidance document is in line with typical operational criterion applied by Dublin City Council. The document describes a method for assessing the impact of a specific noise source at a specific location with respect to the increase in “background” noise level that the specific noise source generates. The standard provides the following definitions that are pertinent to this application:

Ambient Sound Level, $L_{Aeq,T}$ — equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at any given time, usually from many sources near and far, at the assessment location over a given time interval, T.

Residual Sound Level, $L_{Aeq,T}$ — equivalent continuous A-weighted sound pressure level of the residual sound (i.e. ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound) at the assessment location over a given time interval, T.

Specific Sound Level, $L_{Aeq,T}$ — equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, Tr.

Rating Level, $L_{Ar,T}$ — specific sound level plus any adjustment for the characteristic features of the sound.

Background Sound Level, $L_{A90,T}$ — A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.

BS 4142:2014 advises to obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level from the rating level, and consider the following:

- Typically, the greater this difference, the greater the magnitude of the impact;
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and
- The lower the rating level is, relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.

In relation to the Proposed WwTP Component it is also important to highlight the emphasis BS4142:2014 places on the context of the prevailing soundscape. Section 8.1 of the standard provides the following guidance:

> *"Since the intention is to determine a background sound level in the absence of the specific sound that is under consideration, it is necessary to understand that the background sound level can in some circumstances legitimately include industrial and/or commercial sounds that are present as separate to the specific sound".*

In terms of determining the background sound level for the Proposed WwTP Component, due to the fact that the existing plant operations are an established and longstanding component of the prevailing soundscape, it is therefore deemed appropriate that the impact of the additional operational plant items would be regarded as the specific sound under consideration and that background sound levels include sound arising from the existing WwTP operations.

Noise Level in Public Amenity Areas

It is noted that a public amenity area (Irishtown Nature Park) is present to the south of the site. It is important to acknowledge that the prevailing noise climate in this area will include a degree of industrial noise to the longstanding industrial use of the Ringsend Peninsula.

In terms of addressing potential noise impact on users of the adjacent walkway, the character and relative increase in noise levels is therefore deemed to be a more appropriate indicator of potential impact, rather than comparison against fixed noise limits, which are generally intended for private amenity space.

Additional Road Traffic

There are no specific guidelines of limits relating to traffic related sources along the local or surrounding roads. In this instance, in order to assess the potential noise impact from any changes in road traffic, Table 9-6 offers guidance as to the likely impact associated with a particular change in traffic noise level (Highways Agency *Design Manual for Roads and Bridges* HA 213/08).

Table 9-6: Likely Impact Associated with Change in Traffic Noise Level

Change in Sound Level (dB L_{A10})	Subjective Reaction	Impact
< 3	Inaudible	Imperceptible
3 – 5	Perceptible	Slight
6 – 10	Up to a doubling of loudness	Moderate
11 – 15	Over a doubling of loudness	Significant
> 15		Profound

In the case of additional road traffic noise associated with the Proposed WwTP Component, it is deemed appropriate that the impact ratings outlined in Table 9-6 can be taken as equivalent to those outlined in the EIAR guidelines (Section 3.7.7).

9.2.6 Vibration

No significant sources of vibration are expected to arise during the operational phase of the Proposed WwTP Component. Operational vibration has therefore not been addressed further in this section.

9.3 Existing Environment

9.3.1 Baseline Noise Survey

An environmental noise survey was conducted in order to quantify the existing noise environment. The survey was conducted in general accordance with ISO 1996-2:2007 *Acoustics - Description, Measurement and Assessment of Environmental Noise - Determination of Environmental Noise Levels*[13]. Specific details are set out below.

9.3.2 Measurement Locations

Four measurement locations were selected on the basis of proximity and exposure to the site and potential roads impacted by additional road traffic; each is described in turn below and illustrated on Figure 9-4.

- Location S01 is located in the vicinity of the residential dwellings on the corner of Cambridge Avenue adjacent to Pigeon House Road, Ringsend;
- Location S02 is located in the vicinity of the residential dwellings on the corner of Pine Road adjacent to Sean Moore Road, Ringsend;
- Location S03 is located on the South Bank Road in the vicinity of nearest boundary of the SDRA no. 6 which includes the Poolbeg West Strategic Development Zone, Ringsend; and
- Location S04 is located in the vicinity of the nearest residential dwellings at Martello View, Sandymount.

[13] *This standard was withdrawn and replaced with ISO 1996-2:2017 Acoustics - Description, Measurement and Assessment of Environmental Noise - Determination of Sound Pressure Levels. At the time of surveying, the 2007 standard was current. The revised standard has no bearing on the results of the survey.*

Figure 9-4: Baseline Noise Survey Locations

9.3.3 Survey Periods

Noise measurements were conducted at Locations S01 to S04 over the course of two survey periods as follows:

- Daytime: 10:12hrs to 13:07hrs Thursday 02 June 2016, and;
- Night-time: 22:10hrs on Wednesday 08 June 2016 to 02:09hrs on Thursday 09 June 2016

The measurements periods were selected in order to provide a typical snapshot of the existing noise climate, with the primary purpose being to ensure that the proposed noise criteria associated with the Proposed WwTP Component are commensurate with the prevailing environment.

9.3.4 Personnel and Instrumentation

AWN conducted the measurements during both survey periods. Noise measurements were conducted using an NTi Audio XL-2 TA Precision Sound Level Analyser. The measurement apparatus was check calibrated both before and after each survey using a Brüel & Kjær Type 4231 Sound Level Meter Calibrator.

9.3.5 Procedure

Measurements were conducted at Locations S01 to S04 on a cyclical basis. Sample periods for the noise measurements were nominally 15 minutes during all survey periods. The results were 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 noted all primary noise sources contributing to noise build-up.

9.3.6 Weather

The weather during the daytime survey period was dry and calm with temperatures of 13°C and winds of 1 to 3 m/s. The weather during the evening and night survey periods was dry and calm with temperatures of 8 °C and winds not exceeding 1 m/s.

9.3.7 Measurement Parameters

The noise survey results are presented in terms of the following parameters:

L_{Aeq} is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period.

L_{A10} is the sound level that is exceeded for 10% of the sample period. It is typically used as a descriptor for traffic noise.

L_{A90} is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.

The "A" suffix denotes the fact that the sound levels have been "A-weighted" in order to account for the non-linear nature of human hearing. All sound levels in this report are expressed in terms of decibels (dB) relative to $2x10^{-5}$ Pa.

9.3.8 Results and Discussion

The survey results of the baseline survey are summarised in Table 9-7 to Table 9-10.

9.3.9 Survey Location S01

Table 9-7: Survey Results – Survey Location S01

Period	Time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)		
		L_{Aeq}	L_{A10}	L_{A90}
Day	10:12 - 10:27	65	67	60
	11:50 - 12:05	65	67	58
Evening	22:10 - 22:25	57	61	41
Night	23:35 - 23:51	57	61	43
	01:07 - 01:22	53	57	41

During the daytime survey period, the dominant intermittent noise source influencing the ambient noise level was road traffic on the R131. Other intermittent noise sources included local traffic on the Pigeon House Road and dogs barking, as well as the operation of cranes at the South Bank Marine Terminal. Background noise levels were dominated by distant road traffic. Daytime ambient noise levels were of the order of 65 dB $L_{Aeq,15min}$ whilst background noise levels ranged between 58 and 60 dB $L_{A90,15min}$.

During the evening and night time survey periods, the dominant intermittent noise source influencing the ambient noise level was road traffic on the R131 and to a lesser extent, local traffic on Pigeon House Road. Background noise levels were dominated by a ship engine or generator docked at the South Bank Marine Terminal. Evening and Night-time noise levels fell in the range of 53 to 57 dB $L_{Aeq,15min}$ and 41 to 43 dB $L_{A90,15min}$.

9.3.10 Survey Location S02

Table 9-8: Survey Results – Survey Location S02

Period	Time	Measured Noise Levels (dB re. 2x10^{-5} Pa)		
		L_{Aeq}	L_{A10}	L_{A90}
Day	10:39 – 10:54	71	74	60
	12:10 – 12:25	72	75	61
Evening	21:51 – 22:00	67	71	47
Night	23:16 – 23:31	67	70	47
	00:48 – 01:03	56	59	38

During the daytime survey period, the dominant intermittent noise source influencing the ambient noise level was road traffic on the Sean Moore Road. Other intermittent noise sources included the operation of cranes at the South Bank Marine Terminal. Background noise levels were dominated by distant road traffic. Daytime ambient noise levels fell in the range of 71 to 72 dB $L_{Aeq,15min}$ whilst background noise levels ranged between 60 and 61 dB $L_{A90,15min}$.

During the evening and night time survey periods, the dominant intermittent noise source influencing the ambient noise level was road traffic on the Sean Moore Road. Background noise levels were dominated by a ship engine or generator docked at the South Bank Marine Terminal. Evening and Night-time noise levels fell in the range of 56 to 67 dB $L_{Aeq,15min}$ and 38 to 47 dB $L_{A90,15min}$.

9.3.11 Survey Location S03

Table 9-9: Survey Results – Survey Location S03

Period	Time	Measured Noise Levels (dB re. 2x10^{-5} Pa)		
		L_{Aeq}	L_{A10}	L_{A90}
Day	10:58 – 11:13	67	69	57
	12:31 – 12:46	64	66	51
Evening	22:31 – 22:47	56	52	42
Night	23:57 – 00:13	51	47	38
	01:26 – 01:41	39	39	37

During the daytime survey period, the dominant intermittent noise source influencing the ambient noise level was heavy goods vehicles (HGV) traffic on the South Bank Road. Other intermittent noise sources included HGVs parked in the layby with engines running, as well as construction noise from the Dublin Waste to Energy (DWtE) site. Background noise levels were dominated by distant road traffic. Daytime ambient noise levels fell in the range of 64 to 67 dB $L_{Aeq,15min}$ whilst background noise levels ranged between 51 and 57 dB $L_{A90,15min}$.

During the evening and night time survey periods, the dominant intermittent noise source influencing the ambient noise level was intermittent traffic on the South Bank Road and to a lesser extent construction noise from the DWtE site. Background noise levels were dominated by plant noise associated with the nearby Dublin Bay Power Plant. Evening and Night-time noise levels fell in the range of 39 to 56 dB $L_{Aeq,15min}$ and 37 to 42 dB $L_{A90,15min}$.

9.3.12 Survey Location S04

Table 9-10: Survey Results – Survey Location S04

Period	Time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)		
		L_{Aeq}	L_{A10}	L_{A90}
Day	11:27 - 11:43	67	70	56
	12:52 - 13:07	65	69	50
Evening	22:55 - 23:10	70	74	51
Night	00:22 - 00:38	63	67	38
	01:48 - 02:03	62	63	38

During the daytime survey period, the dominant intermittent noise source influencing the ambient noise level was road traffic on the Strand Road or R131. Other intermittent noise sources included birdsong nearby as well some nearby construction activity. Background noise levels were dominated by distant road traffic. Daytime ambient noise levels fell in the range of 65 to 67 dB $L_{Aeq,15min}$ whilst background noise levels ranged between 50 and 56 dB $L_{A90,15min}$.

During the daytime survey period, the dominant intermittent noise source influencing the ambient noise level was road traffic on the Strand Road or R131. Background noise levels were dominated by plant noise from the Poolbeg Peninsula. Evening and Night-time noise levels fell in the range of 62 to 63 dB $L_{Aeq,15min}$ and of the order of 38 dB $L_{A90,15min}$.

9.4 Characteristics of the WwTP Component of the Proposed Upgrade Project

During the construction phase of the Proposed WwTP Component, a variety of items of plant will be in use, such as excavators, lifting equipment, dumper trucks, compressors and generators. Therefore, it is predicted that the construction activities will create typical construction related noise on site.

Due to the nature of daytime activities undertaken on a construction site of this nature, there is potential for generation of significant levels of noise. The flow of vehicular traffic to and from a construction site is also a potential source of noise levels.

It is envisaged that a variety of additional plant will be required to facilitate the operation of the proposed Activated Granular Sludge (AGS) reactors and Sequential Batch Reactor (SBR) upgrades. The following additional noise emitting plant items will be required:

- Blower Fans;
- Centrifuge;
- Compressors; and
- Recirculation Pumps.

The potential for vibration at neighbouring sensitive receptors during construction is typically limited to excavation works, piling and the movement of heavy vehicles on uneven road surfaces. A number of vibration sensitive structures have been identified in close proximity to the site, the impact of vibration on these structures is discussed further in the following sections.

9.5 Potential Impacts

When considering a development of this nature, the potential noise and vibration impact on the surroundings must be considered for each of two distinct stages:

- Construction phase; and
- Operational phase.

The construction phase will involve piling and excavation of the site and the erection of onsite structures over a phased period. The primary sources of noise are expected to arise from onsite construction works, activity in the proposed temporary construction compounds as well as increased traffic on public roads. It is anticipated that construction activity has the potential to give rise to short term negative impacts. The significance of impacts arising during the construction period has been discussed further in section 9.5.4.

The primary sources of outward noise in the operational context are deemed long term and will involve additional wastewater treatment plant items as well as additional vehicular traffic on public roads. Noise during the operational phase has the potential to give rise to long-term negative impacts. The significance of impacts arising during the operational period of the Proposed WwTP Component has been discussed further in section 9.5.5.

These issues are discussed in the following sections.

9.5.1 Do-nothing Impacts

For the Do-Nothing scenario, the existing noise sources contained within the existing Ringsend WwTP will remain in place.

While traffic volumes on the surrounding road network are expected to increase following the Alexandra Basin Redevelopment and the Poolbeg West SDZ, for the purposes of presenting a robust assessment, it has been assumed that there shall be no increase in traffic on the surrounding road network. Details of baseline and predicted traffic volumes are contained in Volume 3 Section 13: Traffic.

Therefore, the existing baseline noise environment is not expected to change in the Do-Nothing scenario, save for the impact of other proposed developments in the general area.

9.5.2 Forecasting Methods

Construction noise calculations have been conducted generally in accordance with British Standard BS5228-1:2009+A1:2014.

Prediction calculations for plant noise and additional vehicular traffic movements have been conducted in accordance with ISO 9613-2:1996 *Acoustics - Attenuation of Sound during Propagation Outdoors - General Method of Calculation*. A more specific appendix relating to the noise model is outlined in Appendix 9B.

9.5.3 Nearest Noise Sensitive Receptors

In the first instance, it is important to identify the receptors located in the vicinity of the Proposed WwTP Component that may be sensitive to noise.

It is important to note that due to the nature and scale of the study area, there is a wide range of topographical features including earth berms and buildings that give rise to acoustic screening between the Proposed WwTP Component and the nearest noise sensitive receptors. As such, depending on the location of the potential noise source, the most sensitive receptor may not be the closest receptor.

In the case of the receptors potentially exposed to additional onsite construction or operational noise, the most sensitive receptors can be regarded as those located along the Strand Road (R131) at Sandymount (R01 to R06). These receptors are located approximately 950 to 1250 metres from the nearest boundary of the existing WwTP.

Receptors that may be exposed to additional road traffic generated during the construction and operational phases are primarily located along the Sean Moore and Pigeon House Roads (R07, R08 and R11). These receptors are located between 10 to 20 metres from the nearest roadway in each case.

Consideration has also been given to the Poolbeg West SDZ as part of the SDRA no. 6 of the Dublin City Development Plan 2016-2022, which has been earmarked for the purposes of providing future residential development (R09 and R10). As no specific plans are available, as a worst case, the nearest boundary of this site has been considered in the assessment. On this basis, receptors located in this area would be approximately 700 to 900 metres from the nearest boundary of the WwTP, although the construction compound is located approximately 600 m from these receptors.

Additional consideration has also been given to the potential impact arising at the nearest Dublin Port Cruise terminal to the site (Ocean Pier 37) which is represented by receptor R12.

For reference, the noise sensitive receptors have been illustrated in Figure 9-5. Full details of the receptor positions referenced in the assessment can be found in Appendix 9B and Appendix 9C.

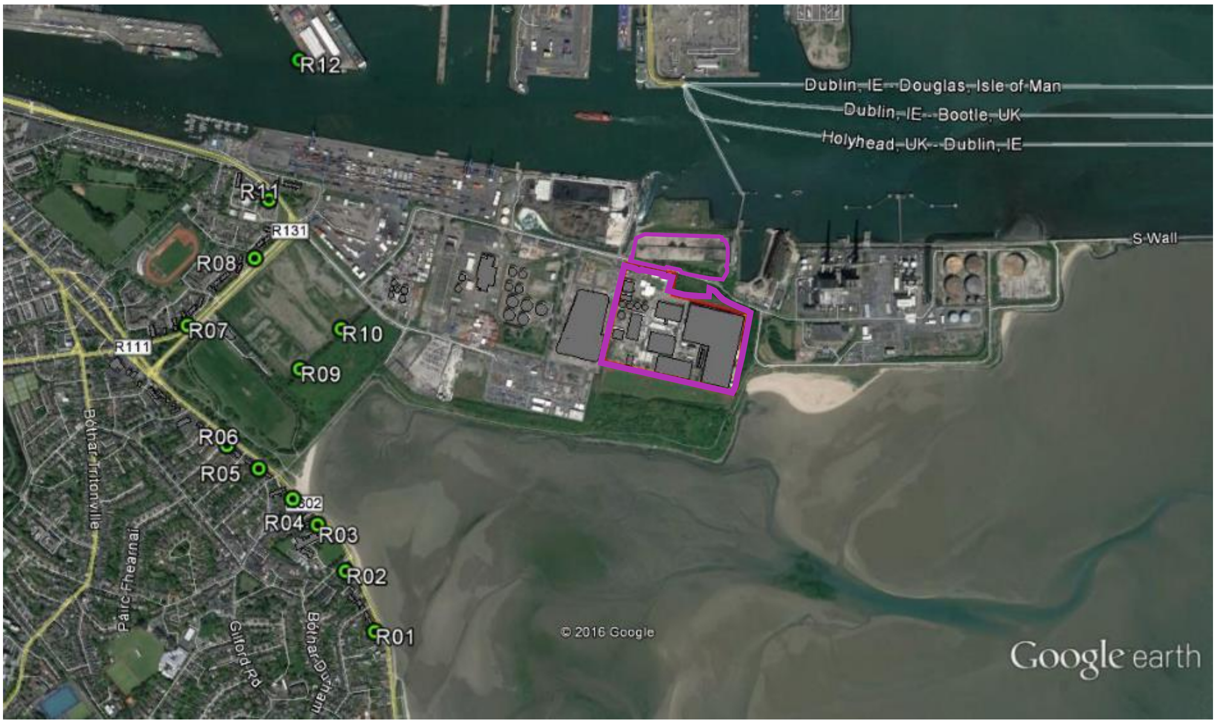


Figure 9-5: Nearest Noise Sensitive Receptors

9.5.4 Construction Phase

It is predicted that the construction programme will create typical construction related noise on site. During the construction phase of the Proposed WwTP Component, a variety of items of plant will be in use, such as excavators, piling rigs, lifting equipment, dumper trucks, compressors and generators. It is understood that the outline construction programme is such that the construction phase will fall between temporary and short term in duration.

Due to the nature of daytime activities undertaken on a construction site of this nature, there is potential for generation of significant levels of noise. The flow of vehicular traffic to and from a construction site is also a potential source of noise levels. The potential for vibration at neighbouring sensitive receptors during construction is typically limited to excavation works, piling and the movement of heavy vehicles on uneven road surfaces. Due to the distance of vibration sensitive residential receptors to onsite or compound related works, there is little likelihood of impact at these locations. A number of vibration sensitive structures have been identified in close proximity to the site, the impact of vibration on these structures is discussed further in the following sections.

The proposed general construction hours are 08:00 to 18:00 for week days and from 08:00 to 13:00 on Saturdays. Evening activities will be significantly reduced in order to manage any associated noise impacts in an appropriate manner. As a result, noise emissions from evening activities are expected to be significantly lower than for other general daytime activities. Prior consultation with Dublin City Council will be undertaken where construction activities outside these hours are anticipated to occur.

9.5.5 Construction Noise

Site and Compound Activity

Generally, it is expected that the construction activities can be subdivided into those relating to the capacity upgrade (i.e. construction of the AGS reactor and associated works) and those required to be completed as part of the retrofit of the SBR tanks.

Due to the fact that only the outline construction programme can be prepared at this stage, it is difficult to determine accurately the specific magnitude of noise emissions from site and compound related construction activity. It is possible however to present a scenario based on worst case noise levels using guidance set out in BS5228-1:2009+A1:2014. Table 9-11 outlines typical plant items and associated noise levels that are anticipated for various phases of the construction programme.

Table 9-11: Typical Noise Levels Associated with Construction Plant Items

Phase	Item of Plant (BS 5228-1:2009+A1:2014 Ref.)	Construction Noise Level at 10 m Distance (dB $L_{Aeq(1hour)}$)
Site Preparation	Pneumatic Breaker (D2.2)	81
	Rock Breaker (C9.12)	85
	Wheeled Loader Lorry (D3 1)	75
	Track Excavator (C2 22)	72
	Dump Truck (C4.2)	78
Foundations and Tank Construction	Large Rotary Bored Piling Rig – Cast In-Situ (C3.14)	83
	Tracked Excavator (C3.24)	74
	Concrete Pump (C3.25)	78

Phase	Item of Plant (BS 5228-1:2009+A1:2014 Ref.)	Construction Noise Level at 10 m Distance (dB $L_{Aeq(1hour)}$)
	Compressor (D7 6)	77
	Poker Vibrator (C4 33)	78
Pipework Installation	Mobile Telescopic Crane 100 tonne (C4.41)	71
	Telescopic Handler 4 tonne (C.4.54)	70
	Articulated lorry (C11.10)	77
General Construction	Hand tools	81
	Pneumatic Circular Saw (D7.79)	75

For the purposes of the assessment we have assumed that standard good practice measures for the control of noise from construction sites will be implemented. These issues are commented upon in further detail in the mitigation section of this report. Table 9-12 and Table 9-13 present the potential noise levels from an indicative construction period on site during both the capacity upgrade and SBR retrofit works. Note, construction noise sources are assumed to be running 66% of the time. This % is estimated as the average percentage on-time from estimates of the time that construction plant will be operating at full power, over the course of a typical working day (Ref BS 5228-1:2009+A1:2014, Figure F5) and is based on our experience of other similar sites.

In the case of the capacity upgrade works, the predictions have been prepared to the nearest residential noise sensitive receptor (R03) to the site which shall be some 600 metres southwest of the nearest point of proposed construction works[14].

During the SBR retrofit it is assumed that no site preparation of foundation works would be required and that the pipework and general construction works would be similar to that required during the capacity upgrade works.

Due to the period of the SBR retrofit (expected duration 7 to 10 years), it is possible that the Poolbeg West SDZ will be developed to the stage that this will constitute the nearest noise sensitive receptor. Assuming residential dwellings could be placed at the boundary of the SDZ site (from the construction compound as a worst-case scenario), the distance to the nearest SBR will of the order of 950 metres.

[14] Which in this instance relates to the edge of the nearest potential construction compound rather than primary works area which would be another 400 m distance. Potential receptors located at the Poolbeg West SDZ have not be assessed as it assumed that construction works will have been completed prior to the presence of residential receptors in this area.

Table 9-12: Construction Noise Impact at Nearest Noise Sensitive Receptor - Capacity Upgrade

Phase	Predicted Construction Noise Level $L_{Aeq(1hour)}$ (dB)	Construction Noise Criteria $L_{Aeq(1hour)}$ (dB)					
		Daytime (07:00 – 19:00) And Saturdays (07:00 – 13:00)		Evening (19:00 to 23:00hrs)		Night time (23:00 to 07:00hrs)	
		Criteria	Complies?	Criteria	Complies?	Criteria	Complies?
Site Preparation	50	70	✓	65	✓	55	✓
Foundations and Tank Construction	49		✓		✓		✓
Pipework Installation	41		✓		✓		✓
General Construction	45		✓		✓		✓

Table 9-13: Construction Noise Impact at Nearest Noise Sensitive Receptor - SBR Retrofit

Phase	Predicted Construction Noise Level $L_{Aeq(1hour)}$ (dB)	Construction Noise Criteria $L_{Aeq(1hour)}$ (dB)					
		Daytime (07:00 – 19:00) And Saturdays (07:00 – 13:00)		Evening (19:00 to 23:00hrs)		Night time (23:00 to 07:00hrs)	
		Criteria	Complies?	Criteria	Complies?	Criteria	Complies?
Pipework Installation	37	70	✓	65	✓	55	✓
General Construction	41		✓		✓		✓

The predicted external construction noise levels are within the relevant noise criteria over the construction phase during both the capacity upgrade or SBR retrofit works. In the event that the two phases overlap and construction works take place simultaneously, given the predicted noise levels from each phase, cumulative construction noise levels are also projected to be comfortably within the criteria.

There are no items of plant that would be expected to give rise to noise levels that would be considered out of the ordinary or in exceedance of the levels outlined. The impact on the noise environment due to construction activities will be transient in nature and mitigation measures will be implemented to minimise the impact of construction activities on the noise environment.

Additional consideration is provided with respect to the potential airborne construction noise levels arising at the nearby tern colony to the north of the site and the area located to the south which is occasionally frequented by Brent Geese. The predicted level of construction noise in each of these areas is expected to fall in the following ranges:

- Tern Colony: 40 to 45 dB LAeq; and
- Brent Geese area: 65 to 80 dB L_{Aeq}.

In respect of the tern colony, it is understood that unattended measurements undertaken in the immediate vicinity of the colony determined noise levels from tern activity fell in the region of 70 to 80 dB L_{Aeq}. The level of operational noise arising at this location would therefore be significantly below the level of noise generated by the terns themselves.

In respect of the Brent Geese area, although the predicted level of noise is expected to fall in the range of 45 to 80 dB L_{Aeq}, it is important to note that the additional construction noise arising within this area would not vary significantly in character from that previously generated by the adjacent DWtE construction works as well as certain maintenance activities onsite.

Further discussion on the potential impacts of the development on local fauna can be found in Section 6: Biodiversity - Terrestrial.

Additional Construction Traffic on Public Roads

In addition to construction activity on the site, the noise impact of additional traffic on the local road network due to the construction activity is assessed. Access to the site for construction traffic will be via the R131 (old Pigeon House Road) and Whitebank Road. The nearest noise sensitive receptors to the proposed haul routes are the dwellings located on Pigeon House Road which are located approximately 15 metres from the nearest roadside. The noise impact on these locations associated with construction traffic is assessed in the following paragraphs.

The noise level associated with an event of short duration, such as a passing vehicle movement, may be expressed in terms of its Sound Exposure Level (L_{AX}). The Sound Exposure Level can be used to calculate the contribution of an event or series of events to the overall noise level in a given period. The appropriate formula is given below:

$$\mathbf{L_{Aeq,T} = L_{AX} + 10log10(N) - 10log10(T) + 20log10(r_1/r_2)dB}$$

where:

$L_{Aeq,T}$	is the equivalent continuous sound level over the time period T (in seconds);
L_{AX}	is the “A-weighted” Sound Exposure Level of the event considered (dB);
N	is the number of events over the course of time period T;
r_1	is the distance at which L_{AX} is expressed;
r_2	is the distance to the assessment location.

The mean Sound Exposure Level for a heavy goods vehicle (HGV) moving at low to moderate speeds (i.e. 15 to 45 km/hr) is in the order of 82 dB L_{AX} at a distance of 5 metres from the vehicle. Similarly, the mean Sound Exposure Level for a car moving at low to moderate speeds (i.e. 15 to 45 km/hr) is in the order of 67 dB L_{AX} at a distance of 5 metres from the vehicle. These figures are based on a series of measurements conducted under controlled conditions.

The following one way peak hourly construction traffic volumes are expected to be generated during the construction:

- 12 disposal trucks arriving and departing;
- 12 concrete deliveries arriving and departing;

- 6 deliveries of materials and equipment, with departures;
- 8 trucks associated with existing plant arriving and departing;
- Arrival/departure of 150 staff vehicles; and
- 12 visits from cars and vans, of which 8 leave within the hour.

The total two-way construction traffic arising during the peak will therefore total 76 movements of HGVs and 166 movements of cars and LGVs. Assuming the worst case of 76 HGV's and 166 cars/LGVs per hour, the worst case predicted noise level at the nearest receptor to the R131 would be expected to fall in the region of 48 dB $L_{Aeq,\ 1hour}$. In consideration of the fact that the prevailing ambient noise level during the daytime is dominated by traffic and falls in the region of 65 dB L_{Aeq}, it can be seen that the level of construction traffic noise will be significantly below the prevailing measured daytime noise levels.

During the evening and night-time periods, it would be expected that the construction traffic volumes would be at least halved. On this basis (38 HGV's and 83 cars per hour), the worst case predicted noise level at the nearest receptor to the R131 would be expected to fall in the region of 46 dB $L_{Aeq,\ 1hour}$. Again, based on the prevailing ambient noise levels at the nearest receptor during these periods, and even in consideration of the lowest measured ambient noise level (53 dB $L_{Aeq,\ 15minute}$), there would only be a 1 dB increase in noise level, which would be regarded as imperceptible.

As such, the impacts of construction related traffic on public roads can be regarded as insignificant.

9.5.6 Construction Vibration

Impact of Piling on Protected Structures

The main source of vibration during the construction programme is likely to be the piling process. A bored piling method is currently proposed. Due to the fact that this a non-percussive piling technique, this option will inherently reduce the level of piling vibration generated. The closest sensitive structures to the piling line is the Wall of the Pigeon House Fort which is located approximately 230 metres from the piling line of the proposed AGS Reactor where the vast majority of piling works will be required.

For the purposes of this assessment, the expected vibration levels during piling have been determined through reference to published empirical data. The British Standard BS5228-2:2014+A1:2014 publishes the measured magnitude of vibration from rotary bored piling using a 600 mm pile diameter during two aspects of the operation, (BS5228-2:2014+A1:2014 Table D.6, Ref. No. 105):

- 230 µm/s at a distance of 3.5 metres, for augering;
- 2,400 µm/s at a distance of 3.5 metres, for auger hitting base of hole;
- 40 µm/s at a distance of 8 metres, for augering, and;
- 1,700 µm/s at a distance of 8 metres, for auger hitting base of hole.

Considering the distance of the piling works from the sensitive structure, the expected vibration levels are estimated to be significantly below the limits recommended to prevent cosmetic damage in sensitive buildings or structures.

Additional reference is made to results of monitoring completed as part of initial piling works. This monitoring would suggest that rotary core piling undertaken in the area of the proposed reactor reduces to within the specified limit of 3 mm/s in the vicinity of the southern end of SBR Block 1. As such, the expected levels of vibration arising further than this would be lower again and of low risk to the wall of the Pigeon House Fort.

Vibration Generated by HGVs on Public Roads

Once an adequate road surface is maintained on the haul road, the level of vibration expected to be generated by unladen or laden HGVs would be expected to be very low. Therefore, once a smooth and level road surface is maintained, the levels of vibration likely to be generated in close proximity to the proposed haul roads would be expected to be below the 3 mm/s PPV recommended for the protected structure forming part of the old Ringsend fort and significantly below the 15 mm/s PPV recommended otherwise for the prevention of cosmetic damage to buildings.

Therefore, the impact of vibration arising from construction traffic is expected to be insignificant.

9.5.7 Operational Phase

The primary sources of outward noise in the operational context are deemed to be long term in nature and will involve:

- Additional Wastewater Treatment Mechanical Plant; and
- Additional Vehicular Traffic on Public Roads.

9.5.8 Operational Noise

Additional Wastewater Treatment Mechanical Plant

The existing plant contains a wide range of noise emitting plant comprising both internal and external based plant, including but not limited to the following major sources:

- Blower Fans;
- Centrifuges;
- Chillers; and
- Pumps.

It is envisaged that a variety of additional plant will be required to facilitate the operation of the proposed AGS reactors and SBR upgrades. The following additional noise emitting plant items will be required:

- Blower Fans;
- Centrifuge; and,
- Compressors.

It is proposed that the additional centrifuge will be housed within the existing Thermal Hydrolysis building, and will also replace 1 No. external centrifuge. The remainder of the plant items (blower fans and compressors) will be housed externally adjacent to the proposed AGS reactor block on a dedicated plinth.

In order to assess the potential noise impact of these plant items, a noise model incorporating all existing and proposed plant items has been prepared. Noise levels have been predicted at a total of 11 no. locations representing noise sensitive receptors in the vicinity of the Proposed WwTP Component. Further details of the noise modelling exercise have been outlined in Appendix 9B.

Proprietary noise calculation package Brüel & Kjær Predictor Type 7810 has been used to develop the model and calculations are based on ISO 9613-2:1996 *Acoustics - Attenuation of Sound during Propagation Outdoors - General Method of Calculation*. This method has the scope to take into account a range of factors affecting sound propagation, including:

- the magnitude of the noise source in terms of sound power;
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- attenuation due to atmospheric absorption; and
- meteorological effects such as wind gradient, temperature gradient and humidity (these can have significant impact at distances greater than approximately 400 m).

The predicted noise levels presented in Table 9-14 have been compared to the night time noise criteria as adopted for this assessment. As it is assumed that all plant will run continuously, the night-time period is deemed to be the most sensitive as has been referenced.

Table 9-14: Predicted Operational Noise Levels

Receptor	Predicted Sound Pressure Level (dB $L_{Aeq,15minute}$)	Lowest Applicable Noise Limit based on BS8223:2014 (Section 9.2.1)	Complies
R01	35	45	✓
R02	34		✓
R03	31		✓
R04	30		✓
R05	29		✓
R06	15		✓
R07	17		✓
R08	19		✓
R09	21		✓
R10	27		✓
R11	25		✓

The predicted operational noise levels at the nearest modelled locations are within the relevant adopted night limits by a significant margin. Figure 9-6 illustrates predicted night-time noise levels (contour at 4.0 m height relative to ground level).

It must be noted that the predicted levels are based on a situation where the receiver is downwind of all noise sources. For the purposes of the assessment against the adopted criteria, this is a robust worst-case assumption.

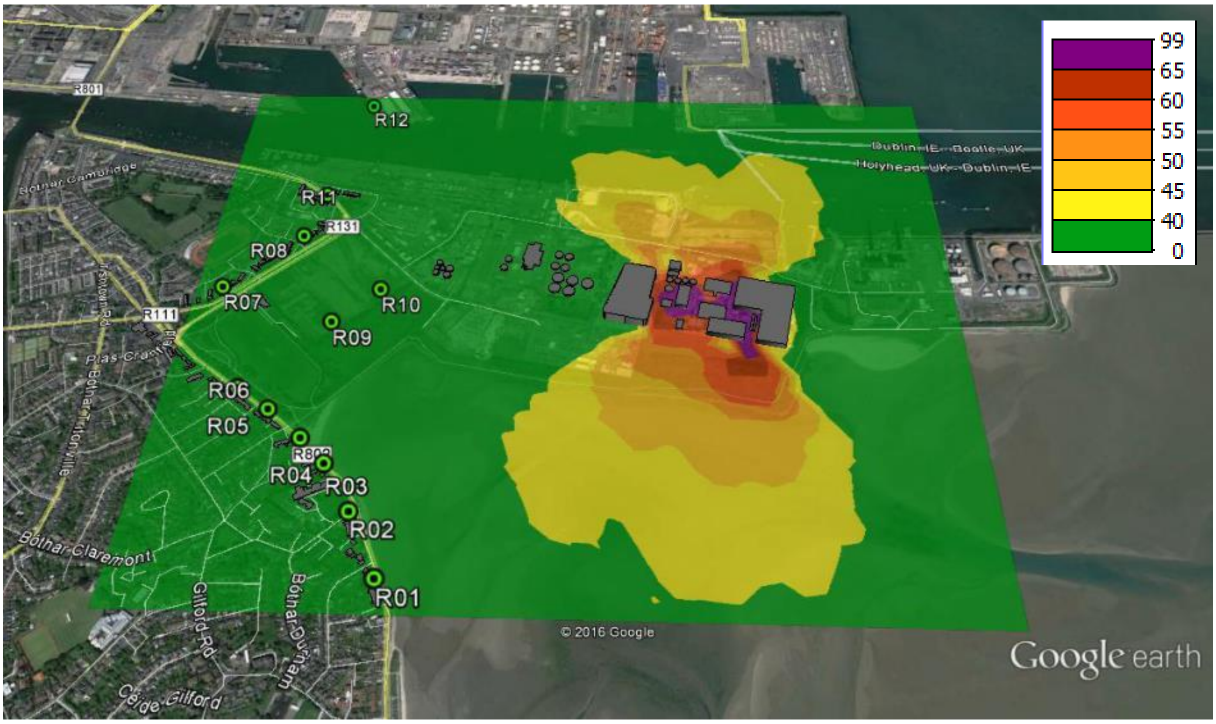


Figure 9-6: Predicted Operational Noise Contour (dB L_{Aeq} – 4m height)

It is important to note that in addition to achieving the adopted night time noise limits, the dimensions and location of the proposed AGS Reactor Block will also provide additional acoustic screening to the existing plant items on the site. It is envisaged that a reduction in operational noise level of between 3 and 5 dB could be achieved once the reactor block is in place.

Making reference to section 9.2.4, the BS 4142:2014 assessment Level for the night-time period has been calculated and presented in Table 9-15.

Table 9-15: BS4142:2014 Predicted Operational Noise Assessment Level

Receptor	Predicted Specific Level, L_{Aeq}	Rating penalty	Rated Level, $L_{Ar,T}$	Lowest Recorded Background Level L_{A90} [8]	Assessment Level
R01	35	0	35	38[15]	-3
R02	34	0	34	38[9]	-4
R03	31	0	31	38[9]	-7
R04	30	0	30	38[9]	-8
R05	29	0	29	38[9]	-9
R06	15	0	15	38[9]	-23

[15] *Based on the lowest recorded night-time LA90 level at survey location S04*

Receptor	Predicted Specific Level, L_{Aeq}	Rating penalty	Rated Level, $L_{Ar,T}$	Lowest Recorded Background Level L_{A90} [8]	Assessment Level
R07	17	0	17	37[16]	-20
R08	19	0	19	37[10]	-18
R09	21	0	21	38[11]	-17
R10	27	0	27	38[17]	-11
R11	25	0	25	37[10]	-12
R12	31	0	31	37[10]	-7

Due to the low noise emissions associated with the proposed operational plant items, in addition to the distance to the nearest properties, the calculated noise level associated with proposed operational plant items will be well below the typical background noise environment during night-time periods. The assessment levels associated with plant items are therefore a strong indication of a low noise impact at the nearest noise sensitive receptors. During daytime periods when background noise levels are higher, the impact will be further reduced.

The impact of the Proposed WwTP Component during the operational phase can therefore be regarded as a slight positive.

Additional comment is provided with respect to the potential airborne operational noise levels arising at the nearby tern colony to the north of the site and the area located to the south which is occasionally frequented by Brent Geese. The predicted level of operational noise in each of these areas is expected to fall in the following ranges:

- Tern Colony: 40 to 45 dB LAeq, and;
- Brent Geese area: 45 to 80 dB L_{Aeq}

Further discussion on the potential impacts of the development on local fauna can be found in Section 6: Biodiversity - Terrestrial.

With regards to the amenity value of Irishtown Nature Park, and specifically the walkway to the south, the predicted noise levels confirm that there will be a potentially reduced level of noise for users of the walkway. Figure 9-7 illustrates predicted daytime noise levels (contour at 1.5 m height relative to ground level) in the vicinity of the walkway. Generally, noise levels along the walkway are expected to fall in the range of 45 to 55 dB L_{Aeq}.

[16] *Based on the lowest recorded night-time L_{A90} level at survey location S03*

[17] *Based on the lowest recorded night-time LA90 level at survey locations S01 and S02*

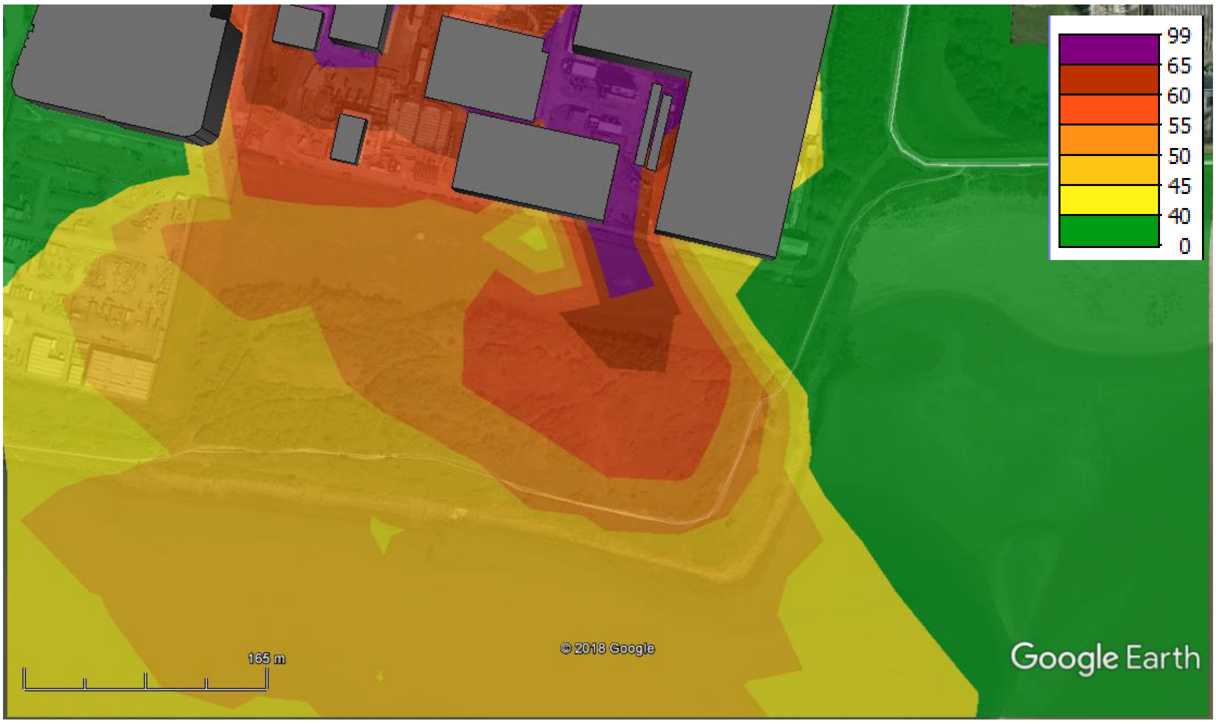


Figure 9-7: Predicted Operational Noise Contour (dB L_{Aeq} – 1.5 m height)

Additional Vehicular Traffic on Public Roads

In terms of the additional traffic on local roads that will be generated as a result of this Proposed WwTP Component, the following comment is presented.

For the purposes of assessing potential noise impact, it is appropriate to consider the relative increase in noise level associated with traffic movements on existing roads and junctions with and without the Proposed WwTP Component using the provided Annual Average Daily Traffic figures. Table 9-16 presents the Do-Nothing, i.e. without the Proposed WwTP Component and the Do-Something, i.e. with the Proposed WwTP Component, traffic figures and associated change in noise level for the surrounding road network.

Table 9-16: Summary of Change in Noise Level Due to Traffic in the Opening Year

Road	Opening Year Traffic Volume (Annual Average Daily Traffic)		Increase in Noise Level (dBA)
	Do-Nothing	Do-Something	
R131 Eastlink	32,583	36,038	-
R131 Sean Moore Road	37,772	38,917	-
Southbank Road	11,037	13,163	-
Pigeon House Road	1,535	1,861	<1

In summary, the predicted increase in noise levels along all of the junctions assessed due to additional vehicular traffic associated with the Proposed WwTP Component is less than 1 dB which can be regarded as imperceptible. The associated noise impact is therefore deemed to be insignificant.

The worst case peak hourly operational traffic volumes are not expected to increase as a result of the Proposed WwTP Component.

9.5.9 Operational Vibration

As previously discussed, the Proposed WwTP Component will not contain any significant sources of vibration during the operational phase. As such, no impacts are expected to occur.

9.6 Mitigation Measures

9.6.1 Construction Phase

The impact assessment conducted for the construction activity during the construction phase has highlighted that the predicted construction noise levels will be within the adopted criterion. Nevertheless, it will be a requirement for the contractor to employ and implement best practice construction noise and vibration management techniques throughout the construction phase in order to further reduce the noise and vibration impact to nearby noise sensitive receptors.

In the first instance, the contractor will compile a Noise and Vibration Management Plan (NVMP) which will deal specifically with management processes and strategic mitigation measures to remove or reduce significant noise and vibration impacts, and cumulative noise and vibration impacts from the construction works. The NVMP will also define noise and vibration monitoring and reporting. The NVMP will also include method statements for each phase of the works, the associated specific measures to minimise noise and vibration in so far as is reasonably practicable for the specific works covered by each plan and a detailed appraisal of the resultant construction noise and vibration generated.

The contractor will provide proactive community relations and will notify the public and vibration sensitive premises before the commencement of any works forecast to generate appreciable levels of noise or vibration, explaining the nature and duration of the works.

The contractor will distribute information circulars informing people of the progress of works and any likely periods of significant noise and vibration.

With regard to potential mitigation measures during construction activities, the standard planning condition typically issued by Dublin City Council states:

"During the construction and demolition phases, the proposal development shall comply with British Standard 5228 Noise Control on Construction and open sites Part 1. Code of practice for basic information and procedures for noise control."

The BS5228 standards include guidance on several aspects of construction site mitigation measures, including, but not limited to:

- selection of quiet and or low vibration emitting plant;
- control of noise sources;
- screening;
- hours of work;
- liaison with the public; and
- monitoring.

Detailed comment is offered on these items in Appendix 9C.

9.6.2 Operational Phase

Additional Wastewater Treatment Mechanical Plant

Noise from onsite will be minimised through the selection of 'low noise' equipment where required, as well as the incorporation of appropriate attenuation in the form of:

- Acoustic enclosures for blower fans and compressors;
- Provision of silencers for blower fan intake and extract points;
- Vibration isolation mounts for all proposed internal and external plant items;
- Use of acoustic rated doors on all relevant enclosures and plant room access points; and
- Appropriate siting of all fixed plant.

It is envisaged that adoption of the measures outlined above will ensure that the level of noise emissions from the Proposed WwTP Component will remain in line with the relevant day, evening and night criteria going forward.

Additional Vehicular Traffic on Public Roads

The noise impact assessment outlined previously has demonstrated that mitigation measures are not required.

9.7 Residual Impacts

9.7.1 Construction Phase

In so far as the mitigation measures are applied in full, the level of residual noise generated from the Proposed WwTP Component during the construction phase would be expected to fall within the appropriate limits.

As the predicted impacts to the environment are slight in the short term, the cumulative impacts from simultaneous construction of the Proposed WwTP Component and any external developments in the immediate vicinity of the site are also expected to fall within appropriate limits.

A description of the likely effects is summarised in Table 9-17 for the nearest noise sensitive locations:

Table 9-17: Description of Expected Construction Phase Effects

Quality	Significance	Duration
Negative	Moderate Effects	Short-term

9.7.2 Operational Phase

In so far as the mitigation measures are applied in full, the level of residual noise generated from the Proposed WwTP Component during the operational phase would be expected to fall within the appropriate limits. A description of the likely effects is summarised in Table 9-18 for the nearest noise sensitive locations:

Table 9-18: Description of Expected Operational Phase Effects

Quality	Significance	Duration
Neutral	Slight	Long-term

9.7.3 Interactions

In preparing the EIAR Noise and Vibration impact assessment, AWN made interactions with a number of team members including Traffic (Section 13), Biodiversity - Terrestrial (Section 6) and Population and Human Health (Section 3).

9.7.4 Cumulative Impacts

As the predicted impacts to the environment are slight in the short term, the cumulative impacts from simultaneous construction of the Proposed WwTP Component and any external developments in the immediate vicinity of the site are deemed to be short-term and slight with appropriate mitigation measures are put into place.

The potential cumulative impact of the Proposed WwTP Component, when considered in the context of proposed but not yet constructed development is deemed to be insignificant once appropriate mitigation measures are put into place.

With respect to recently completed developments, it is noted that the baseline survey was completed in advance of the commissioning of the Dublin Waste to Energy (DWtE) facility. Compliance monitoring data for this site has been reviewed to determine potential cumulative noise impacts. The monitoring report indicates the site is compliant with its permitted noise limits. As such, the cumulative impacts arising are deemed to be insignificant once appropriate mitigation measures are put into place.

Further detail on cumulative impacts is provided in Volume 3, Section 19.

9.8 Monitoring

It is recommended that the appointed contractor monitor levels of noise and vibration at nearby sensitive locations and/or development site boundaries.

In the operational phase, and as part of the sites Licence to operate (i.e. IEL / IED), noise levels will be required to be monitored annually in accordance with the EPA *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities* (NG4).

9.9 Difficulties Encountered

Limitation of Study

With regards to the amenity value of Irishtown Nature Park, and specifically the walkway to the south, it is envisaged that construction noise would be similar in nature to that generated during the construction of the adjacent DWtE facility. Although the topography between both the temporary construction compounds and construction site will offer significant acoustic screening to the walkway, it is expected that construction will give rise to increased noise levels during periods along certain sections of the walkway. Due to the transient nature of both the users of the walkway and the construction noise itself, it is difficult to accurately determine the potential noise impact arising from such increased noise levels. However, with consideration of the location of the walkway (i.e. adjacent to a large industrial area) and previous construction works carried out in the same general area, it is expected that similar impacts to those recently encountered would be expected over the course of the proposed construction period.

Otherwise, there were no difficulties encountered during the noise and vibration assessment of the Proposed WwTP Component.

9.10 References

British Standards Institution, (2008). BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise.

British Standards Institution, (2008). BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Vibration.

British Standard BS 7385: 1993: Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration.

British Standard - Methods for Rating and Assessing Industrial and Commercial Sound (BS4142:2014)

BS8233:2014 Guidance on sound insulation and noise reduction for buildings

DIN 4150-3 (1999-02) Structural Vibration - Effects of Vibration on Structures

ISO 1996: 2017: Acoustics – Description, measurement and assessment of environmental noise.

ISO 9613-2:1996 Acoustics - Attenuation of Sound during Propagation Outdoors - General Method of Calculation

World Health Organization (WHO) Guidelines for Community Noise.

Dublin City Development Plan 2016-2022.

Dublin Agglomeration Environmental Noise Action Plan (2013 - 2018)

Transport Infrastructure Ireland (TII) Guidelines for the Treatment of Noise and Vibration in National Road Schemes (TII 2004).

Transport Infrastructure Ireland (TII) (2014), Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes

Environmental Protection Agency (EPA) documents Guidelines on the information to be contained in Environmental Impact Assessment Reports (Draft, August 2017)

EPA Advice Notes for Preparing Environmental Impact Statements (Draft, September 2015)

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

Highways England Company Limited, Transport Scotland, The Welsh Government and The Department for Regional Development (Northern Ireland), Design Manual for Roads and Bridges (DMRB)

Section 10: Odour

10.1 Introduction

This Section of the EIAR assesses the potential odour impacts (and resulting effects) likely to occur as a result of the WwTP component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component"). Wastewater and sludge treatment facilities have the potential to cause nuisance odours and as such the potential odour impact of the Proposed WwTP Component requires consideration.

Full details of the Proposed Upgrade Project and the Ringsend WwTP component can be found in Volume 2, Section 3: Description of Proposed Upgrade Project.

This Section and assessment have been completed having regard to the guidance outlined in the Environmental Protection Agency documents *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (Draft, August 2017) and *Advice Notes for Preparing Environmental Impact Statements* (Draft, September 2015).

In accordance with the 2016 Irish Water Ringsend WwTP EIS and NIS Scoping Document, this assessment has considered the potential for odour impacts on the basis that:

> *"Section 5.6.6. Odour – Likely Significant impact*
>
> *Wastewater and sludge treatment facilities have the potential to cause nuisance odours, and it is noted that the Ringsend facility caused significant odour nuisance when it first commenced operation. As a consequence, odour is identified as a likely significant impact, which needs to be assessed.*
>
> *There is no likely significant impact anticipated from the construction activities, save where those construction activities require temporary interference with the odour control units or their standard operating procedures."*

As described in Section 1 of this Volume of the EIAR, the existing Ringsend WwTP was commissioned in 2005 and comprises modern wastewater treatment processes including primary settlement, Sequencing Batch Reactors (SBRs) providing aeration and secondary settlement, sludge treatment, sludge storage, anaerobic digestion and mechanical and thermal sludge thickening. Following commissioning of the WwTP in 2005, a number of odour complaints were reported to the operator by members of the local community. An ongoing programme of odour containment and treatment has been implemented to reduce the odour impact of the Ringsend WwTP which includes additional measures identified within the ongoing Proposed WwTP Component.

This Section considers the potential impact of odour emissions from the Ringsend WwTP Component of the Proposed Upgrade Project. This includes conversion of the current SBRs to the Aerobic Granular Sludge (AGS) technology, and the operation of additional AGS reactors and associated wastewater and sludge treatment infrastructure.

If unmanaged, construction of the Proposed WwTP Component has the potential to lead to an increase in odour emissions from the Ringsend WwTP. The level of odour emitted will depend on the type of process installed, the level of odour containment or mitigation and any temporary implications on existing odour control to allow ducting connections. As determined in the scoping assessment, construction impacts are likely not to be significant and, if occur, will be temporary and short-term events.

This assessment considered the potential odour impacts of the Proposed WwTP Component using dispersion modelling assessment tools and previous odour monitoring surveys of the Ringsend WwTP.

10.2 Methodology

This section outlines the methodology used to assess the potential odour impacts of the Ringsend WwTP before and after implementation of the Proposed WwTP Component. It includes a review of relevant legislation and guidance, selection of odour assessment criteria, a description of the dispersion model and the selected methodology. Assessment assumptions and calculation of odour emission rates used in the modelling study are also presented.

10.2.1 Legislation

The legislative context and policies which are applicable to the odour emissions and management of the Proposed WwTP Component include:

10.2.1.1 Protection of the Environment Act 2003

The requirement to consider the potential impacts of odour is defined in the Protection of the Environment Act (2003), referred to herein as 'the Act'. The Act states that:

> *" (1) In this Act 'environmental protection' , includes -*
>
> > *(a) the prevention, limitation, elimination, medium and abatement or reduction of environmental pollution, and*
> >
> > *(b) the preservation of the quality of the environment as a whole.*
>
> *(2) In this Act 'environmental pollution' means the direct or indirect introduction to an environmental medium, as a result of human activity, of substances, heat or noise which may be harmful to human health or the quality of the environment, result in damage to material property, or impair or interfere with amenities and other legitimate uses of the environment […]*
>
> *[…](c) in relation to waste, the holding, transport, recovery or disposal of waste in a manner which would, to a significant extent, endanger human health or harm the environment and, in particular—*
>
> > *(i) create a risk to the atmosphere, waters, land, plants or animals,*
> >
> > *(ii) create a nuisance through noise, odours or litter, or*
> >
> > *(iii) adversely affect the countryside or places of special interest […]"*

The Act does not specifically define what constitutes a "nuisance" in relation to odour.

10.2.1.2 Statutory Instrument 787/2005

SI 787/2005 - European Communities (Waste Water Treatment) (Prevention of Odours and Noise) Regulations 2005, defines the operational principles to prevent odours and noise from wastewater treatment plants and associated facilities in Ireland.

The regulations apply to both the operation of existing works and to the planning process for new or upgraded wastewater infrastructure. The regulations state that:

> *"A sanitary authority shall ensure that-*
>
> i. *in formulating and approving plans for a waste water treatment plant to be provided by the authority or on its behalf the plant is so designed and constructed as to ensure that it avoids causing nuisance through odours or noise,*
>
> ii. *any waste water treatment plant under the sanitary authority's control is so operated and maintained as to ensure that it avoids causing nuisance through odours or noise."*

The regulations require that WwTP's are operated and maintained in a way that avoids causing a nuisance through odours or noise. The regulations also define the sanitary authority's, now Irish Water Uisce Éireann Ltd, requirements for the management of odour complaints and other environmental standards.

10.2.2 Guidance

10.2.2.1 EPA - Air Dispersion Modelling from Industrial Installations Guidance Note (AG4)

Although intended as guidance for Environmental Protection Agency (EPA) licensed industrial installations, the EPA (2010) AG4 Guidance provides a structure for assessing potential air quality impacts using dispersion modelling. Section 6.9 and Appendix I provide specific guidance on the assessment of odour impacts including suggestions for appropriate odour criteria. The guidance provides a framework for selection of the appropriate assessment tool, meteorological data site, source building and terrain data and consideration of input data sensitivity. The guidance does provide some information on odour criteria used overseas but does not suggest a specific criterion which is applicable for studies in Ireland.

Wherever appropriate this odour assessment has followed the principles and suggestions of the AG4 guidance document.

10.2.2.2 EPA - Air Guidance Note 5 (AG5) Odour Impact Assessment Guidance for EPA Licensed Sites (2017)

EPA licensed operational sites are expected to adhere to a systematic approach to quantify odour impacts at off-site locations in the local community. The EPA AG5 guidance provides a consistent approach for operators to objectively quantify the level of odour using a standardised 'sniff test' and qualitative assessment procedure. The guidance is designed to provide observational evidence of reported real time peaks in response to determining whether odour conditions, provided as part of an operational site's environmental permit, are met.

As the AG5 methodology is designed to quantify observed off-site conditions, it is unsuitable for uses which require prediction of impacts from proposed sources which are not yet present. The predictive methodologies presented in the AG4 guidance are therefore generally more appropriate to the planning process. The guidance however does prescribe a method of assessment to ensure that odour emissions are minimised wherever practically possible and usually forms a key part of the operational policies detailed, where required, in a site's Odour Management Plan (OMP).

10.2.3 Selection of Odour Target

10.2.3.1 Odour Annoyance Criterion – Protection of the Public

Currently there is no defined statutory odour standard in Ireland which is applied universally in either planning applications or within the Integrated Pollution Control regulations. This assessment has sought to apply an appropriate odour assessment level in order to quantify the magnitude and likely significance of odour impacts.

The AG4 guidance references the UK Environmental Permitting Regulations and approaches defined in New Zealand. These approaches all use the European Odour Unit (ou_E) as a unit of assessing odour concentrations and include a time-based criterion over which the odour should be assessed. Appendix I of AG4 states that overseas regulations identify that an odour impact could occur when magnitudes of between 1 and 10 $ou_E.m^{-3}$ are predicted using a specific time-based compliance criteria.

The time-based criteria are described in terms of a percentile compliance value which effectively allows a defined number of hourly exceedances of the unitary standard. The AG4 guidance notes case studies which have a time-based compliance of between the 98^{th} to 99.9^{th} percentile, which reflect that a duration of exposure is required before an impact is likely to cause annoyance. In Ireland, it is common practice to use the 98^{th} percentile assessment criterion for planning assessments.

The AG4 guidance identifies that the odour magnitude criterion for international environmental permitting regimes are based on the relative offensiveness of the emitted odour. It is important to note that the AG4 guidance references draft UK Environmental Permitting Guidance which was updated and corrected in 2011. As such, the specific relevant standards quoted in the AG4 guidance are considered to be out of date and do not align with submitted UK guidance. This includes the blanket classification of wastewater treatment plant within the 'Most offensive' group of odour sources, which was clarified and corrected to "processes involving septic effluent and sludge" in the 2011 H4 document.

The current UK Environmental Permitting Regulations (EPR) regime, defined in the Environment Agency's (2011) H4 Odour Management guidance document, applies a set of benchmark odour criteria for the most offensive (1.5 $ou_E.m^{-3}$), moderately offensive (3.0 $ou_E.m^{-3}$) and least offensive (6.0 $ou_E.m^{-3}$) sources of odours. Guidance is provided within the H4 document to help an assessor classify the appropriate benchmark criteria. The key considerations include:

- Examples of the most stringent odour benchmarks relate to processes that involve decaying animal or fish remains, involving septic effluent or sludge and biological landfill odours;
- Any odours, which do not obviously fall into the more offensive or less offensive categories are regulated under the moderately offensive category;
- Ranking is based on the odour not the activity;
- Ranking is based on the unmodified odour and the character or offensiveness may be changed by changing the hedonic score, e.g. treating the odour stream, or the odour character may change with distance;
- Ranking may be different for odours from different parts of the process; and
- Benchmarks may be influenced by local factors. "For example if the local population has already become sensitised, it may be prudent to reduce the benchmark by say 0.5."

On the basis of the above, a selected odour standard of 3 $ou_E.m^{-3}$ as the 98^{th} percentile, assessed at highly sensitive receptor locations (e.g. residential), is considered appropriate for use for a WwTP process. The assessment criteria is suggested as an appropriate level where above this value there is, at worst, a slight risk of odour annoyance at the most sensitive areas of public exposure. An odour criterion based upon a maximum number of 175 1-hour exceedances per year is equivalent to the 98% percentile.

It is considered that at predicted odour levels exceeding 5 $ou_E.m^{-3}$ as the 98th percentile there is an increased probability that an annoyance is likely to be established. This assessment criterion is in accordance within the principles and examples provided in the AG4 guidance.

The project odour standard is designed to be applied at the most sensitive areas of public exposure. These are defined as areas which are occupied by individual members of the public for a duration equivalent to the annual assessment standard (i.e. a significant portion of the day, most days per year), and where odour can have a material impact on the amenity of the location. The most sensitive receptors are normally attributed to areas of long term habitation including private residences, care homes and hospitals. Other public areas, i.e. those with a shorter duration of public use by an individual or with a lower impact on amenity, are be considered to be a sensitive receptor, however a higher 98th percentile odour concentration would be expected before a complaint would be received.

Acknowledgement is made to a certain level of subjectivity in setting appropriate odour assessment criteria with project specific considerations and differing professional opinions leading to varying applications of standards in Ireland and overseas. The selected odour nuisance level for this assessment applied at the receptor is, however, considered appropriate given the interpretation of the EPA AG4 guidance, UK H4 guidance and planning applications submitted in Ireland and overseas. In addition, professional institution position statements and international court cases support the use of a standard similar to that suggested for assessment of the Ringsend WwTP. This includes the Chartered Institution of Water and Environmental Management (CIWEM), which is regarded as the leading chartered body for professionals in the water services sector. CIWEM published a policy statement () in September 2012, which reviews some of the issues arising from the regulatory documents and is useful reading on this topic, in addition to UK court cases relating to the Thames Water operated Mogden WwTP (2011) and Anglian Water operated Stanton WwTP (2012).

Selection of the odour criteria is justified by the following site and process specific considerations:

- The Ringsend WwTP is not intended to handle any significant quantities of septic effluent or sludge, some tankers do discharge to the site, and their contribution is negligible compared to the main flow through the plant;
- The Ringsend WwTP does produce a primary sludge, which is similar to a septic sludge, but it is treated promptly and covered and extracted to an odour control unit;
- The Ringsend WwTP only has two open odour sources, which are the storm tanks and the secondary wastewater treatment process. It is not considered that either of these sources would qualify in the most offensive category;
- The Ringsend WwTP enclosed odour sources are all treated before discharge to the atmosphere. Treated emissions from the odour control units have a different character to the original odours and would not normally be categorised as within most offensive category;
- The Ringsend WwTP has processes which create odours, which in their original state would be categorised as within the most offensive classification, including the thermal hydrolysis process. If this odour stream was to be discharged directly to the environment, then the benchmark attaching to the most offensive category would apply to this source alone. Fugitive emissions would be a concern in this regard, but odour control practices should minimise uncontrolled emissions; and

- When the Ringsend WwTP is assessed in its totality, it does not obviously fall into the most offensive category.

10.2.4 Ringsend WwTP "Project Odour Goal"

On occasions, variations of odour standards have been proposed to provide an enhanced level of protection on high profile developments or where certain locations may be highly sensitive to potential impact.

This assessment follows a programme of odour assessments and resultant mitigation infrastructure which commenced after the commissioning of the Ringsend WwTP in 2005. The assessments, including the 2012 planning approval for the Ringsend WwTP, used a site-specific odour standard at the site boundary, known as the 'Ringsend Project Odour Goal'. In accordance with the 2016 Irish Water Ringsend WwTP EIS and NIS Scoping Document (Section 1.6), "The revised project will meet the same stringent odour control standards as set out by An Bord Pleanála in 2012". The Ringsend Project Odour Goal is as follows:

The odour emanating from the site shall not exceed 10 ou_E/m^3 for more than 50 hours per year at the site boundary

This criterion was designed to provide an additional level of protection beyond commonly used assessment criteria and has been used as a target level for ongoing design of odour improvements for the Proposed WwTP Component. It is a specifically applied odour criterion, assessed at the Ringsend WwTP boundary as opposed to at positions of relevant public exposure.

This 'Ringsend Project Odour Goal' applied to the effect of long term releases from all sources within the Ringsend WwTP site boundary, and as such excluded any network infrastructure, associated off-site wastewater processes including storm tanks and temporarily used assets. An odour criterion based upon a maximum number of 50 1-hour exceedances per year is equivalent to the 99.4th percentile.

10.2.5 Assessment Odour Criterion

This assessment has assessed the Proposed WwTP Component against the following odour standards:

- **Odour Annoyance Criterion** - 3 $ouE.m^{-3}$ as the 98th percentile of hourly averages at sensitive receptor locations - to consider the likelihood of odour impacts at sensitive receptor locations.
- Ringsend Project Odour Goal - 10 $ouE.m^{-3}$ as the 99.4th percentile of hourly averages at the boundary of the Ringsend WwTP site - to consider the likelihood of breaching the previously applied and site specific 'Project Odour Goal' at the boundary of the Ringsend WwTP.

10.2.6 Odour Dispersion Modelling

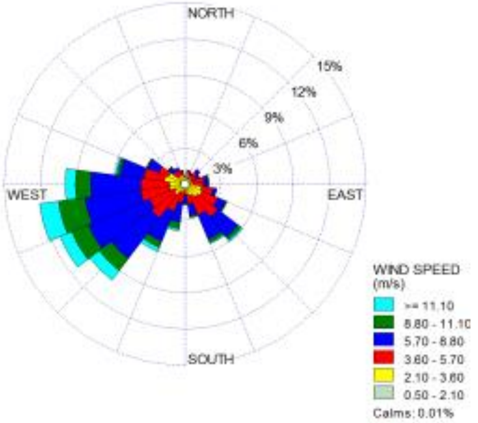
The assessment used the United States Environmental Protection Agency (US EPA) AERMOD model, version 16216, an advanced dispersion model based on the Gaussian theory of plume dispersion. It is widely used in Ireland and overseas for regulatory and assessment purposes. Atmospheric dispersion is determined by input data (source and pollutant release parameters, terrain, meteorological data and building dimensions) to calculate ground level odour concentrations at the WwTP boundary and across a regular receptor grid.

10.2.7 Meteorological Data

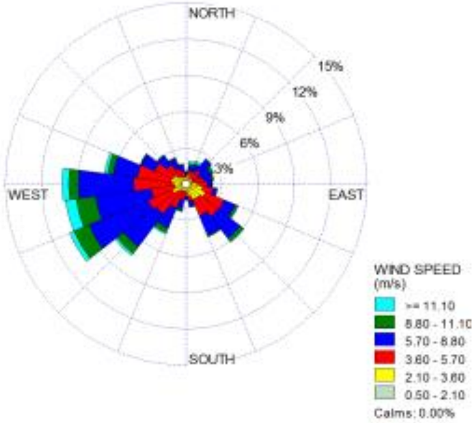
Long term conditions at the study area were represented by hourly sequential meteorological data from the Dublin Airport meteorological station for the years 2011 - 2015 and were considered within the dispersion modelling assessment.

This meteorological station is the closest recording station to the Ringsend WwTP, and is located approximately 9 km to the north-west of the Ringsend WwTP. It represents an area with few complex topographical features in the vicinity of the coast and data are considered to be representative of the Ringsend WwTP location. The second closest recording station, Casement Aerodrome, is located 17 km to the west of the Ringsend WwTP. This site is considered less representative as it is located further from the Ringsend WwTP, located further inland and adjacent to more complex terrain features. Wind roses for the five assessment years are provided in Figure 10-1.

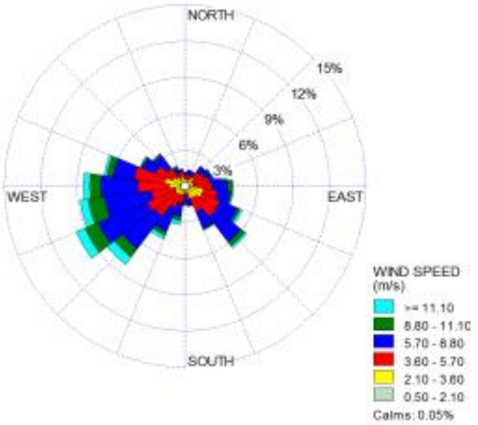
2011



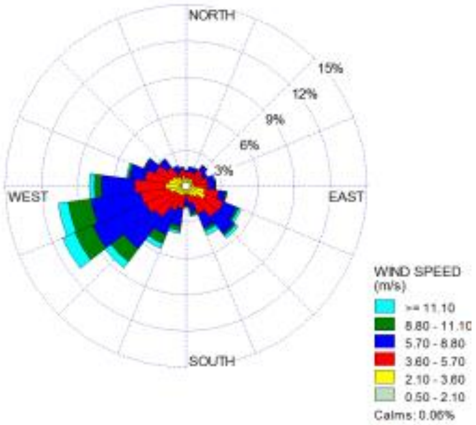
2012



2013



2014



2015

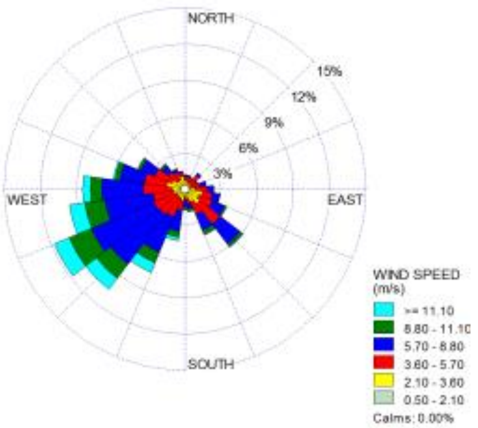


Figure 10-1: Wind Roses for Dublin Airport Meteorological Station (2011-2015)

The raw meteorological data files were processed using the AERMET software to make their interaction with the land surface representative of the area surrounding the Proposed WwTP Component. The area surrounding the Proposed WwTP Component was separated into four sectors to provide a representative description of the local land types. The selected land use classification parameters were used to process the meteorological data, for each sector, as detailed in Table 10-1. The assessment used default land use parameters provided in the software unless otherwise stated.

Table 10-1: Surface characteristics used in the processing of the meteorological data

Sector (Degrees)	Land Use Classification	Surface Roughness
0-80˚	Water	0.0001
80-110˚	Urban	1
110-190˚	Water	0.0001
190-360˚	Urban	1

The highest predicted odour concentration from the five individually assessed meteorological datasets (2011 – 2015) was used to represent baseline conditions at each receptor location. The assessment conclusions were based upon the odour contour that gave rise to the highest concentration at the most sensitive receptor location (i.e. residential receptor).

10.2.8 Treatment of Buildings

Atmospheric dispersion tools can consider the influence of buildings and structures on dispersion within a modelled domain. The AERMOD model uses the BPIP building downwash program which considers the impact of early grounding of dispersion plumes from stack sources.

The AERMOD dispersion model incorporates downwash analysis upon point sources where they are located within the Structure Influence Zone (SIZ). The Building Profile Input Program (BPIP) assesses downwash influences where a building is located 5 L downwind or 2 L upwind of a point source (L being the lesser of the building height or projected building width).

The model included the main Ringsend WwTP site buildings and the Covanta operated, Dublin Waste to Energy (DWtE) building which is located on the western boundary of the Ringsend WwTP. A visualisation of the buildings considered, for the baseline Do-nothing scenario, in the model is presented as Figure 10-2 whilst all building input data is detailed in Table 10-2.

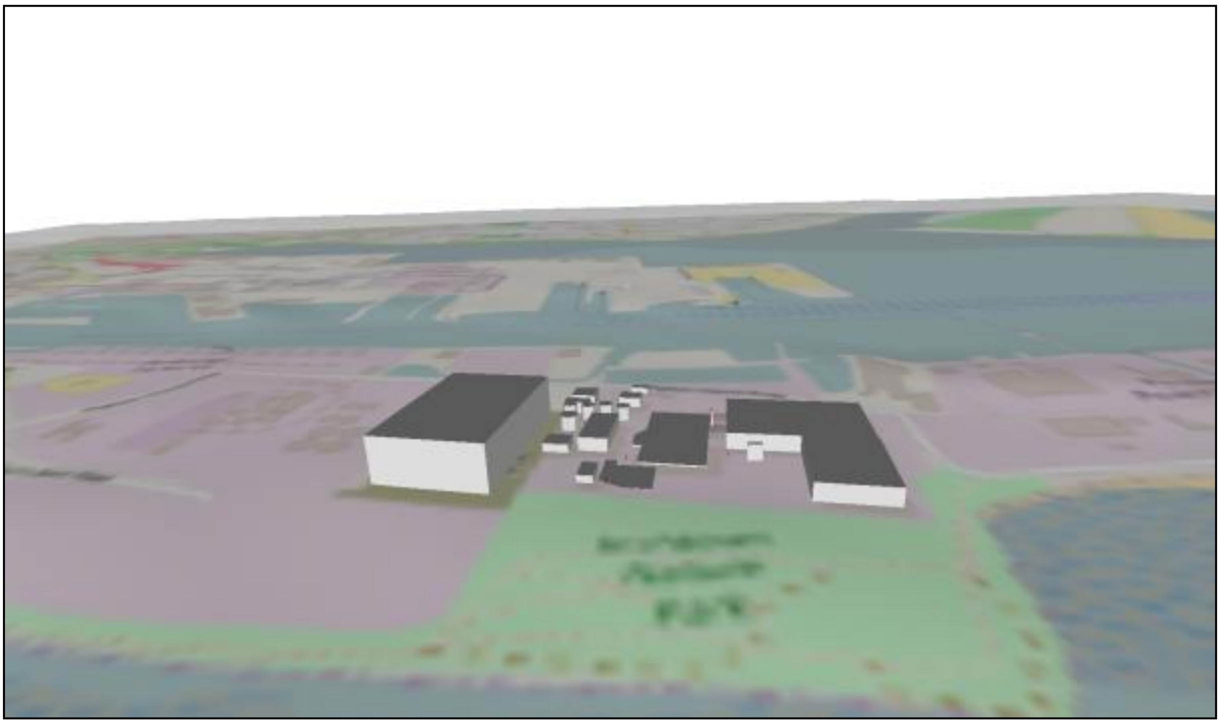


Figure 10-2: Buildings Considered Within the Study Area - Baseline Do-Nothing Scenario (OpenStreetMap, 2018)

Table 10-2: Buildings Considered within the Dispersion Model

Building name	Height	Diameter	X length	Y length	Coordinate (UTM)	
	(m)	(m)	(m)	(m)	Y	Y
SBR	20	N/A	80	107	686727	5913449
SBR	20	N/A	160	107	686669	5913567
Screening Building	8.2	N/A	17.5	30	686504	5913494
Sludge Treatment and OCU	16.25	N/A	34	74	686502	5913572
CHP	9.95	N/A	30	27	686462	5913570
Biogas holder	18	23	N/A	N/A	686488	5913636
Digester	18	18	N/A	N/A	686555	5913662
Digester	18	18	N/A	N/A	686487	5913668
Digester	18	18	N/A	N/A	686510	5913664
Digester	18	18	N/A	N/A	686533	5913667
Sludge Dryer	15.5	N/A	30	31	686492	5913735
Sludge Dryer C	15.5	N/A	32	16	686478	5913683
Workshop	12.75	N/A	28	23	686550	5913699
Admin Building	8.5	N/A	23	13	686568	5913747
Screens + Infrastructure	2	N/A	N/A	N/A	686533	5913545
PST + Sludge Infrastructure	2	N/A	N/A	N/A	686665	5913662
Lamella North OCU 1	10	3	N/A	N/A	686666	5913655
Lamella North OCU 2	10	3	N/A	N/A	686663	5913637

Building name	Height	Diameter	X length	Y length	Coordinate (UTM)	
	(m)	(m)	(m)	(m)	Y	Y
ILPS	20	N/A	16	5	686686	5913537
Dublin WtE	55	N/A	130	200	686292	5913503
Capacity Upgrade	18.5	N/A	110	45	686589	5913476
ELPS	6	N/A	17.8	14.3	686653	5913517

10.2.9 Terrain Data and Surface Parameters

To represent the influence of terrain elevations on odour dispersion a digital elevation file was used in the AERMOD model setup. Shuttle Radar Topography Mission (SRTM1) elevation data was extrapolated from the WebGIS website and incorporated into the modelling assessment. This dataset provides terrain data at a resolution of 30 m from satellite data collected in February 2000. This dataset is considered to be more recent and at a higher resolution than standard OS topographical survey data.

For both the receptors and grid points the recommended Lakes Inverse Distance interpolation was used. This function interpolates the neighbouring points using inverse distance to obtain the elevation at the desired point. The terrain data was applied to an area, as a minimum, extending 4.5 km from the WwTP site in all directions, which is in excess of the study area size considered in Section 10.2.6. A visualisation of terrain inputs used for the assessment is provided in Figure 10-3.

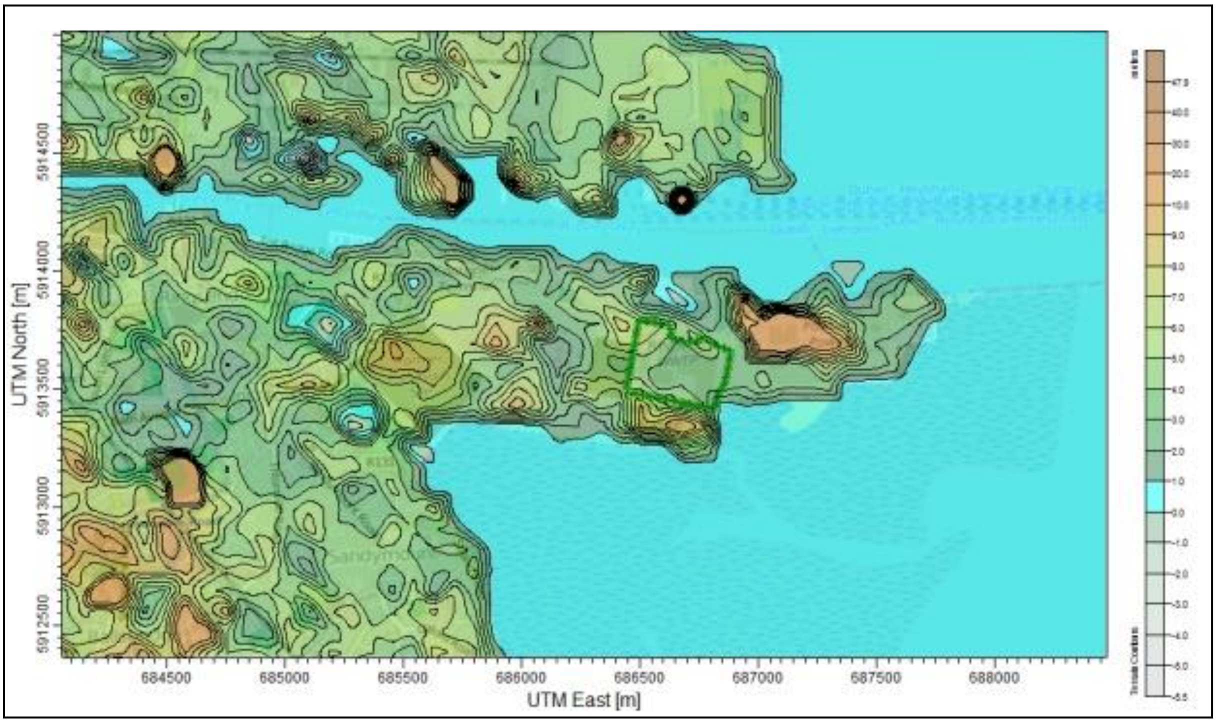


Figure 10-3: Terrain data considered within the study area © OpenStreetMap contributors - Copyright (http://www.openstreetmap.org/copyright)

10.2.10 Scenarios Considered within the Assessment

The assessment considered the following scenarios:

- Baseline 'Do-nothing' Scenario – Future baseline scenario after full implementation of the current odour improvement programme of works associated with the Proposed WwTP Component; and
- Future 'Post Development' Scenario – Future development scenario after implementation of the current odour improvement program of works and Proposed WwTP Component.

The 'Do-Nothing' scenario was defined as the future baseline odour conditions after full implementation of the current odour improvement programme. These include proposed or already operating odour mitigation methods which are not part of this Proposed WwTP Component, including the 'surgical upgrades' identified in the 2012 EIS.

The Future 'Post Development' Scenario represents future odour conditions after full implementation of the current odour improvement programme and the completion of the Proposed WwTP Component. The assessment therefore considers the incremental change in future odour concentrations as a direct result of the Proposed WwTP Component.

In accordance with the 2016 project scoping document, there is no likely significant impact anticipated from construction activities. Interim changes in odour concentrations during the construction phase of the Proposed WwTP Component were therefore not considered on a quantitative basis. As described in the EIAR scoping assessment there could be periods where construction activities may require the temporary shut-down of existing odour control units to facilitate connections to the units. The risk of off-site impacts will be managed in accordance with the site's Odour Management Plan (OMP) with all steps being made to minimise the magnitude and duration of potential impacts.

10.2.11 Selection of Receptor Locations

The assessment has evaluated the significance of impacts using odour impact assessment criteria at both specific receptors and at the site boundary. Use of a site boundary condition represents a conservative position where all offsite receptor locations are automatically considered, irrespective of their sensitivity to the impact.

The modelling assessment considered two receptor networks in order to quantify the impact of the Proposed WwTP Component. These included:

- A site boundary network for comparison to the Ringsend Project Odour Goal at the WwTP boundary; and
- A 3 km by 3 km receptor grid centred upon the site, at a resolution of 25 m, to show:
  - any areas of public exposure which breach the odour annoyance criterion; and
  - the extent, if any, of the breach of the 'Project Odour Goal' criterion.

Figure 10-4 shows the position of these two receptor networks. Specific discrete receptor locations were not selected. Key locations will be discussed in the assessment; however, compliance with the odour annoyance standard can be obtained by evaluation of provided odour contour (isopleth) maps.

The main existing residential areas and other relevant receptors near to the Ringsend WwTP were identified as:

- Existing Residences in Docklands South (closest on Pigeon House Road) - approximately 950 m to the west of the WwTP;
- Existing Residences in Sandymount (closest on Beach Road) - approximately 1 km to the southwest of the WwTP;
- Future residential receptors as part of the Poolbeg West Strategic Development Zone (SDZ) (including the potential Irish Glass Bottle site) - approximately 650 m to the west of the WwTP; and
- Future residential and leisure zones forming part of the North Lotts and Grand Canal Dock SDZ – approximately 2 km to the west of the WwTP.

These locations represent the closest areas of existing or potential future long-term public exposure, likely to have a high sensitivity to odour. Areas of long-term residential use (housing, hospitals and care homes) are considered to be high risk areas due to likely high receptor sensitivity to odour and long-term exposure (i.e. a large portion of a year).

Other areas, where only short-term public use is expected (hotels, parks, leisure areas), may be equally sensitive to odour but the temporary or infrequent duration of use is likely to reduce the overall odour annoyance of a nearby odour source. Areas of the city which are used for commercial, industrial and port uses are likely to be considered as locations with a low sensitivity to odour.

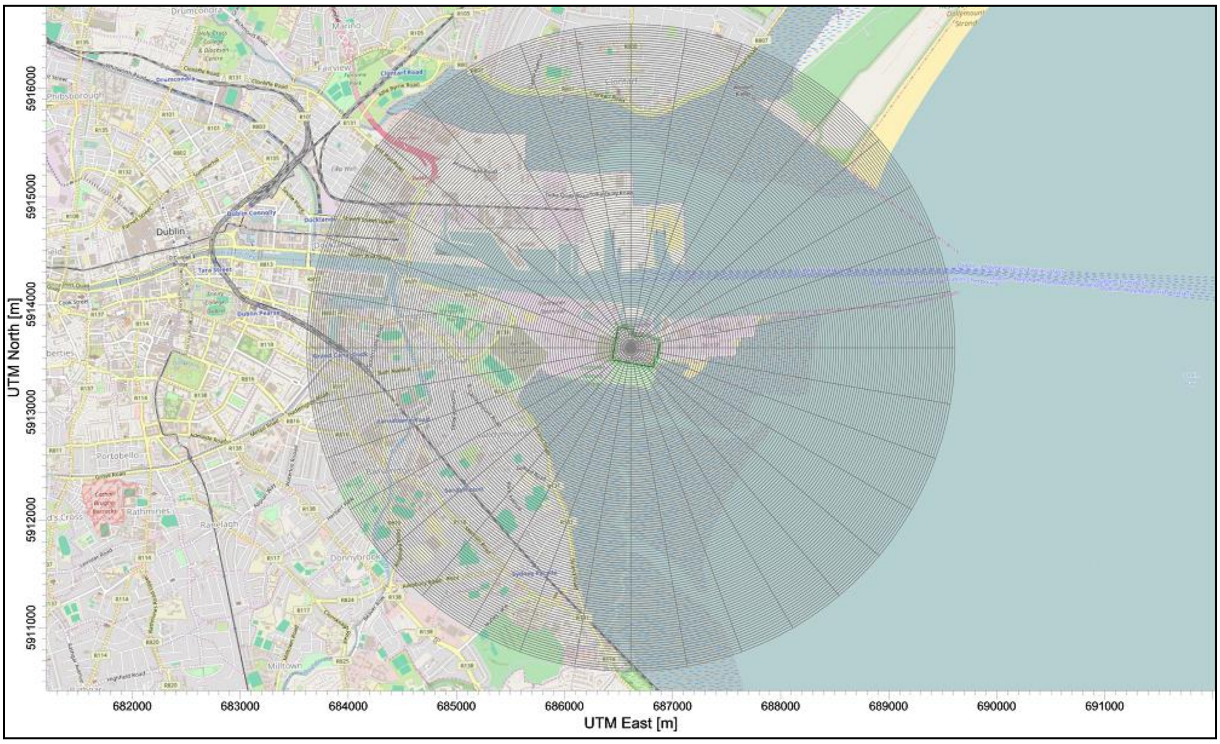


Figure 10-4: Receptor Network Map (OpenStreetMap, 2018)

10.2.12 Representation of Odour Emission Rates

Calculation of the odour emission rates were based on target odour emission concentrations and rates for all site processes provided or approved by the project team. These target odour emission rates are based on expected performance levels from on-site odour control units (OCU) and reference values for area sources.

Odour control unit emissions were calculated by applying an outlet odour concentration in accordance with the type of mitigation applied. The assessment has assumed that site OCUs should meet the following outlet concentrations:

- Single Stage OCU - 1,500 $ou_E.m^{-3}$; and
- Dual Stage OCU (including activated carbon polishing) - 1,000 $ou_E.m^{-3}$.

The OCU outlet concentrations are expected to be conservative and are in most cases above the stated performance levels by the manufacturer. The values have been used as conservative model inputs of achievable odour concentrations. Any derivations from these concentrations are explained where applied. The concentrations were applied to the most recent in-duct air flow measurements taken in August 2017.

The only uncovered sources considered in the assessment were the current Sequencing Batch Reactors (SBRs) and the storm overflow tanks. There are no Irish guidelines as to the expected emissions from these sources and as such the following emission rates were used from international information sources:

- SBR - All stages represented by to reference emission rate values from Activate Sludge Plant - 0.35 $ouE.m^{-2}.s^{-1}$. Netherlands Regulation of the Minister for Housing, Spatial Planning and the Environment of 9 November 2007, no. DJZ2007104180, containing general rules for establishments (Regulation on general rules for environmental management); and
- Storm tanks - Average value of 2.64 $ouE.m^{-2}.s^{-1}$. Best Practice in Odour Control Management, AquaEnviro Conference (Nottingham, UK), 06 February 2014.

The above rates have been applied to represent average emissions from the two open sources considered in this assessment. The SBR rate was applied at all times, a conservative assumption as odour emission from the non-aerated phases of the SBR (settle and decant phases account for approximately the majority of the treatment time) are likely to be less than those from aerated phases. The storm tank emission rate was also applied at all times and as such does not account for periods when the tanks are empty and clean.

The target and reference emission rates were compared to odour monitoring undertaken at the Ringsend WwTP in 2009, 2016 and 2017. The comparison showed that for most sources, measured odour emission rates were below or comparable to the emission target levels used in this assessment. A summary of the odour monitoring and suggested target levels are provided in Table 10-3.

Table 10-3: Comparison of Target Emission Rates to Monitored Odour Survey Data

Process Source	Odour Emission Rate ($ouE.s^{-1}$)			
	Target	2009	2016	2017
Lamella North OCU	9,556	9,933	40,703	5,301
Lamella South OCU	9,556	9,379	36,287	1,021
Combined THP OCU	23,430	10,688	18,802	35,771
Bord na Mona OCU 1	10,374	[2]	[2]	10,374
Bord na Mona OCU 2	3,095	[2]	[2]	223
Bord na Mona OCU 3	798	[2]	[2]	409

Process Source	Odour Emission Rate ($ou_E.s^{-1}$)			
	Target	2009	2016	2017
PST Outlet Channel OCU	2,196	391	29	193
Overflow Channel OCU	823	251	208	157
Curved Channel OCU	209	2,281	530	187
PST Inlet Channel OCU	1,770	1,267	8,179	10,020
ILPS OCU	1,926	1,834	6,652	14,074
CHP exhaust (4 sources)	2,539 [1]	2,539	*	*
SBR Upper Deck - (12 reactors)	8,518[3]	4,368	13,689	29,872
SBR Lower Deck - (12 reactors)	8,518[3]	4,368	13,689	29,872
Storm Tanks	54,759[3]	[3]	[3]	[3]

[1] Emission data provided in 2009 Odour Monitoring Report – No monitoring undertaken in 2016 or 2017
[2] OCU not in operation during survey, Theoretical odour emission rates based on manufacturer data, 4696,2700 and 708 $ou_E.s^{-1}$ for Bord na Mona OCU1, 2 and 3 respectively[1]
[3] calculated from literature emission rate as described in section 10.2.7

For the Ringsend WwTP OCUs the target level was calculated to result in an emission rate of 63,734 $ou_E.s^{-1}$. This level of suggested odour emission is above what was measured in 2009 (44,129 $ou_E.s^{-1}$) but less than that measured in 2016 (119,493 $ou_E.s^{-1}$) and 2017 (77,730 $ou_E.s^{-1}$).

The target level is designed to provide a realistic representation of odour emitted from the site which includes a safety factor to reflect minor performance deviations on a day-to-day basis. The target level therefore assumes that all OCUs provide a satisfactory odour removal and does not account for any major deficiencies with individual units. There are instances where individual sources do emit at levels exceeding the target/reference values, however it is expected that ongoing maintenance and targeted corrective actions would rectify any specific issues. The model input level also assumes the use of spare capacity in currently under-loaded odour control units (in terms of both extraction capacity and inlet odour concentration) by new connections to covered and abated processes associated with the Proposed WwTP Component.

The baseline and future predictions in this assessment are presented on the basis that performance and fault identification procedures, detailed in the site Odour Management Plan (OMP) and subsequent corrective maintenance, are robust and effective. The CAW OMP includes a daily condition and operation check, weekly marker compound surveys and biannual olfactometry testing for all OCUs. This level of odour management is considered to exceed what would normally be considered appropriate for wastewater infrastructure.

An example of the effectiveness of the odour management procedure was the identification and subsequent rectification of the Plasticon (Lamella North and South) OCU performance in 2016.

2016 and 2017 monitoring identified that the odour emission rates from the SBRs breached the target levels. This is expected to be a symptom of the overloaded nature of the WwTP, which is treating incoming loads exceeding its design. The SBR odour emission rate in 2009 was below the model input level suggested for this assessment and demonstrates that the outlet odour concentrations can be achieved.

10.2.13 Calculation of Emission Rates - 'Do-Nothing' Scenario

Table 10-4 and Table 10-5 summarise the odour sources and calculated emissions rates used to represent conditions under the 'Do-nothing' Scenario. The emissions inventory was compiled based on the target odour emission levels for the WwTP and the most recent flow rate data collected during the 2017 odour monitoring survey.

Table 10-4: Calculated Odour Emission Rates - 'Do-Nothing' Scenario - Point Sources

Process Source	Stack Height	Volumetric Flow rate	Efflux Velocity	Stack Diameter	Odour Concentration	Odour Emission Rate
	(m)	($m^3.s^{-1}$)	(m/s)	(m)	($ou_E.m^{-3}$)	($ou_E.s^{-1}$)
Lamella North OCU	13	9.56	12.17	1	1,000	9,556
Lamella South OCU	13	9.56	12.17	1	1,000	9,556
THP OCU Combined Outlet Stack	12	15.62	13.81	1.2	1,500	23,430
BnM OCU 1	10	13.74	12.1	1.2	755[1]	10,370
BnM OCU 2	10	3.10	12.6	0.56	1,000	3,096
BnM OCU 3	10	2.66	9.41	0.6	300[2]	798
PST Outlet Channel OCU	4	1.46	18.2	0.32	1,500	2,196
BnM Overflow Channel OCU	4	0.55	20.41	0.185	1,500	823
Curved Channel Peacemaker OCU	4.5	0.14	1.14	0.394	1,500	209
PST Inlet Channel OCU	4.5	1.18	12.34	0.349	1,500	1,770
ILPS Peacemaker OCU	6.5	1.28	4.7	0.59	1,500	1,926
CHP Exhaust 1	11.5	2.01	Capped[3]	0.4	N/A	635
CHP Exhaust 2	11.5	2.01	Capped[3]	0.4	N/A	635
CHP Exhaust 3	11.5	2.01	Capped[3]	0.4	N/A	635
CHP Exhaust 4	11.5	2.01	Capped[3]	0.4	N/A	635

[1] Monitoring showed breach of manufacturers guidance 300 $ouE.m^{-3}$ however monitored performance of the new OCU was better than the target level. As no new connections are expected to this OCU the highest monitored concentration has been used.
[2] Based on manufacturers guarantee (300 $ouE.m^{-3}$) and subsequent monitoring confirmed performance.
[3] Capped velocity model option selected due to presence of rain covers over exhaust.

Table 10-5: Calculated Odour Emission Rates - 'Do-Nothing' Scenario - Area/Volume Sources

Process Source	Surface Area	Odour Emission Factor	Odour Emission Rate
	(m^2)	($ouE/m^2/s$)	(ouE/s)
SBR Tank – Upper deck Area Source	24,336 (2,028 per reactor)	0.35	8,518
SBR Tanks Level 1 Volume Source*	N/A	N/A	8,518

* use of volume source option, applied to lower deck emissions as source is contained within the SBR structure. This is in accordance with modelling conducted for the 2012 EIA. Surface Area not required to be inserted as a model input but used for emission rate calculation.

10.3 Existing Environment

10.3.1 Historical and Current Odour Baseline Situation

A programme of works between 2005 and 2009 was established to provide odour treatment for the Ringsend WwTP in order to minimise the impact of odour within the local community. An ongoing continuation of this odour improvement scheme is in place, most recently including the provision of the three new BnM OCUs at the Ringsend WwTP. It is expected that the three new OCUs will be fully connected and operational by the end of 2018.

Information provided by the site operator, Celtic Anglian Water, suggests that odour complaints from the WwTP have reduced significantly since the facility was commissioned in 2005 and all complaints are fully investigated by the operator to ensure that the odour events do not correspond to high risk activities or process failures.

The reduction in odour complaints suggests that the ongoing additional odour control measures are providing improved and effective odour management. Future odour baseline conditions after completion of the current odour improvement works are defined in this assessment as the 'Do-nothing' scenario.

Reported Ringsend WwTP Odour Event Data

CAW provided a record of reported odour events for the last five years. This data was used to qualitatively assess baseline odour impacts of the Ringsend WwTP. The data presented represents a period of operation during the implementation of the 'surgical works' odour improvements. It is an important distinction that the data presented is a record of all public odour events reported to the WwTP operator and records have not been removed where the cause of the odour is unlikely to be the WwTP. With this distinction made and consideration of subsequent operator odour investigation conclusions, the reported odour event data can be used to infer current baseline odour impacts of the Ringsend WwTP.

A summary of the number of reported odour events is presented in Table 10-6.

The data indicated that, in general, a low-level of public odour events were reported to CAW during the last five years. During this period, the number of months where either zero, one or two odour events occurred were 44, 11 and 3 months respectively. These periods indicate that there could be off site detection of WwTP odours but the frequency and persistence is unlikely to be considered to cause a loss of amenity or an annoyance.

There were two periods when reported odour events were elevated. 15 reported odour events were received between September and October 2016 and 16 were received between May and June 2017. A full odour investigation into potential sources was conducted by CAW in relation to these periods. The results were as follows:

Table 10-6: Public Odour Event Reports Received by Ringsend WwTP Operator

Receptor	Odour Concentration Assessment Criterion					
	2013	2014	2015	2016	2017	2018
January	0	0	0	0	0	0
February	0	0	0	0	0	0
March	0	0	0	1	0	0
April	0	1	0	1	0	0
May	1	0	0	1	4	-
June	0	0	1	0	15	-
July	0	0	0	0	1	-
August	2	0	0	1	2	-
September	0	0	1	4	0	-
October	1	0	0	11	0	-
November	0	0	0	2	0	-
December	0	0	0	1	0	-

September to October 2016

The odour events coincided with a period of elevated usage of the off-site Storm Tanks. Usage was increased due to excessive flows and debris damage of the WwTP screen house and as such flows were diverted into the Storm Tanks to allow repair. The elevated usage during the repairs could have resulted in elevated odour emissions. Typically storm tanks are used for a short period (a day or two) after a significant rainfall event and are cleaned promptly to ensure there is no long-term build-up of residue. Continuous use of the tanks was required during the period of the repairs to prevent a backup in the sewer network, release of untreated wastewater into Dublin Bay and prevent elevated odours from WwTP processes due to overloading.

May to June 2017

No site failures or elevated emissions were reported during this period. Consideration of the location of the reported odour events (Sandymount), an absence of complaints at receptors closer to the WwTP and no known reason for elevated emissions from the WwTP, suggested that the WwTP may not be the cause of the reported odour. As such an investigation into the likely source was conducted. CAW presented that environmental odours, caused by a decaying Ectocarbus (Algae) bloom emitting hydrogen sulphide, could be the source. No further investigation was undertaken to determine the source of the odour due to reported odour event levels returning to the low baseline in July.

In summary, the reported odour event data indicated that, on occasions, odours from the WwTP may be detectable and identifiable in the local environment. The quantity and frequency of the reported odour events however does not suggest that there is a persistent, long term issue and that loss of amenity or annoyance is established. The September to October period in 2016 highlights that for infrequent short periods, odours may be elevated due to enforced process issues. These are managed by adherence to the Ringsend WwTP OMP in order to minimise emissions, alongside a stated obligation to rectify any operational issues in the shortest time possible.

10.3.2 Assessed Future 'Do-Nothing' Scenario

The assessment considered the 'Do-nothing' scenario as the operation of the Ringsend WwTP following the completion of the current program of odour improvement works, to allow a direct comparison of the impact of the Proposed WwTP Component. The current odour improvement works are likely to be fully completed in 2018.

Use of the Project Odour Goal boundary odour criterion allows the incremental change of the Proposed WwTP Component compared to a future 'Do-nothing' Scenario. A contour plot of odour concentrations as the 98th percentile of hourly averages has been produced to show the possible areas where an odour annoyance could occur.

10.3.3 Odour Concentration Predictions - 'Do-Nothing' Scenario

10.3.4 Ringsend Project Odour Goal

Predicted odour concentrations for a range of dispersion years for the future baseline 'Do-nothing' Scenario are detailed in Table 10-7. The table allows for comparison against the Ringsend Project Odour Goal (10 $ou_E.m^{-3}$ as the 99.4th percentile of hourly averages) which is assessed at the site boundary.

Table 10-7: Predicted Odour Concentrations at the site Boundary - "Do-Nothing" Scenario

Receptor	Odour Concentration					Assessment Criterion
	2011	2012	2013	2014	2015	
Assessment of Site Specific Boundary 'Project Odour Goal'						
Maximum at Site Boundary	7.73	7.46	7.56	7.85	7.15	10 $ouE.m^{-3}$ as the 99.4th percentile of hourly averages

The results of the future baseline 'Do-nothing' assessment show that:

- The site specific 'Project Odour Goal', of 10 $ouE.m^{-3}$ as the 99.4th percentile of hourly averages, was not breached at the Ringsend WwTP site boundary; and
- The maximum predicted concentrations at the site boundary for the Do-Nothing scenario were between 7.15 and 7.85 $ou_E.m^{-3}$ as the 99.4th percentile of hourly averages, less than 80% of the assessment criterion.

Figure 10-5 shows the predicted odour concentration for 2014 as the 99.4th percentile of hourly averages, which is the predicted worst meteorological year from the five-year dataset.

This odour criterion is a project-specific criterion for the Ringsend site. The project goal is used as a target level for the operator which is used to determine the requirement for and design of odour mitigation.

10.3.5 Adopted Odour Annoyance Criterion

The adopted assessment odour annoyance criterion, a level to indicate whether an odour annoyance is likely to occur at the most sensitive receptor locations, is 3 $ou_E.m^{-3}$ as the 98th percentile of hourly averages. It is unlikely that an odour annoyance will occur at locations with predicted concentrations below this level.

- The results of the future baseline 'Do-nothing' assessment show that:

- Predicted odour concentrations at all areas of long-term public exposure were below the adopted odour criterion of 3 $ouE.m^{-3}$ as the 98th percentile of hourly averages. This includes the closest receptors in Docklands South and residences to the southwest in Sandymount;
- Odour concentrations at potential areas of future residential use, including the Poolbeg West SDZ were predicted to be below the adopted odour criterion of 3 $ouE.m^{-3}$ as the 98th percentile of hourly averages;
- Odour concentrations at the majority of the Poolbeg West SDZ area designated for mixed uses (the areas directly south of the Dublin Bay Power station and Dublin WtE sites) were predicted to be below the adopted odour criterion of 3 $ouE.m^{-3}$ as the 98th percentile of hourly averages; and
- A small area, at the extremity of the mixed-use area, exceeded this criterion where concentrations not exceeding 5 $ouE.m^{-3}$ as the 98th percentile of hourly averages were predicted. As these areas are unlikely to be classified as highly sensitive to odour, public exposure will not be classified as long term, it is unlikely that an odour impact would occur.

Figure 10-6 shows the predicted odour concentration for 2014 as the 98th percentile of hourly averages, which is the predicted worst meteorological year.

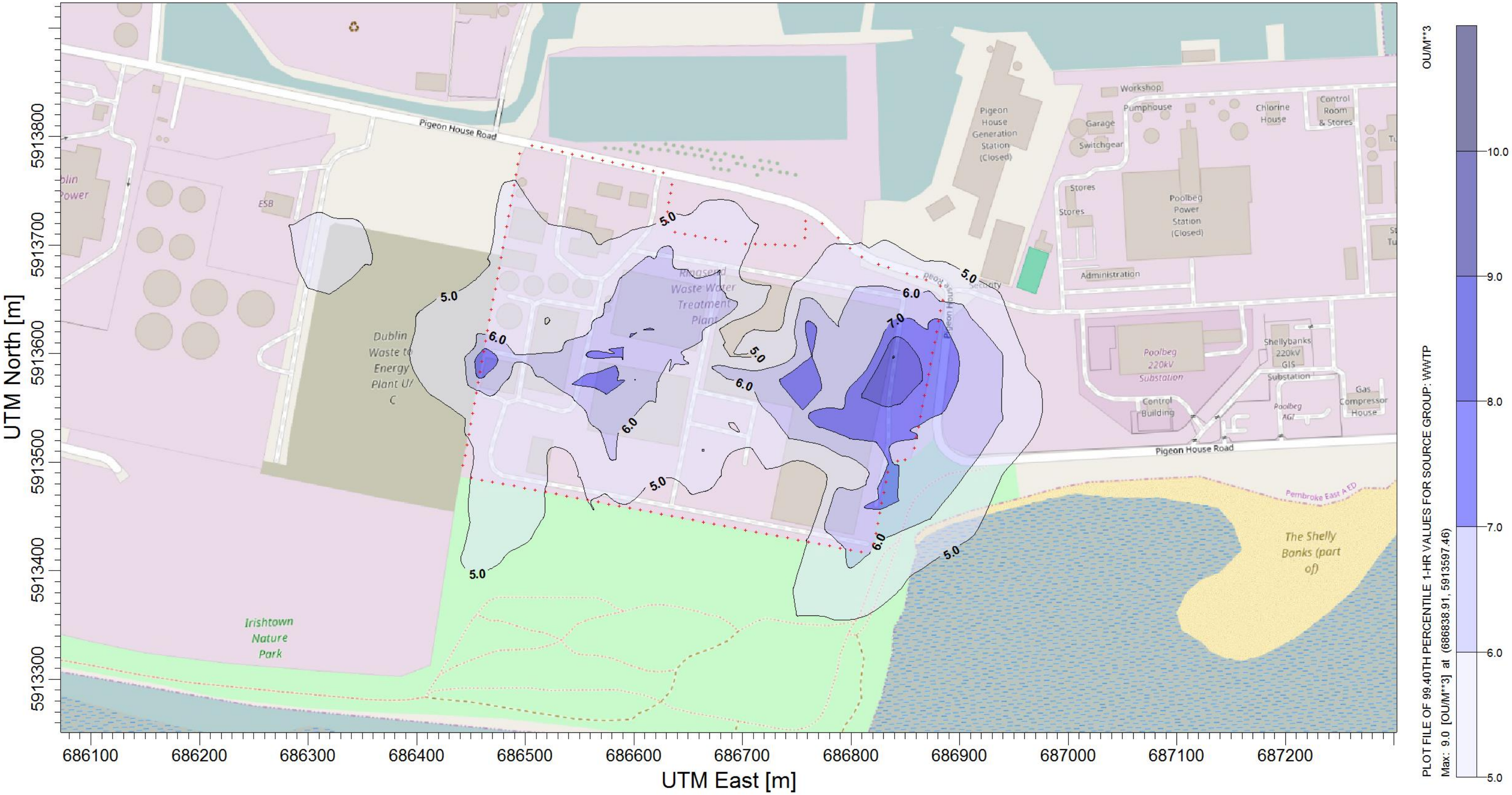


Figure 10-5: Predicted Odour Concentration - Ringsend Project Odour Goal - 'Do-Nothing' Scenario - $ou_E.m^{-3}$ as the 99.4th percentile of hourly averages 2014

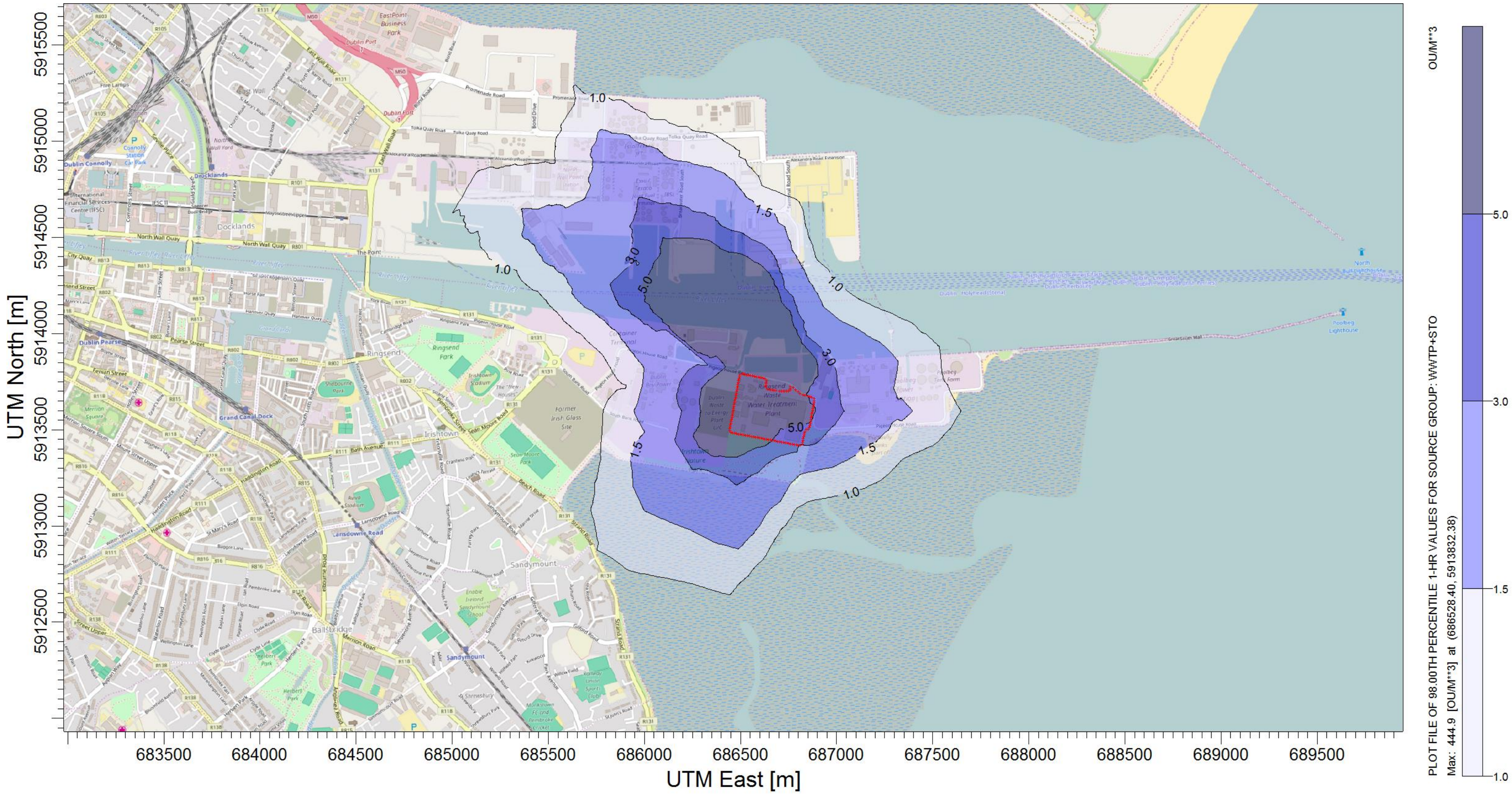


Figure 10-6: Predicted Odour Concentration - Adopted Odour Annoyance Criterion - 'Do-Nothing' Scenario - ouE.m^{-3} as the 98th percentile of hourly averages 2011

10.4 Characteristics of the WwTP Component of the Proposed Upgrade Project

The Proposed WwTP Component will introduce both new and amended processes, each with the potential to change the odour emission profile of the Ringsend WwTP. The scenario description, which defines the specific changes which have been assessed with regard to odour, is presented in Section 10.2.10. This includes the requirement to assess future, as opposed to current, baseline emissions due to the ongoing nature of the current, and committed, phase odour improvement works referred to as the 'surgical works'.

The odour assessment therefore considers that the following aspects of the Proposed WwTP Component are material to the assessment of odour impacts and are distinct from a 'Do-nothing' future baseline:

- The conversion of the current SBR reactors to the AGS technology - Part of the Proposed WwTP Component;
- The provision of additional secondary treatment capacity - Part of the 2012 Approval but modified in line with the specific technology stipulated in the Proposed WwTP Component; and
- The provision of ancillary and additional process improvements including additional sludge storage, P-Fixation and Pasteurization processes - Part of the Proposed WwTP Component.

The design of the Proposed WwTP Component is that, with the exception of the open sources, all other sources will be contained, extracted and treated using available spare capacity within the existing WwTP odour control units. The site OCUs are considered to be able to accept the additional flows with no loss of expected performance below target emission parameters.

In addition, for the purposes of the odour assessment, the completion of the 'surgical works' is considered to be outside of the 'with-development' scenario. This is due to the existing commitment to these improvements which is not dependant on planning consent for the full Proposed WwTP Component. This is a specific divergence from the Proposed WwTP Component description made specifically for the odour assessment as to not overstate the positive or negative impact of the development by double counting already committed changes.

It must be noted that the specific odour impact of the full Proposed WwTP Component cannot be made due to the partial completion of the surgical works odour improvements.

The calculation of emission rates, from sources associated with the Proposed WwTP Component that are pertinent to odour impacts, are presented in Section 10.4.1.

10.4.1 Calculation of Emission Rates - 'Post-Development' Scenario

The 'Post-development' scenario included a number of additional wastewater treatment processes which emit odours to the atmosphere. These include the incorporation of new Secondary Treatment Capacity Upgrade, new pumping station (ELPS), conversion of the existing SBRs to incorporate AGS technology, associated water treatment infrastructure, additional sludge treatment, additional sludge storage and a new sludge digester.

The review of the design indicated that the only direct odour emissions to atmosphere will be from the proposed Secondary Treatment Capacity Upgrade tanks and any changes in the odour profile caused by conversion of the SBRs to the AGS process. All other odour sources are proposed to be covered and extracted to existing onsite OCUs. The extracted flows will be treated using available spare treatment capacity within the existing OCUs. At the detailed design stage an assessment will be undertaken to ensure that none of the existing OCUs will be presented with inlet odour concentrations in excess of the unit's design. As a result, the outlet concentration is likely to remain at (or below) target levels after an initial acclimatisation period where biological treatment methods are used.

AGS Odour Emission Rate

Odour emission rates from new and converted AGS sources were obtained through consideration of the proposed phases of operation and treatment loading rates for the elements of the Proposed WwTP Component. The AGS system operates as a batch process utilising three treatment phases, feed/decant, aerate and settle.

As a conservative assumption, the three phased AGS process will be represented by emissions from the aeration phase, the phase expected to emit the most odour. The odour emission rate for the process was provided by the project engineering team based on the expected sludge loading after completion of the Proposed WwTP Component and reference to Dutch odour reference values. The odour emission rate for all AGS rectors, the 6 new reactors and 24 retro-fitted reactors, at the expected operating loads is 0.2 $ou_E.m^{-2}.s^{-1}$.

10.4.2 Odour Emission Rates - 'Post Development' Scenario

Table 10-8 summarises the odour sources that were considered in the assessment in addition to the 'Do-nothing' scenario detailed in Section 10.2.8. The converted AGS reactors replace the SBRs in the 'Do-nothing' scenario; however, the new AGS reactors, relating to the Proposed WwTP Component, are additional sources compared to the "Do-nothing" baseline scenario.

Table 10-8: Calculated Additional/Amended Odour Emission Rates - 'Post Development' Scenario

Process Source	Surface Area	Odour Emission Factor	Odour Emission rate
	(m^2)	($ou_E/m^2/s$)	(ou_E/s)
AGS Conversion - Upper deck Area Source	243,36 (2,028 per reactor)	0.20	4,867
AGS Conversion - Lower Level Volume Source*	N/A	N/A	4,867
Secondary Treatment Capacity Upgrade (3) - Upper deck Area Source	3,672 (1224 per reactor)	0.20	734
Capacity Upgrade (3) - Lower Level Volume Source*	Volume Source	Volume Source	734

* use of volume source option, applied to lower deck emissions as source is contained within the SBR structure. This is in accordance with modelling conducted for the 2012 EIA. Surface Area not required to be inserted as a model input but used for emission rate calculation.

10.5 Potential Impacts

10.5.1 Do-nothing Impacts

The potential impact of the Proposed WwTP Component was assessed by predicting the increase in odour concentrations across the study area and comparing these with the future baseline 'Do-nothing' scenario predictions detailed in Section 10.3.3. The assessment considered the design of the Proposed

WwTP Component and incorporated all sources where an odour emission to the atmosphere is likely to occur.

10.5.2 Odour Concentration Predictions - Construction Impacts

In accordance with the 2016 project EIAR scoping document, there is no likely significant impact anticipated from construction activities.

10.5.3 Odour Concentration Predictions - Operational Phase

10.5.4 Ringsend Project Odour Goal

Predicted odour concentrations for a range of dispersion years for the Proposed WwTP Component are detailed in Table 10-9. The table allows comparison against the Ringsend Project Odour Goal (10 $ou_E.m^{-3}$ as the 99.4th percentile of hourly averages) which is assessed at the site boundary.

Table 10-9: Predicted Odour Concentrations at the site Boundary - 'Post-Development' Scenario

Receptor	Odour Concentration					Assessment Criterion
	2011	2012	2013	2014	2015	
Assessment of Site Specific Boundary 'Project Odour Goal'						
Maximum at Site Boundary	6.20	6.82	7.04	7.30	6.88	10 $ou_E.m^{-3}$ as the 99.4th percentile of hourly averages

- The results of the post-development assessment scenario indicated that:
- The boundary 'Project Odour Goal' of 10 $ouE.m^{-3}$ as the 99.4th percentile of hourly averages will not be breached at the Ringsend WwTP site boundary;
- The maximum predicted concentrations at the site boundary were between 6.20 and 7.30 $ouE.m^{-3}$ as the 99.4th percentile of hourly averages, less than 75% of the assessment criterion; and
- The improvements in odour due to the expected reduced odour emission from the open sources is predicted to reduce the odour concentration by between 5 and 13% compared to the future baseline 'Do-nothing' scenario.

Figure 10-7 shows the predicted odour concentration for 2015, which is the predicted worst meteorological year.

10.5.5 Adopted Odour Annoyance Criterion

The adopted assessment odour annoyance criterion, a level to indicate whether an odour annoyance is likely to occur at the most sensitive receptor locations, is 3 $ou_E.m^{-3}$ as the 98th percentile of hourly averages. It is unlikely that an odour annoyance will occur at locations with predicted concentrations below this level.

The results of the Proposed WwTP Component assessment show that:

- The predicted odour concentrations at all areas of long term public exposure were below the adopted odour criterion of 3 $ouE.m^{-3}$ as the 98th percentile of hourly averages. This includes the closest receptors in Docklands South and residences to the south-west in Sandymount;
- Odour concentrations at potential areas of future residential use, including the Poolbeg West SDZ were predicted to be below the adopted odour criterion of 3 $ouE.m^{-3}$ as the 98th percentile of hourly averages; and

- Odour concentrations at areas of the Poolbeg West SDZ designated for mixed uses (the areas directly south of the Dublin Bay Power station and Dublin WtE sites) were predicted to be between 1 and 8.5 ouE.m^{-3} as the 98th percentile of hourly averages. These areas are unlikely to be classified as highly sensitive to odour, however if the development results in creation of areas for long-term public use (on an individual basis), concentrations between of 5-10 ouE.m^{-3} could result in a higher likelihood of complaints.

The Proposed WwTP Component scenario results in a slight improvement in odour concentrations at existing receptor locations. The improvements are likely to be imperceptible but represent an improvement compared to the future 'Do-nothing' scenario. Specific receptor concentrations are not provided due to the wide scale of the study area; however, an indicative comparison of receptors in Sandymount (off Strand Road) and Docklands South (off Sean Moor Road) is as follows:

- Strand Road, Sandymount, 950 m to the south-west of the WwTP - odour reduction of 6%
  - Future Baseline 'Do-nothing' Scenario - 0.97 $ou_E.m^{-3}$ as the 98th percentile of hourly averages
  - Proposed WwTP Component - 0.91 $ou_E.m^{-3}$ as the 98th percentile of hourly averages

- Sean Moore Road, Docklands South, 1 km to the west of the WwTP - odour reduction of 2%
  - Future Baseline 'Do-nothing' Scenario - 0.46 $ou_E.m^{-3}$ as the 98th percentile of hourly averages
  - Proposed WwTP Component - 0.45 $ou_E.m^{-3}$ as the 98th percentile of hourly averages

Figure 10-8 shows the predicted odour concentration for 2014, which is the predicted worst meteorological year.

Figure 10-7: Predicted Odour Concentration - Ringsend Project Odour Goal - 'Post-Development' Scenario - $ou_E.m^{-3}$ as the 99.4th percentile of hourly averages 2014

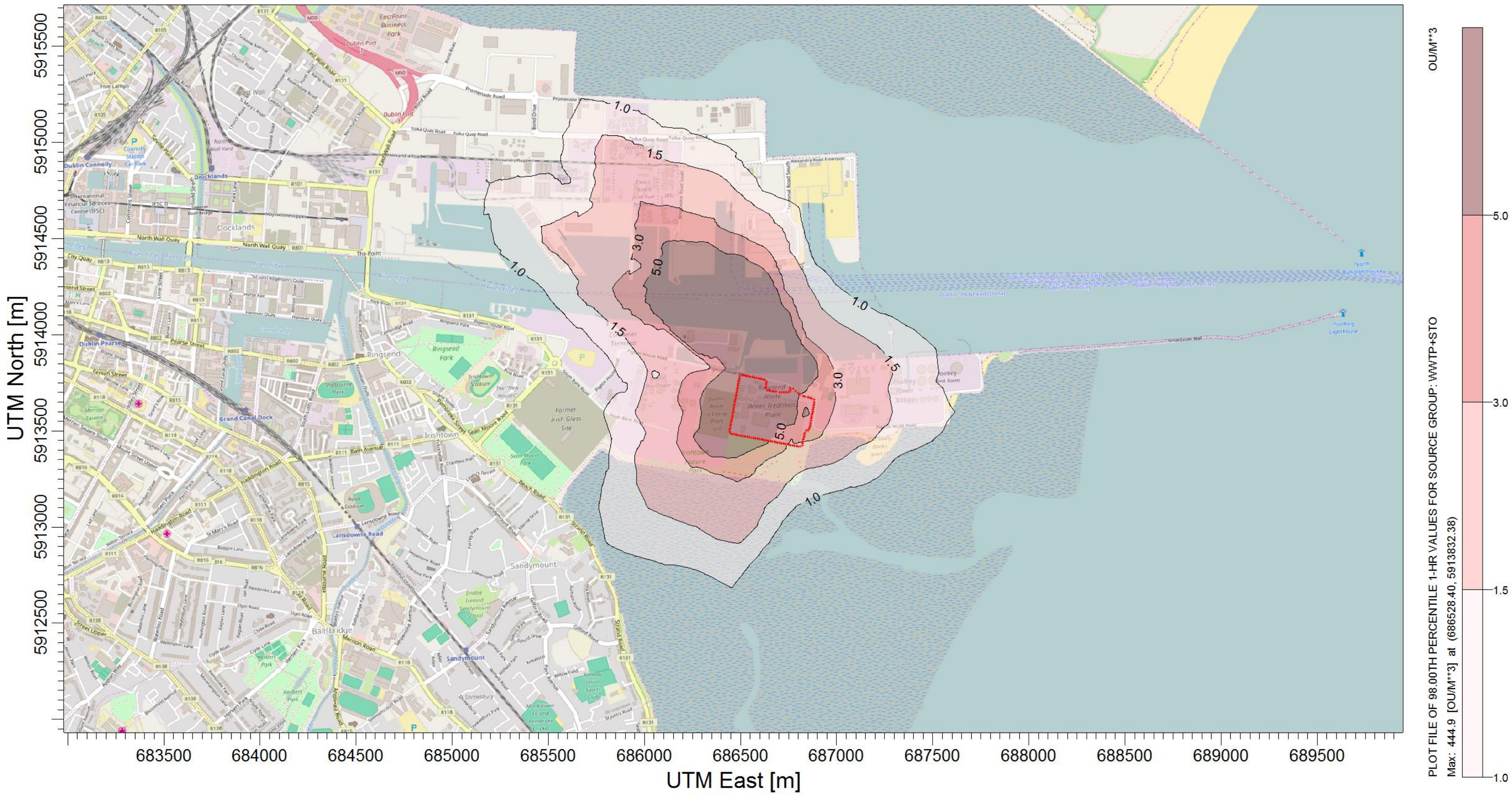


Figure 10-8: Predicted Odour Concentration - Adopted Odour Annoyance Criterion - 'Post-Development' Scenario - $ou_E.m^{-3}$ as the 98th percentile of hourly averages 2014

10.5.6 Impact Significance

This assessment concludes that odour effects from the Proposed WwTP Component will have a minor positive impact based upon:

- Predicted odour concentrations at the Ringsend WwTP boundary do not breach the Ringsend Project Odour Goal (10 $ou_E.m^{-3}$ as the 99.4th percentile of hourly averages) for both the future baseline 'Do-nothing' and Proposed WwTP Component scenarios:
  - The maximum post Proposed WwTP Component concentration was predicted to be 7.45 $ou_E.m^{-3}$ as the 99.4th percentile of hourly averages
- Predicted odour concentrations are below the adopted odour annoyance criterion of 3 $ou_E.m^{-3}$ as the 98th percentile of hourly averages at all existing and planned future areas of likely long-term and highly sensitive public exposure (including residential areas of the mixed use Poolbeg West SDZ); and
- The Proposed WwTP Component results in a predicted reduction in ambient odour concentrations at the site boundary and at receptor locations when considering both the Ringsend Project Odour Goal and the adopted odour annoyance criterion.

As defined in the assessed scenario descriptions, this assessment predicted the impact of the Proposed WwTP Component upon future (as opposed to current) baseline odour conditions. The future baseline predictions include the operation of three new OCUs installed to treat currently untreated areas of the WwTP. With effective implementation of this additional odour mitigation infrastructure, future baseline off site odour concentrations are likely to improve compared to the current baseline conditions.

10.6 Mitigation Measures

10.6.1 Construction Phase

The principles of the site Odour Management Procedures (OMP) will be followed to include odour management of the construction phase of the new processes. The OMP will also detail the operational, management and maintenance procedures to minimise emissions including during the construction phase. This includes a daily condition and operation check, weekly marker compound surveys and biannual olfactometry testing for all OCUs.

10.6.2 Operational Phase

The assessment considered the potential odour impact of the Proposed WwTP Component with the inclusion of mitigation measures incorporated into the design. The proposals include provision for all new sources associated with the upgrade, apart from the open capacity upgrade reactors, to be covered, extracted and treated using spare capacity within the site's OCU systems.

The site Odour Management Procedures (OMP) will be updated to include odour management of the new processes. This will include updating the OMP to identify all potential new odour emission sources. The OMP will also detail the operational, management and maintenance procedures to minimise emissions including during plant failure or emergency situations. The operator has an established management procedure for reporting and investigating public odour complaints and this procedure will be maintained. This includes a daily condition and operation check, weekly marker compound surveys and biannual olfactometry testing for all OCUs. The specific monitoring obligations within the current OMP are detailed in Table which will, as a minimum, be retained in future versions.

Table 10-10: Odour Management Procedure (OMP) - Monitoring Schedule

Source	Monitoring For	Frequency	Units
Key site locations and odour control unit inlets and outlets, channels	H_2S	Weekly	ppb
Influent and lamella influent and effluent	Dissolved sulphide	Mon-Fri during summer	Spot sample - colour change
Influent and lamella influent /effluent	Dissolved sulphide	Weekly	Lab analysis - mg/l
OCU stacks in THP and driers	H_2S	Continuous on-line	ppb
Stack emissions	Olfactometry for perceived odour	6 monthly	Odour units
Nearest receptor (property off site)	H_2S and presence of odour	In response to complaint	ppb
Full survey	Olfactometry for perceived odour	Annual (at request of DCC/IW)	Odour units
Main OCU	Inlet H_2S Load	Continuously	PPM 0 -200

The OMP will also form the management process to ensure that process sources and OCUs are operated correctly and do not fall into disrepair. In accordance with the OMP, regular flow and olfactometry testing would be used to quantify the odour removal performance. Although not suggested in the current OMP, it is suggested that any odour monitoring result in excess of the model input levels detailed in Section 10.2.7 should be confirmed, investigated and rectified.

10.7 Residual Impacts

10.7.1 Construction Phase

No residual impacts were identified that would occur during the construction phase of the Proposed WwTP Component.

10.7.2 Operational Phase

No residual impacts were identified that would occur after implementation of the Proposed WwTP Component.

10.7.3 Interactions

There are no interactions that are considered material to the assessment of odour impacts associated with the Proposed WwTP Component.

10.7.4 Cumulative Impacts

Due to the way the brain responds to odours, it is not often possible to quantitatively assess the cumulative impacts of multiple odour sources. This is due to the way in which the brain responds to odours, which is not generally additive (Environment Agency/Scottish Environmental Protection

Agency, 2002)[18] in the same way as decibels for noise or specific air quality pollutant concentrations. The brain has a tendency to screen out odours which are always present but those that are out of place or intermittent may noticeably stand out. As an example, an out of place or unexpected odour at a concentration of a few odour units, could be distinct and detectable within an environment where the overall concentration is much higher, typically up to 40 $ou_E.m^{-3}$ (Wijen, 1986).

As a result, where odours have notably different characters, it is not expected that an arithmetically combined odour, which includes all local and environmental background sources, is representative of total exposure. However, it must be noted that although odours from different sources are not combinable, an annoyance or loss of amenity may be created by the cumulative burden from a range of different sources.

A review of the local area was undertaken to identify any odour sources that could be of a similar nature to the Proposed WwTP Component. The Proposed WwTP Component is located in an area designated for industrial and port uses. In the immediate vicinity of the Ringsend WwTP, there are facilities which could contribute to baseline odour concentrations at receptor locations, however these were classified as mainly associated with waste handling/processing and port activities. As such, it is not expected that there will be any direct cumulative impacts that would exacerbate the detection of sewage like smells. The notable exception would be odours from existing wastewater treatment processes at the Ringsend WwTP which have been included in the assessment and have been assessed quantitatively.

This observation does not preclude the potential for cumulative impacts, but suggests that odours from the WwTP could be identified in isolation from other background, environmental and industrial sources. The burden of WwTP odours in the area can therefore be considered distinct from other odours in the area.

The assessment considered future baseline emissions from the Proposed WwTP Component, and predictions indicate a small improvement in the local environment. It is also notable that future emission from the WwTP, with or without implementation of the proposed upgrades, will be less than current emissions due to the completion of the already committed phases of odour improvement works. As such, the development is unlikely to exacerbate the cumulative burden of odour impacts from all other sources in the local area.

The assessment team is unaware of any plans for new odour producing sources in the vicinity of the WwTP and as such, the future trends in baseline odour conditions, excluding the WwTP are likely be similar to current levels. As is the case with the Proposed WwTP Component, it is expected that any proposed or newly commissioned sites would only be consented with sufficient odour containment and reduction techniques and associated management controls as to minimise potential odour impacts.

As such, it is considered that the Proposed WwTP Component is unlikely to contribute to significant cumulative odour impacts in the local area.

[18] *Environment Agency/Scottish Environmental Protection Agency, Integrated Pollution Prevention and Control (IPPC) - Draft Horizontal Guidance for Odour - Part 1, Regulation and Permitting. Note, guidance superseded in 2010 however where not contradicted by subsequent guidance information is still considered relevant*

10.8 Monitoring

Although the selected emission rates are considered to be appropriate, for newly commissioned sources, post commissioning odour testing is recommended. This monitoring will be used to confirm the emission rate assumptions and ensure that actual emissions impacts do not exceed those presented in this assessment. The following programme of post commissioning testing is proposed:

- Post commissioning olfactometry survey for the following sources
  - Converted AGS reactor for all three operational phases;
  - Secondary Treatment Upgrade;
  - BnM OCU 1, 2 and 3, which were at the time of the most recent sampling, not fully commissioned or connected to all proposed odour sources; and
  - Any existing OCU that is modified in any way as to accommodate processes forming part of the Proposed WwTP Component.
- All testing to be conducted on the following schedule/basis
  - Survey to be undertaken after full commissioning of the source/OCU (maximum 6 months after commissioning);
  - Surveys will persist on a 6-month basis until two concurrent tests are shown to be below the stated target level. Note: compliance required with both the outlet odour concentration $ou_{E.}m^{-3}$ and odour emission rate $ou_{E.}s^{-1}$ targets;
  - Odour analysis undertaken by a nationally or internationally accredited laboratory including accreditation to the EN 13725 European standard for odour analysis; and
  - Surveys would be considered void if conducted during periods of low odour generation, i.e. persistent cold weather and large-scale precipitation events.

It is important to acknowledge that a breach of an individual target level may not result in an annoyance at a receptor. However, any breaches of target levels should be highlighted as an operation concern in line with a commitment to maintain and minimise odour emissions from the Ringsend WwTP on a long-term basis. The following operator responses are proposed based on the result of the post-commissioning testing (three cycles).

- In the event that the newly commissioned source meets the stipulated target level
  - The source should be added to the odour monitoring schedule indicated in the current Ringsend OMP
- In the event that the newly commissioned source meets the target level
  - Option a) an engineering or process solution should be sought to address the elevated emissions. Further monitoring would be required post improvement to confirm that the target levels are met.
  - Option b) A full site odour modelling assessment is presented to show that an elevated emission from the source does not result in a predicted impact at any receptor location

This post-commissioning monitoring is presented in addition to the schedule of monitoring proposed as part of the Ringsend WwTP OMP. The current testing schedule in relation to olfactometry analysis is summarised in Section 10.6.2.

10.9 Difficulties Encountered

An inherent difficulty in assessing the impacts of proposed odour sources is associated with the selection of odour emission rates used to represent the sources. This assessment used information provided by the target levels set by the project team to predict odour emission from the site based on the proposed odour removal technology. Although the selected emission rates are considered to be appropriate, the post commissioning testing schedule, discussed in Section 10.8, will be used to confirm that both actual emission levels (odour concentration and emission rates) and dispersion properties (air speed and volumetric flow rates) flow rate meet the parameters stipulated in this assessment.

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Section 11: Cultural Heritage

11.1 Introduction

This Section of the EIAR assesses the potential impacts (and resulting effects) likely to occur as a result of the Ringsend WwTP component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component") on the archaeological and architectural heritage.

Full details of the Proposed Upgrade Project and the Ringsend WwTP component can be found in Volume 2, Section 3: Description of Proposed Upgrade Project.

A wide variety of paper, cartographic, photographic and archival sources were consulted. All of the lands of the WwTP site were visually inspected.

This Section and assessment have been completed having regard to the guidance outlined in the Environmental Protection Agency documents *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (Draft, August 2017) and *Advice Notes for Preparing Environmental Impact Statements* (Draft, September 2015).

11.2 Methodology

This study, which complies with the requirements of Directive EIA 2014/52/EU, is an assessment of the known or potential cultural heritage resource within a specified area and includes the information that may reasonably be required for reaching a reasoned conclusion on the significant effects of the Proposed WwTP Component on the environment, taking into account current knowledge and methods of assessment. It consists of a collation of existing written and graphic information in order to identify the likely context, character, significance and sensitivity of the known or potential cultural heritage, archaeological and structural resource using an appropriate methodology.

The study involved detailed investigation of the cultural heritage, archaeological, architectural and historical background of the Ringsend WwTP site and the surrounding area. The overall study area extends 1 km from the Ringsend WwTP site.

- This area was examined using information from:
- The Record of Monuments and Places (RMP) for County Dublin;
- The Dublin Development Plan 2016-22;
- The Sites and Monuments Record;
- The National Inventory of Architectural Heritage;
- Aerial photographs;
- Excavation reports;
- Cartographic sources; and
- Documentary sources.

A field visit was carried out on 17 May 2016 to identify and assess any unknown archaeological sites, structures and previously unrecorded features and possible finds within the Ringsend WwTP site.

An impact evaluation and mitigation strategy has been prepared. The evaluation which follows *Guidelines for the Assessment of Archaeological Heritage Impacts of National Road Schemes* (National Roads Authority undated) has been undertaken to evaluate the significant effects, if any, on the cultural heritage, archaeology and architecture which can reasonably be expected to occur because of the Proposed WwTP Component, while a mitigation strategy has been designed to remedy any significant adverse effects on the cultural heritage.

The only receptors with the potential to be impacted by the construction phase of the Proposed WwTP Component are the Pigeon House Fort and Pigeon House Harbour. These are masonry structures and have a low sensitivity to construction impacts, the magnitude of the potential impacts is low and the significance of the impacts is low. Any potential impact will only last for the duration of the construction.

11.3 Characteristics of the WwTP Component of the Proposed Upgrade Project

Characteristics of the Proposed WwTP Component, associated with both the construction and operational phases, have the potential to impact on the Cultural Heritage of the area, in particular the following issues are considered:

- Land utilisation required for temporary construction compounds and access roads;
- Changes to site layout and fence lines;
- Public utilities and the need to make connections across areas of archaeological interest;
- Excavation works and the need to monitor for areas of archaeological interest;
- Piling operations; and
- Surcharging on areas of archaeological interest during construction phase.

11.4 Existing Environment

11.4.1 The Landscape

The Ringsend WwTP site is situated in the east of Dublin City to the east of Ringsend on the man-made Poolbeg Peninsula which is situated on the South Bull sand bank. The Ringsend WwTP site is an area of dry land that has been made by people through the reclamation of Dublin Bay (i.e. made ground).

11.4.2 Historical and Archaeological Background

The following is a summary of the archaeological and historical development of the study area as shown in Fig 11-2 and the main types of sites, monuments and structures that are known from the surrounding area. The purpose of this approach is to place the types of sites, monuments and structures in the study area in a cultural and chronological context to assist the assessment.

11.4.3 The Prehistoric Period

The Ringsend WwTP site is situated on the South Bull sand bank in an area of made ground reclaimed from Dublin Bay in the eighteenth, nineteenth and twentieth centuries known as the Poolbeg Peninsula. During the prehistoric period the area was characterised by shifting tidal sand banks. There are no prehistoric monuments or sites known from the area. A single un-associated glass bead of prehistoric origin was found on the shore at the Pigeon House Fort in 1918.

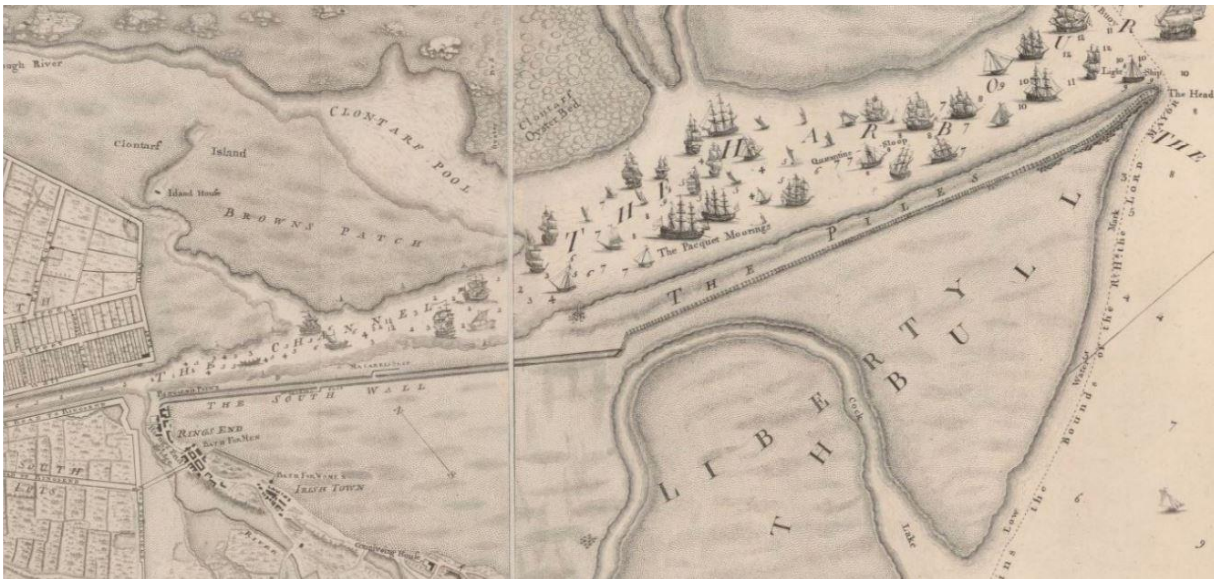
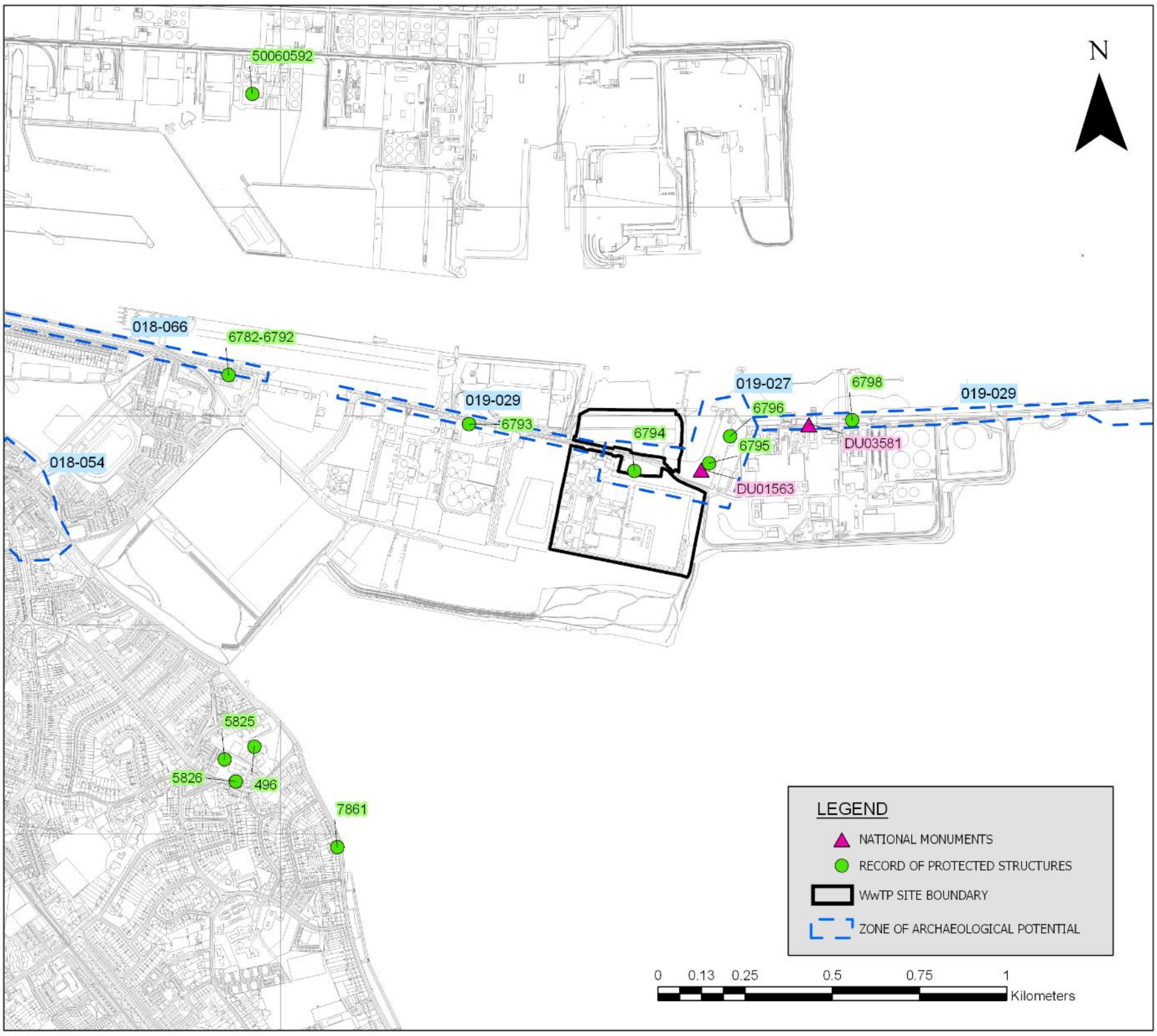


Figure 11-1: Except from John Rocque's map of Dublin 1760 illustrating The South Wall and The Piles



Data source: Statutory Record of Monuments and Places map for Dublin Sheet Nos. 3264 and 3265

Figure 11-2: The study area which extends 1 km from the WwTP site at the four cardinal points.

11.4.4 The Modern Period

Poolbeg appears on Bernard de Gomme's map of 1673 as a channel between the North and South Bulls (Giacometti, 2009). The area was a notable fishery, vested in Dublin Corporation and in 1705 the Lord Mayor granted the lease of the oyster bed of Poolbeg to John Payne for 21 years at an annual rent of £5 (Went, 1954). Between 1717 and 1731 the Dublin Ballast Office constructed a breakwater later known as the "The Piles" running east from a small area of high ground on the South Bull sands known as the "Green Patch", later the site of Pigeon House Fort, as far as the site of the later Poolbeg Lighthouse (McCullough *et al.* 2011).

The piles were timbers driven into the sand banks with stone, gravel and shingle laid along the line of piling. In 1748, the Dublin Ballast Office commenced the construction of a double stone wall known as the Ballast Office Wall or the South Wall (RMP DU019-029) and later Pigeon House Road, between Ringsend and the site of the later Pigeon House Fort, which was completed about 1759 and appears on John Rocque's map of 1760 (Figure 11-1).

About 1760, a blockhouse was built on the later location of Pigeon House Fort and the eponymous John Pigeon was appointed Caretaker in 1761. In 1766, two wharfs were constructed either side of the blockhouse to which were later added a Revenue barracks and a storehouse. In 1787, a larger blockhouse was built. The South Wall (RMP DU019-029; Protected Structure No. 6798) was constructed along the line of the piles from the Poolbeg Lighthouse which was completed by 1792-5. A harbour was built at the Pigeon House in 1791. In 1793-5 the Pigeon House Hotel (Protected Structure No. 6795) was constructed. From 1798 the Pigeon House Fort (RMP DU019-027, Protected Structure No. 6794), consisting of walls, gateways, barracks, stores, magazine, hospital, canteen, prison and water tanks, was built by the Army to the south and east of the Pigeon House Harbour and the Pigeon House Hotel was taken over as officer's quarters. In 1897 the Army evacuated the Pigeon House Fort and the site was sold to Dublin Corporation. Between 1897 and 1906 the outfall works of the Municipal Sewage Scheme was constructed by filling in the Pigeon House Harbour with made ground.

In 1902, the red-brick Pigeon House generating station (Protected Structure No. 6796) was constructed on the eastern part of the Pigeon House Fort to supply electrical power for the City of Dublin. In 1971, the 1902 Pigeon House generating station was replaced by a new one. From the 1940s, reclamation work took place to the south of and against the walls of the Pigeon House Fort. This work created the made ground that is now occupied by the Ringsend WwTP.

11.4.5 Architectural/Building Heritage

11.4.6 Protected Structures

The Dublin City Development Plan 2016-22 was examined as part of the baseline study for this Section of the EIAR. The review established that there is one structure situated partly within the Ringsend WwTP site listed as a Protected Structure (see Table 11-1). This is No. 6794, the remnants of the Pigeon House Fort. The WwTP site extends into the south-east part of the interior of the fort (see Figure 11-2 and Figure 11-3).

There are an additional 20 Protected Structures situated in the study area. The closest Protected Structure to the Ringsend WwTP site is No. 6795 the former Pigeon House Hotel. This structure is situated c.43 m north-east of the WwTP site.

Table 11-1: Protected Structures in the study area

Ref	No.	Address	Description	Type of impact
496	-	-	Roslyn Park House	None
5825	-	-	Methodist Church	None
5826	-	-	House	None
6782	70	Pigeon House Road, Dublin 4	House	None
6783	71	Pigeon House Road, Dublin 4	House	None
6784	72	Pigeon House Road, Dublin 4	House	None
6785	73	Pigeon House Road, Dublin 4	House	None
6786	74	Pigeon House Road, Dublin 4	House	None
6787	75	Pigeon House Road, Dublin 4	House	None
6788	76	Pigeon House Road, Dublin 4	House	None
6789	77	Pigeon House Road, Dublin 4	House	None
6790	78	Pigeon House Road, Dublin 4	House	None
6791	79	Pigeon House Road, Dublin 4	House	None
6792	80	Pigeon House Road, Dublin 4	House, including former coastguard premises	None
6793	-	Pigeon House Road, Dublin 4	Former St. Catherine's Hospital: surviving parts, including northern and western site boundary walls	None
6794	-	Pigeon House Road, Dublin 4	Remnants of Pigeon House Fort	None
6795	-	Pigeon House Road, Dublin 4	Former Pigeon House Hotel	None
6796	-	Pigeon House Road, Dublin 4	Pigeon House power station: former red-brick electricity generating station	None
6797	-	Pigeon House Road, Dublin 4	Limestone and granite ashlar sea wall	None
6798	-	Pigeon House Road, Dublin 4	Great South Wall (to lighthouse)	None
7861	-	Strand Road, Sandymount and Merrion, Dublin 4	Sea wall	None

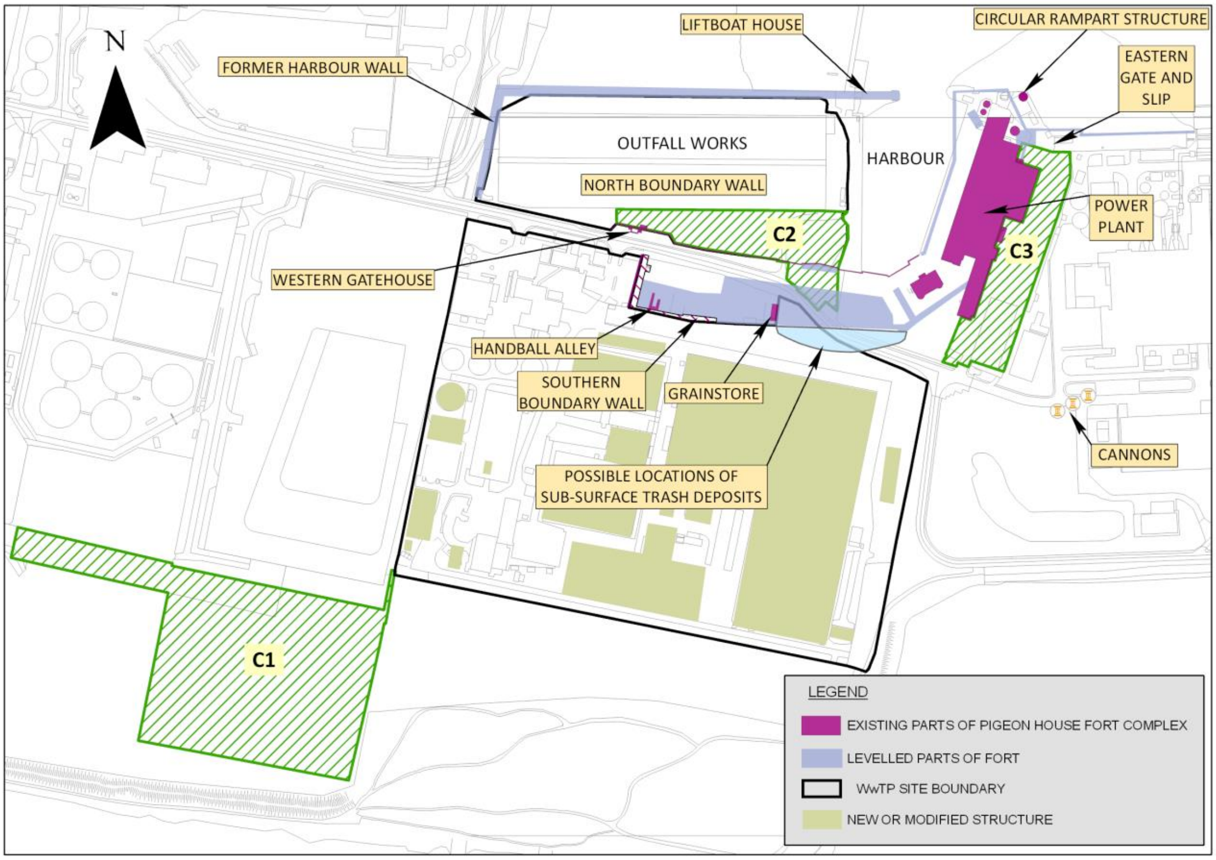


Figure 11-3: Plan of the Pigeon House Fort from Giacommetti 2009 superimposed on a plan of the Proposed WwTP Component

11.4.7 Non-Designated Structures

The National Inventory of Architectural Heritage (NIAH) maintained by the Department of Culture, Heritage and the Gaeltacht was examined as part of the assessment. This review established that there are no structures in the Ringsend WwTP site listed in the NIAH. There is one structure in the study area listed in the NIAH. This is an industrial building (5006059) on Alexandra Road (see Table 11-2 and Figure 11-2). This building is situated 1.3 km north-west of the WwTP site and will not be impacted by the construction and operation of the Proposed WwTP Component.

Table 11-2: NIAH Structures in the study area

Ref	No.	Address	Description	Type of impact
50060592	-	Alexandra Road, Branch Road South, Dublin, Dublin City	Detached multiple-bay multi-storey industrial building, built c.1920	None

11.4.8 Field Inspection

On 17 May 2016, fieldwork was carried out to identify any additional structures in the vicinity of the Ringsend WwTP site omitted from the Record of Protected Structures and the National Inventory of Architectural Heritage. This involved assessing all upstanding structures within 100 m of the WwTP site (see Figure 11-2). There are no additional structures of heritage interest within this area.

11.4.9 Archaeology

11.4.10 Recorded Monuments

Examination of the Record of Monuments and Places for Dublin indicated that there are two Recorded Monuments located partly within the Ringsend WwTP site (see Figure 11-2, Table 11-1 and Appendix 11A). These are:

- DU019-027 Dublin South City Blockhouse; and
- DU019-029 Dublin South City Sea wall.

DU019-027 Dublin South City Blockhouse

A harbour was built at the Pigeon House in 1791 by enclosing a tidal pool on the northern side of an area of ground on the South Bull sands known as the "Green Patch". This had been connected to Ringsend by the construction of the Ballast Office Wall which was completed about 1759 and supported the later Pigeon House road. Pigeon House Fort was constructed from 1798 to the south-east and east of the Pigeon House harbour and consisted of walls, gateways, barracks, stores, magazine, hospital, canteen, prison and water tanks and the Pigeon House Hotel was taken over as officer quarters. The full extent of the fort can be seen in Figure 11-3. The Pigeon House Fort and Harbour were completely surrounded by the tidal South Bull sands and most historical illustrations of the fort depict it surrounded by water (Figure 11-4 and Figure 11-5). Giacometti (2009) has suggested that rubbish from the fort may have been deposited outside the walls. Any material disposed of outside the fort would have been either thrown into the harbour or onto the Bull sands. The harbour may also contain material associated with the shipping that used the harbour.

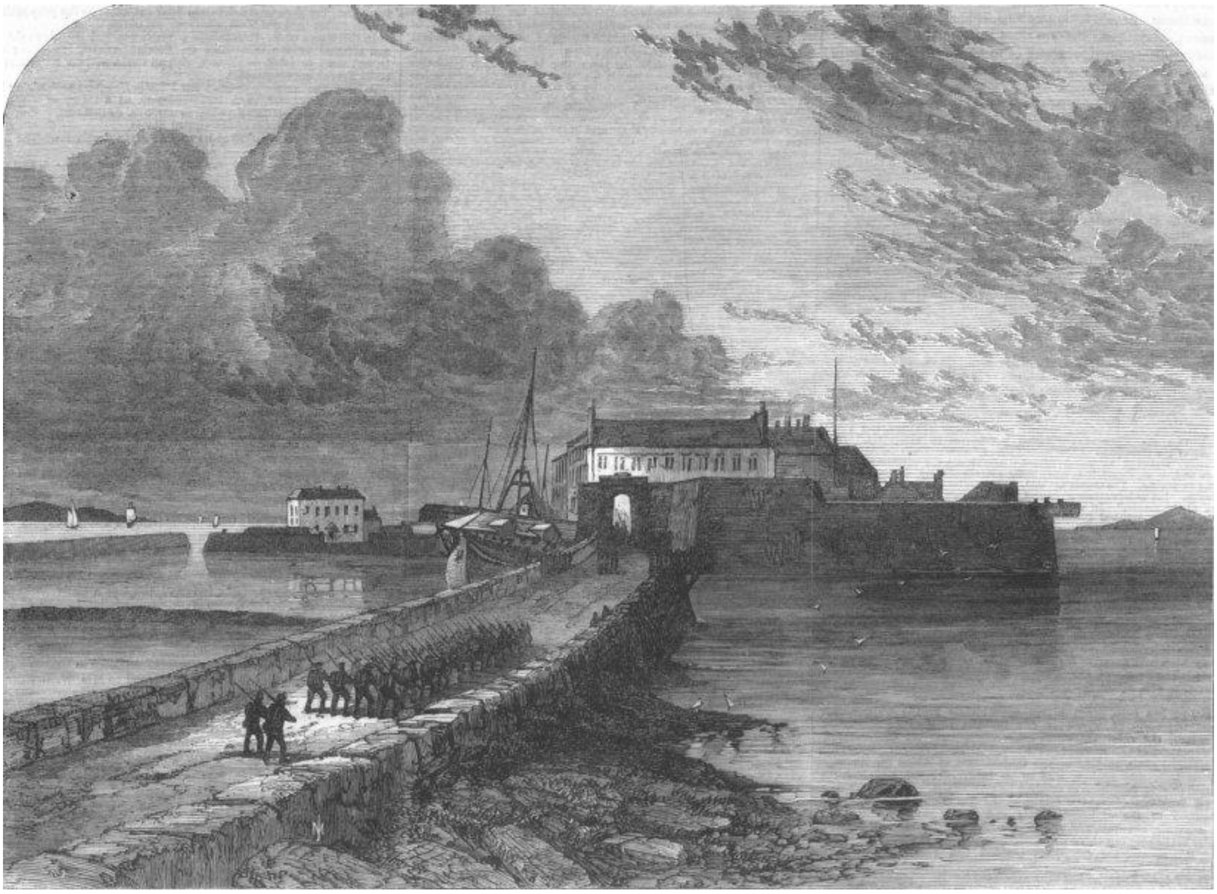


Figure 11-4: Depiction of the Pigeon House Fort in 1866 looking along the Pigeon House Road east to the gate. From the Illustrated London News No. 1359 Vol. XLVIII

Figure 11-5: Depiction of the Pigeon House Fort in 1877 by Robert Seymour. National gallery of Ireland NGI2498

In 1897, the Army evacuated the Pigeon House Fort and the site was sold to Dublin Corporation. Between 1897 and 1906 the Pigeon House Harbour was infilled and used to construct the outfall works of the Municipal Sewage Scheme. This infill would have sealed any archaeological material in the harbour below the level of the outflow works. Today most of the buildings within the Pigeon House Fort have been demolished or are in ruins. The main surviving structures are the fort, the western gatehouse, the northern fort wall and Pigeon House Harbour to the North of the Pigeon House Road and to the south of the road the southern fort wall (Figure 11-6), a handball alley, grain store and Pigeon House Hotel. From the 1940s the area to the south of the Pigeon House Fort, on which the Ringsend WwTP is situated, was reclaimed with a considerable depth of made ground. This made ground has mostly buried the walls of the fort on the southern side. The made ground has also sealed any fort rubbish deposited on the sands.

DU019-029--- Dublin South City Sea wall

In 1748 the Dublin Ballast Office commenced the construction of a double stone wall known as the Ballast Office Wall and later Pigeon House Road, between Ringsend and the site of the later Pigeon House Fort, which was completed about 1759 and appears on John Rocque's map of 1760. The wall, which is now beneath the Pigeon House Road, runs into the Ringsend WwTP site at the north-east corner and extends under the Pigeon House Fort (Giacometti, 2009).

Figure 11-6: View of the south wall of the Pigeon House Fort where it faces the Ringsend WwTP site

11.4.11 Undesignated Monuments

The Sites and Monuments Record which is maintained by the Department of Culture, Heritage and the Gaeltacht was examined as part of the assessment. This review established that there are no additional undesignated monuments entered in the database in the Ringsend WwTP site or the study area.

11.4.12 Shipwrecks

The Inventory of Shipwrecks produced by the Underwater Unit in the Department of Environment, Community and Local Government was examined as part of the assessment. This review established that there are no shipwrecks known in the Ringsend WwTP site.

11.4.13 Cartographic Sources

John Rocque's 1760 Survey of the city harbour and environs of Dublin, Captain William Bligh's 1800 Survey of the Bay of Dublin, and the Ordnance Survey 1st and 3rd edition six-inch and 1st edition 25-inch maps of the Ringsend WwTP site were examined as part of the assessment. This analysis did not indicate any previously unrecorded archaeological sites or monuments in the WwTP site or in the vicinity of it.

11.4.14 Aerial Photography

High level Luftwaffe aerial photography of the Pigeon House generating station flown in 1940 (DT/TM-3/Great Britain, Dublin/Reg No. 2037 N53 W6), 1947 oblique aerial photography and Ordnance Survey aerial photography taken in 1995, 2000 and 2005 were examined as part of the assessment (Figure 11-7). This analysis did not identify any additional cultural heritage material in the Ringsend WwTP site or vicinity.

11.4.15Placename Evidence

The Placenames Database of Ireland (Logainm.ie) states that at the point known as "the pile ends" the Dublin Port Authorities erected a wooden house to serve as a watch house. The house caretaker was called Pidgeon. The house came to be known as "Pidgeon's House" which gave its name to the area.

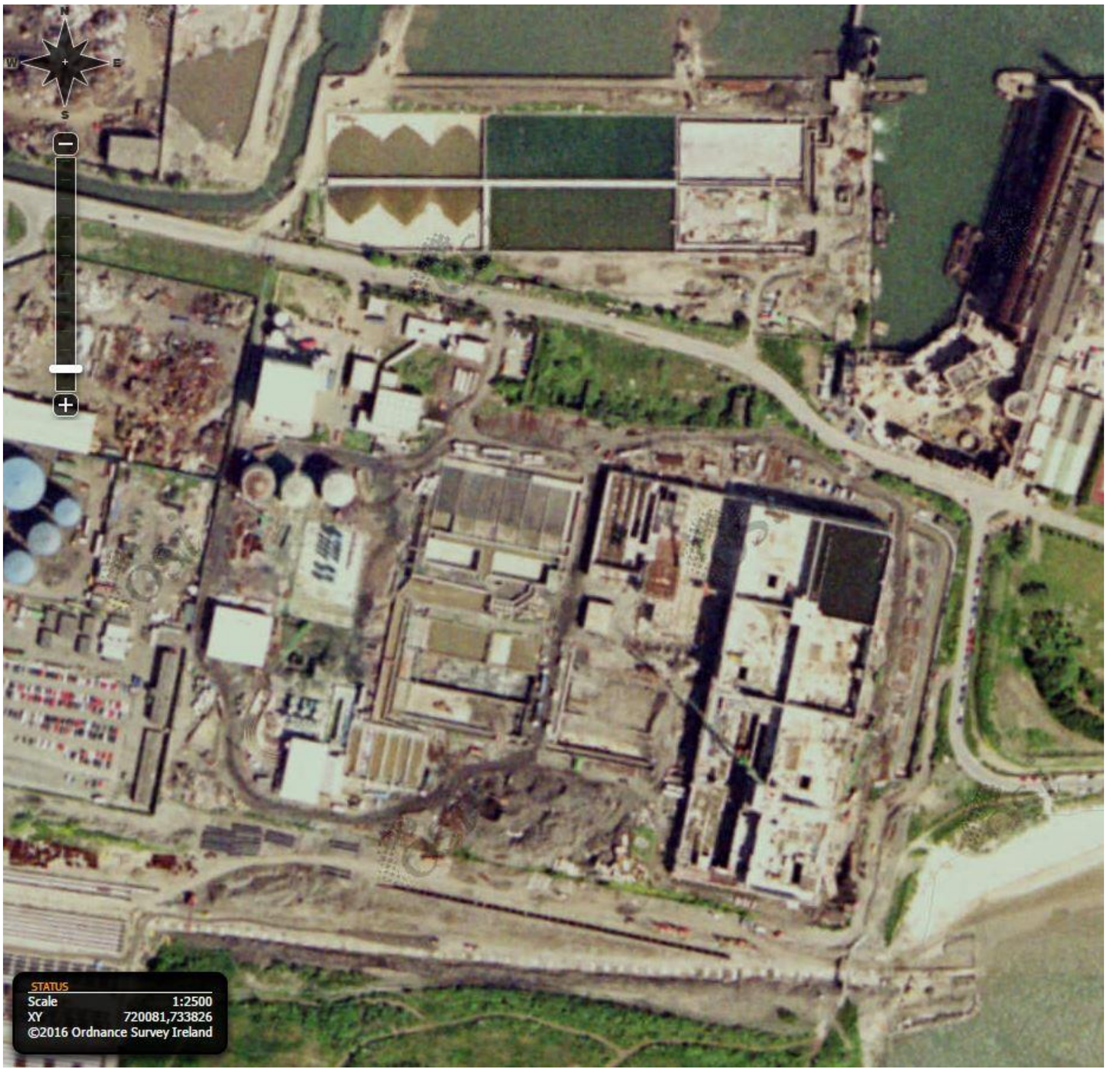


Figure 11-7: OSI 2000 orthophoto of the Pigeon House Fort showing the disturbance of topsoil that occurred during construction in the late 1990s

11.4.16National Museum of Ireland

Two archaeological finds made at the Pigeon House have been reported to the National Museum, these are detailed below.

- NMI 1954:4 Medieval Jug
- A portion of a medieval jug was reported found at Pigeon House, Ringsend in 1954; and
- NMI RIA 1918:368 Glass Bead
- A broken glass bead blue in colour with white and blue ridges and white and blue spiral knobs with yellow insets was found on the shore at Pigeon House Fort in 1918.

11.4.17Archaeological Investigations

There have been two archaeological investigations carried out in the Ringsend WwTP site.

Pre-development Monitoring 2015-16

Monitoring of the excavation of investigative test pits and test piles at the Ringsend Wastewater Treatment Plant took place in December 2015 and February 2016.

The test pits were excavated into made ground and did not penetrate to depths where any original pre-1940 ground surface with potential archaeological material is present. The continuous flight augering test piles were excavated with a 450 mm auger which produced undifferentiated arisings. Boreholes established that the made ground in the area monitored extends from a minimum of 6.3 m to a maximum of 10.4 m below the current surface. Therefore, groundworks carried out to a depth of less than 6 m will have no impact on any potential archaeological material and should not require archaeological monitoring (Mount, 2016).

Archaeological and architectural assessment of the Pigeon House Fort 2009

An archaeological and architectural assessment of the Pigeon House Fort was carried out in 2009 (Giacometti, 2009). The report defined the existing extent of the monument on the ground and identified its constituent features and areas of potential sub-surface archaeological material. The report identified a potential area of rubbish dumps dating to the time of the fort's use situated on the seaward side of the fort's boundary wall which is within the Ringsend WwTP site (see Figure 11-3).

Figure 11-8: View of the SBR tanks which it is proposed to upgrade and the location of the proposed Capacity Upgrade in the open ground in the foreground looking north-east

11.4.18Field Inspection

A field inspection was carried out on 17 May 2016 and involved a walkover of all the areas of the Proposed WwTP Component. The Ringsend WwTP site is an existing industrial complex constructed on made ground reclaimed from Dublin Bay since the 1940s (see Figure 11-8). All of the Proposed WwTP Component elements indicated on Figure 11-3 will be constructed in made ground.

Although parts of the Pigeon House Fort have been demolished, there are still upstanding internal remains, although these are overgrown (Figure 11-3 and Figure 11-9). The walls of the fort still survive around most of the perimeter and along much of the boundary to the WwTP site (Figure 11-6). The WwTP site extends into part of the south-east part of the Pigeon House Fort interior. Although this ground today appears as greenfield, the OSI Orthophotography from 2000 indicates that the topsoil in this area was disturbed during construction in the 1990s (Figure 11-7).

Figure 11-9: View of the interior of the Pigeon House Fort looking east

11.5 Potential Impacts

11.5.1 Do-Nothing Impacts

Were the Proposed WwTP Component not to go ahead there would be no impact on any items of cultural heritage, archaeology or structures.

11.5.2 Construction Phase

The only receptors with the potential to be impacted by the construction phase of the Proposed WwTP Component are the Pigeon House Fort and Pigeon House Harbour. These are masonry structures and have a low sensitivity to construction impacts, the magnitude of the potential impacts is low and the significance of the impacts is low. Any potential impact will only last for the duration of the construction.

11.5.3 Piles

The construction of the Proposed WwTP Component will take place in made ground reclaimed from Dublin Bay which extends from a minimum of 6.3 m to a maximum of 10.4 m below the current surface. Piles will be bored through the made ground and may impact potential archaeology associated with the old ground beneath. There is a potential for pile boring to cause vibration during the construction phase that has the potential to impact heritage buildings.

Where Continuous Flight Auger (CFA) piles are bored through the made ground and may impact potential archaeology associated with the old ground beneath, they will be archaeologically monitored.

The CFA piles will be bored using a non-percussive technique. In the case of the Proposed WwTP Component, an existing protected structure (Pigeon House Fort) abounds the site to the North. Where percussive piling techniques are used, it is proposed to apply the lower vibration limits listed in Table 11-3 to these buildings which have been taken from the German Standard DIN 4150-3 (1999-02) Structural Vibration - Effects of Vibration on Structures.

Table 11-3: Allowable vibration during construction phase for sensitive buildings

Less than 10 Hz	10 to 50 Hz	50 to 100 Hz (and above)
3 mm/s	3 – 8 mm/s	8 – 10 mm/s

The expected vibration levels during piling have been determined through reference to published empirical data. The British Standard BS 5228-2:2014+A1:2014 - *Code of practice for noise and vibration control on construction and open sites - Part 2: Vibration*, publishes the measured magnitude of vibration from rotary bored piling using a 600 mm pile diameter during two aspects of the operation, (BS 5228-2:2014+A1:2014 Table D.6, Ref. No. 105):

- 230 µm/s at a distance of 3.5 m, for augering;
- 2,400 µm/s at a distance of 3.5 m, for auger hitting base of hole;
- 40 µm/s at a distance of 8 m, for augering; and
- 1,700 µm/s at a distance of 8 m, for auger hitting base of hole.

Considering the distance of the piling works from the Pigeon House Fort, the expected vibration levels are estimated to be significantly below the limits recommended to prevent cosmetic damage in sensitive buildings or structures.

Additional reference is made to results of monitoring completed as part of initial piling works. This monitoring would suggest that rotary core piling undertaken in the area of the proposed reactor reduces to within the specified limit of 3 mm/s in the vicinity of the southern end of SBR Block 1. As such, the expected levels of vibration arising from piling works further away than this would be lower again and the predicted impact is of a low risk to the Pigeon House Fort.

11.5.4 Construction Machinery and HGVs

Construction machinery has the potential to damage the upstanding parts of the Pigeon House Fort, particularly the northern and southern boundary walls. Vibration generated by HGV movements on public roads have the potential to damage heritage structures.

11.5.5 Temporary Construction Compounds

The WwTP site extends into part of the south-east of the area of the Pigeon House Fort. Although the ground to the south of the Pigeon House Fort today appears as greenfield, the OSI Orthophotography from 2000 indicates that the topsoil in this area was disturbed during construction in the late 1990s (Figure 11-7). The development of construction compound C2 in this area to the north of the Pigeon House Fort will have no additional impact where it is placed onto the ground surface. The area of the Pigeon House harbour was infilled during the development of the outfall works of the municipal sewage scheme and any potential archaeological material is sealed beneath this made ground. The development of construction compounds on this made ground will not have any archaeological impact. Where construction compounds are placed on the old sea walls enclosing the infilled harbour they do have the potential to cause impact. There is potential to cause accidental vehicular damage to the structure of the Fort Wall.

Where the construction compound is placed within the footprint of the Pigeon House Fort and requires any sub-surface works to provide areas of hard standing, there is the potential to impact subsurface archaeological material. Any deeper excavation that penetrates through the base of the made ground on the external side of the fort has the potential to have an impact on any potential surviving trash deposits outside the fort wall.

The development of construction compound C3 on a paved area immediately east of the old Pigeon House Power Station, which is a Protected Structure, has the potential to cause accidental vehicular damage to the structure.

11.5.6 Cranes

Where cranes placed within the footprint of the Pigeon House Fort, Pigeon House Harbour and in the area with potential trash deposits to the south of the fort walls require the emplacement of hardstanding material, they have the potential to impact subsurface archaeological material.

11.5.7 Underwater Survey

As the Proposed WwTP Component does not include the construction of an effluent outfall tunnel, no underwater survey is required.

11.5.8 Operational Phase

The operation of the proposed Ringsend WwTP upgrade will not give rise to emissions or impacts that have the potential to cause direct, indirect or cumulative effects on cultural heritage. Therefore, no impacts on cultural heritage in the operational phase of the Proposed WwTP Component have been identified.

11.6 Mitigation Measures

11.6.1 Construction Phase

11.6.2 Piles

The appointed contract will ensure that piling activities remain below the thresholds set out in the German Standard DIN 4150-3 (1999-02) Structural Vibration - Effects of Vibration on Structures.

Table 11-4: Allowable vibration during construction phase for sensitive buildings

Less than 10 Hz	10 to 50 Hz	50 to 100 Hz (and above)
3 mm/s	3 – 8 mm/s	8 – 10 mm/s

11.6.3 Construction Machinery and HGVs

Construction machinery has the potential to damage the upstanding parts of the Pigeon House Fort such as the south wall and the north wall and these areas should be protected with concrete traffic barriers during construction to prevent any impacts. Once an adequate road surface is maintained on the haul road, the level of vibration expected to be generated by unladen or laden HGVs would be expected to be very low. Therefore, a smooth and level road surface will be maintained such that the levels of vibration likely to be generated in close proximity to the proposed haul roads would be expected to be below the 3 mm/s peak particle velocity (PPV) recommended for the protected structure forming part of the old Ringsend fort and significantly below the 15 mm/s PPV recommended otherwise for the prevention of cosmetic damage to buildings.

11.6.4 Temporary Construction Compounds

Where construction compounds requiring any sub-surface works to provide areas of hard standing are developed within the area of the Pigeon House Fort, Pigeon House Harbour and in the area with potential trash deposits to the south of the fort walls, any excavation work will be archaeologically monitored. Construction compounds will not be placed over the old sea wall of the infilled Pigeon House Harbour.

Compound C1 will be located in an area of made ground that has been created through the reclamation of Dublin Bay. The development of a construction compound in this area will have no impact on cultural heritage. As such, no mitigation measures are necessary.

Compound C2 will be situated on the external side of the north wall of the Pigeon House Fort within the area of the old Pigeon House Harbour with a new access to the compound which traverses over the area of the Pigeon House Fort. The upstanding walls form part of the Pigeon House Fort which is a Protected Structure and should not be impacted. The walls will be protected with concrete traffic barriers during construction to prevent any vehicular impacts. The ground beneath C2, north of the area of the Pigeon House Fort, was originally part of the Pigeon House harbour and between 1897 and 1906 the outfall works of the Municipal Sewage Scheme was constructed here by filling in the harbour with made ground. Therefore, shallow subsurface works to the north of the wall of the Pigeon House Fort should have no impact on cultural heritage. The site preparation within the interior of the Pigeon House Fort will require topsoil stripping for the access road and has the potential to uncover material associated with the fort and will be monitored by a suitably qualified archaeologist.

Compound C3 is situated on a paved area immediately east of the old Pigeon House Power Station which is a Protected Structure. The structure of the power station should not be impacted and as with the Pigeon House Fort, the walls will be protected with concrete traffic barriers during construction to prevent any impacts.

11.6.5 Cranes

Where construction of hard standing for cranes requires any sub-surface works within the area of the Pigeon House Fort and in the area with potential trash deposits to the south of the fort walls, any excavation work will be archaeologically monitored.

11.6.6 Operational Phase

As no impacts on cultural heritage in the operational phase of the Proposed WwTP Component have been identified, no mitigation measures are required.

11.7 Residual Impacts

11.7.1 Construction Phase

There will be no residual impacts relating to the construction phase of the Proposed WwTP Component after the proposed mitigation measures have been implemented.

11.7.2 Operational Phase

As no impacts on cultural heritage in the operational phase of the Proposed WwTP Component have been identified, there will be no residual impacts.

11.7.3 Interactions

Interactions have been identified in relation to noise and vibration and HGV traffic on public roads.

11.7.4 Cumulative Impacts

No other plans or projects within the vicinity of the study are have been identified that may give rise to significant cumulative impacts or effects on cultural heritage during the construction stage. There are no potential impacts for cumulative effects from cumulative impacts arising from the operation stage.

11.8 Monitoring

Where CFA piles are bored through the made ground and may impact potential archaeology associated with the old ground beneath, they will be archaeologically monitored.

Where construction compounds requiring any sub-surface works to provide areas of hard standing are developed within the area of the Pigeon House Fort, Pigeon House Harbour and in the area with potential trash deposits to the south of the fort walls, any excavation work will be archaeologically monitored.

The site preparation within the interior of the Pigeon House Fort will require topsoil stripping for the access road and has the potential to uncover material associated with the fort and will be monitored by a suitably qualified archaeologist.

Where construction of hard standing for cranes requires any sub-surface works within the area of the Pigeon House Fort and in the area with potential trash deposits to the south of the fort walls, any excavation work will be archaeologically monitored.

11.9 Difficulties Encountered

No difficulties were encountered in the compilation of this Section of the EIAR.

11.10 References

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Section 12: Material Assets

12.1 Introduction

This Section of the EIAR assesses the potential impacts (and resulting effects) likely to occur as a result of the Ringsend WwTP component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component") on the material assets of the area.

This Section considers the impact on the Assets and not the people using it. People along with issues and impacts are discussed in Volume 3, Section 3: Population and Human Health.

Material Assets are resources and amenities that are valued and intrinsic to places, including Cultural Heritage and Archaeology, which are discussed separately in Volume 3, Section 11: Cultural Heritage.

Full details of the Proposed Upgrade Project and the Ringsend WwTP component can be found in Volume 2, Section 3: Description of Proposed Upgrade Project.

This Section and assessment have been completed having regard to the guidance outlined in the Environmental Protection Agency documents *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (Draft, August 2017) and *Advice Notes for Preparing Environmental Impact Statements* (Draft, September 2015).

12.2 Methodology

The Material Assets assessment was prepared in accordance with the *"Guidelines on the information to be contained in Environmental Impact Statements"* (EPA, 2002) and the Draft *"Revised Guidelines on the information to be contained in Environmental Impact Statements"* (EPA, 2017). The effects of the Proposed WwTP Component are assessed in terms of Quality, Significance, Magnitude, Probability, Duration, and Types as detailed in Volume 2, Section 2: The EIA Process.

A desk study, site visits and site-specific investigations were undertaken to provide the data to compile the description of the existing material assets. Consultation with stakeholders was undertaken as necessary.

The likely significant effects of the Proposed WwTP Component on Material Assets are discussed, and the measures to mitigate adverse impacts are described. Adverse impacts are those that result in a detrimental effect to the current environment, e.g. deterioration in material assets.

Documents and plans reviewed included:

- Dublin City Draft Development Plan 2016 - 2022;
- Poolbeg West, Dublin City Strategic Development Zone, Order May 2016;
- Dublin Port Development Plan 2012 - 2040;
- SDRA 6 - Docklands (SDZ & Wider Docklands Area);
- Correspondence with DCC and utility providers;
- Geological Survey of Ireland (GSI) Bedrock Geology map, Sheet 16 (Kildare - Wicklow);
- Ringsend Wastewater Treatment Works Extension EIS March 2012; and
- Revised EPA "Guidelines on the Information to be contained in Environmental Impact Statements" Draft August 2017.

This Section provides an evaluation of the range of potential impacts to the Material Assets of Poolbeg and adjoining areas, arising from the Proposed WwTP Component. The object of the evaluation is to identify impacts resulting from the Proposed WwTP Component on material assets and to propose mitigation measures as outlined in Volume 2, Section 2: The EIA Process.

12.3 Existing Environment

In this Section material assets are considered in two main categories; material assets of a human origin and material assets of a natural origin.

Material Assets of a human origin include:

- Existing Properties and Operational Plants;
- Road Network;
- Land Utilisation;
- Recreational facilities and amenities;
- Dublin Port; and
- Public Utilities.

Material Assets of a natural origin include:

- Undeveloped land resource;
- Geological Resource; and
- Natural Amenities.

12.3.1 Existing Environment- Material Assets of a Human Origin

12.3.1.1 Existing Properties and Operational Plants

The land around the Ringsend WwTP and throughout the Poolbeg Peninsula, is typically used for the provision of industrial and storage facilities. The Poolbeg Peninsula largely consists of reclaimed land dating back to the early 1900s. Nowadays the area is also an important amenity area and is widely used by members of the public.

The existing Ringsend WwTP site is capable of housing the Proposed WwTP Component.

Seveso Sites Upper and Lower Tiers, are located in the immediate vicinity of Ringsend WwTP. See Volume 3, Section 2: Planning and Policy Context. Properties and sites of archaeological and cultural heritage interest are addressed in Volume 3, Section 11: Cultural Heritage, including Pigeon House Hotel, Pigeon House Fort, Pigeon House Power Station, Poolbeg Lighthouse and Great South Wall.

Poolbeg Peninsula is predominated by industry. There are no residential areas within 500 metres of the Ringsend WwTP. See Volume 3, Section 2: Planning and Policy Context for details on proposed “Poolbeg West Strategic Development Zone”.

There are no retail properties within 500 metres of the Ringsend WwTP.

Irishtown, Ringsend and Sandymount villages are the main residential and retail hubs within a 2 km radius of the Proposed WwTP Component. These villages and Poolbeg Peninsula lie within the jurisdiction of Dublin City Council.

Construction of the Dublin Waste to Energy plant on the adjoining westerly site has been completed and the plant is now operational. See Volume 3, Section 2: Planning and Policy Context.

ESB power generation plant and Synergen Dublin Bay Power Plant are also situated in the immediate vicinity of Ringsend WwTP.

The National Oil Reserves Agency (NORA) manages Ireland's emergency oil stocks, through holding tanks at Pigeon House Road (some 300 metres from the perimeter of Ringsend WwTP) and through offshore short-term supply contracts which may be released in a crisis in line with the National Oil Security Policy Alexandra Basin Redevelopment. The existing cargo and passenger ship facilities at Alexandra Basin are being upgraded to meet future port requirements. See section 12.6.2 below and Volume 3, Section 2: Planning and Policy Context.

12.3.1.2 Road Network

The existing road network Figure 12-1 is described in Volume 3, Section 13: Traffic and included in the assessment are:

- Pigeon House Road;
- Shellybanks Road;
- Whitebank Road;
- South Bank Road;
- R131 Sean Moore Road;
- York Road;
- R131 East Link Bridge;
- North Wall Quay; and
- East Link Road.

12.3.1.3 Land Utilisation

The nearby 34 hectare, former Glass Bottle site has been designated as a Strategic Development Zone, namely the 'Poolbeg West Strategic Development Zone' (SDZ). Final design details are not currently available but it is envisaged that a mixed zone development may arise, subject to the necessary planning approvals. Refer to Volume 3, Section 2: Planning and Policy Context.

An area of grassland has been provided for overwintering Brent Geese immediately to the south of the WwTP. This was incorporated into the South Dublin Bay SPA, refer to Figure 12-12.

There are a number of land parcels adjacent to Ringsend WwTP which will be used to site 3 No. temporary construction compounds (C1, C2 and C3), for use during the construction phase. The temporary construction compounds will also be used as car parks and storage areas. The temporary construction compound details and layouts are outlined in Volume 2, Section 3: Description of Proposed Upgrade Project and are also considered later in this Material Assets section 12.5.2.3 under Potential Impacts to Land Utilisation.

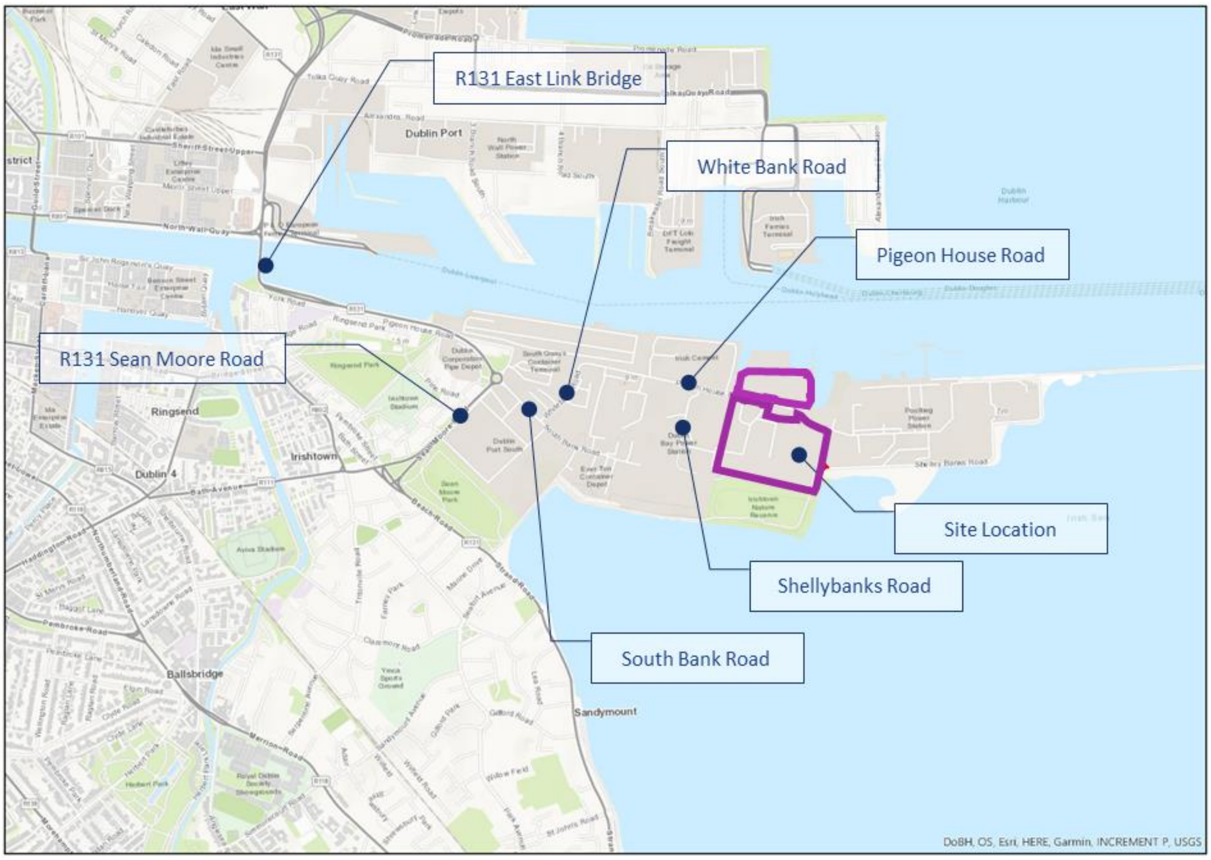

Figure 12-1: Local Road Network

Figure 12-2: Brent Geese Grassland outside Southern Site Boundary

12.3.2 Existing Environment - Recreational Facilities and Amenities

12.3.2.1 Marine

Dublin Bay continues to develop as an amenity area given its proximity to the city and the increased popularity of water-based leisure activities.

Sailing and Boating

Several yacht and boat clubs are located along Dublin Bay from Howth to Dun Laoghaire including:

- Dublin Bay Sailing Club;
- Royal St. George Sailing Club;
- Royal Irish Yacht Club;
- National Yacht Club;
- Dun Laoghaire Motor Yacht Club;
- Poolbeg Yacht and Boat Club;
- Clontarf Yacht Club;
- Sutton Dinghy Club; and
- Howth Yacht Club.

Clubs and specialist operators offer a range of activities for youth and adult members covering racing, cruising, and tuition. Clubs and marinas also offer mooring facilities. The marinas are situated as follows:

- Dun Laoghaire;
- Poolbeg; and
- Howth.

A further marina has been opened in Greystones in recent times which is also used by sailing and boating enthusiasts from the Dublin Bay area.

Angling

Similar to racing, angling is popular across the Bay from Howth to Killiney. Shore and boat angling are equally popular. Angling is not confined to any one season but is predominantly a summer time activity. Howth is a major commercial fishing port with its own dedicated facilities. Commercial fishing is also conducted from Dun Laoghaire. The Great South Wall is proximate to the Proposed WwTP Component that members of the public use for angling (see Figure 12-3 and Figure 12-4).

Rowing

Sea based rowing has been a long established sport in the Dublin Bay area. The rowing clubs are situated in the greater Dublin Bay / Liffey Estuary area, offering regular training sessions throughout the spring / summer seasons. Youth and adult club members make up the rowing crews. The following clubs are most prominent:

- St. Michael’s Rowing Club; and
- St. Patrick’s Rowing Club.

Paddle Boarding / Wind surfing / Kite Surfing / Surfing / Kayaking / Jet Skis

- Paddle boarding or SUP (Stand Up Paddle) is a relatively new leisure activity but growing in popularity;
- Wind surfing has been popular for many years and is practised throughout Dublin Bay inshore areas;

- Kite surfing is a relatively new water-based sport but growing in popularity in Dublin Bay;
- Traditional surfing is not a common sport in the bay as the wave heights are typically unsuitable for surfing;
- Kayaking has been practised in Dublin Bay for many years but has become more popular in recent years; and
- Jet skis have been used in Dublin Bay for some 20 years and are most commonly used in the summer months.

Figure 12-3: Great South Wall and Dublin Bay

Figure 12-4: Great South Wall

Bathing

Swimming has long been a popular Dublin Bay and Liffey Estuary sporting activity. Swimming clubs, including the nearby Half Moon Swimming Club are located along the bay and swimming is a popular activity for very many casual, non-club members. Bathing water quality details are included in Section 1.2.5. It should be noted that Shelly Banks and the Half Moon Club on Great South Wall is not a designated swimming area, however, DCC monitors water quality in the area throughout the year- refer to Figure 12-5 and Figure 12-6.

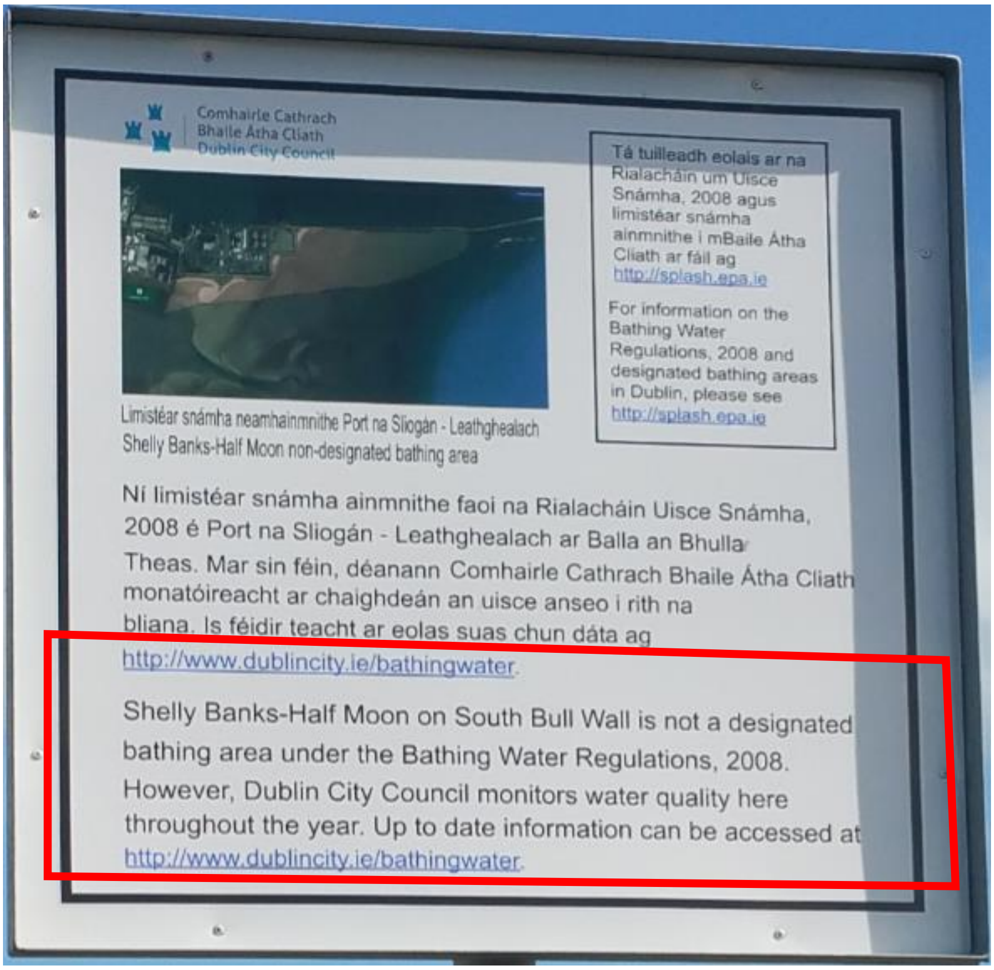

Figure 12-5: Shelly Banks-Half Moon Non Designated Bathing Area

Figure 12-6: Shelly Banks Beach (Looking towards Ringsend WwTP)

Scuba Diving

Scuba diving groups operate throughout Dublin Bay but particularly at the Muglins Rock, Dalkey Island and known shipwreck sites. Trident Sub Aqua Club operates in this area. Diving is a full year activity but tends to be more concentrated during the summer months. Diving Schools and Diving Centres also operate and provide introductory courses for newcomers to diving. Diving Schools include:

- Triton Diving Ireland;
- Oceandivers;
- Feelgood Scuba; and
- Flagship Scuba.

12.3.2.2 Terrestrial Recreational Facilities and Amenities

In the nearby Ringsend, Irishtown and Sandymount areas, there are many sports clubs including the nearest club Clanna Gael Fontenoy GAA Club which is situated at Sean Moore Park and is less than 1 km from Ringsend WwTP (see Figure 12-7). Gaelic football and hurling, rugby (Railway Union and Monkstown F.C.), soccer, tennis, cricket (Railway Union and Pembroke CC) and hockey are played in schools and clubs in the area. See Volume 3, Section 3: Population and Human Health. Walking on both the beach and adjacent walking paths is also a popular pastime. There are also golf courses nearby at Elm Park and Milltown. Likewise, on the northern side of the bay, similar recreational facilities and clubs exist in the Clontarf / Sutton / Howth area.

Figure 12-7: Clanna Gael Fontenoy GAA Club

Aviva Stadium

The Aviva Stadium on Lansdowne Road, less than 2 km from the Proposed WwTP Component, is home to the national rugby and soccer teams with a 50,000 person capacity. The stadium is also used in summer months for outdoor concerts. Conference and business meetings are also staged in the Premium Level Suites.

Shelbourne Park

Shelbourne Park Greyhound Track is situated in the Irishtown area. Greyhound racing takes place every Wednesday, Thursday and Saturday evenings. The venue is also used for meetings and social gatherings.

Walking/Irishtown Nature Park

Irishtown Nature Park consists of a small linear park adjacent to Ringsend WwTP, see Figure 12-8 and Figure 12-9. It offers a walking / jogging trail from Beach Road Sandymount, on to the Great South Wall at the tip of the Poolbeg Peninsula, see Figure 12-4. The park, in common with much of the of the Poolbeg Peninsula, has been developed on reclaimed land. As such, Irishtown Nature Park is a relatively new development, and will evolve further in the coming years.

Figure 12-8: Irishtown Nature Park

Figure 12-9: Irishtown Nature Park

Dublin Port

Dublin Port Company is the largest port company in the Republic of Ireland and accounts for approximately 43% of all seaborne trade (Dublin Port Masterplan 2012-2040), catering for over 36 m tonnes of cargo/freight and 1.84 m passengers in 2017. The port is the single most important Lo-Lo (lift-on lift-off) and Ro-Ro (roll-on roll-off) port facility in the country (see Figure 12-10). A number of ferries currently use Dublin Port on a daily basis including Stena Line, Isle of Man Steam Packet Company, Irish Ferries and P&O Irish Sea. Isle of Man Steam Packet Company operates a summer service whereas the other companies operate on a 12-month basis.

It is also an extremely important international gateway to Ireland.

The Dublin Port Estate comprises an area of c. 260 hectares spanning both the North and South banks of the River Liffey, with 215 ha of the estate lying to the north of the river. In 2015, Dublin Port received planning approval to proceed with a major development of the port, known as the Alexandra Basin Redevelopment project. The project, which is currently in construction phase, includes construction of new quays and jetties, dredging of the shipping channel and berthing area together with completion of decontamination measures.

Figure 12-10: Entrance to Dublin Port

In 2016, 112 cruise ships called at Dublin Port, as outlined in the Dublin Port website. Cruise ships and associated tourist visitors are an important part of the port development. Dublin Port Company predict that Cruise Liner passengers will increase from 106,324 passengers in 2013 to 342,965 passengers by 2032 in line with an increase in Cruise Liner landings, increasing from 83 in 2013 to 140 landings in 2032. It is also predicted that cruise vessels will increase in size.

A Dublin Port Masterplan was published in February 2012 which outlined a vision of the port development over a 30-year period. The Masterplan, endorsed by Government and developed in line with the strategic objectives of the National Ports Policy, is underpinned by three core principles:

- Maximise usage of existing port lands;
- Reintegration of the port within the city; and

- Development of the port to the highest environmental standards.

12.3.2.3 Public Utilities

Electricity Network

There are a number of electrical power cables in the area. ESB Networks have 2 wayleaves in the immediate vicinity; one on the northern boundary and one on the southern boundary. See Volume 5, Part A Drawing No. Y15710-PL-911 “Existing Utilities”.

A 38 kV cable and a 220 kV cable run underground along Pigeon House Road. There are also 38 kV, 110 kV and 220 kV underground ESB cables installed parallel to Pigeon House Road.

There a number of transmission cables currently running parallel to the southern boundary of Ringsend WwTP. Inside the site a 110 kV cable runs parallel to the existing fence line. Likewise, outside the site boundary, a 110 kV and 2 no. 220 kV cables currently run parallel to the boundary.

Gas Network

Gas Networks Ireland have a single wayleave adjacent to the southern boundary of the Ringsend WwTP site.

This wayleave accommodates two high pressure steel gas pipelines installed for the Poolbeg Peninsula. These are the 400 mm diameter, 19 bar Dublin City pipeline and the 500 mm diameter, 40 bar gas transmission pipeline which supplies the ESB - Poolbeg Power Generation Station.

A 180 mm diameter, 4 bar distribution gas pipeline runs from the Poolbeg Above Ground Installation (AGI), located south of ESB - Poolbeg Power Generation Station, along Pigeon House Road, with a connection point at Ringsend WwTP.

Drainage Network and Water Supply

The Dodder Valley trunk sewer (1.35 m internal diameter and 1.5 m internal diameter twin siphons) runs along South Bank Road and continues south of the Synergen Dublin Bay Power Plant on Pigeon House Road and along the southern end of the Dublin WtE facility before entering the Ringsend WwTP.

The 0.96 m steel internal diameter Dun Laoghaire rising main runs outside but parallel to the southern boundary of Ringsend WwTP and enters at the south western end of the Ringsend WwTP.

The Sutton rising main, steel 1.6 m internal diameter pipeline, runs parallel but external to the WwTP boundary before entering at the south western end of the Ringsend WwTP site.

A single watermain runs along Pigeon House Road.

See Existing Utilities Drawing No. Y15710-PL-911 in Volume 5, Part A.

12.3.3 Existing Environment - Material Assets of Natural Origin

12.3.3.1 Undeveloped Land Resource

The main undeveloped land bank in the Poolbeg Peninsula vicinity, is the Poolbeg West SDZ which has been described earlier and also in Volume 3, Section 2: Planning and Policy Context. There are no other land banks in the Poolbeg Peninsula vicinity which could be considered as an undeveloped land resource.

12.3.3.2 Geological Heritage

The two areas of geological heritage in closest proximity to the Proposed WwTP Component are North Bull Island and Bottle Quay (see Volume 3, Section 7: Land and Soils).

North Bull Island is a sandy barrier island truncated at the southern end by a breakwater running out from Clontarf. The island is a sandy spit which formed after the building of the Great South Wall and North Bull Wall in the 18th and 19th centuries. It now extends for about 5 km in length and is up to 1 km wide in places. It is continually evolving, especially at the tip. It has been recommended for a County Geological Site designation under Coastal Geomorphology Theme (IGH 13) and is already designated as part as North Dublin Bay NHA, SAC and SPA.

Bottle Quay is located along the southern shores of Howth Head. It is considered an excellent example of both Cambrian and Quaternary features along the same short stretch of shoreline. It is a proposed County Geological Site under the Cambrian-Silurian Theme (IGH 4) and Quaternary (IGH 7) and a proposed NHA.

12.3.3.3 Natural Amenities

There are a number of ecologically designated areas in the Dublin Bay area as follows:

- South Dublin Bay and River Tolka Estuary SPA (site code 004024);
- South Dublin Bay cSAC;
- North Bull Island SPA;
- North Dublin Bay cSAC;
- Howth Head Coast SPA;
- Howth Head cSAC;
- Dalkey Islands SPA;
- Rockabill to Dalkey Island cSAC;
- South Dublin Bay pNHA;
- North Bull Island pNHA;
- Howth Head pNHA; and
- Dalkey Coastal Zone & Killiney Hill pNHA.

12.4 Characteristics of the WwTP Component of the Proposed Upgrade Project

Characteristics of the Proposed WwTP Component, associated with both the construction and operational phases, have the potential to impact on the Material Assets of the area. In particular the following issues are considered:

- Utilisation of land required for temporary construction compounds and access roads;
- Changes to site layout and fence lines;
- Effects of the Proposed WwTP Component on road network and pedestrian pathways;
- Power Supply - the Proposed WwTP Component will require an electrical supply upgrade for the operational phase. The connection to the network will be made on the southern side of the site through the existing SPA Brent Geese Grasslands; and
- Public Utilities and the need to provide adequate protection during construction activities.

12.5 Potential Impacts

12.5.1 Do-Nothing Impacts

The positive development based impacts, as outlined in 12.7.1 and 12.7.2 of this section on Material Assets, will not follow and so would impact negatively on the future development in the Poolbeg Peninsula and Greater Dublin region. The absence of the completed Proposed WwTP Component would also greatly hinder the development of new industrial/commercial and residential development in the entire catchment area.

In a "Do-Nothing Scenario", the current non-compliant effluent discharged into the receiving water environment of the Lower Liffey Estuary would have a long term slight negative impact on water based recreational activities undertaken in Dublin Bay. See Volume 3, Section 4: Water.

12.5.2 Construction Phase

12.5.2.1 Existing Properties and Operational Plants

There is no potential impact on existing properties or operational plants in the surrounding area. They are all contained within the existing site which is long established. An imperceptible negative visual impact may arise on adjoining lands and buildings during the construction of the Proposed WwTP Component - refer to Volume 3, Section 14: Landscape.

12.5.2.2 Road Network

There will be a moderate negative short-term impact, on the road network surface quality during the construction phase arising from wear and tear due to additional construction traffic. Likewise, some minor roadworks, are likely to lead to short term slight negative impacts during the construction phase.

12.5.2.3 Land Utilisation

The 3 no. temporary construction compound areas C1, C2 and C3 (See Fig. 12-11) are described in Volume 2, Section 3: Description of Proposed Upgrade Project. The compound areas will include 'portakabin' type office, welfare and storage facilities, some of which will be over two levels. The compound areas will also include car parking for site staff (see Figure 12-11 and Figure 12-2).

In relation to C1, the site is located on the adjacent lands to the southwest of the Ringsend facility and comprises 3.01 ha, as shown on drawing Y15710-PL-961, provided in Volume 5, Part A. The lands are owned by Dublin Port Company and were used by Covanta as a construction compound to facilitate the works within the Dublin Waste to Energy facility. At present, the compound area is utilized as a car park, welfare facilities, storage area and temporary site offices in the form of portacabins. The compound is currently accessed from Shellybanks Road and it is proposed that compound C1 will continue to be accessed from Shellybanks Road. The compound will also be accessible from South Bank Road. It is envisaged that the compound will be maintained in its existing use as a car park facility, storage area and site offices.

Pedestrian access will be provided into the works site via a 3 metre wide temporary access with double gate entry. It should be noted that the pedestrian access will not encroach into the adjacent SPA (Special Protection Area) to the east of the compound. The new temporary access road from compound C1 will be enclosed with a palisade fencing with screening. Consent has been provided for access across Dublin City Council lands to facilitate the temporary access.

There is a direct short term imperceptible negative impact on land utilisation arising from the construction phase. The impact arises from the temporary change of use of land for temporary construction compounds during the construction phase of the Proposed WwTP Component. This impact is rated as being imperceptible and Short-term.

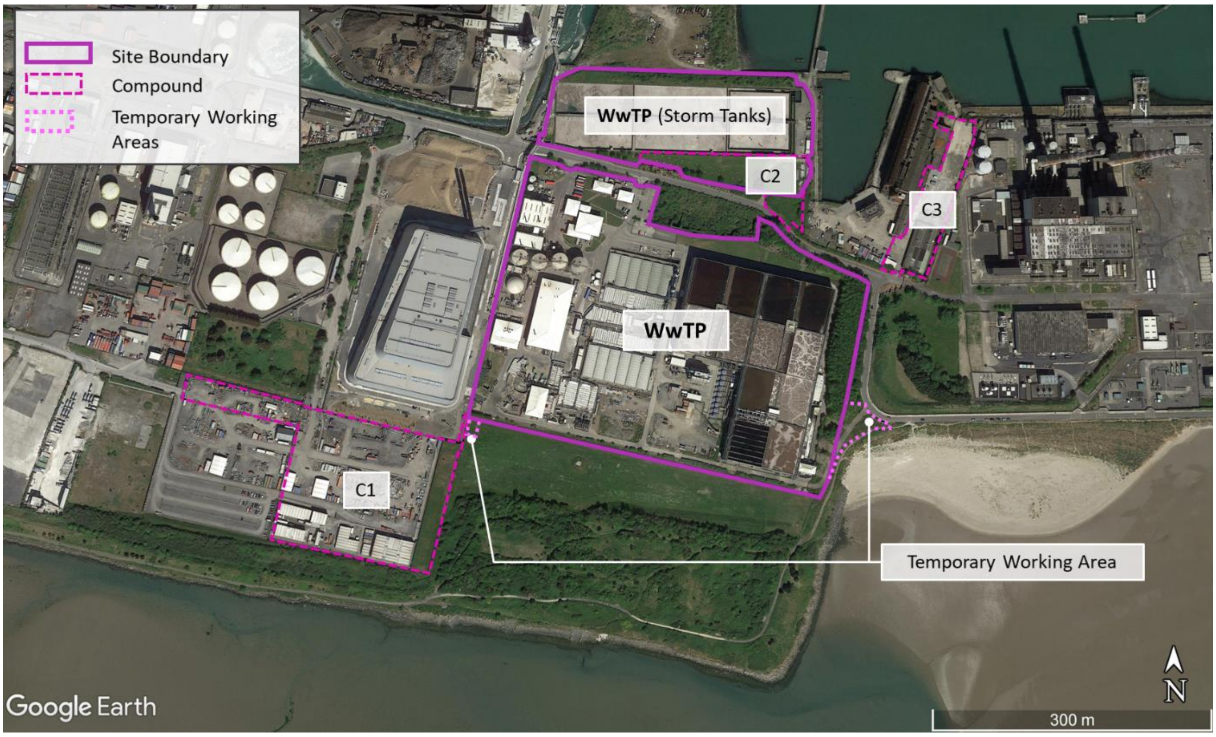

Figure 12-11: Ringsend WwTP site location

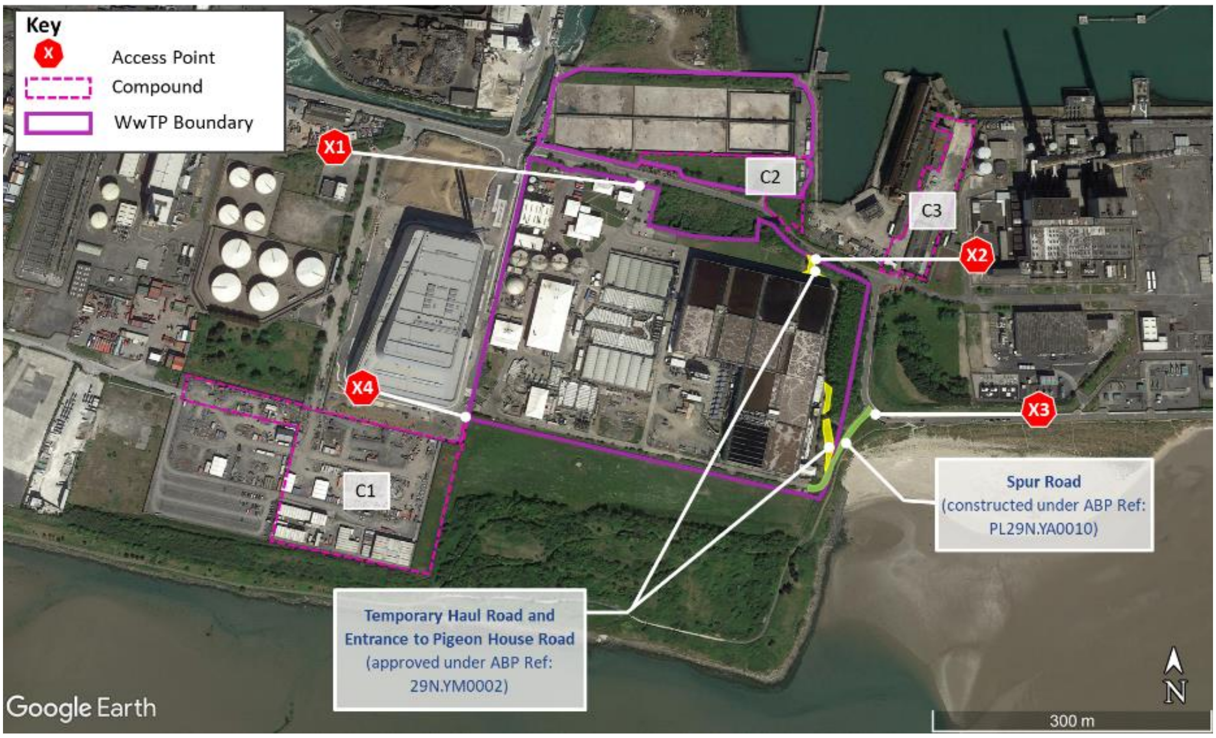

Figure 12-12: Compound Areas and Access Locations

12.5.2.4 Marine Recreational Facilities and Amenities

There are no direct or indirect impacts on water based recreational facilities or amenities arising from the construction phase as the facilities and amenities noted above can continue to be used during the construction phase.

12.5.2.5 Terrestrial Recreational Facilities

There are no direct or indirect impacts on terrestrial recreational facilities or amenities arising from the construction phase. The facilities and amenities noted above can continue to be used during the construction phase.

12.5.2.6 Dublin Port

There are no direct or indirect impacts on maritime traffic arising from the construction phase of the Proposed WwTP Component.

12.5.2.7 Public Utilities

Potential negative impacts on Public Utilities could arise due to severing of existing utility networks during the construction phase of Proposed WwTP Component. Severing of electrical or gas supplies has the potential to affect the operation of the existing Ringsend WwTP and surrounding facilities (Dublin WtE, Synergen and Poolbeg Power Station) due to disruption of supply. The potential impacts are considered to be temporary significant negative during the construction phase.

12.5.2.8 Undeveloped Land

There are no direct or indirect impacts on undeveloped Land arising from the construction phase of the Proposed WwTP Component.

12.5.2.9 Geological Heritage

The construction phase of the Proposed WwTP Component will not impact the existing geological heritage sites as there are no material assets of a geological heritage nature within the boundary of the WwTP site or the immediate vicinity of the WwTP site.

12.5.2.10 Natural Amenities

The connection to the ESBN high voltage cable in the grasslands area used by over wintering Brent Geese has the potential to lead to temporary negative effects on the grasslands being used by the Brent Geese. This topic and the proposed mitigation measures are addressed in detail in Volume 3, Section 6: Biodiversity - Terrestrial. The mitigation measures in 12.6.7 of this Material Assets section also address this issue.

12.5.3 Operational Phase

12.5.3.1 Existing Properties and Operational Plants

There is no potential impact on existing properties or operational plants in the surrounding area. The construction elements are all contained within the existing site which is long established. An imperceptible negative visual impact may arise on adjoining lands and buildings during the operation of the Proposed WwTP Component - refer to Volume 3, Section 14: Landscape.

12.5.3.2 Road Network

Impacts on the road network during the operational phase will be no more than negative "imperceptible".

12.5.3.3 Marine Recreational Facilities and Amenities

The Proposed WwTP Component will ensure a reliable wastewater treatment facility and ensure protection of the receiving water environment as the Greater Dublin region grows. See Volume 3, Section 4: Water. As such, the direct and indirect impacts on marine recreational facilities and amenities will lead to imperceptible long term positive impacts.

12.5.3.4 Terrestrial Recreational Facilities

There are no direct or indirect impacts on terrestrial recreational facilities or amenities arising from the operational phase. The facilities and amenities noted above can continue to be used during the operational phase.

12.5.3.5 Dublin Port

There are no direct or indirect impacts on maritime traffic arising from the operational phase of the Proposed WwTP Component.

12.5.3.6 Public Utilities

Potential negative impacts on Public Utilities are unlikely to arise during the operational phase due to severing of existing utility services. The energy requirements of Proposed WwTP Component will not impact on any of the existing or likely future Poolbeg developments. Therefore, the operational phase of the Proposed WwTP Component will not impact on Public Utilities either directly or indirectly.

12.5.3.7 Undeveloped Land Resource

The Proposed WwTP Component will provide a positive impact on undeveloped land resource in the Poolbeg and Greater Dublin Region in its operational phase as the upgraded Ringsend WwTP will allow future development of such lands, due to increased wastewater treatment capacity.

12.5.3.8 Geological Heritage

The operational phase of the Proposed WwTP Component will not impact the existing geological heritage sites as there are no material assets of a geological heritage nature within the boundary of the WwTP site or the immediate vicinity of the WwTP site.

12.6 Mitigation Measures

12.6.1 Construction Phase

12.6.1.1 Existing Properties and Operational Plants

No specific mitigation measures are required during the construction phase.

12.6.1.2 Road Network

A Traffic Management Plan, together with safety management plans will be developed for the construction phase. See Volume 3, Section 13: Traffic.

Any damage arising to the road network will be addressed in conjunction with Dublin City Council Roads Department.

12.6.1.3 Land Utilisation

- Screening will be erected along the southern and eastern site boundary of the treatment plant / works site;
- Screening will be erected around construction compound sites; and
- A project specific Construction Environmental Management Plan will be agreed with DCC and implemented.

12.6.1.4 Recreational Facilities and Amenities

Marine Based Recreational Activities

No specific mitigation measures required during the construction phase.

Terrestrial Based Recreational Activities

No specific mitigation measures required during the construction phase.

12.6.1.5 Public Utilities

- Communication and consultation will be conducted with public utility providers ahead of construction commencement;
- Underground surveying techniques are a key method of understanding the below ground conditions and confirming the presence of utility services. A Cable Avoidance Tool and a Signal Generator (CAT and Genny) are used to scan the surface of the ground with an audible signal being developed where underground utilities are detected. Surface radar scanning shall also be used to locate underground services before commencement of any mechanical excavation in the vicinity of underground services. These detection surveys shall be undertaken by the contractor;
- Method Statements shall be developed for the construction phase by the contractor to ensure that all underground services are located manually and carefully protected. The CEMP, prepared by the contractor and approved by IW shall outline a methodology and procedure for carrying out such detection surveys;
- An avoidance policy shall be adopted where possible in relation to all services and appropriate protection shall be provided for all above and below ground services as necessary; and
- Connection to the ESB high voltage cable shall be undertaken in summer months to avoid disruption to over wintering Brent Geese.

12.6.1.6 Geological Heritage

No specific mitigation measures are required during the construction phase.

12.6.1.7 Natural Amenities

The potential disruption to the usage of the grasslands by over wintering Brent Geese can be mitigated by completing the connection to the ESBN cable during non-winter months of May-October, as outlined in the Volume 3, Section 6: Biodiversity Terrestrial - Residual Impacts. Works within the grassland area will be fully re-instated and re-vegetated.

12.6.2 Operational Phase

12.6.2.1 Existing Properties and Operational Plants

No specific mitigation measures are required during the operational phase.

12.6.2.2 Road Network

No specific mitigation measures required during the operational phase.

12.6.2.3 Recreational Facilities and Amenities

Marine Based Recreational Activities

No specific mitigation measures required during the operational phase.

Terrestrial Based Recreational Activities

No specific mitigation measures required during the operational phase.

12.6.2.4 Public Utilities

Method Statements shall be developed during the operational phase to ensure that any underground services are located manually and carefully protected during any onsite maintenance work requiring excavation works in the vicinity of the underground utilities.

12.6.2.5 Undeveloped Land Resource

No specific mitigation measures required during the operational phase.

12.6.2.6 Geological Heritage

No specific mitigation measures required during the operational phase.

12.6.2.7 Natural Amenities

No specific mitigation measures required during the operational phase

12.7 Residual Impacts

12.7.1 Construction Phase

No negative residual impacts are predicted to the material assets of the area resulting from the Proposed WwTP Component and implementation of the mitigation measures as outlined during the construction phase.

Construction of the Proposed WwTP Component will result in new work opportunities on a short-term basis for people in the immediate Poolbeg, Ringsend, Irishtown and Sandymount areas as well as the Greater Dublin Region. Short term construction work will be available as these new developments are constructed. It is estimated that up to 150 operatives maximum will be employed during the peak construction phase 2019-2020.

12.7.2 Operational Phase

No negative residual impacts are predicted to the material assets of the area resulting from the Proposed WwTP Component and implementation of the mitigation measures as outlined during the operational phase.

Positive effects will follow with respect to future development in the Poolbeg Peninsula and Greater Dublin Region. Future development, which could have been constrained due to a lack of wastewater treatment capacity, will be possible in future years. The net result will facilitate the provision of sites capable of being developed for new housing. In addition, it will facilitate development of new industrial / commercial and residential development in the entire catchment area. The completed Proposed

WwTP Component will facilitate future residential, industrial and commercial development not just in the immediate Poolbeg area but in the Greater Dublin region. This positive impact will have the ability to provide sufficient wastewater treatment capacity as one of the key elements needed to facilitate social and economic growth and developments like housing, schools, hospitals and businesses. Treated wastewater is also essential in protecting public health and the environment.

It is estimated that 15 no. additional long-term positions will arise during the future operational phase bringing the total workforce to 55 no. operatives during the operational phase. As such the Proposed WwTP Component will have a significant positive, long term impact on the development of Poolbeg and Greater Dublin Region, in line with Development Plans as outlined in section 12.1 above. The positive impact is rated as "Significant" long term during the operational phase for the reasons stated.

12.7.3 Interactions

12.7.3.1 Construction

Traffic movements of HGVs are outlined in Volume 3, Section 13: Traffic. The traffic volumes and proposed mitigation measures will influence the potential impact on the road surface quality during the construction phase.

The connection to the ESBN transmission High Voltage cable in the grasslands used by the over wintering Brent Geese, is considered in detail in Volume 3, Section 6: Biodiversity - Terrestrial. The mitigation measures outlined 12.6 of this section are consistent with measures outlined in the Biodiversity - Terrestrial section.

12.7.3.2 Operations

Traffic movements of HGVs are outlined in Volume 4, Section 13: Traffic. The traffic volumes and proposed mitigation measures will influence the potential impact on the road surface quality during the operational phase.

12.7.4 Cumulative Impacts

12.7.4.1 Construction

There are no predicted cumulative impacts with other projects during the construction phase.

12.7.4.2 Operations

There are no predicted cumulative impacts with other projects during the operational phase.

12.8 Monitoring

No monitoring will be required pre or post implementation of mitigation measures as outlined.

12.9 Difficulties Encountered

No significant difficulties were encountered during the evaluation of the Material Assets section.

12.10 References

Correspondence with DCC and utility providers

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Section 13: Traffic

13.1 Introduction

This Section of the EIAR assesses the potential traffic related impacts (and resulting effects) likely to occur as a result of the WwTP component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component").

Full details of the Proposed Upgrade Project and the Ringsend WwTP component can be found in Volume 2, Section 3: Description of Proposed Upgrade Project.

This Section and assessment have been completed having regard to the guidance outlined in the Environmental Protection Agency documents *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (Draft, August 2017) and *Advice Notes for Preparing Environmental Impact Statements* (Draft, September 2015).

13.2 Methodology

13.2.1 Introduction

The methodology adopted for this section is based on published guidance as referenced in Section 13.10, primarily TII "Traffic and Transport Assessment Guidelines" May 2014, and is summarised as follows:

- Reference was made to site layout drawings;
- Existing and proposed access arrangements for the Proposed WwTP Component onto the surrounding road network were considered;
- Traffic surveys were undertaken at the junctions most likely to be impacted by the Proposed WwTP Component;
- The project specific trip generation was calculated for the construction phase and operational phase;
- The project specific trip generation was assigned and distributed throughout the study area. Refer to Figure 13-1 in Section 13.2.3 for details of the study area;
- The anticipated traffic associated with developments on adjoining sites were applied to the future network models to develop the 2020, 2028 and 2040 models; and
- The junctions considered most likely to be impacted upon by traffic movements associated with the Proposed WwTP Component based on an assessment of the selected haul route to and from the Proposed WwTP Component were assessed in terms of capacity and road safety.

The assessment is based on the findings of site visits, observations, on-site traffic counts, plans associated with the Proposed WwTP Component and consultation with the Design Team. The criteria utilised for the assessment are Ratio of Flow to Capacity (RFC), Queuing Delay and Maximum Queue Length. Consultation meetings were held with the Roads and Traffic Planning Division, Dublin City Council on 05 May 2016. A follow up meeting was held with the Roads and Traffic Planning Division, and the Environment and Transportation Department, Dublin City Council on 21 July 2016.

13.2.2 Objectives

The primary objectives of this assessment are to:

- Assess the existing environment within the scope of the study area in terms of traffic and transportation;
- Estimate the Proposed WwTP Component's likely trip generation during the construction phase and operational phase;
- Quantify and analyse the likely traffic impacts on the surrounding road network which are likely to result from the construction and operation of the Proposed WwTP Component; and
- Identify mitigation measures to alleviate traffic impacts and residual impacts, if any, occurring as a result of the Proposed WwTP Component.

13.2.3 Scope of Study

The scope of the traffic and transportation section was developed in consultation with Dublin City Council's Roads and Traffic Department based on an assessment of selected haul routes to and from the Proposed WwTP Component. The scoping study also included the cumulative impacts of other committed developments, including the Dublin Waste to Energy (WtE) Facility (currently operational), the Alexandra Basin Redevelopment, and the Poolbeg West SDZ.

Following the scoping consultation process with Dublin City Council's Roads and Traffic Department, the study area included in this report includes sections of the following public roads:

- Pigeon House Road;
- Shellybanks Road;
- Whitebank Road;
- South Bank Road;
- R131 Sean Moore Road;
- York Road;
- R131 East Link Bridge;
- North Wall Quay; and
- East Link Road.

The Local Road Network which forms the study area for this assessment is illustrated in Figure 13-1.

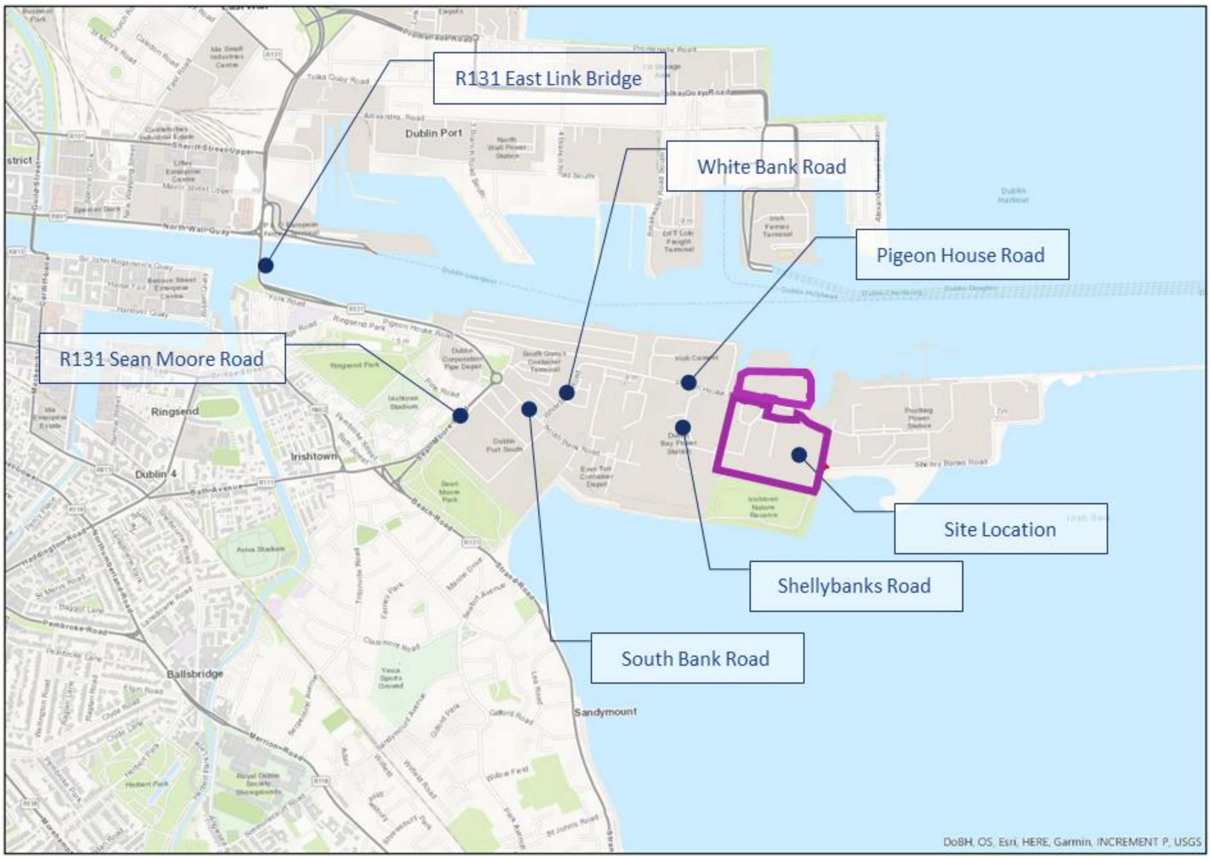

Figure 13-1: Local Road Network

The local road network north of the Point Depot junction was not modelled as part of this study. The construction phase of the Proposed WwTP Component will result in an increase of traffic of approximately 5.1% to 5.6% in the AM Peak period and 5.4% to 5.9% in the PM Peak period through the junctions to the north of the Point Depot junction. This is less than the 10% threshold for transport assessments as stated in the Traffic and Transport Assessment Guidelines (TII/NRA, 2014). The 10% threshold for transport assessments is appropriate for the construction phase due to the phased nature of the works which will result in short term traffic peaks. These peaks will not be sustained throughout the construction period and will coincide with peak construction activity on the site. The operational phase of the Proposed WwTP Component will result in an increase of traffic of approximately 2.0% in the AM Peak period and 1.9% in the PM Peak period through the junctions to the north of the Point Depot junction. This is less than the 5% threshold for transport assessments where congestion exists, or the location is sensitive as stated in the Traffic and Transport Assessment Guidelines (TII/NRA, 2014). As such, it is not anticipated that the Proposed WwTP Component will result in any quantifiable changes in operation of these junctions.

13.2.4 Traffic Surveys

In order to determine current traffic behaviour in the vicinity of the Proposed WwTP Component, classified traffic count surveys were carried out at the following locations:

- Location 1 - East Wall Road (R131)/Bond Road junction;
- Location 2 - East Wall Road (R131)/Alexandra Road junction;
- Location 3 - East Wall Road (R131)/Sherriff Street Upper junction;
- Location 4 - East Wall Road (R131)/North Wall Quay junction (Point Depot Junction);
- Location 5 - Pigeon House Road (R131)/Sean Moore Road (R131) junction (Sean Moore Junction);

- Location 6 - Whitebank Road/South Bank Road junction (Whitebank Junction); and
- Location 7 - Pigeon House Road at the access to existing WwTP.

The traffic count survey locations were identified in consultation with Dublin City Council's Roads and Traffic Department and included the junctions most likely to be affected by the Proposed WwTP Component, based on assessment of available haul routes to and from the Proposed WwTP Component.

Idaso were commissioned to undertake the classified traffic counts between 12:00 am on Tuesday 26 September 2017 and 12:00 am on Wednesday 27 September 2017. The counts were designed to establish a 24-hour profile of traffic and trip patterns at each junction and also to identify the critical peak hour periods of traffic flow through each junction.

Refer to Figure 13-2 for the traffic count survey location map.

Figure 13-2: Traffic Count Location Map

Full turning counts were recorded, and data was collected in 15-minute intervals. The following count classifications were employed:

- Light Vehicles (LV):
  - Pedal Cycles (PCL);
  - Motorcycles (MCL);
  - Car; and
  - Light Goods Vehicles (LGV)
- Heavy Goods Vehicles (HGV):
  - Other Goods Vehicles - 2-axle and 3-axle rigid commercial vehicles (OGV1)

- Other Goods Vehicles - 4-axle-rigid and 3-axle (or more) articulated commercial vehicles (OGV2); and
- Public Service Vehicles (PSV).

An initial analysis of the traffic data was undertaken in order to establish the baseline peak hour traffic flows for the junctions which are examined as part of this assessment.

The AADT flow was obtained by utilising the methodology specified in TII (NRA) Project Appraisal Guidelines - Unit 16.1: Expansion Factors for Short Period Traffic Counts.

13.2.5 Existing Traffic Models

13.2.6 Transport Strategy for the Greater Dublin Area 2016 – 2035

The *Transport Strategy for the Greater Dublin Area 2016 - 2035* utilises a macroscopic model to determine the impact of population growth and employment distribution on the Greater Dublin Area (GDA). This model examines the demand on the road network within the GDA as a whole and does not examine the impact on individual junctions.

The *Transport Strategy for the Greater Dublin Area 2016 - 2035* was not interrogated for the construction phase due to difficulties in predicting the phasing of population growth and employment distribution in the short term. The Transport Strategy for the Greater Dublin Area 2016 - 2035 utilises 2035 as the horizon year and it can be assumed that the full population growth and employment distribution anticipated will be realised by this year. The adjoining junctions were examined only with traffic count data and derived trip rates from committed developments in the surrounding area.

The do-minimum macroscopic model which was developed as part of the *Transport Strategy for the Greater Dublin Area 2016 - 2035,* was interrogated for the 2035 scenario. The do-minimum scenario assumes that no additional transport interventions have been applied to the road network in the GDA and presents a “worst-case” situation where the full impact of population growth and employment distribution is assigned to the existing road network. It was found that the operational phase of the Proposed WwTP Component will result in an increase in traffic of 3.4% to 4.0% at the Point Depot Junction and 3.0% to 3.1% at the Sean Moore Junction. This is less than the 5% threshold for transport assessments where congestion exists, or the location is sensitive, as stated in the Traffic and Transport Assessment Guidelines (TII/NRA, 2014). As such, it is not anticipated that the Proposed WwTP Component will result in any quantifiable changes in the operation of these junctions when the NTA macroscopic model is utilised.

13.2.7 Modelling Methodology

Classified traffic count surveys were carried out in the vicinity of the Proposed WwTP Component, see Section 13.2.4, at the junctions most likely to be affected by the Proposed WwTP Component as identified in consultation with Dublin City Council’s Roads and Traffic Department, based on assessment of available haul routes to and from the Proposed WwTP Component. These traffic count surveys were utilised to develop the 2017 AM and PM Peak baseline models.

This assessment has developed a microscopic model to assess the impact of the Proposed WwTP Component on the adjoining impacted junctions, based on traffic count data and derived trip rates from committed developments in the surrounding area.

Following consultation with Dublin City Council and to align with the NTA's *Transport Strategy for the Greater Dublin Area 2016 - 2035* it was determined that 2035 should be utilised as the "Design Year" scenario.

To establish future year flows, the Light Vehicle (LV) traffic flow figures contained in the baseline model have been factored up to the design years 2020 (Year of Peak Construction Activity), 2028 (Year of Opening) and 2035 (Design Year) using TII (NRA) *Project Appraisal Guidelines: Unit 5.3 - Travel Demand Projections*[19]. The Heavy Goods Vehicle (HGV) traffic flow figures contained in the baseline model have been factored up to the design years 2020, 2028 and 2035 using the Annual Average Growth Rate (AAGR) for gross tonnes of cargo contained within the *Dublin Port Company Masterplan 2012-2040*[20].

Dublin City Council propose to upgrade the Point Depot Junction to a signalised junction. Construction of the Point Depot Improvement Scheme was proposed for Q3 2016 to Q1 2017 (Point Depot Improvement Scheme Public Consultation Information Leaflet produced by DCC, NTA and Arup Consulting Engineers, 2015). However, at the time of writing, construction of this scheme has not commenced. In order to provide a robust analysis of the road network and to allow for further potential delays to the delivery of the Point Depot Improvement Scheme, the existing roundabout is assumed to be in operation in the 2020 scenario to provide a more conservative assessment. It has been assumed that the Point Depot Improvement Scheme will be complete by 2028.

It is anticipated that the construction of the Proposed WwTP Component will commence in 2018 and is expected to last for 10 years, with all works completed by 2028. With construction of the Alexandra Basin Redevelopment and the Poolbeg West Strategic Development Zone (SDZ) potentially running concurrently, the 2028 final year of construction has been identified as the period during which the network is likely to experience the largest background traffic during the construction phase. This is based on the completion of the Alexandra Basin Redevelopment, Dublin Waste to Energy (WtE) Facility (currently operational), and the Point Roundabout Improvement Scheme and the full construction of the Poolbeg West SDZ.

For the purposes of this analysis, it has been assumed that approximately 25% of the Poolbeg West SDZ will be under construction concurrently in the 2020 scenario. Furthermore, it has been assumed that the full Poolbeg West SDZ will be constructed in the 2028 scenario without any trip attenuation associated with public transport measures in the surrounding area. This presents a "Worst-case" scenario, however it is anticipated that in line with the Dublin City Council Development Plan, 2016-2022, the development of this site will be undertaken in a phased manner, with early provision of public transport infrastructure. It is anticipated that a limit will be placed on the amount of development allowable before the provision of the Dodder Public Transport Bridge.

A worst-case scenario was developed based on the scenario of peak construction activity for the Proposed WwTP Component occurring in 2020 coinciding with the completion of the Alexandra Basin

[19] Medium Growth.

[20] Dublin Port Company Masterplan 2012-2040 assumes 2.5% AAGR across all cargo modes.

Redevelopment, Dublin WtE Facility (currently operational), the construction of the Poolbeg West SDZ and the retention of Point Depot junction in its current configuration.

A capacity assessment of the Sean Moore Junction was undertaken utilising Transport Research Laboratory's (TRL) ARCADY (Assessment of Roundabout CApacity and DelaY) software for roundabout junctions. A capacity assessment of the Whitebank Junction was undertaken using TRL's PICADY (Priority Intersection CApacity and DelaY) software for priority-controlled junctions. A capacity assessment of the Point Depot Junction was undertaken utilising TRL's ARCADY software for the 2017 (Existing Environment) and 2020 (Year of Peak Construction Activity) scenario, whilst a capacity assessment of the 2028 (Year of Opening) and 2035 (Design Year) scenarios was undertaken utilising TRL's OSCADY (Optimised Signal Capacity and DelaY).

13.2.8 Do-Nothing Scenario

To establish future year flows the Light Vehicle (LV) traffic flow figures contained in the baseline model were factored up to the design years 2028 and 2035 using TII (NRA) Project Appraisal Guidelines: Unit 5.3 - Travel Demand Projections. The Heavy Goods Vehicle (HGV) traffic flow figures contained in the baseline model were factored up to the design years 2020, 2028 and 2035 using the Annual Average Growth Rate (AAGR) for gross tonnes of cargo contained within the Dublin Port Company Masterplan 2012-2040. Future construction and operational phase trips associated with the Poolbeg West SDZ, Dublin WtE Facility and the Alexandra Basin Redevelopment were estimated, and these traffic figures were applied to the surrounding road network to develop the future network models. Refer to Table 13-1 for a summary of adjacent developments included in the future design year scenarios.

Table 13-1: Adjoining Developments Included in Each Design Year Scenario

Scenario	2017	2020	2028	2035
Baseline	Existing Traffic Conditions	25% Poolbeg West SDZ under Construction	100% Poolbeg West SDZ Complete	100% Poolbeg West SDZ Complete
		Alexandria Basin Redevelopment Complete	Alexandria Basin Redevelopment Complete	Alexandria Basin Redevelopment Complete
		Dublin Waste to Energy Facility Operational (currently operational)	Dublin Waste to Energy Facility Operational (currently operational)	Dublin Waste to Energy Facility Operational (currently operational)
		Point Depot Improvement Scheme not Complete	Point Depot Improvement Scheme Complete	Point Depot Improvement Scheme Complete
Construction	N/A	Average Construction Trips for all elements being constructed concurrently	Average Construction Trips for all elements being constructed concurrently	N/A
Operation	N/A	N/A	All operational trips for Proposed WwTP Component	All operational trips for Proposed WwTP Component

To estimate the number of trips directly associated with this Poolbeg West SDZ, the Trip Rate Information Computer System (TRICS) database was interrogated to determine the anticipated trip rates. The trip rates were estimated utilising the TRICS sub land use of "Flats Privately Owned", within the main land use of "Residential". Whilst details of the nature and type of development in the SDZ are unknown at the time of writing, it is anticipated that the development may include up to 3,500 residential units along with approximately 5,000 m^2 retail space and 100,000 m^2 commercial units. To accurately reflect the location of the development, the results were filtered to include TRICS "Town Centre" and "Edge of Town Centre" location types only. It has been estimated that during the AM peak period, 8:00 am to 9:00 am, that there would be 1,608 inbound trips and 873 outbound trips associated with this development.

Similarly, the TRICS database was interrogated to determine the PM peak hour trip generation rates associated with this site. It has been estimated that during the PM peak period that there will be 924 inbound trips and 1,636 outbound trips associated with the Poolbeg West SDZ.

Table 13-2: TRICS Trip Generation Poolbeg West SDZ

Time	Retail		Employment		Residential		Total	
	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures
AM	354	309	1105	144	149	420	1608	873
PM	335	373	100	961	489	302	924	1636

The trip generation figures illustrated in Table 13-2 above are considered to be conservative due to public transport interventions planned under *Transport Strategy for the Greater Dublin Area 2016 - 2035*, such as the provision of the new Dodder Public Transport Bridge and the extension of the Luas Red Line to Poolbeg. The Draft Dublin City Development Plan, 2016 - 2022 states that development of the Poolbeg West SDZ site will be undertaken in a phased manner, with early provision of public transport infrastructure. It is anticipated that a limit will be placed on the amount of development allowable before the provision of the Dodder Public Transport Bridge. This will serve to promote the use of sustainable transport modes. The trip generation rates illustrated in Table 13-2 above do not allow for trip attenuation associated with the measures described and as such, represent a worst-case scenario for the development. Additionally, it is anticipated that limits will be placed on car parking provision within the development which will further reduce private car trips. The Poolbeg West SDZ is currently located within parking zone 3 as identified in the Dublin City Council Development Plan 2016 - 2022. Parking zone 3 identifies the maximum rate of car park provision as 1.5 spaces per dwelling. This maximum car parking rate was utilised to limit the trip generation associated with the residential units within the SDZ.

Construction vehicles associated with the Poolbeg West SDZ were estimated based on construction traffic trips associated with a current development in the North Lotts and Grand Canal Dock SDZ. This development features commercial units and approximately 270 residential units. The trip rates for the Poolbeg West SDZ were estimated by increasing the estimated construction trips by a factor of three, which is equivalent to approximately 25% of the Poolbeg West SDZ being constructed at any one time. It is considered that this represents a conservative estimate of the construction traffic associated with the Poolbeg West SDZ as it is likely that the development will be phased in smaller sections.

Trips associated with the operation of the Alexandra Basin Redevelopment were obtained from the EIS associated with the scheme. The EIS identified a number of different future year scenarios and estimated the percentage change on the surrounding road network as a result of the Proposed WwTP

Component in 2019, 2024, 2034, and 2040. These percentage changes where applied to the network baseline 2020, 2028 and 2035 models to develop the future year scenarios.

Trips associated with the operation of the Dublin WtE Facility (currently operational) were obtained from the EIS prepared for the scheme. It was estimated that the scheme will result in 121 HGV deliveries per day, 2 HGV's associated with the removal of Flue Gas Treatment (FGT), and 76 staff vehicles on local road network (Table 13-3).

The main source of HGV trips associated with the Dublin WtE Facility are direct trips which consist of a certain quantity of waste from within a defined boundary which will be delivered directly to the Dublin WtE Facility via the local road network and transfer trips which will come from the transfer stations to the facility via the strategic road network. This is referred to as Proposed Strategy: Direct and Transfer.

Table 13-3: Dublin Waste to Energy Daily Trip Generation

	Proposed Strategy (No. HGV's Per Day)	Waste Residue Removal (No. HGV's Per Day)	Staff (No. Cars Per Day)	Total (No. Vehicles Per Day)
Arrivals	121	2	36	280
Departures	121	2	36	280

Light vehicular traffic associated with the Dublin WtE Facility and the Poolbeg West SDZ is likely to be attracted to and distributed from the subject site in a similar proportion to the baseline traffic model.

In this regard, the peak turn-in and turn-out flows associated with the Dublin WtE Facility and Poolbeg West SDZ developments calculated for the Proposed WwTP Component were distributed and assigned throughout the junctions considered in similar proportions to the overall traffic flows established as part of the baseline traffic model.

Access to the site for Heavy Goods Vehicles (HGVs) associated with the Proposed WwTP Component, Dublin WtE Facility and the Poolbeg West SDZ will be restricted by the DCC HGV Cordon, with HGVs routed via the Port Tunnel, East Link Bridge and York Road. Refer to Section 13.3.2 herein for further information relating to the DCC HGV Cordon.

13.2.9 Do-Something Scenario

13.2.10Trip Distribution and Trip Assignment

Light vehicular traffic associated with the Proposed WwTP Component is likely to be attracted to and distributed from the Proposed WwTP Component in a similar proportion to the baseline traffic model.

In this regard, the peak turn-in and turn-out flows calculated for the Proposed WwTP Component were distributed and assigned throughout the junctions considered in similar proportions to the overall traffic flows established as part of the baseline traffic model.

Access to the site for Heavy Goods Vehicles (HGVs) associated with the Proposed WwTP Component, Dublin WtE Facility (currently operational) and the Poolbeg West SDZ will be restricted by the DCC HGV Cordon, with HGVs routed via the Port Tunnel, East Link Bridge and York Road. Refer to Section 13.3.2 herein for further information relating to the DCC HGV Cordon.

13.2.11 Construction Phase

The future operation of the road network without the Proposed WwTP Component taking place was examined in the Do-nothing scenario. The results of this Do-nothing assessment were compared to the Do-something scenarios to determine the impact of the Proposed WwTP Component on the road network. The Do-nothing scenario utilises the baseline traffic models for each of the design years considered. Refer to Table 13-1 in Section 13.2.7: Do-nothing Scenario, for a summary of adjacent developments included in the future design year scenarios.

Assessment Years

Some of the works permitted under the 2012 Approval have commenced, so start date of the works has been considered to commence in 2018. Construction works are expected to last for 7 to 10 years. For the purposes of this assessment a worse-case scenario of a 10-year construction period has been assumed, with all works completed by 2028. Traffic analysis associated with the impact of the construction works will, therefore, focus on the following future scenarios:

- Peak Construction Period - 2020; and
- Final Year of Construction - 2028.

As noted, the projected 2020 and 2028 baseline network flows have been calculated by factoring up the 2017 recorded network flows in accordance with TII (NRA) Project Appraisal Guidelines Unit 5.3 – Travel Demand Projections for LVs and using *Dublin Port Company Masterplan 2012 – 2040* tonnage growth rates for HGVs. The Dublin Port Masterplan assumes 2.5% growth per annum between 2012 and 2040 which provides a more conservative estimate of future HGV flows.

Trips associated with the Poolbeg West SDZ, Dublin WtE Facility (currently operational) and Alexandra Basin Redevelopment have been applied to the baseline 2020 and 2028 models to develop the without-development (Proposed WwTP Component) scenarios. Refer to Table 13-1 in Section 13.2.7: Do-Nothing Scenario, for a summary of adjacent developments included in the 2020 and 2028 construction phase scenarios.

Construction Traffic Trip Generation

Estimates of the total construction traffic and future staff numbers associated with the Proposed WwTP Component were obtained from the Engineering team for each element of the Proposed WwTP Component. Table 13-4 summarises the anticipated construction traffic trips associated with each element of the works.

Table 13-4: Total Construction Traffic Trips

Element	Deliveries Vehicles	Concrete Trucks	Disposal Trucks
Retrofit	1,600	832	50
Capacity Upgrade and Expansion	400	1,800	1,000
Advance Works 4	0	0	1,875
Other Site Developments	400	416	500
Total	2,400	3,048	3,425

Estimates of the average construction HGV trips associated with the Proposed WwTP Component were calculated based on the total construction HGV trips and applied to the surrounding road network. This average construction HGV trips, represents the average number of trips for all elements of the Proposed WwTP Component running concurrently. Table 13-5 summarises the average construction HGV trips per hour for each element of the works.

Table 13-5: Average Peak Hour HGV Trip Generation During Peak Construction

Activity	Total No. HGV's	Duration of Works (Months)	No. HGV's/Day [21] (Arriving)	Haulage Hrs/Day	No. HGV Trips/Hr[22]
Retrofit	2,482	28	4	12	1
Capacity Upgrade and Expansion	3,200	25	6	12	1
Advance Works 4	1,875	5	17	12	3
Other Site Developments	1,316	60	1	12	1
Total	8,873	-	26	-	6

Daily peak construction traffic figures were extrapolated from the AM peak estimates for the Capacity Upgrade and Expansion works occurring concurrently. These figures consist of day-time and night-time works. It is anticipated that there will be 240 HGV trips daily during the peak construction period and 396 cars/light vehicles. The daily estimates are presented in Table 13-6.

Table 13-6: 2020 Daily Trip Generation During Peak Construction

Activity	Arrivals (Vehicles)	Departures (Vehicles)	Total (Vehicles)
Disposal HGVs	48	48	96
Concrete Deliveries	48	48	96
Materials and Equipment Deliveries	24	24	48
Vans	48	48	96
Staff	150	150	300
Total	318	318	636

Some elements of the works, such as large concrete pours, during the peak construction may require night-time working between 6:00 pm and 6:00 am. The exact sequence and programme of works will be determined by the contractor, but it has been conservatively estimated that 80 of the HGV trips will occur during this night-time period with the remaining 160 HGV trips occurring between 6:00 am and 6:00 pm.

[21] Based on 22 working days per month.

[22] A vehicle "Trip" is noted as each HGV movement, therefore, empty HGV's arriving to site and removing spoil, or HGV's delivering to site and departing empty represent a total of two "Trips".

Noting the lower background network traffic between 6:00 am and 6:00 pm and the estimated volumes of HGVs during this period, it is not anticipated that night-time working will result in significant impacts to the operation of the road network.

The 2020 peak construction period scenario utilised estimates of the maximum anticipated construction traffic associated with the Proposed WwTP Component. It is anticipated that construction staff will arrive on site prior to the AM peak period of 8:00 am to 9:00 am, however, to provide a robust analysis it has been assumed that 10% of construction staff will arrive during the AM peak hour period. These construction traffic figures were applied to the surrounding road network and represent a worst-case trip generation scenario (Table 13-7).

Table 13-7: 2020 AM Peak Trip Generation During Peak Construction

	Disposal	Concrete	Deliveries	Light Goods Vehicles	Staff Vehicles	Total
Arrivals	12	12	6	12	15	57
Departures	12	12	6	12	2	44
Total	24	24	12	24	17	101

For the purposes of this assessment it has been assumed that PM Peak trips are the inverse of the AM Peak, i.e. 57 total departures and 44 arrivals during the peak hour.

13.2.12Operation Phase

Assessment Years

It is anticipated that the construction works will commence in 2018 and are expected to last for 10 years, with all works completed by 2028. Traffic analysis associated with the impact of the Proposed WwTP Component will, therefore, focus on the following future scenarios:

- Year of Opening - 2028[23]; and
- Design Year - 2035.

The projected 2028 and 2035 flows have been calculated by factoring up the 2017 recorded network flows in accordance with TII PAGs Unit 5.3 - Travel Demand Projections for LVs and using Dublin Port Company Masterplan tonnage growth rates for HGVs. The Dublin Port Masterplan assumes 2.5% growth per annum between 2012 and 2040, which provides a more conservative estimate of future HGV flows.

Operational Trip Generation

HGV trips associated with the existing WwTP site are detailed in Table 13-8.

[23] As the facility is currently and will continue to be operational, the "year of opening" is considered to be the year when construction is anticipated to be complete.

Table 13-8: Existing HGV Deliveries etc to the existing WwTP site

Activity	No. HGV's	Frequency	Avg/Day[24]
Total HGV Arrivals	475	Per Month	22

It is anticipated that the future operation of the Proposed WwTP Component will result in an increase in HGV trips to 100 trips per day, which comprises 50 deliveries and 50 departures. These additional HGVs are associated with increased deliveries and removal of additional waste products and are likely to be spread across the working day.

There are currently 40 staff employed at the existing Ringsend WwTP. The Proposed WwTP Component will result in an increase in the existing staff numbers employed at the Ringsend WwTP to 55.

13.3 Existing Environment

13.3.1 Site Location

The existing Ringsend WwTP is located on the Poolbeg peninsula with the main access points provided off Pigeon House Road (as shown on Figure 13-1).

13.3.2 Local Road Network

Linking the site with the Regional Road Network are a series of Local Roads. These Local Roads include Pigeon House Road, Whitebank Road and South Bank Road.

South Bank Road meets the Regional Road R131 at the roundabout intersection with Sean Moore Road. The R131 then skirts the edge of Dublin City's Heavy Goods Vehicle (HGV) Cordon Area (refer to Figure 13-3) running north west via the R131 York Road before crossing the tolled East Link Bridge over the River Liffey.

North of the Liffey, the R131 becomes known as East Wall Road. Continuing north on East Wall Road from this point provides the option for access to the national motorway network via the Dublin Port Tunnel which connects Dublin Port to the M1 (Belfast) motorway and the M50 orbital motorway.

[24] Based on 22 working days per month

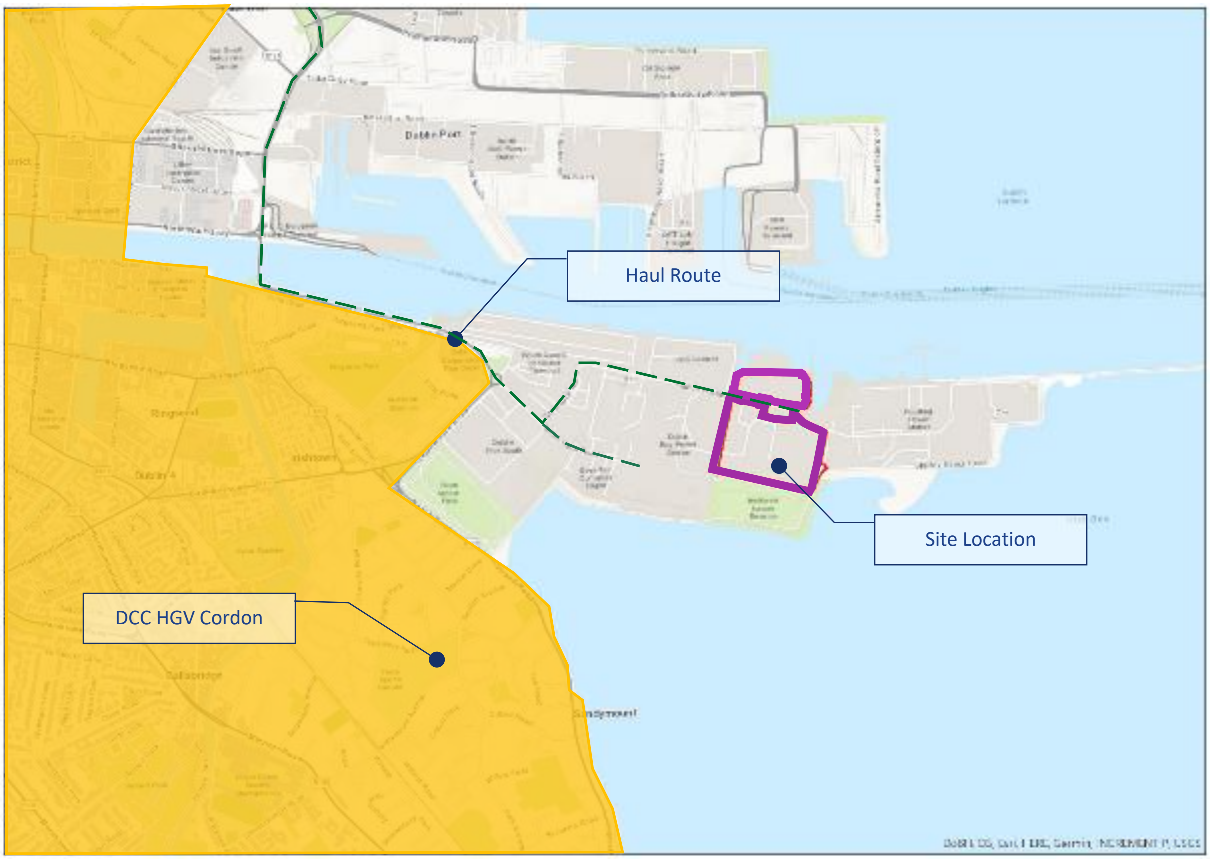

Figure 13-3: Dublin City Council HGV Cordon Area in relation to site and proposed HGV route

The Dublin City Council HGV Management Strategy was introduced on the 19 February 2007. The HGV Strategy provides for a ban on 5+ axle vehicles during the hours of 07.00 - 19.00 seven days a week from a designated cordon area and provides a limited permit scheme for 5+ axle vehicles that need to load/unload within the city centre area.

In accordance with the Dublin City Council HGV Management Strategy, access to the Proposed WwTP Component for 5+ axel HGVs is via the Port Tunnel, East Link Bridge and York Road. Refer to Section 13.2.11: Construction Phase for further information relating to the proposed HGV haul route.

13.3.3 Existing Traffic Flows

An initial analysis of the traffic data obtained from the traffic survey (refer to Section 13.2.4) was undertaken in order to establish the baseline peak hour traffic flows for the junctions which are examined as part of this assessment.

13.3.4 Count Location 1 (East Wall Road (R131)/Bond Road Junction)

Count Location 1 is a signal-controlled junction at the junction of the East Wall Road (R131) and Bond Road.

The morning (AM) peak hour was identified as the period from 8:00 am to 9:00 am, when a total of 2,988 vehicles passed through the junction. The evening (PM) peak hour was identified as the period from 5:00 pm to 6:00 pm when 2,817 vehicles passed through the junction. The AM and PM peak hour traffic flows through the junction are illustrated in Figure 13-4 and Figure 13-5.

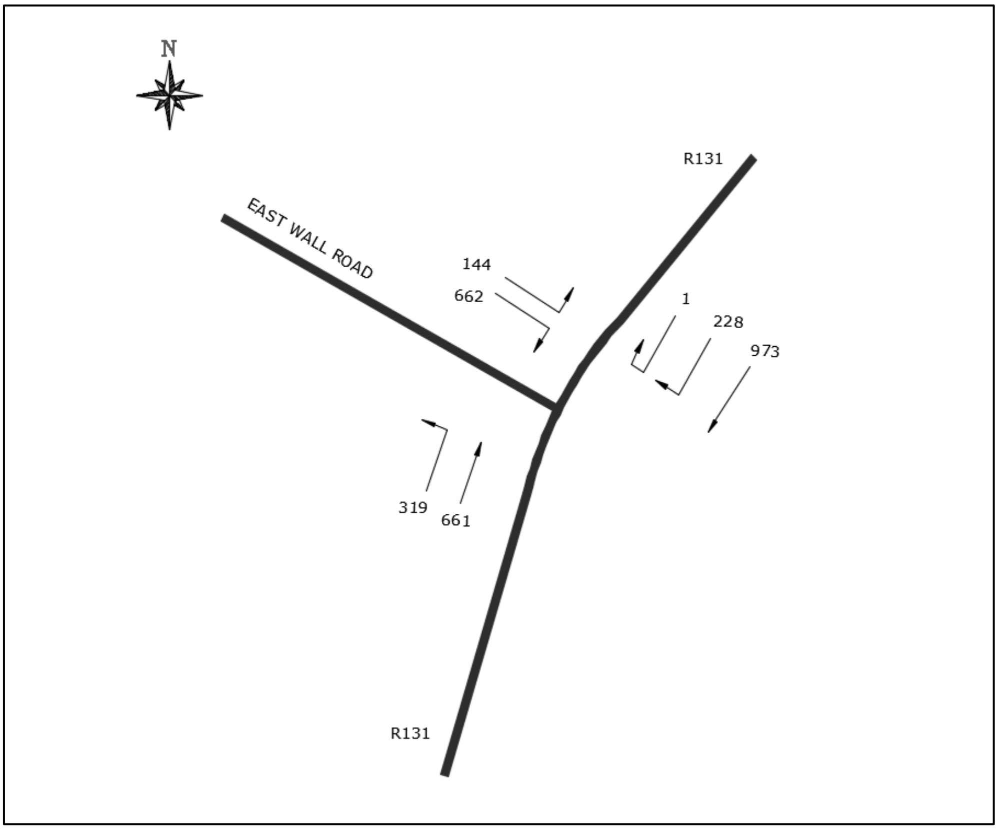

Figure 13-4: AM Peak Traffic Flows for Count Location 1

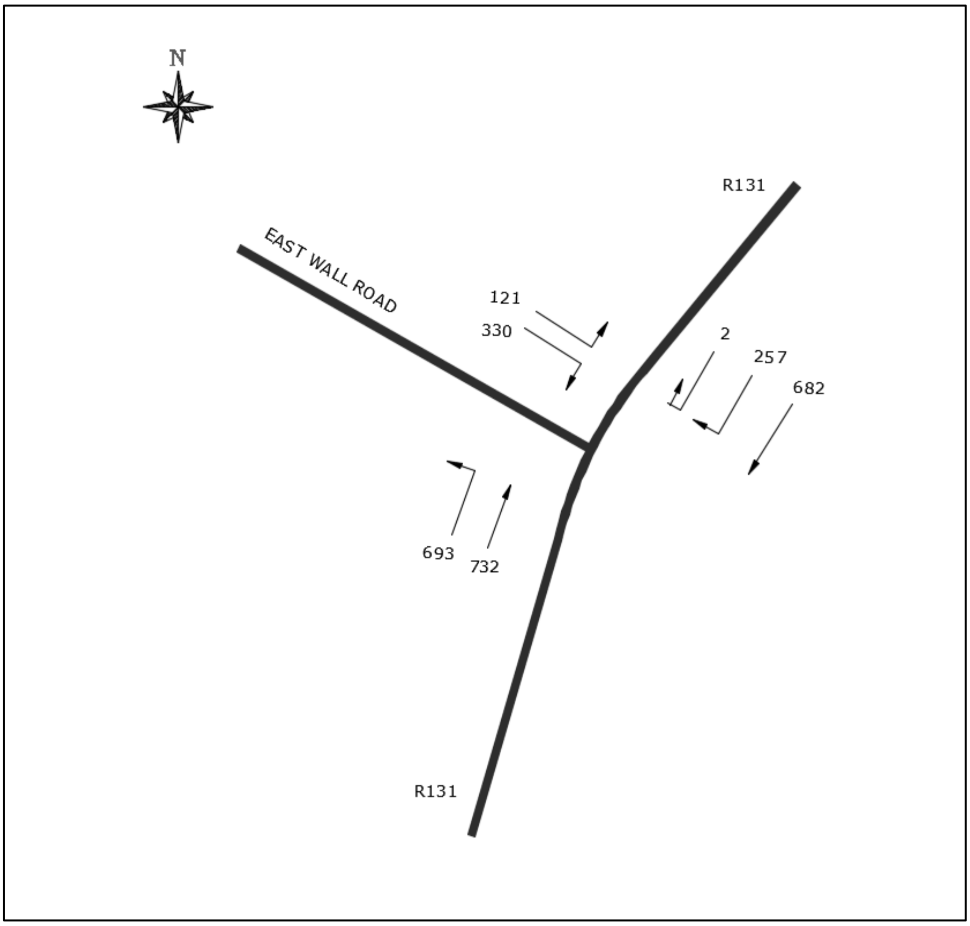

Figure 13-5: PM Peak Traffic Flows for Count Location 1

During the AM peak hour, 1,635 southbound vehicles and 805 northbound (Port Tunnel direction) were recorded on the East Wall Road, and similarly during the PM peak hour 1,012 southbound vehicles and 853 northbound vehicles were recorded. HGVs comprised 13.7 % of total daily traffic flows.

13.3.5 Count Location 2 (East Wall Road (R131)/Alexandra Road Junction)

Count Location 2 is a signal-controlled junction at the junction of the East Wall Road (R131) and Alexandra Road.

The morning (AM) peak hour was identified as the period from 8:00 am to 9:00 am, when a total of 2,766 vehicles passed through the junction. The evening (PM) peak hour was identified as the period from 5:00 pm to 6:00 pm when 2,593 vehicles passed through the junction. The AM and PM peak hour traffic flows through the junction are illustrated in Figure 13-6 and Figure 13-7.

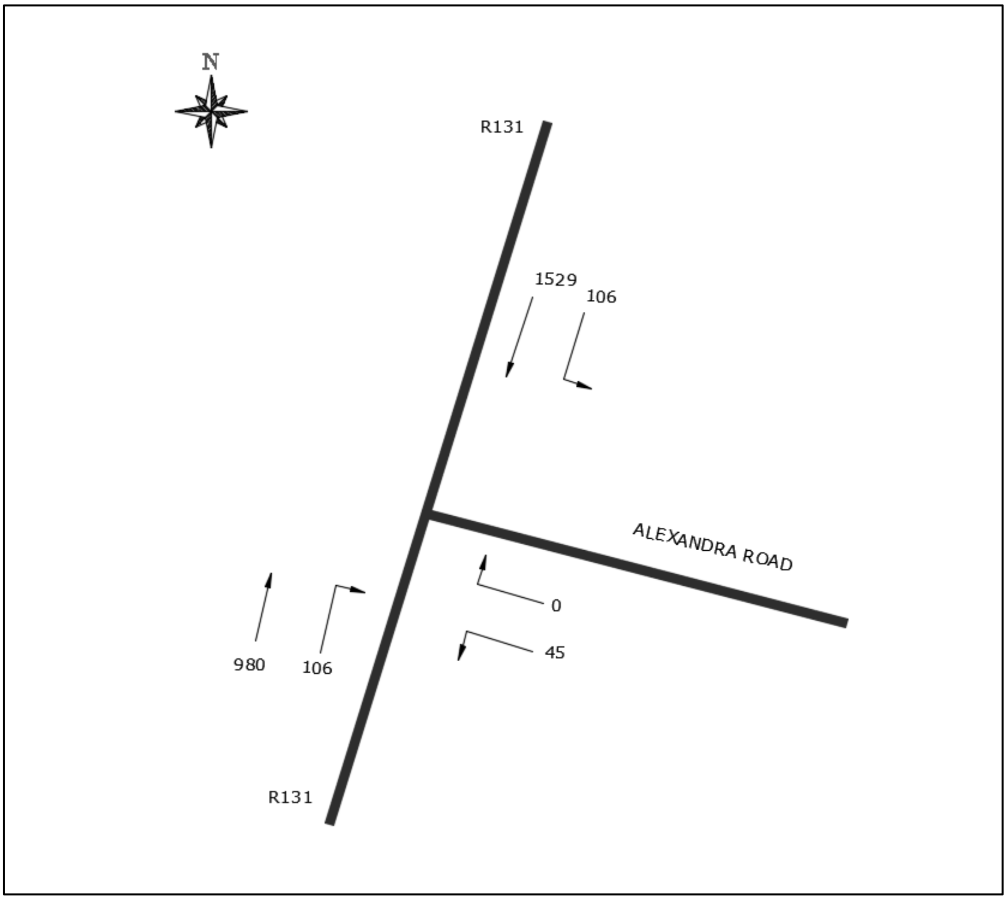

Figure 13-6: AM Peak Traffic Flows for Count Location 2

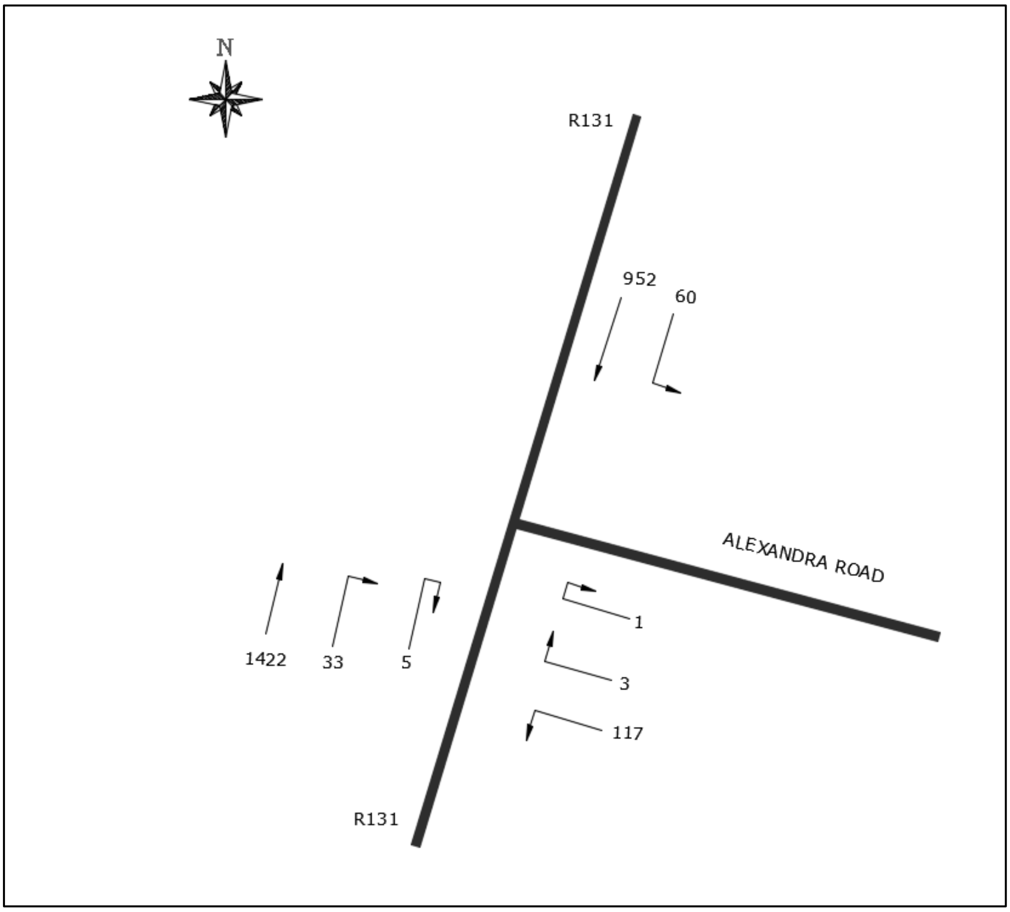

Figure 13-7: PM Peak Traffic Flows for Count Location 2

During the AM peak hour, 1,574 southbound vehicles and 980 northbound (Port Tunnel direction) were recorded on the East Wall Road, and similarly during the PM peak hour 1,074 southbound vehicles and 1,425 northbound vehicles were recorded. HGVs comprised 15.6 % of total daily traffic flows.

13.3.6 Count Location 3 (East Wall Road (R131)/Sherriff Street Upper Junction)

Count Location 3 is a signal-controlled junction at the junction of the East Wall Road (R131) and Sherriff Street Upper.

The morning (AM) peak hour was identified as the period from 8:00 am to 9:00 am, when a total of 2,707 vehicles passed through the junction. The evening (PM) peak hour was identified as the period from 5:00 pm to 6:00 pm when 2,583 vehicles passed through the junction. The AM and PM peak hour traffic flows through the junction are illustrated in Figure 13-8 and Figure 13-9.

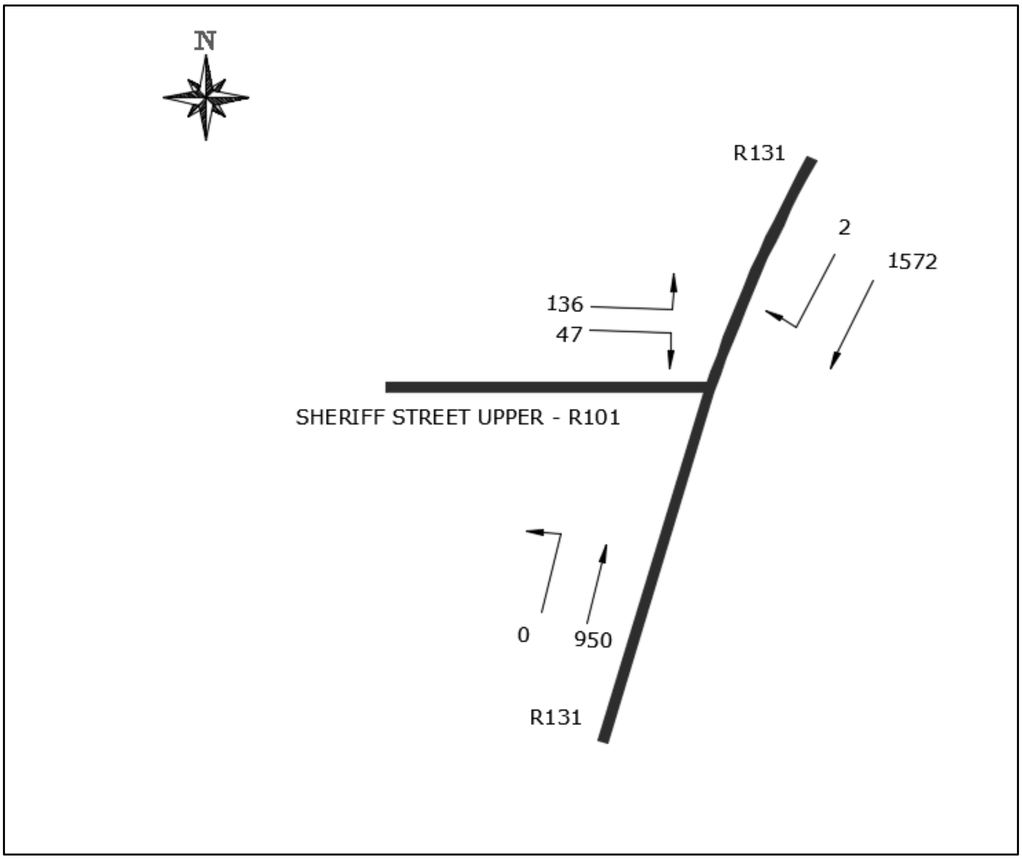

Figure 13-8: AM Peak Traffic Flows for Count Location 3

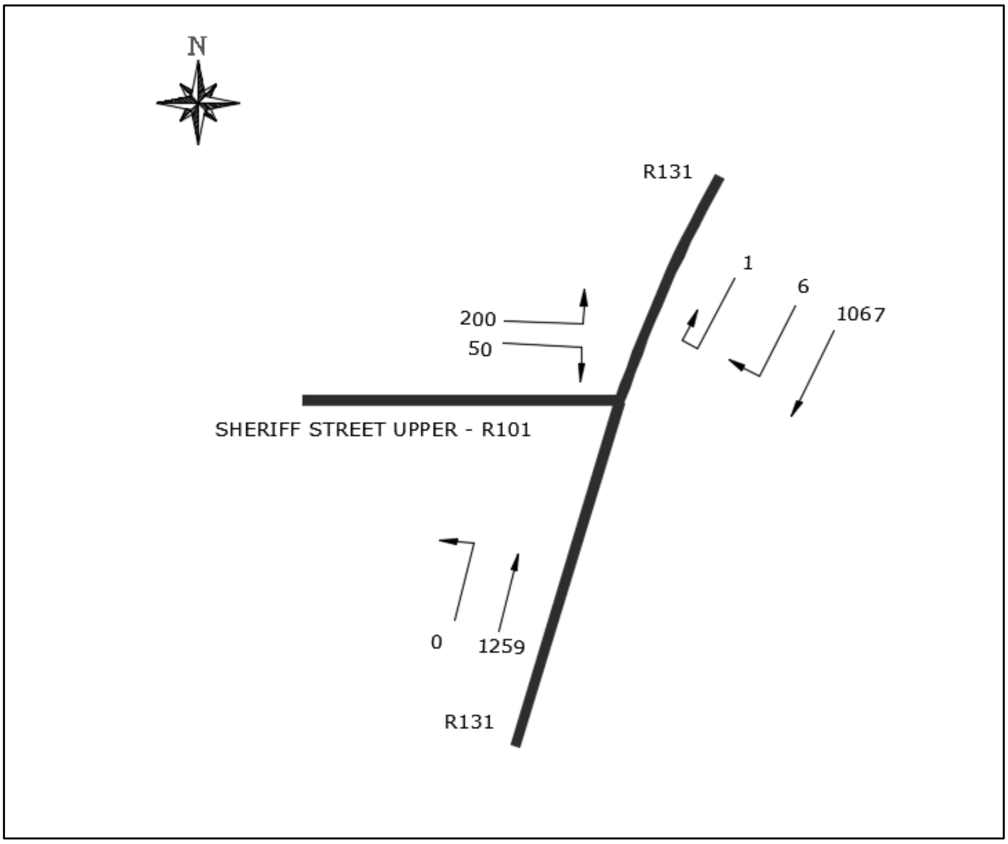

Figure 13-9: PM Peak Traffic Flows for Count Location 3

During the AM peak hour, 1,619 southbound vehicles and 1,086 northbound (Port Tunnel direction) were recorded on the East Wall Road, and similarly during the PM peak hour 1,117 southbound vehicles and 1,459 northbound vehicles were recorded. HGVs comprised 13.2 % of total daily traffic flows.

13.3.7 Count Location 4 (Point Depot Junction)

Count Location 4 is a priority-controlled roundabout junction at the junction of the East Wall Road (R131), East Link Road (R131) and North Wall Quay (R801).

The morning (AM) peak hour was identified as the period from 8:00 am to 9:00 am, when a total of 2,860 vehicles passed through the junction. The evening (PM) peak hour was identified as the period from 5:00 pm to 6:00 pm when 2,546 vehicles passed through the junction. The AM and PM peak hour traffic flows through the Point Depot Junction are illustrated in Figure 13-10 and Figure 13-11.

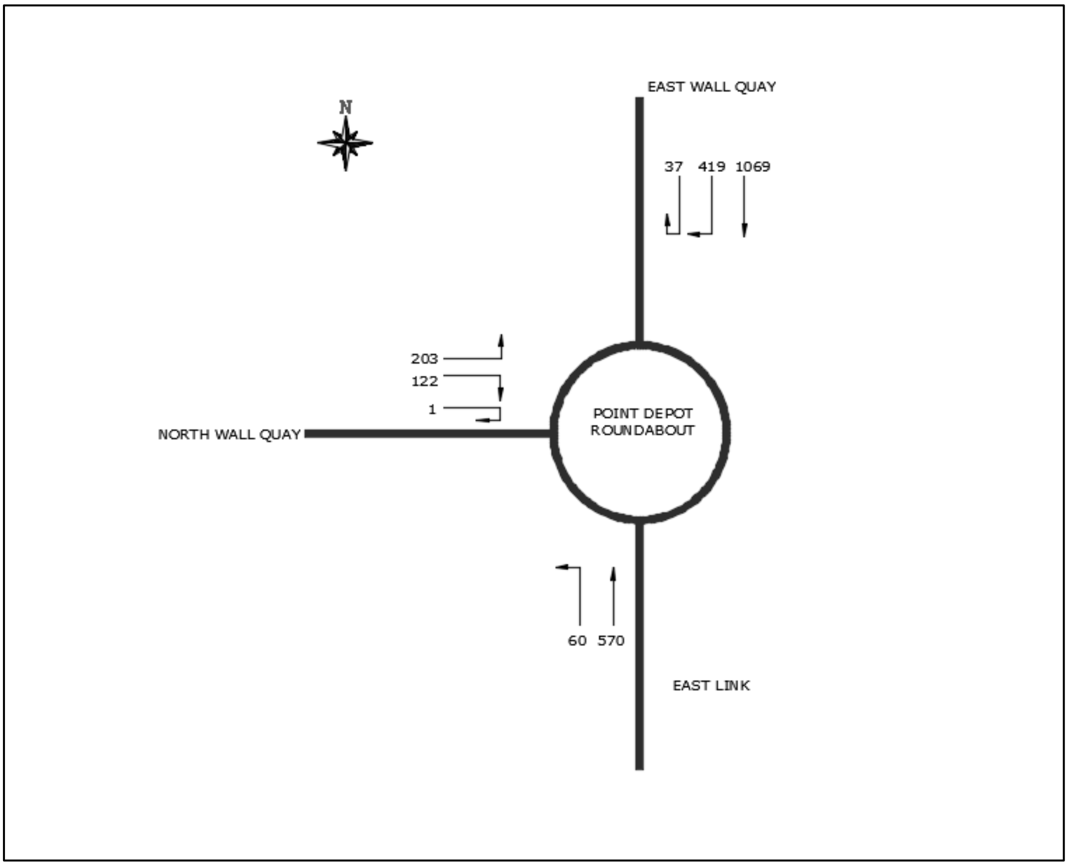

Figure 13-10: AM Peak Traffic Flows for Count Location 4

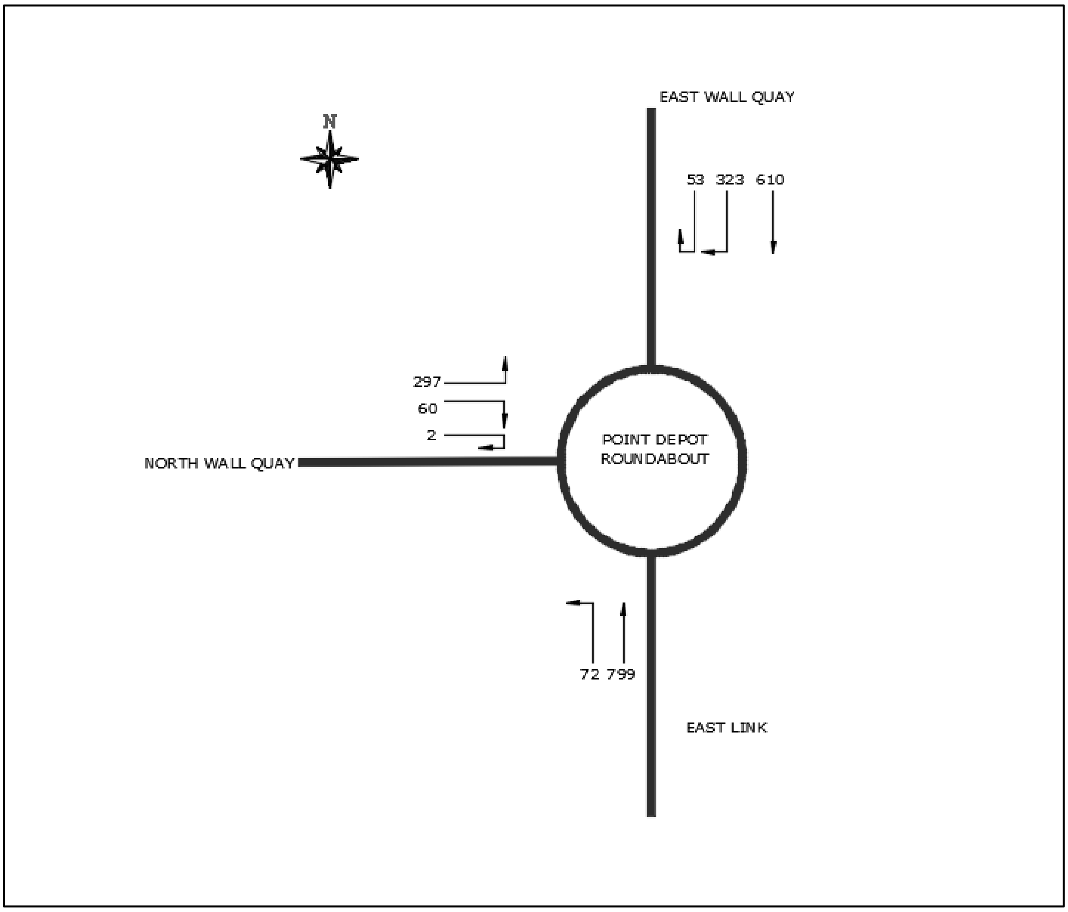

Figure 13-11: PM Peak Traffic Flows for Count Location 4

During the AM peak hour, 1,677 southbound vehicles and 961 northbound (Port Tunnel direction) were recorded on the East Wall Road, and similarly during the PM peak hour 1,101 southbound vehicles and 1,293 northbound vehicles were recorded. HGVs comprised 11.6 % of total daily traffic flows.

13.3.8 Count Location 5 (Sean Moore Junction)

Count Location 5 is a priority-controlled roundabout junction at the junction of the East Link Road (R131), Sean Moore Road (R131), Pigeon House Road and South Bank Road.

The morning (AM) peak hour was identified as the period from 7:00 am to 8:00 am, when a total of 2,014 vehicles passed through the junction. The evening (PM) peak hour was identified as the period from 4:00 pm to 5:00 pm when 1,705 vehicles passed through the junction. The AM and PM peak hour traffic flows through the junction are illustrated in Figure 13-12 and Figure 13-13.

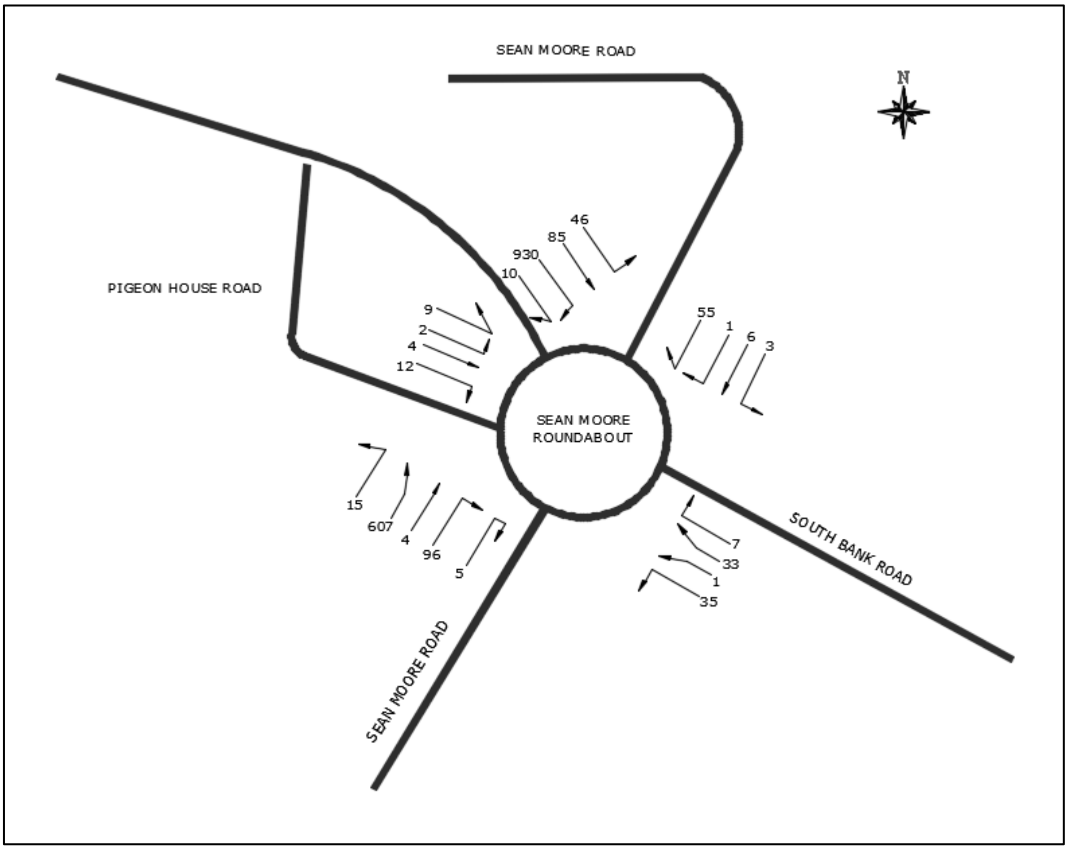

Figure 13-12: AM Peak Traffic Flows for Count Location 5

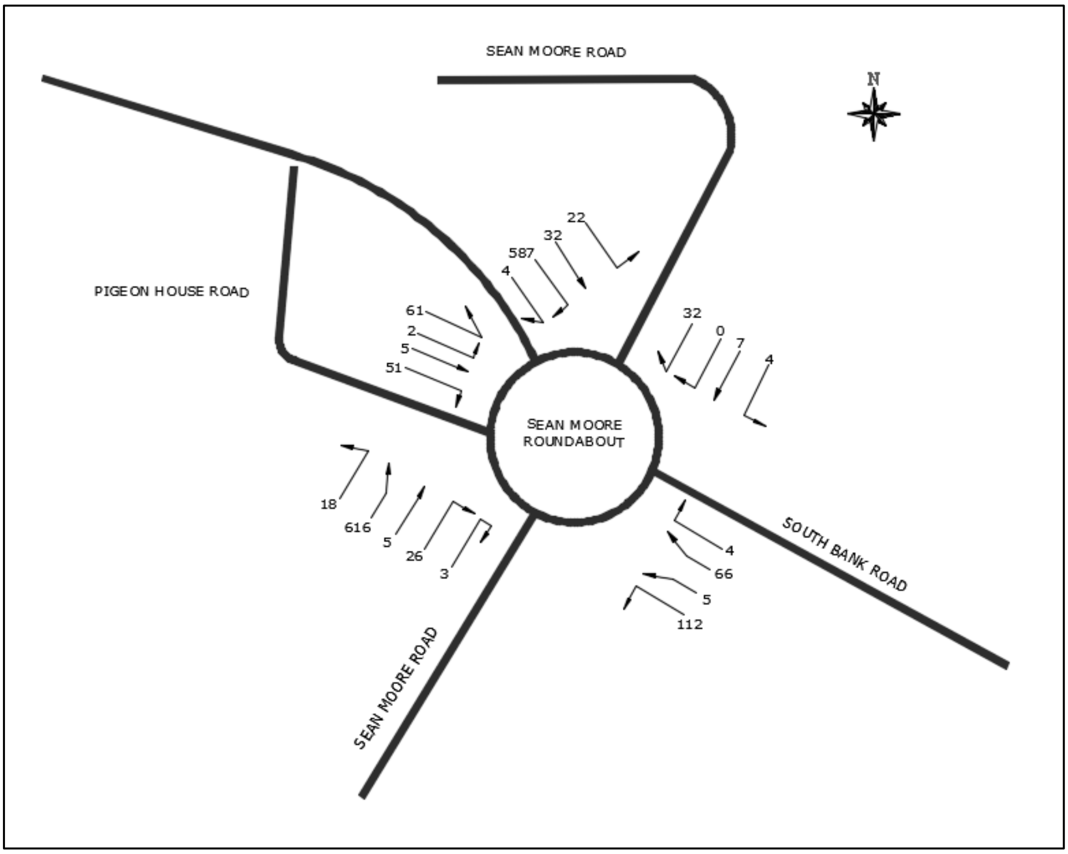

Figure 13-13: PM Peak Traffic Flows for Count Location 5

HGVs comprised 11.3 % of total daily traffic flows. During the AM peak period, traffic flows on Sean Moore Road comprised 743 vehicles in the northbound direction and 1,004 in the southbound (Sandymount) direction. During the PM peak period traffic flows on Sean Moore Road comprised 676 vehicles in the northbound direction and 786 in the southbound (Sandymount) direction.

13.3.9 Count Location 6 (Whitebank Junction)

Count Location 3 is a priority-controlled T-junction at the junction of the Whitebank Road and South Bank Road.

The AM peak traffic hour was identified as the period from 7:00 am to 8:00 am when a total of 298 vehicles passed through the junction. The PM peak traffic hour was identified as the period 12:00 pm to 13:00 pm when a total of 309 vehicles passed through the junction. HGVs comprised 35.3 % of total daily traffic flows. The AM and PM peak hour traffic flows through the junction are illustrated in Figure 13-14 and Figure 13-15.

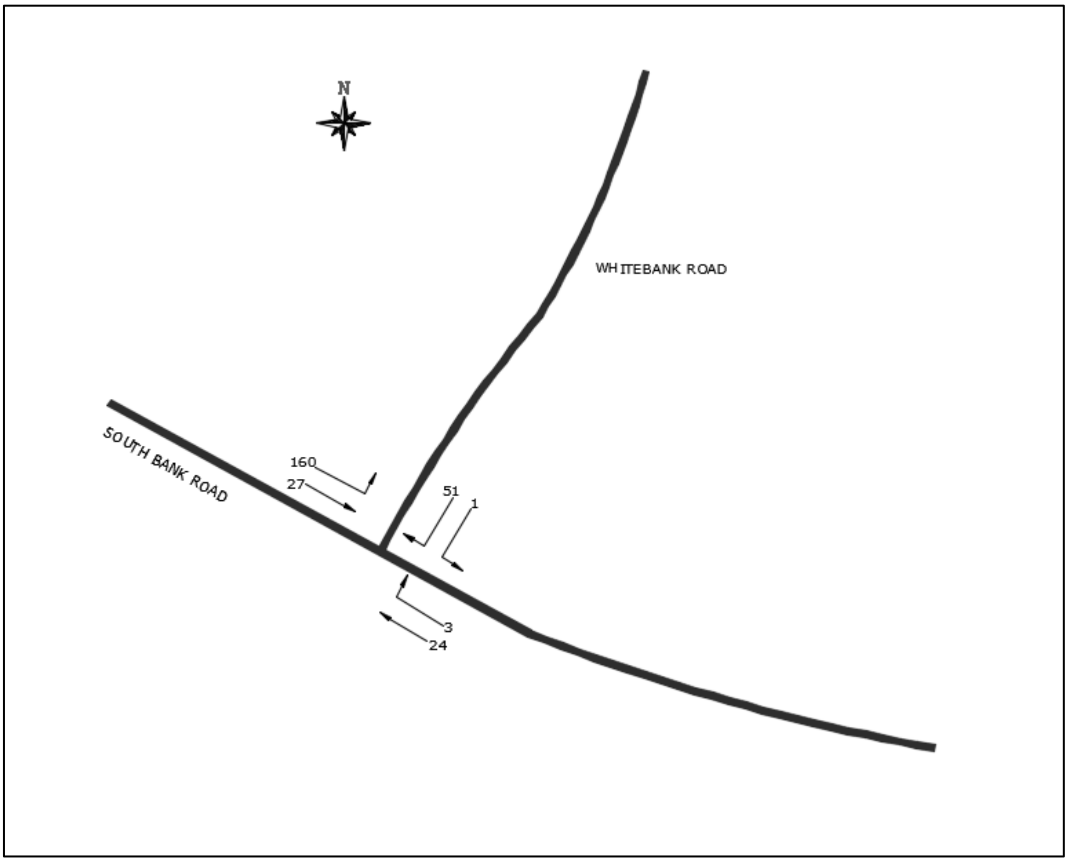

Figure 13-14: AM Peak Traffic Flows for Count Location 6

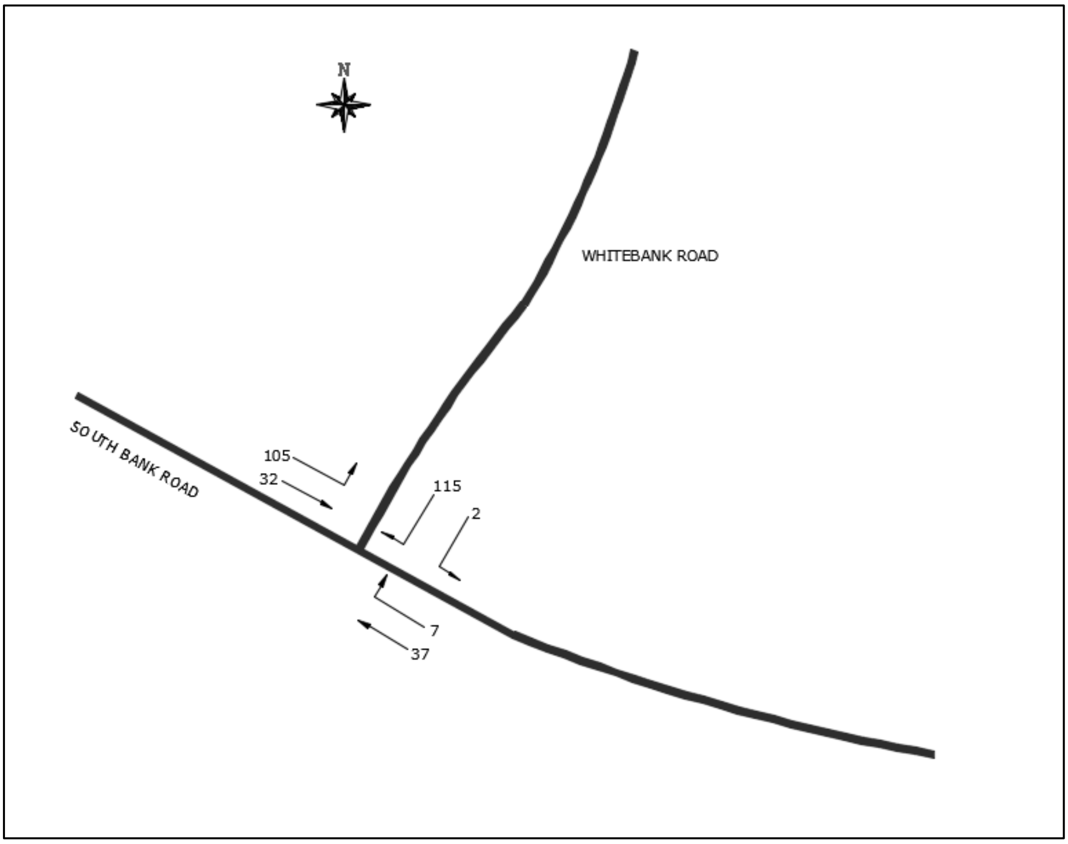

Figure 13-15: PM Peak Traffic Flows for Count Location 6

13.3.10Count Location 7 (Pigeon House Road/WwTP Access)

Count Location 2 is a priority-controlled T-junction at the junction of Pigeon House Road and the existing Wastewater Treatment Plant Access.

The AM peak traffic hour was identified as the period from 7:00 am to 8:00 am. During this period a total of 81 vehicles travelled Pigeon House Road in the eastbound direction and a total of 16 vehicles travelled in the westbound direction. The PM peak traffic hour was identified as the period from 4:00 pm to 5:00 pm. The AM and PM peak hour traffic flows through the junction are illustrated in Figure 13-16 and Figure 13-17.

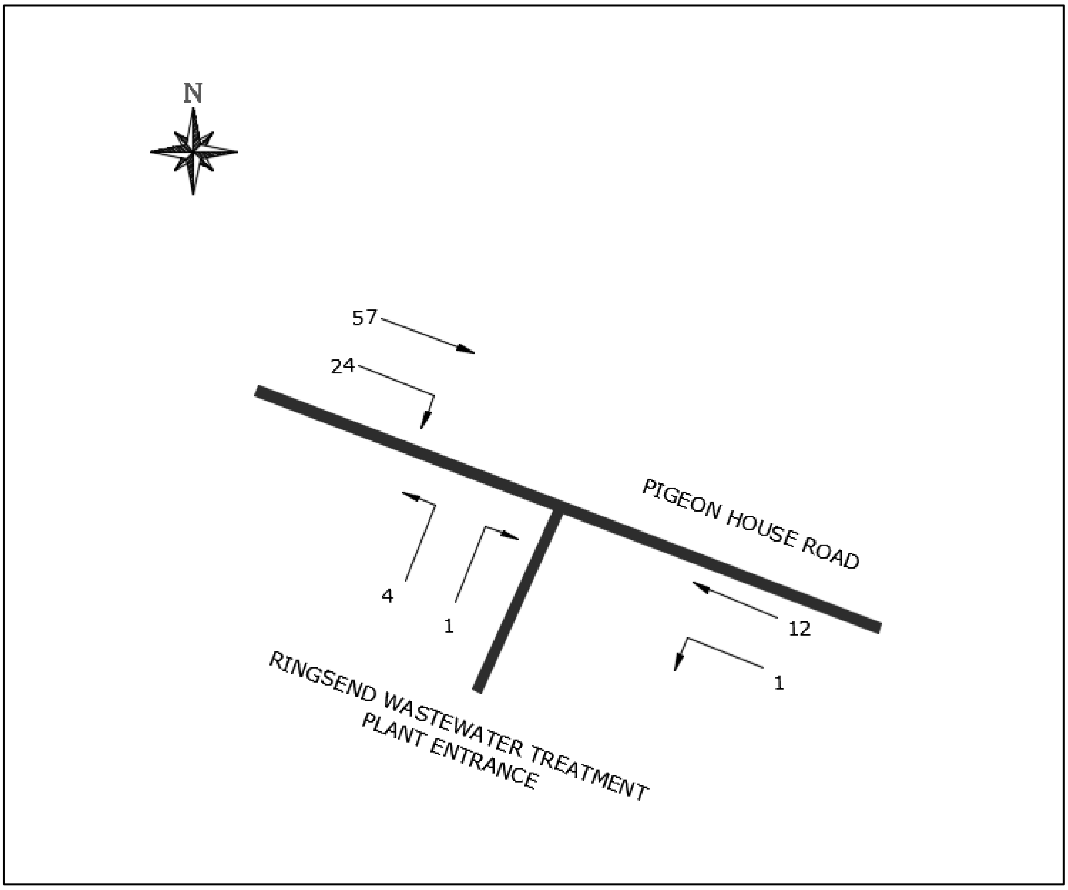

Figure 13-16: AM Peak Traffic Flows for Count Location 7

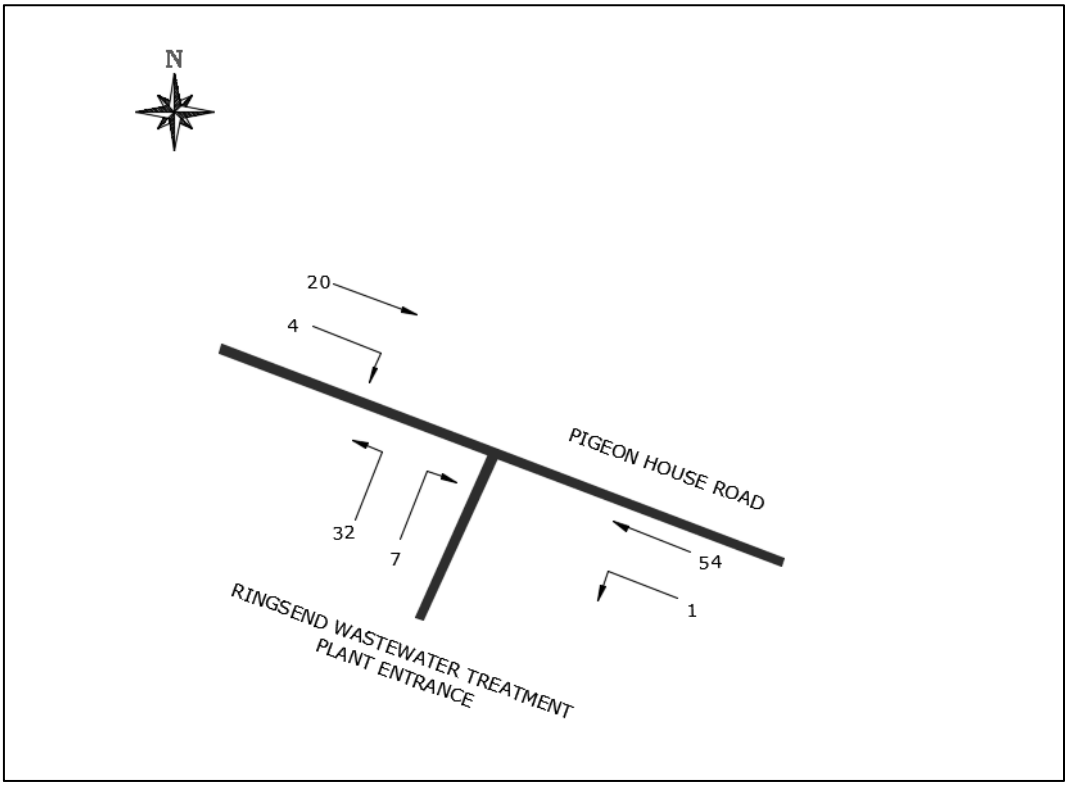

Figure 13-17: PM Peak Traffic Flows for Count Location 7

During this period, a total of 24 vehicles travelled Pigeon House Road in the eastbound direction and a total of 86 in the westbound direction. HGVs comprised 4.8 % of the total daily traffic flow.

Count location 7 was also used to identify the current number of vehicle trips into and out of the existing Ringsend WwTP site. Over the course of the 24-hour count period, 172 vehicles entered and exited the site. HGV's accounted for 12.8 % of vehicles entering and exiting the site.

Figure 13-18 illustrates the total traffic flows through each junction and the combined flows for the road network during the period surveyed.

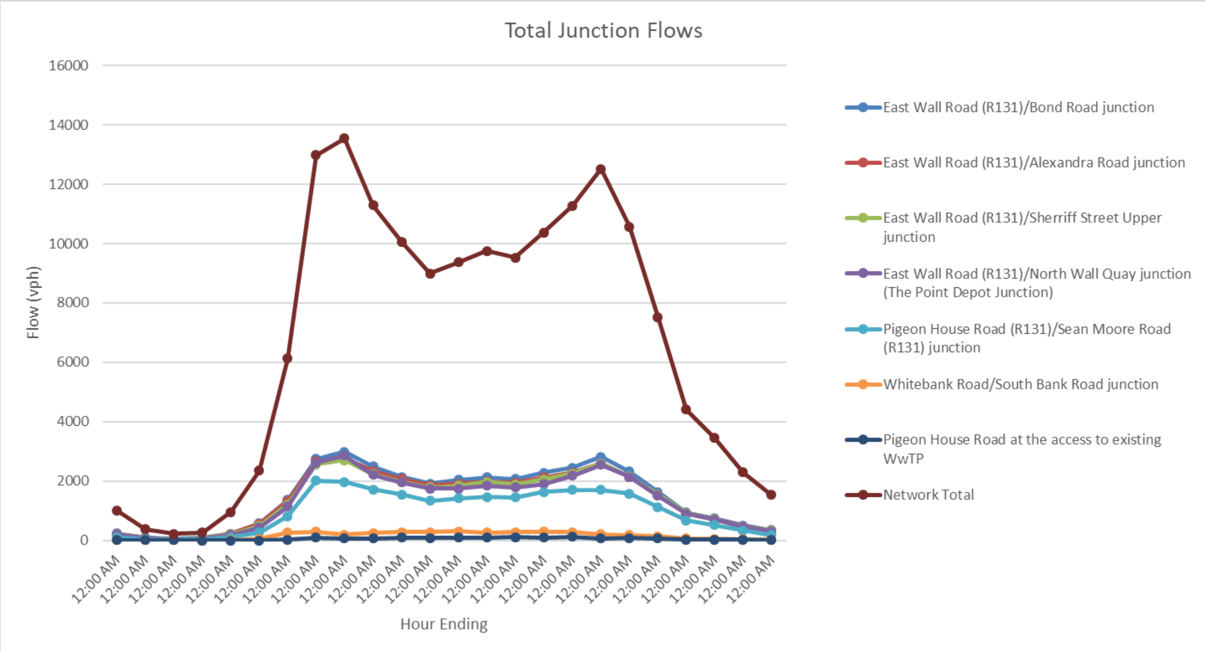

Figure 13-18: Total Junction Flows

Interrogation of the traffic count data revealed that 12,987 vehicles movements were recorded through the network in the AM Peak hour between 7:00 am and 8:00 am. The PM Peak hour occurred between 5:00 pm and 6:00 pm with 12,513 vehicles recorded through the network.

13.3.11 2017 Base Year Capacity Analysis

13.3.12Base Year 2017 Annual Average Daily Traffic Flows (AADT)

The AADT flows for the R131 East Link Bridge, the R131 Sean Moore Road and the Pigeon House Road were calculated using the TII (NRA) Project Appraisal Guidelines - Unit 16.1: Expansion Factors for Short Period Traffic Counts and are set out in Table 13-9.

Table 13-9: 2017 AADTs Derived from Traffic Count Data

Link	24 Hour Flow (Vehicles)	AADT
R131 East Link Bridge	21,716	24,166
R131 Sean Moore Road	20,411	22,713
Southbank Road	3,635	3,294
Pigeon House Road	1,171	1,303

The calculated AADTs for the links identified are illustrated in Figure 13-19.

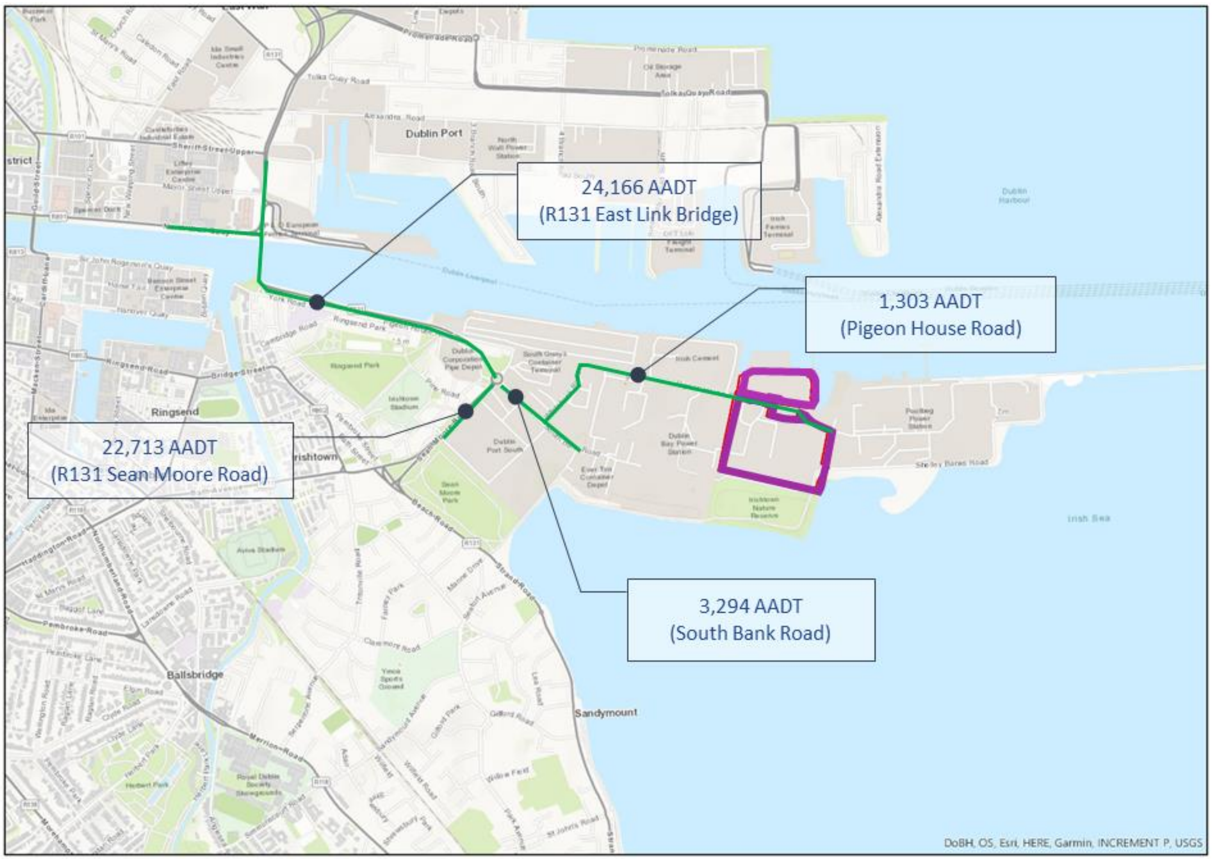

Figure 13-19: 2017 AADTs on Local Road Network

13.3.132017 Base Year Capacity Assessment

The normal design threshold for the Ratio of Flow to Capacity (RFC) is 0.85. The theoretical capacity is 1.0. The results shown in Table 13-10 and Table 13-11 demonstrate that the Sean Moore Junction and Whitebank Junction currently operate well within capacity during the AM and PM peak periods, with no significant queuing or delays to motorists. The Point Depot Junction currently exceeds this design threshold in the PM peak period. Whilst the RFC is still within the theoretical capacity of 1.0 for PM peak period, it exceeds the theoretical traffic carrying capacity in the AM scenario.

Table 13-10: 2017 Baseline AM Peak Junction Capacity Analysis

Junction	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
Point Depot Junction	1.411	455.4	343.5
Sean Moore Junction	0.888	18.0	6.9
Whitebank Junction	0.376	9.6	0.6

Table 13-11: 2017 Baseline PM Peak Junction Capacity Analysis

Junction	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
Point Depot Junction	0.902	15.0	8.0
Sean Moore Junction	0.798	12.6	3.8
Whitebank Junction	0.294	9.0	0.4

Vehicle queue lengths recorded during the traffic count on Wednesday 27 September 2017 validated the results established in Table 13-10 and Table 13-11 as it was observed that the Sean Moore Junction and Whitebank Junction operated efficiently with little or no queuing. A queue length of 300+ metres was recorded southbound on East Wall Road on the approach to the Point Depot Junction and it was noted that this queue extended upstream through the next four significant junctions to the north resulting in a queue length of approximately 790 m.

13.3.14 Existing Road Safety Assessment

The Road Safety Authority (RSA) database of road collision information was interrogated to establish if the surrounding road network in the vicinity of the Proposed WwTP Component holds records relating to historical collision occurrence (refer to Figure 13-20).

The exercise revealed that there were three serious collisions and three fatal collisions on the surrounding road network. Two serious and one fatal collision occurred at the Point Depot Junction, however this is not considered relevant to the study area as this applies to the junction in its current configuration. Additionally, one serious and one fatal collision occurred north of the Point Depot Junction on the approach to the Port Tunnel. These collisions are also not relevant to the study area as the trips generated by the Proposed WwTP Component, on this section of the road network, are less than the 5% threshold for transport assessments where congestion exists as stated in the Traffic and Transport Assessment Guidelines (TII/NRA, 2014).

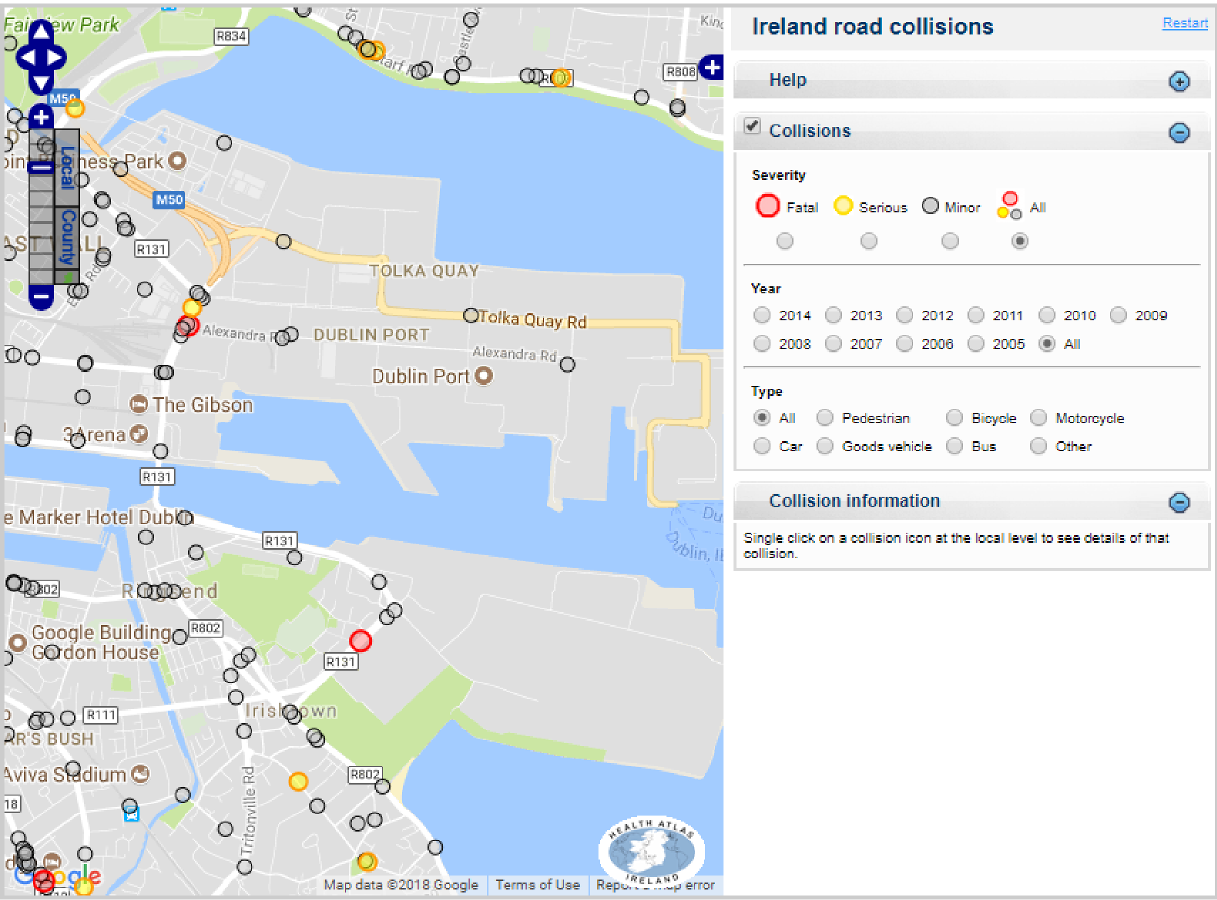

Figure 13-20: Road Safety Authority Collision Database

13.4 Characteristics of the WwTP Component of the Proposed Upgrade Project

As discussed in Volume 2, Section 3: Description of Proposed Upgrade Project, the proposed changes to Ringsend WwTP comprises several different project elements including modifications and retrofitting to existing plant in addition to the construction of new facilities.

Elements of the Proposed WwTP Component that will impact on the traffic environment and road network at Ringsend are discussed in the following sections.

13.4.1 Access Arrangements

Overhead services form height restrictions at three locations along Pigeon House Road. The clearance provided at these locations is 5.64 m, 6 m and 6 m. Refer to Figure 13-21, Figure 13-22 and Figure 13-23. The contractor will be required to make provision for these restrictions when delivering oversized loads to the site.

Figure 13-21: Height restriction on Pigeon House Road (5.64 m)

Figure 13-22: Height restriction on Pigeon House Road (6 m)

Figure 13-23: Height restriction on Pigeon House Road (6 m)

There are 5 No. existing accesses to the existing Ringsend WwTP which will be retained and used for the future operation of the Ringsend WwTP. Two accesses are provided to the Ringsend WwTP from Pigeon House Road as shown in Figure 13-24 and Figure 13-25. One access is provided to the storm overflow tanks and one access is provided to the Pigeon House.

Figure 13-24: Existing WwTP Site Primary Entrance

Figure 13-25: Existing WwTP Site Maintenance Entrance

There is an existing access to the east of the Ringsend WwTP site via the existing Spur Road which runs immediately adjacent to the coastal walking route between Sandymount and Great South Wall. This Spur Road is accessed from Pigeon House Road. A height-restriction of 1.95 m is provided on Pigeon

House Road approximately 50 m south of the main ESB entrance. To facilitate access of oversized HGVs to the site during the construction phase, the height restriction barrier will be temporarily removed and access control provided at this location when access is required.

It is proposed to construct a new access from the Pigeon House Road at a location c. 100 m west of the main entrance into the ESB Poolbeg Power Station and c. 250 m east of the two existing Ringsend WwTP operational accesses identified in Figure 13-24 and Figure 13-25 above. The proposed entrance location is at the site of a former temporary construction entrance to the existing WwTP. This entrance was used during the construction of the existing WwTP but was closed in c. 2005 on completion of the works. The Proposed WwTP Component includes the provision of a circulation road (c. 80 m long) connecting the existing internal WwTP roads along the southern and eastern boundaries of the site. It is proposed to retain both the access and circulation road following completion of the works to facilitate future operational access and site circulation requirements. See Figure 13-26 for the locations of existing and proposed entrances as well as circulation and access roads.

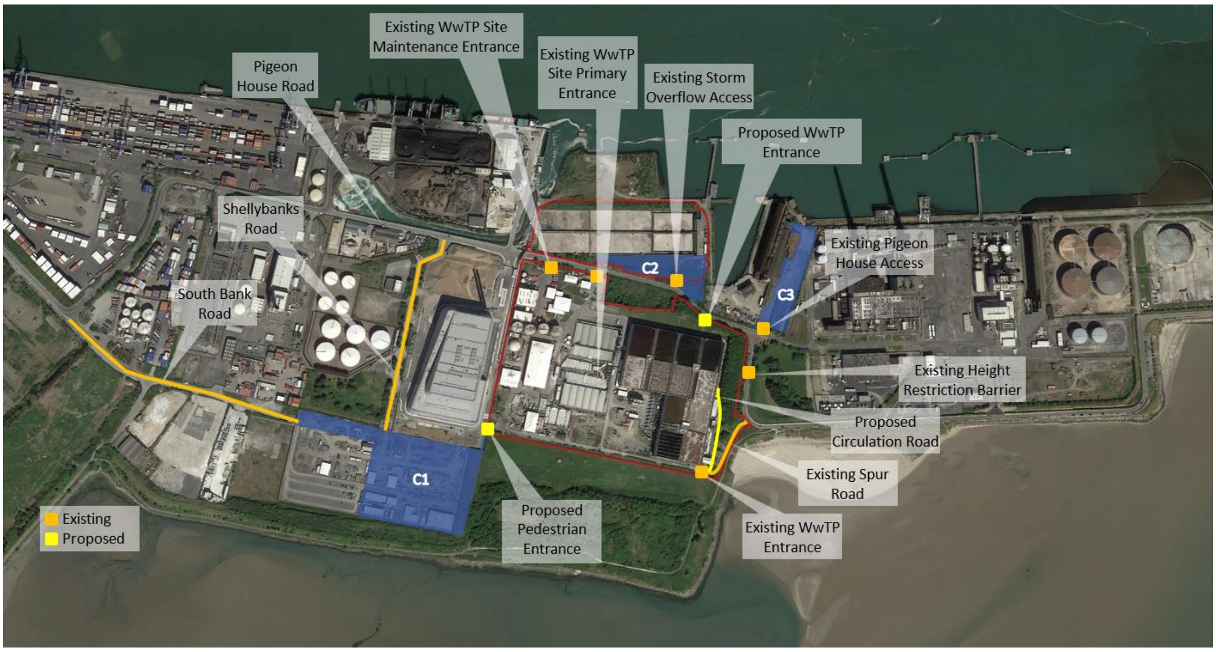

Figure 13-26: Existing and Proposed Access Locations

13.4.2 Temporary Construction Compounds

To facilitate construction works and plant installation, three no. temporary construction compounds (C1, C2 and C3) are required. The locations of these temporary construction compounds are shown in blue on Figure 13-27.

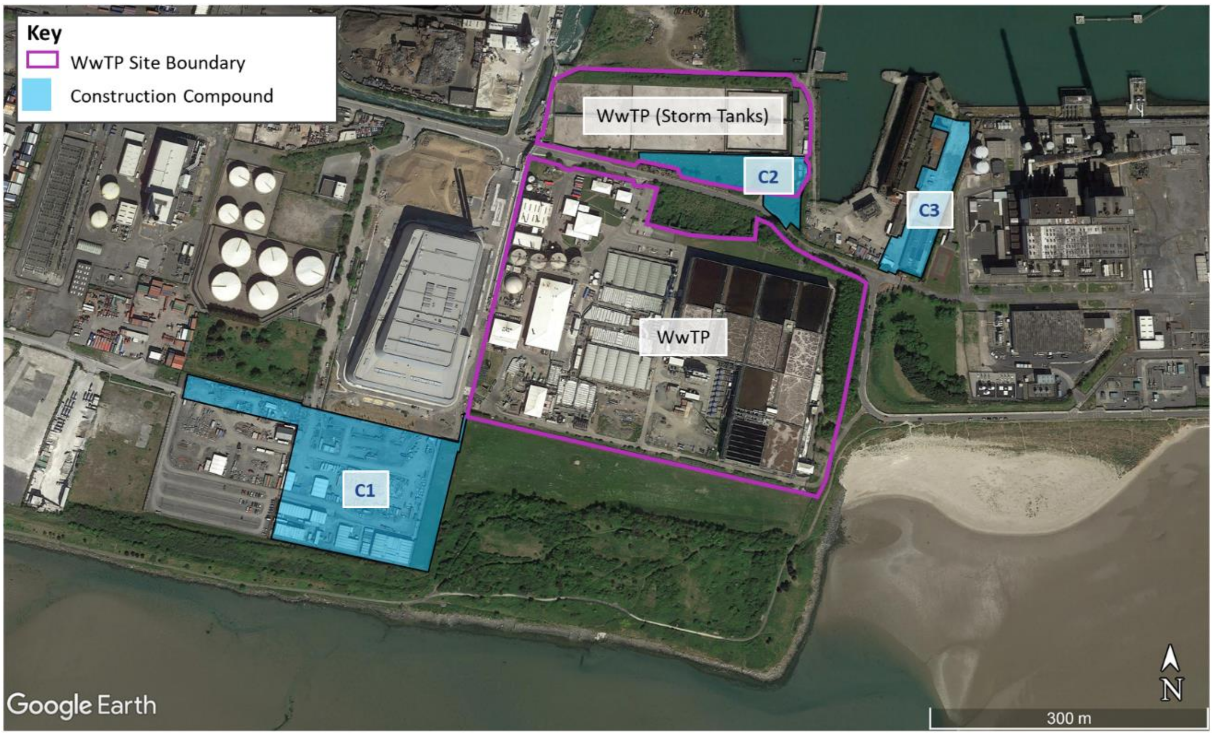

Figure 13-27: Temporary Construction Compound Locations

Compound C1

The site is located on the adjacent lands to the southwest of the Ringsend facility and comprises 3.01 ha, as shown on drawing Y15710-PL-961, provided in Volume 5, Part A. The lands are owned by Dublin Port Company and were used by Covanta as a construction compound to facilitate the works within the Waste to Energy facility. At present the compound area is utilized as a car park, welfare facilities, storage area and temporary site offices in the form of portacabins. The compound is currently accessed from Shellybanks Road and it is proposed that compound C1 will continue to be accessed from Shellybanks Road. The compound will also be accessible from South Bank Road. It is envisaged that the compound will be maintained in its existing use as a car park facility, storage area and site offices.

Pedestrian access will be provided into the works site via a 3 metre wide temporary access with double gate entry. It should be noted that the pedestrian access will not encroach into the adjacent SPA (Special Protection Area) to the east of the compound. The new temporary access road from compound C1 will be enclosed with a palisade fencing with screening. Consent has been provided for access across Dublin City Council lands to facilitate the temporary access.

Compound C2

Compound C2 is proposed to be located to the north of the existing Ringsend WwTP and comprises approximately 0.75 ha. The proposed site is owned by the Applicant and Dublin City Council. The site is currently unused and is bounded to the north by the storm tanks for the Ringsend WwTP and to the south by the north wall of Pigeon House Fort. The site is currently accessed from Pigeon House Road through an existing 3.7 m entrance gate. The proposed Compound C2 will require shared access to facilitate entry for the WwTP operator and Dublin City Council for the ongoing operation and maintenance of the Ringsend WwTP storm tanks. As the existing access is part of a protected structure (i.e. Pigeon House Fort), a more suitable access arrangement for HGV movements is proposed and is shown on Drawing Y15710-PL-962 (Volume 5, Part A). This arrangement incorporates the Design Manual for Urban Roads and Streets (DMURS) principles in creating a new temporary access from the compound to Pigeon House Road for the duration of the works. A 6.9 m wide palisade gate installed in the early

2000s will be utilised as an access point to the proposed temporary construction compound with a new temporary access road as denoted on Drawing Y15710-PL-964. This proposal provides flexibility to the works contractor for the segregation of pedestrians and HGVs entering the site, thus minimising health and safety risks. It is proposed to utilise the existing access for pedestrian segregation and smaller vehicles while the new access will provide for HGV access only.

Compound C3

The site is located to the northeast of the existing Ringsend WwTP Upgrade works and comprises approximately 0.73 ha. The site is owned by Dublin City Council. The site is accessed from Pigeon House Road and bounded by a disused power plant on the west and an ESB facility to the east.

The temporary construction compound areas will include 'portakabin' type office, welfare and storage facilities, some of which will be in two storeys. The compound areas will also include car parking for site staff.

13.5 Potential Impacts

13.5.1 Do-Nothing Impacts

13.5.1.1 2020 Junction Analysis

A summary of the Do-nothing Impacts for 2020 for the AM and PM peak hours are shown in Table 13-12 and Table 13-13.

The normal design threshold for the ratio of flow to capacity (RFC) at a priority junction is 0.85. As can be seen from the above tables, the RFCs in the 2020 scenario will be in excess of this value for both the AM and PM scenarios. It should be noted that Sean Moore Junction will still operate within theoretical capacity in the PM scenario, with a maximum queue of 15 vehicles. Furthermore, the RFC on the Point Depot Junction exceeds the theoretical traffic carrying capacity of 1.0 in both the AM and PM scenarios. The Point Depot Junction in its current configuration will be operating over its theoretical capacity in the PM scenario. DCC intend to upgrade this junction to a signalised junction and it is anticipated that these works will be completed by 2020, however, the junction was analysed in its current configuration to provide a more conservative assessment.

Table 13-12: 2020 AM Peak Junction Capacity Analysis

Junction	Scenario	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
Point Depot Junction	Do-Nothing	1.502	566.4	444.9
Sean Moore Junction	Do-Nothing	0.946	24.6	11.6
Whitebank Junction	Do-Nothing	0.415	10.8	0.7

Table 13-13: 2020 PM Peak Junction Capacity Analysis

Junction	Scenario	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
Point Depot Junction	Do-Nothing	1.028	42.0	32.9
Sean Moore Junction	Do-Nothing	0.924	22.8	9.2
Whitebank Junction	Do-Nothing	0.309	9.6	0.4

13.5.1.2 2028 Junction Analysis

A summary of the Do-nothing Impacts for 2028 for the AM and PM peak hours are shown in Table 13-14 and Table 13-15.

The normal design threshold for the ratio of flow to capacity (RFC) at a priority junction is 0.85 and 0.90 at a signal-controlled junction. As can be seen from the below tables, the RFCs in the 2028 scenario at the Point Depot Junction and Sean Moore Junction will be in excess of this value for both the AM and PM scenarios. It should be noted that the Point Depot Junction will still operate within theoretical capacity in the PM scenario. However, the theoretical traffic carrying capacity of 1.0 will be exceeded in the AM scenario. Furthermore, the RFC on the Sean Moore Junction exceeds the theoretical traffic carrying capacity of 1.0 in both the AM and PM scenarios.

Table 13-14: 2028 AM Peak Junction Capacity Analysis

Junction	Scenario	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
Point Depot Junction	Do-Nothing	1.291	474.6	275.9
Sean Moore Junction	Do-Nothing	1.053	58.2	36.5
Whitebank Junction	Do-Nothing	0.471	11.4	0.9

Table 13-15: 2028 PM Peak Junction Capacity Analysis

Junction	Scenario	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
Point Depot Junction	Do-Nothing	0.953	100.2	21.8
Sean Moore Junction	Do-Nothing	1.005	39.0	21.7
Whitebank Junction	Do-Nothing	0.364	10.2	0.6

13.5.1.3 2035 Junction Analysis

A summary of the Do-nothing Impacts for 2035 for the AM and PM peak hours are shown in Table 13-16 and Table 13-17.

The normal design threshold for the ratio of flow to capacity (RFC) at a priority junction is 0.85 and 0.90 at a signal-controlled junction. As can be seen from the below tables, the RFCs in the 2035 scenario will be in excess of this value for both the AM and PM scenarios. It should be noted that the Point Depot Junction and Sean Moore Junction exceeds the theoretical traffic carrying capacity of 1.0 in both the AM and PM scenarios.

Table 13-16: 2035 AM Peak Junction Capacity Analysis

Junction	Scenario	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
Point Depot Junction	Do-Nothing	1.373	596.4	384.3
Sean Moore Junction	Do-Nothing	1.106	97.8	57.3

Junction	Scenario	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
Whitebank Junction	Do-Nothing	0.507	12.0	1.0

Table 13-17: 2035 PM Peak Junction Capacity Analysis

Junction	Scenario	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
Point Depot Junction	Do-Nothing	1.005	121.8	34.3
Sean Moore Junction	Do-Nothing	1.058	63	37.5
Whitebank Junction	Do-Nothing	0.408	10.8	0.7

13.5.2 Construction Phase

13.5.2.1 Peak Construction Activity 2020

A summary of the 'With' and 'Without' Development (Proposed WwTP Component) results of the analysis for the 2020 Peak Construction Year for the AM and PM peak hours are shown in Table 13-18 and Table 13-19.

The normal design threshold for the ratio of flow to capacity (RFC) at a priority junction is 0.85. As can be seen from the below tables, the RFCs in the 2020 scenario will be in excess of this value for both the AM and PM scenarios.

It should be noted that Sean Moore Junction will still operate within theoretical capacity in the PM scenario, with a maximum queue of 15 vehicles. Furthermore, the RFC on the Point Depot Junction exceeds the theoretical traffic carrying capacity of 1.0 in both the With and Without Development PM scenarios. However, it should be noted that the With Development scenario results in an increase in RFC of between 3.4 and 5.5% at the Point Depot Junction and the Sean Moore Junction which is only a slight reduction in capacity and increase in queue lengths. The With Development scenario also results in an increase in RFC of between 31.8 and 35.9% at the Whitebank Junction which is only an imperceptible reduction in capacity and increase in queue lengths. The Proposed WwTP Component is therefore expected to result in a Slight Negative Short-Term Impact during 2020 the Peak Construction Year in both the AM and PM peak hours.

The Point Depot Junction in its current configuration will be operating over its theoretical capacity in the PM scenario. DCC intend to upgrade this junction to a signalised junction and it is anticipated that these works will be completed by 2020, however, the junction was analysed in its current configuration to provide a more conservative assessment.

Table 13-18: 2020 Year of Peak Construction Activity AM Peak Junction Capacity Analysis

Junction	Scenario	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
Point Depot Junction	With Development	1.555	630.0	513.3
	Do-Nothing	1.502	566.4	444.9
Sean Moore Junction	With Development	0.998	36.6	20.1
	Do-Nothing	0.946	24.6	11.6
Whitebank Junction	With Development	0.547	13.2	1.2

Junction	Scenario	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
	Do-Nothing	0.415	10.8	0.7

Table 13-19: 2020 Year of Peak Construction Activity PM Peak Junction Capacity Analysis

Junction	Scenario	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
Point Depot Junction	With Development	1.066	63.0	49.1
	Do-Nothing	1.028	42.0	32.9
Sean Moore Junction	With Development	0.955	27.6	12.4
	Do-Nothing	0.924	22.8	9.2
Whitebank Junction	With Development	0.420	10.8	0.7
	Do-Nothing	0.309	9.6	0.4

It should be noted that these 'With' and 'Without' Development scenarios have been developed based on conservative estimates of traffic associated with the Proposed WwTP Component and the Poolbeg West SDZ. It is not anticipated that the estimated construction traffic associated with the Poolbeg West SDZ will be representative of the actual construction traffic.

The Dublin City Development Plan, 2016 - 2022 states that development of this site will be undertaken in a phased manner, with early provision of public transport infrastructure. It is anticipated that a limit will be placed on the amount of development allowable before the provision of the Dodder Public Transport Bridge.

13.5.2.2 Final Year of Construction 2028

A summary of the With and Without Development results of the analysis for the 2028 Final Year of Construction for the AM and PM peak hours are shown in Table 13-20 and Table 13-21.

The normal design threshold for the ratio of flow to capacity (RFC) at a priority junction is 0.85 and 0.90 at a signal-controlled junction. As can be seen from the below tables, the RFCs in the 2028 during construction scenario will be in excess of this value for both the AM and PM scenarios. It should be noted that The Point Depot Junction will still operate within theoretical capacity in the PM scenario. Furthermore, the RFC on the Sean Moore Junction exceeds the theoretical traffic carrying capacity of 1.0 in both the With and Without Development AM and PM scenarios. However, it should be noted that the With Development scenario results in an increase in RFC of between 0.9 and 1.8% at the Point Depot Junction and the Sean Moore Junction which is only a slight reduction in capacity and increase in queue lengths. The With Development scenario also results in an increase in RFC of between 11.0 and 14.6% at the Whitebank Junction which is only an imperceptible reduction in capacity and increase in queue lengths. The Proposed WwTP Component will result in a Slight Negative Short-Term Impact during the 2028 Final Construction Year in both the AM and PM peak hours.

Table 13-20: 2028 Final Year of Construction AM Peak Junction Capacity Analysis

Junction	Scenario	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
Point Depot Junction	With Development	1.302	493.2	289.7
	Do-Nothing	1.291	474.6	275.9
Sean Moore Junction	With Development	1.070	69.6	42.9

Junction	Scenario	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
	Do-Nothing	1.053	58.2	36.5
Whitebank Junction	With Development	0.523	12.0	1.1
	Do-Nothing	0.471	11.4	0.9

Table 13-21: 2028 Final Year of Construction PM Peak Junction Capacity Analysis

Junction	Scenario	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
Point Depot Junction	With Development	0.970	120.6	24.5
	Do-Nothing	0.953	100.2	21.8
Sean Moore Junction	With Development	1.015	42.0	24.2
	Do-Nothing	1.005	39.0	21.7
Whitebank Junction	With Development	0.417	10.8	0.7
	Do-Nothing	0.364	10.2	0.6

13.5.2.3 Road Safety

It is considered that the Proposed WwTP Component, which is located off the public road network within the existing Ringsend WwTP, will have an imperceptible impact on road safety during the construction phase.

13.5.3 Operational Phase

13.5.3.1 Year of Opening 2028

A summary of the 'With' and 'Without# Development results of the analysis for the 2028 Year of Opening for the AM and PM peak hours are shown in Table 13-22 and Table 13-23.

The normal design threshold for the ratio of flow to capacity (RFC) at a priority junction is 0.85 and 0.90 at a signal-controlled junction. As can be seen from the below tables, the RFCs in the 2028 scenario will be in excess of this value for both the AM and PM scenarios. It should be noted that Sean Moore Junction exceeds the theoretical traffic carrying capacity of 1.0 in both the With Development and Do-nothing AM and PM scenarios. Furthermore, the RFC on the Point Depot Junction, examined in its upgraded signalised configuration exceeds the theoretical traffic carrying capacity of 1.0 in both the With Development and Do-nothing AM scenarios. However, it should be noted that the With Development scenario results in an increase in RFC of between 0.2 and 7.4% at the Point Depot Junction and the Sean Moore Junction which is only a slight reduction in capacity and increase in queue lengths. The With Development scenario also results in an increase in RFC of between 26.7 and 35.7% at the Whitebank Junction which is only an imperceptible reduction in capacity and increase in queue lengths. The Proposed WwTP Component will result in a Slight Negative Long-Term Impact during the 2028 Year of Opening in both the AM and PM peak hours.

Table 13-22: 2028 Year of Opening AM Peak Junction Capacity Analysis

Junction	Scenario	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
Point Depot Junction	With Development	1.293	474.6	277.2
	Do-Nothing	1.291	474.6	275.9
Sean Moore Junction	With Development	1.131	120.6	66.2
	Do-Nothing	1.053	58.2	36.5
Whitebank Junction	With Development	0.639	15.6	1.7
	Do-Nothing	0.471	11.4	0.9

Table 13-23: 2028 Year of Opening PM Peak Junction Capacity Analysis

Junction	Scenario	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
Point Depot Junction	With Development	0.967	104.4	24.0
	Do-Nothing	0.953	100.2	21.8
Sean Moore Junction	With Development	1.042	54.6	31.9
	Do-Nothing	1.005	39.0	21.7
Whitebank Junction	With Development	0.462	11.4	0.8
	Do-Nothing	0.364	10.2	0.6

13.5.3.2 Design Year 2035

A summary of the With and Without Development results of the analysis for the 2035 Design Year for the AM and PM peak hours are shown in Table 13-24 and Table 13-25.

The normal design threshold for the ratio of flow to capacity (RFC) at a priority junction is 0.85 and 0.90 at a signal-controlled junction. As can be seen from the below tables, the RFCs in the 2035 scenario will be in excess of this value for both the AM and PM scenarios. It should be noted that the Point Depot Junction and Sean Moore Junction exceeds the theoretical traffic carrying capacity of 1.0 in both the With Development and Do-nothing AM and PM scenarios. However, it should be noted that the With Development scenario results in an increase in RFC of between 1.3 and 7.4% at the Point Depot Junction and the Sean Moore Junction which is only a slight reduction in capacity and increase in queue lengths. The With Development scenario also results in an increase in RFC of between 25.2 and 31.2% at the Whitebank Junction which is only an imperceptible reduction in capacity and increase in queue lengths. The Proposed WwTP Component will result in a Slight Negative Long-Term Impact during the 2035 Design Year in both the AM and PM peak hours.

Table 13-24: 2035 Design Year AM Peak Junction Capacity Analysis

Junction	Scenario	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
Point Depot Junction	With Development	1.392	615.6	411.4
	Do-Nothing	1.373	596.4	384.3
Sean Moore Junction	With Development	1.188	182.4	91.4
	Do-Nothing	1.106	97.8	57.3
Whitebank Junction	With Development	0.665	16.2	1.9
	Do-Nothing	0.507	12.0	1.0

Table 13-25: 2035 Design Year PM Peak Junction Capacity Analysis

Junction	Scenario	Highest RFC	Queuing Delay (sec/veh)	Maximum Queue Length (veh)
Point Depot Junction	With Development	1.018	126.6	39.5
	Do-Nothing	1.005	121.8	34.3
Sean Moore Junction	With Development	1.106	99	54.4
	Do-Nothing	1.058	63	37.5
Whitebank Junction	With Development	0.511	12.6	1.0
	Do-Nothing	0.408	10.8	0.7

13.5.3.3 Road Safety

It is considered that the Proposed WwTP Component, which is located off the public road network within the existing Ringsend Wastewater Treatment Plant, will an imperceptible impact on road safety during the operational phase.

13.6 Mitigation Measures

There are no effects that require specific mitigation but the following best practice measures (based on local authority requirements) are proposed for the Proposed WwTP Component:

13.6.1 Construction Phase

- Construction related HGV trips will adhere rigidly to the Dublin City Council HGV Management Strategy and associated cordon;
- A Preliminary Traffic Management Plan will be drafted by the Project Supervisor Design Process for the works in full consultation with Dublin City Council, An Garda Síochána, the Fire Service and the Ambulance service. When the works are awarded to a contractor, the Preliminary Traffic Management Plan will be developed by the Project Supervisor Construction Phase into a Detailed Traffic Management Plan in full consultation with the same stakeholders. All traffic management plans, including working times, shall be agreed with and approved by Dublin City County Council Transportation Department in advance of implementation;
- Protection measures are to be provided at sensitive archaeology sites as noted in Section 11: Cultural Heritage;
- Tracked excavators will be moved to and from the site on low-loaders and will not be permitted to drive on the street pavements;
- The contractor is to arrange for staff parking at an off-site location. Contractor's, Subcontractor's or Supplier's vehicles or staff vehicles, or any vehicles associated with the works are not permitted to park, idle or queue on the public road network;
- Wheel washers / judder bars will be placed at all site access points to minimise the migration of detritus onto the public roads. The roads will be inspected and cleaned on a regular basis;
- Haul vehicles must be covered after loading to ensure there is no risk of construction material falling;
- Water bowsers will be deployed within the sites during periods of hot weather to damp down potential dust generation from unbound surfaces; and
- An Application for an Abnormal Load Permit will be made to DCC in advance for any abnormal loads exceeding the thresholds laid out in the Road Traffic (Construction and Use of Vehicles)

Regulations 2003. Where possible, abnormal load movements will be restricted to evening or night time to minimise disruption to local traffic and traffic on strategic routes.

13.6.2 Operational Phase

No mitigation measures are proposed during the operational phase.

13.7 Residual Impacts

13.7.1 Construction Phase

No residual impacts to the safety of the road network are anticipated as a result of the construction phase of the Proposed WwTP Component following implementation of the mitigation measures outlined.

Residual impacts are anticipated to the traffic flows on the adjoining roading road network. Traffic analysis associated with the impact of the construction works focused on the AM and PM peak periods in both the 2020 Peak Construction Activity Scenario and the 2028 Final Year of Construction Scenario.

The Point Depot Junction, Sean Moore Junction and Whitebank Junctions were examined in 2020 and 2028 in both the With Development and Do-nothing scenarios. The Point Depot junction was examined in its current configuration in the 2020 scenario. DCC intend to upgrade this junction to a signalised junction and it is anticipated that these works will be completed by 2020, however, analysing the junction in its current configuration provided a more conservative assessment. It has been assumed that the Point Depot Improvement Scheme will be complete by 2028.

In both the 2020 and 2028 scenarios the Point Depot Junction and Sean Moore Junction will operate above the usual design threshold of 0.85 for a priority junction and 0.90 for a signalised junction. The Point Depot Junction will operate within theoretical capacity in the PM scenarios however, it will operate over the theoretical capacity in the AM scenarios. The Sean Moore Junction will operate over the theoretical Capacity in both the AM and PM scenarios. The Whitebank Junction will operate within usual design thresholds in both scenarios. However, it should be noted that the "With" Development scenario results in only slight increases in RFC at both the Point Depot Junction and Sean Moore Junction in the AM and PM Peak scenarios. The Proposed WwTP Component will result in a Slight Negative Short-Term Impact during both the 2020 Peak Construction Year and 2028 Year of Final Construction in both the AM and PM peak hours. The percentage change in RFC for each construction stage scenario at each junction as a result of the Proposed WwTP Component is presented in Table 13-26 to Table 13-29.

Table 13-26: 2020 Year of Peak Construction Activity AM Peak Percentage Change in RFC

Junction	Do-Nothing RFC	With Development RFC	Percentage Change in RFC
Point Depot Junction	1.502	1.555	3.5
Sean Moore Junction	0.946	0.998	5.5
Whitebank Junction	0.415	0.547	31.8

Table 13-27: 2020 Year of Peak Construction Activity PM Peak Percentage Change in RFC

Junction	Do-Nothing RFC	With Development RFC	Percentage Change in RFC
Point Depot Junction	1.028	1.066	3.7
Sean Moore Junction	0.924	0.955	3.4

Junction	Do-Nothing RFC	With Development RFC	Percentage Change in RFC
Whitebank Junction	0.309	0.420	35.9

Table 13-28: 2028 Final Year of Construction Activity AM Peak Percentage Change in RFC

Junction	Do-Nothing RFC	With Development RFC	Percentage Change in RFC
Point Depot Junction	1.274	1.302	0.9
Sean Moore Junction	1.053	1.070	1.6
Whitebank Junction	0.471	0.523	11.0

Table 13-29: 2028 Final Year of Construction Activity PM Peak Percentage Change in RFC

Junction	Do-Nothing RFC	With Development RFC	Percentage Change in RFC
Point Depot Junction	0.953	0.970	1.8
Sean Moore Junction	1.005	1.015	1.0
Whitebank Junction	0.364	0.417	14.6

13.7.2 Operational Phase

No residual impacts to the safety of the road network are anticipated as a result of the operational phase of the Proposed WwTP Component.

Residual impacts are anticipated to the traffic flows on the adjoining roading road network. Traffic analysis was undertaken to examine the impact of traffic associated with the operational phase of the Proposed WwTP Component on the surrounding road network in the 2028 Year of Opening scenario and the 2035 Design Year scenario in the AM and PM peak periods.

The Point Depot Junction, Sean Moore Junction and Whitebank Junctions were examined in 2028 and 2035 in both the With Development and Do-Nothing scenarios. In both the 2028 and 2035 scenarios, the Point Depot Junction and Sean Moore Junction will operate above the usual design threshold of 0.85 for a priority junction and 0.90 for a signalised junction. The Point Depot Junction will operate within theoretical capacity in the 2028 PM scenarios however, it will operate over the theoretical capacity in the AM scenarios and 2035 PM scenario. The Sean Moore Junction will operate over the theoretical Capacity in both the AM and PM scenarios. The Whitebank Junction will operate within usual design thresholds in both scenarios. The Proposed WwTP Component will result in a Slight Negative Long-Term Impact in both the AM and PM peak hours. However, it should be noted that the With Development scenario results in only slight increases in RFC. The percentage change in RFC for each scenario at each junction as a result of the Proposed WwTP Component is presented in Table 13-30 to Table 13-33.

Based on the assessment of RFC, Queuing Delay and Maximum Queue Length it has been determined that the Proposed WwTP Component will result in a Slight Negative Long-Term Impact during the operational phase.

Table 13-30: 2028 Year of Opening AM Peak Percentage Change in RFC

Junction	Do-Nothing RFC	With Development RFC	Percentage Change in RFC
Point Depot Junction	1.291	1.293	0.2
Sean Moore Junction	1.053	1.131	7.4

Junction	Do-Nothing RFC	With Development RFC	Percentage Change in RFC
Whitebank Junction	0.471	0.639	35.7

Table 13-31: 2028 Year of Opening PM Peak Percentage Change in RFC

Junction	Do-Nothing RFC	With Development RFC	Percentage Change in RFC
Point Depot Junction	0.953	0.967	1.5
Sean Moore Junction	1.005	1.042	3.7
Whitebank Junction	0.364	0.462	26.9

Table 13-32: 2035 Design Year AM Peak Percentage Change in RFC

Junction	Do-Nothing RFC	With Development RFC	Percentage Change in RFC
Point Depot Junction	1.373	1.392	1.4
Sean Moore Junction	1.106	1.188	7.4
Whitebank Junction	0.507	0.665	31.2

Table 13-33: 2035 Design Year PM Peak Percentage Change in RFC

Junction	Do-Nothing RFC	With Development RFC	Percentage Change in RFC
Point Depot Junction	1.005	1.018	1.3
Sean Moore Junction	1.058	1.106	4.5
Whitebank Junction	0.408	0.511	25.2

13.7.3 Interactions

The most significant interactions are between air quality and traffic. Emissions increase with increased traffic movements. The impacts of the Proposed WwTP Component on air quality are assessed in Section 8. The change in annual average daily traffic on roads close to the site was assessed and the impact of the interactions between traffic and air quality in both the construction and operational phases are considered to be not significant.

Significant interactions may also occur between traffic and noise and vibration. Noise and vibration increase with increased traffic movements. The impacts of the Proposed WwTP Component on noise and vibration are assessed in Section 9. The change in annual average daily traffic on roads close to the site was assessed and the impact of the interactions between traffic and noise and vibration in both the construction and operational phases are considered to be not significant.

Traffic has the potential to interact with human health, both directly in the form of traffic accidents and associate injuries, and indirectly through the effect emissions as identified in the above paragraphs, and in the potential impairment of physical activities such as walking and cycling. The effects of traffic impacts on human health arising from the proposed Ringsend WwTP Component is addressed in Section 3. With the implementation of the traffic management plan as described under the Mitigation sub-section above, it is considered that this potential impact will not give rise to effects on human health.

13.7.4 Cumulative Impacts

The assessments contained in Section 13.5: Potential Impacts, are based on the current traffic flow conditions with the cumulative impacts of Dublin WtE Facility (currently operational), Alexandra Basin Redevelopment and the Poolbeg West SDZ taken into account.

Both the construction phase and operational phase scenarios were developed by factoring up the baseline 2017 model to 2020, 2028 and 2035. Traffic associated with the Proposed WwTP Component, Dublin WtE Facility (currently operational), the Poolbeg West SDZ and the Alexandra Basin Redevelopment were also applied to the network. It has been assumed that the Poolbeg West SDZ will be under construction in the 2020 scenario and be fully operational during the 2028 scenario without any trip attenuation associated with public transport measures in the surrounding area. This presents a "Worst-Case" scenario; however, it is anticipated that in line with the Dublin City Council Development Plan, 2016-2022, the development of this site will be undertaken in a phased manner, with early provision of public transport infrastructure which include the provision of a new public transport bridge crossing the Grand Canal/Dodder River on Sir John Rogerson's Quay and the extension of the Luas Red Line to Poolbeg. These interventions will reduce the impact of the adjoining developments on the local road network. It is anticipated that a limit will be placed on the amount of development allowable before the provision of the Dodder Public Transport Bridge, however the impact of these limits has not been assessed.

13.8 Monitoring

Traffic flow and vehicle queue lengths at the Sean Moore Junction and the Point Depot junction shall be monitored as part of the Detailed Traffic Management Plan process and restrictions shall be placed on the movement of construction related traffic if deemed necessary by Dublin City Council and/or an Garda Síochána.

13.9 Difficulties Encountered

Minor difficulties were encountered in estimating the traffic impacts from the Poolbeg West SDZ. Exact details of the SDZ are not currently available and an approximation of the construction traffic and operational traffic was made following consultation with DCC. Minor difficulties were also encountered in anticipating the timing of works on the surrounding road network such as the upgrade of the Point Depot Junction.

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Section 14: Landscape

14.1 Introduction

This Section of the EIAR assesses the potential landscape and visual impacts (and resulting effects) likely to occur as a result of the WwTP component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component").

Full details of the Proposed Upgrade Project and the Ringsend WwTP component can be found in Volume 2, Section 3: Description of Proposed Upgrade Project.

This Section and assessment have been completed having regard to the guidance outlined in the Environmental Protection Agency documents *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (Draft, August 2017) and *Advice Notes for Preparing Environmental Impact Statements* (Draft, September 2015).

14.2 Methodology

The landscape assessment has considered the likely significant effects of the Proposed WwTP Component 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 operational phases of the Proposed WwTP Component. This section is accompanied by Photomontages of the Proposed WwTP Component which are included in Volume 3B, Appendix 14A.

The landscape and visual assessment involved visits to the site and environs of the Proposed WwTP Component, to review the nature and scale of existing development both on and surrounding the site, to identify landscape features, local character and landuses, to identify key views to and from the site, and to note receptor sensitivity. This site-based assessment was augmented by reviewing aerial photography, publications and reports and project information included with the application and in this EIAR.

In addition, a series of photomontages, illustrating the physical and visual appearance of the Proposed WwTP Component, 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 are included within Appendix 14A of Volume 3B.

This assessment has had regard to the following guidance documentation:

- Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, 2017);
- Draft Advice Notes for preparing Environmental Impact Statements (2015); and
- Environmental Impact Assessment of Projects: Guidance on the Preparation of the Environmental Impact Assessment of Projects (EU publication, 2017).

The landscape and visual impact assessment for the Proposed WwTP Component 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 or impacts as set out in Table 14-1 has been derived from the EPA's Draft *Guidelines on information to be contained in Environmental Impact Assessment Reports;* from the UK Landscape Institute's *Guidelines for Landscape and Visual Impact Assessment (3rd Edition)*; and from the experience of the author in carrying out landscape and visual assessments for over 25 years.

Table 14-1: Classification of Significance of Effects (Impacts)

		Existing Environment Significance / Sensitivity			
		High	**Medium**	**Low**	**Negligible**
Description of Impact 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 described as follows:

- 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.

14.3 Existing Environment

14.3.1 Site Context and Description

The Proposed WwTP Component is located on the site of the existing Ringsend WwTP on Poolbeg Peninsula.

The prominent ESB Poolbeg Power Station lies to the east of the site and its twin stacks, which rise to c. 210 m, are acknowledged landmarks at the entrance to Dublin Port and within the wider Dublin City landscape. The Great South Wall extends circa 2 km east out from the end of the peninsula.

The Dublin Waste to Energy facility, located to the immediate west of the site, is a prominent feature in the middle ground of the peninsula - especially when viewed from the south. Further oil and gas storage and utility developments lie west of the Dublin Waste to Energy site. The Ringsend WwTP lies to either side of Pigeon House Road, with the main treatment plant to the south and storm water holding tanks to the north. The River Liffey and its port-related activities lie further north. A small area of open grassland and the locally elevated landscape amenity of Irishtown Nature Park lie to the immediate south of the Ringsend WwTP. Refer to Figure 14-1 which illustrates the site context.

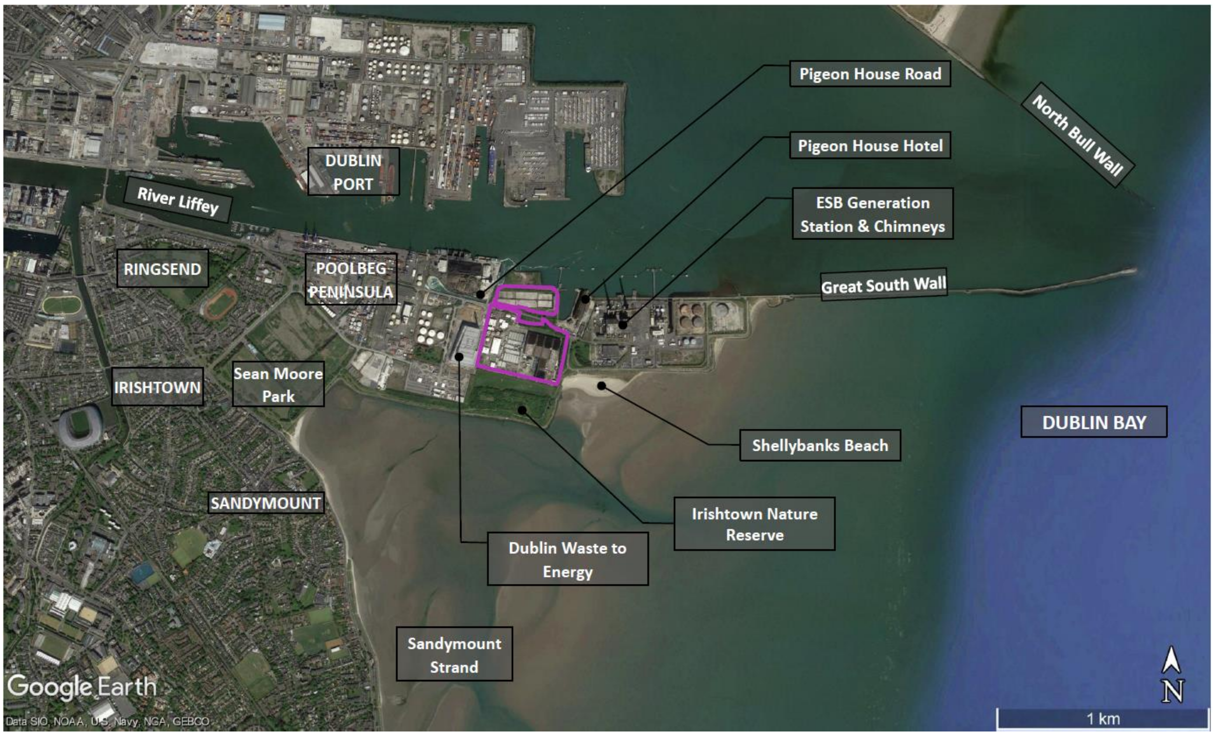

Figure 14-1: Site Context

Poolbeg peninsula sits prominently at the centre of the C-ring of Dublin Bay. The existing Ringsend WwTP, which covers a site of c. 14.5 ha. (c. 3.5 ha to the north of Pigeon House Road and c. 11 ha to the south), is a relatively low-scale development in comparison to port developments to the north; to the Waste to Energy Facility located immediately west; or to the ESB developments to the east.

There are no views of the existing Ringsend WwTP from north of Dublin Port (e.g. Clontarf) or from west of Poolbeg (e.g. Irishtown, Ringsend). Views from south (e.g. Strand Road and Sandymount Strand) are largely screened by the elevated landscape amenity of Irishtown Nature Park.

The nature and scale of the existing Ringsend WwTP is most readily apparent in views from the locally elevated landscape of the nature park located immediately to the south. The WwTP is also prominent in views west from Shellybanks Road and from the adjoining Shellybanks Beach located to the east of the site.

A wide belt of dense planting, located on a mound up to c. 3 m high, provides for a landscape and visual buffer along the majority of the eastern and northern boundaries of the Ringsend WwTP site. This mixed semi-mature planting also provides good screening of the Ringsend WwTP from close views along Pigeon House Road and Shellybanks Road. North of Pigeon House Road, the storm water holding tanks of the Ringsend WwTP are set within an open grassed site with some semi-mature trees planted close to the road.

Irishtown Nature Park, Shellybanks Beach and the Great South Wall are all important amenities linking to Sandymount Strand by means of a coastal walk. There is no residential development surrounding the site, with the closest properties at Ringsend c. 975 m to the west and at Sandymount c. 950 m to the southwest. However, proposals under the Draft Poolbeg West Planning Scheme (currently under consideration with An Bord Pleanála Ref.: 29S.ZD2013) to provide for greater mixed-use development on the western end of Poolbeg peninsula could bring residential development to within c. 650 m of the WwTP.

The overwhelming character of the site and its immediate context is that of a city-scale industrial / utility nature dominated by the unique coastal context and setting of the overall peninsula.

14.3.2 Landscape Planning Designations

There are no national landscape or visual designations pertaining to the site of the existing Ringsend WwTP. In the local context, Dublin Bay has been awarded Biosphere Designation by UNESCO in recognition of its unique ecological and cultural status. The Core Zone of the designation includes the southern area of Dublin Bay and its coastal edges. The southern edge of Poolbeg Peninsula, including Irishtown nature Reserve, is identified as part of the Buffer Zone, while the remainder of the peninsula is considered Transition Zone (Refer to Figure 14-2).

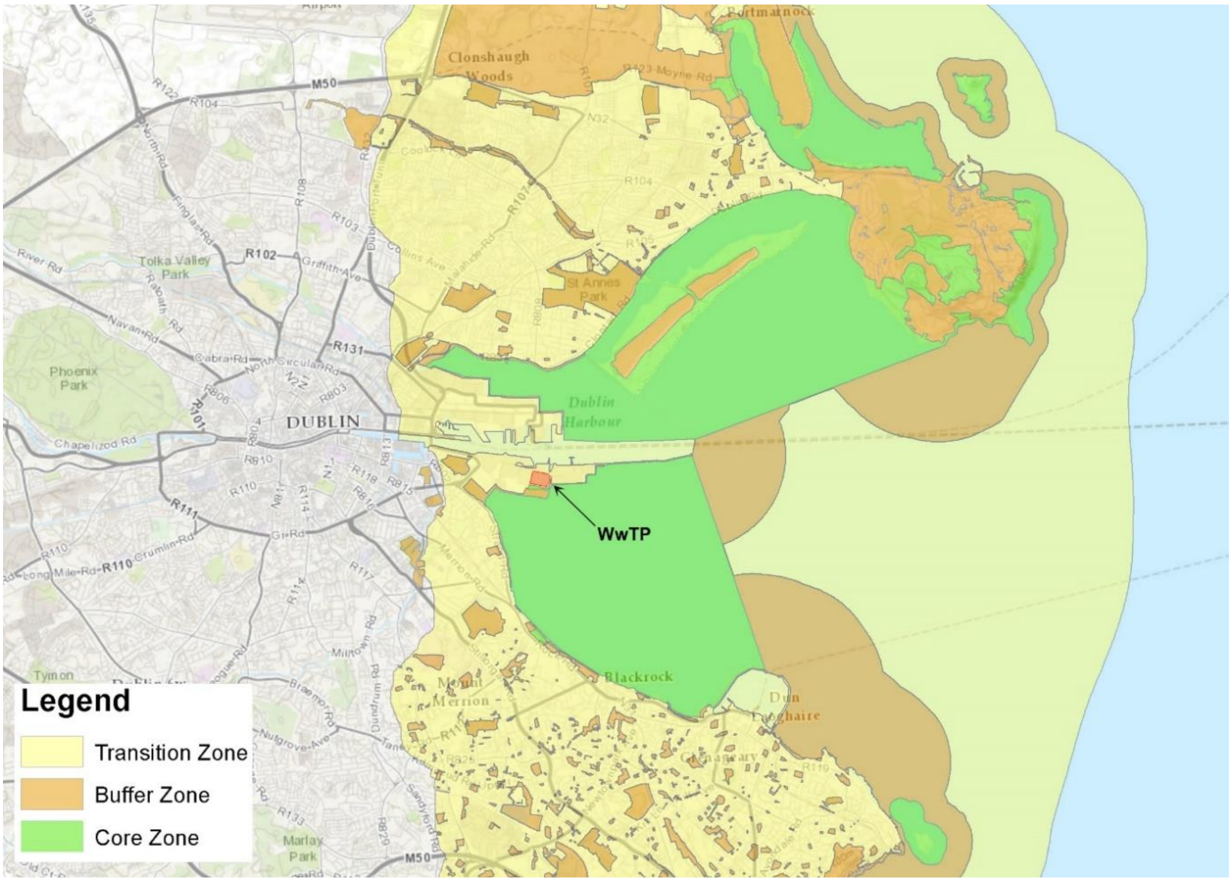

Figure 14-2: Dublin Bay Biosphere (source: extract from figure on http://www.dublincity.ie/dublinbaybiosphere)

Dublin Bay and the tidal section of the River Liffey are both identified as 'Waters of National Tourism Significance' (Fáilte Ireland, 2009).

Dublin City Development Plan 2016-2022

This site is located within the wider context of Dublin Port - where the Dublin City Development Plan 2016-2022 provides the statutory planning framework. As previously noted, the proposed Draft Poolbeg West Planning Scheme (SDZ) is also of relevance in the surrounding area.

The following principal landscape and visual references from the Dublin City Development Plan (the Plan) are noted.

Chapter 4 **Shape and Structure of the City**, sub-section 4.5.1.1 'Approach to the Inner City' notes the policy of Dublin City Council:

> *"SC7: To protect and enhance important views and view corridors into, out of and within the city, and to protect existing landmarks and their prominence."*

Figure 3 of the Plan identifies the **Key Spaces and Connections** in the city, none of which extend as far east as the Poolbeg Peninsula.

Figure 4 of the Plan identifies the **Key Views and Prospects** in the city, none of which pertain to the Poolbeg Peninsula.

Chapter 10 **Green Infrastructure, Open Space and Recreation**, Section 10.2 'Achievements' notes that:

> "*Recently, Dublin City Council initiated a partnership and successfully completed an application for a new Dublin Bay UNESCO Biosphere designation, www.unesco.org*"

This UNESCO Biosphere designation has subsequently been awarded to Dublin Bay as discussed at the beginning of section 14.4.2 above.

Figure 13 of the Plan identifies the **Strategic Green Network**, including the Core Green Areas, Hub Areas and Blue / Green Corridors. None of these strategic areas are identified on Poolbeg Peninsula. Related policies (GI1, GI3) and objectives (GIO1, GIO2) seek to develop the green infrastructure network of the city providing for improved links and opportunity through new developments.

At sub-section 10.5.2 **Landscape,** the Plan notes that:

> "*Howth peninsula to the north, and also the amenities and wildlife of Dublin Bay, is a unique one, and it is critical to retain existing key landscapes and open spaces which offer so much to the city in terms of amenity and character*."

At sub-section 10.5.4 **Rivers, Canals and the Coastline,** the Plan notes that it is the policy of Dublin City Council:

> *"GI15: To protect, maintain, and enhance the natural and organic character of the watercourses in the city, including opening up to daylight where safe and feasible. The creation and/or enhancement of riparian buffer zones will be required where possible. It is the policy of Dublin City Council to maintain and enhance the safety of the public in its use and enjoyment of the many public parks, open spaces, waterways and linkages within the city, including the River Dodder between Ringsend and Orwell (Waldrons) bridge, and at the area known as Scully's Field between Clonskeagh and Milltown."*

It is also an Objective of Dublin City Council:

> *"GIO17: To seek the continued improvement of water quality, bathing facilities and other recreational opportunities in the coastal, estuarine and surface waters in the city and to protect the ecology and wildlife of Dublin Bay."*

> *"GIO19: To maintain beaches at Dollymount, Sandymount, Merrion and Poolbeg/Shelly Banks to a high standard, and to develop their recreational potential as a seaside amenity, in order to bring them to 'Blue Flag' standard subject to Article 6 Assessment of the Habitats Directive."*

Under sub-section 10.5.3 **Parks and Open Spaces** the Plan notes that it is a policy of Dublin City Council:

> *"GI10: To continue to manage and protect and/or enhance public open spaces to meet the social, recreational, conservation and ecological needs of the city and to consider the development of appropriate complementary facilities which do not detract from the amenities of spaces."*

It is an Objective of Dublin City Council:

> *"GIO14: (i)To seek the designation of Liffey Valley (from Islandbridge to the city boundary), Sandymount and Merrion Strands, the Phoenix Park and also Irishtown Nature Park as Special Amenity Areas and to prepare Special Amenity Area Orders (SAAO's) for same."*

At sub-section 10.5.5 **Dublin Bay** the Plan notes that:

> *"Dublin Bay is a major resource for the city deserving of appropriate management. It contains three internationally recognised bio-diversity designations. Dublin Bay has recently been awarded a UNESCO Biosphere designation. The new Biosphere provides Dublin with an important national special amenity area for recreation and a conservation area of national and international importance."*

It is the policy of Dublin City Council:

> *"GI20: To seek continued improvement in water quality, bathing facilities and other recreational opportunities in the coastal, estuarine and surface waters in the city, having regard to the sensitivities of Dublin Bay and to protect the ecology and wildlife of Dublin Bay."*

At sub-section 10.5.7 **Trees** the Plan notes that it is the Policy of Dublin City Council:

> *"GI30: To encourage and promote tree planting in the planning and development of urban spaces, streets, roads and infrastructure projects."*

In Chapter 11 **Culture & Heritage**, Policy CHC9 and Objective CHCO10 sets out detailed requirements in relation to the protection of archaeological heritage.

Under Culture and Heritage, sub-section 11.1.5.16 **City Heritage Plan Protection**,

It is an Objective of Dublin City Council:

> *"CHCO16: To undertake a feasibility study to identify suitable uses, potential partners, funding opportunities and a conservation strategy to secure the conservation, future use and appropriate development of the former Pigeon House hotel and former Pigeon House Power Station for the benefit of the City of Dublin. Provide further reports to the Area Committee on the technical appraisal being carried out by ESB in relation to the Poolbeg chimneys, which are iconic features of the Dublin skyline and of the industrial heritage of Dublin."*

In Chapter 14 **Land Use Zoning**, under sub-section 14.8.11 **Waterways Protection** - Zone Z11 it states:

> *"Land-Use Zoning Objective Z11: To protect and improve canal, coastal and river amenities."*

> *"These areas generally include all the waterways and waterbodies in the Dublin City Council area. The purpose of the zoning is to protect the amenity of these areas including views and prospects into/out of the areas (see Chapter 9, Sections 9.5.4 Surface water drainage and sustainable drainage systems (SUDS) and also Chapter 10, Sections 10.5.4 Rivers canals and the coastline, Dublin Bay, and Biodiversity). The coast, canals, and rivers have a role in contributing to the development of a strategic green network.*

> *The chapters detailing the policies and objectives for landscape, biodiversity, open space/recreation and standards respectively, should be consulted to inform any proposed development (see Chapters 10 and 16)."*

Under sub-section 14.8.13, "*The Docklands - including SDZ area and Poolbeg West*" is identified as Strategic Development and Regeneration Area (SDRA) 6. The land-use zoning objective is "*To seek the* *social, economic and physical development and/or rejuvenation of an area with mixed use, of which residential and "Z6" would be the predominant uses*". The area is indicated in the SDRA 6 Docklands Poolbeg West Figure in the Development Plan (refer to Development Plan extract on Figure 14-3) and is now subject of the proposed Poolbeg West Planning Scheme.

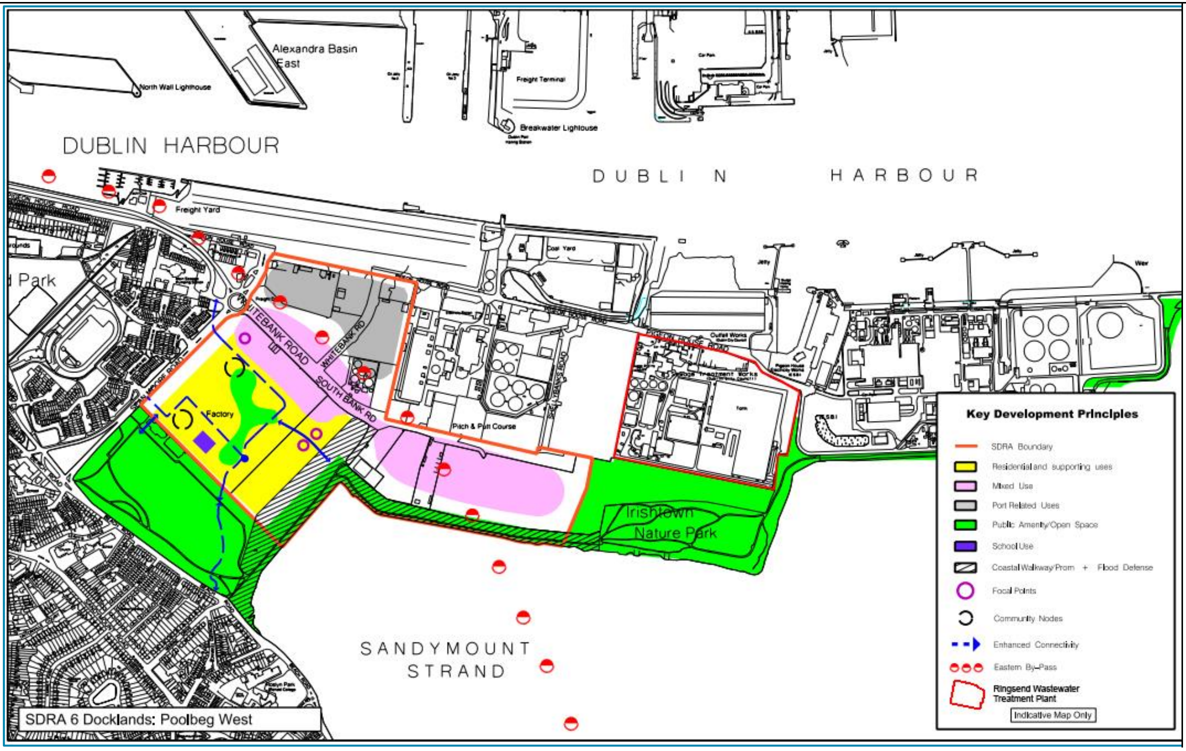

Figure 14-3: Poolbeg West from Dublin City Development Plan (source: Extract from Figure SDRA 6 Docklands - annotated to show site of Ringsend WwTP)

In Chapter 15 **Strategic Development Regeneration Areas** under sub-section 15.1.1.7 Docklands Area: **Movement / Transport**, includes the following objective:

> *"To develop a cycle and walkway along the waterfront around the Docklands, around the Poolbeg Peninsula and linking the City with the South Bull Wall."*
> (Note the South Bull Wall is synonymous with the Great South Wall referred to within the rest of this EIAR)

Under sub-section 15.1.1.9 Poolbeg West: **Use and Urban Form**, includes the following objectives:

> *"A high-quality coastal public promenade at an appropriate scale will link Irishtown Nature Park with Beach Road."*
>
> *"Connections are to be created and improved between existing public parks, recreational and amenity assets in the area including the south bay and shore line, Sean Moore Park, Sandymount promenade and strand, that will optimise their amenity value."*
>
> *"Development should take account of views towards the bay and to the Dublin Mountains."*

Under **Environment**, sub-section 15.1.1.9 Poolbeg West: includes the following objectives:

"Development will be compatible with and protect the nature conservation designations of the south bay, including the Habitats Directive."

"The unique landscape qualities of the Poolbeg Peninsula, rivers and bay area will be protected and enhanced, and the existing open character and nature of the coastal views from Irishtown Nature Park will be retained."

14.3.3 Summary of Significance and Sensitivity of the Existing Landscape/ Townscape and Visual Environment

Poolbeg peninsula is an important element within Dublin Bay and within the physical and visual structure of the wider city. It is a significant landscape and visual feature, dominated by the long-standing tall red and white banded stacks of the ESB Poolbeg Power Station and by the more recent Dublin Waste to Energy Facility. Despite its industrial/utility character, the area is a popular recreational resource and a focal point for leisure activities in Dublin Bay.

The site of the Proposed WwTP Component, which includes the existing Ringsend WwTP, is industrial in nature and is both visually indistinct from, and visually consistent with, the prevailing industrial and port-related character of its surrounds.

The site of the Proposed WwTP Component has an industrial / utility appearance and is of a low landscape and visual sensitivity. The site has no specific landscape or visual-related designation. Nevertheless, the wider peninsula is important as an amenity and recreational resource, particularly in terms of its central location within Dublin Bay; the availability of coastal walks; views to and from the area; the presence of Shellybanks Beach; and because of Irishtown Nature Park and the pedestrian links to Sandymount and the Great South Wall. The existing site and Proposed WwTP Component are located within, or take place adjoining to, many of these features.

Under the Draft Planning Scheme for Poolbeg West, the western portion of Poolbeg peninsula is envisaged as having an important role in future regeneration plans developed by Dublin City Council. This will see the provision of significant areas of mixed use, residential and further amenity development within c. 650 m west of the Proposed WwTP Component.

In summary, highly sensitive landscapes and landscape features include the southern edge of the peninsula, specifically Shellybanks Beach and Irishtown Nature Park; the planted boundary/mound to the east and north of the Ringsend WwTP site; and the existing semi-mature tree planting to the north of Pigeon House Road. Highly sensitive visual receptors include users of the amenities of the eastern end of the peninsula, including the nature park, Shellybanks Beach, the Great South Wall and the coastal walk along the southern edge of the peninsula. Given the existing visual context views of the Proposed WwTP Component site from Sandymount Strand, and from existing developed residential areas at Sandymount, Irishtown and Ringsend, as well as from potential future residential areas within the Draft Poolbeg West Planning Scheme, are considered to be medium sensitivity.

14.4 Characteristics of the WwTP Component of the Proposed Upgrade Project

The Proposed WwTP Component is described in detail in Volume 2, Section 3: Description of Proposed Upgrade Project, of this EIAR. The Proposed WwTP Component will utilise some of the remaining undeveloped space within the existing Ringsend WwTP to provide additional treatment facilities and equipment. Temporary construction compounds will be provided both on site and on adjoining lands. Construction Phase works will be significant and will require a number of years to complete. However, the most prominent period of construction works will be in the initial stages when all of the principal new structures are to be constructed (refer to Drawing Y15710-PL-921 in Volume 5, Part A).

Later work stages involving process and plant upgrade and refit works will not be significant in terms of landscape / townscape or visual effects.

Construction works will be carried out on a phased basis over 7 to 10 years commencing in 2018.

An outline of the construction works and construction programme is provided on Drawing Y15710-PL-921 in Volume 5, Part A. The references shown in the figure and table for construction works elements (Drawing Y15710-PL-921) are denoted in the following paragraphs in square brackets.

14.5 Potential Impacts

14.5.1 Do-Nothing Impacts

The eastern and northern end of the peninsula is the setting for a wide range of port-related bulk handling and import/export activities, and infrastructure developments, including waste and wastewater receiving and treatment facilities and power generation plants. Much of the southern portion of the peninsula is given over to provision of open space, green infrastructure and biodiversity. These are uses which are likely to remain and be further enhanced into the future.

The western end of the peninsula is covered by brownfield lands and existing mixed-use developments. A central portion of the western peninsula is covered by proposals as set out in the Draft Poolbeg West Planning Scheme (Refer to Figure 14-4). The draft planning scheme, which is before An Bord Pleanála, locates mixed-use community, education and residential areas to the west of the planning scheme area, with further industrial and port-related land uses to the north and east. Additional open space is also provided for along the southern coastal boundary of the planning scheme area.

Figure 14-4: Poolbeg West: Proposed Land Uses (*source: Figure 9.1 Draft Poolbeg West Planning Scheme* (annotated))

In the scenario where the Proposed WwTP Component does not proceed, it is likely that the eastern end of the peninsula will continue with port-related and infrastructure land uses, with open space along the southern edge. This will have little to no change for the landscape and visual environment. By contrast the realisation of the Draft Poolbeg West Planning Scheme will give rise to substantial change in the landscape and visual character of the western peninsula - both in views from the peninsula and from Sandymount Bay and adjoining developed areas south thereof.

14.5.2 Construction Stage

14.5.2.1 Site Establishment

Initial site establishment and site development will result in significant local temporary or short-term landscape and visual effects, especially as a result of the visual disruption and attention that is normally associated with such construction works. These visual impacts will arise for viewers using Irishtown Nature Park, Shellybanks Beach, the coastal walk along the south shore and Pigeon House Road/Shellybanks Road. Removal of the planted mound along the east side of the facility will be a locally moderate to significant negative effect that will open up currently screened views of the existing development and of construction activity for viewers at Shellybanks Beach, the coastal walk along the south shore and Pigeon House Road/Shellybanks Road.

Establishment of a site compound on the north side of Pigeon House Road, and the removal of some existing landscape area and trees will also give rise to visual disruption and attention and to locally slight negative visual impacts for viewers along Pigeon House Road. Some areas of existing planting are to be retained and protected during construction (refer to Figure 14-5).

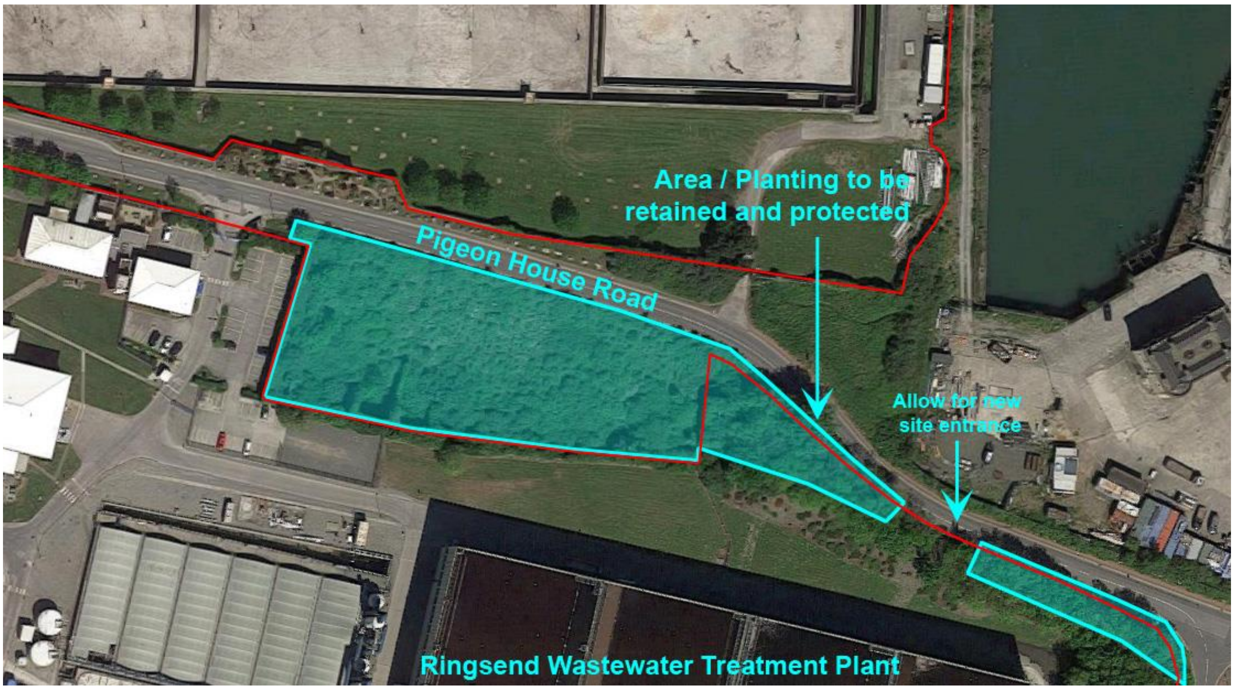

Figure 14-5: Aerial Photograph showing landscape areas / planting for retention and protection

14.5.2.2 Main Works

The new buildings, structures and tanks, (discussed below) likely to give rise to the greatest visual interest and potential visual impact for viewers, will be constructed within years 1 and 2 of the construction programme under the, now commenced, Capacity Upgrade Contract.

The **Capacity Upgrade [W3/W4]** involves the construction of new SBR tanks within a new structure of c. 110 m x 38 m x 19 m high. The nature and scale of this new structure is consistent with that of the existing SBR tanks structure. The new structure will appear as a significant westward extension along the southern boundary of the site of the existing large SBR tank structure. While generally well screened from surrounding areas, and from the wider townscape setting, the construction of the new structure will be visible from areas directly south of the site, including from the slightly elevated setting of Irishtown Nature Park.

Activity around the provision of the **P-Fixation/Recovery Facility [S4]** (c. 40 m x 20 m x 20 m high) during year 3 of the construction programme will only have limited and localised landscape and visual effects for viewers from immediately surrounding areas along Pigeon House Road.

The balance of construction works, including **Retrofitting of the Existing Lower and Upper Decks [W5]** of the SBR tanks and provision of new plant and plant upgrades will not give rise to notable or significant landscape or visual effects.

The presence and use of cranes will be of particular visual interest - though not necessarily a negative visual effect in itself. While the use of cranes will be visible across a wide area, especially south of Dublin Bay, this will not result in significant landscape/townscape or visual effects.

Taken together with the scale and extent of overall construction activity, traffic, *etc.*, landscape and visual effects have the potential to be significant and negative at an immediate local level - particularly from the Shellybanks Road/Beach to the east and to a lesser degree from Irishtown Nature Park to the south. It is noted that all of these areas are already significantly influenced by the nature and scale of existing utility-style developments in their immediate vicinity.

14.5.3 Compounds

Apart from the WwTP site itself, three temporary construction compounds are to be utilised for the construction works. These include an area to the southwest of the WwTP that has been used previously as a construction compound for the construction of the adjoining Dublin Waste to Energy Facility. A second temporary construction compound area is located immediately north of Pigeon House Road and north of the main WwTP site. The third temporary construction compound area is an open yard located between Pigeon House Power Plant and ESB Poolbeg Power Plant on the north side of Pigeon House Road. The existing construction compound to the southwest of the WwTP site is of low landscape and visual sensitivity and the magnitude of impact from its continued use as a construction compound would also be low, resulting in a slight short-term impact. The two northern construction compound sites are currently in grassland / brownfield use and are of medium landscape and visual sensitivity. The magnitude of impact from their proposed use as construction compounds would result in moderate to significant short-term landscape and visual impacts. All impacts are localised and limited to Irishtown Nature Park for the existing southern compound and immediately adjoining public roads and areas for the two northern compounds.

14.5.4 Access Routes

Access to the WwTP site will be via 4 entrances, comprising the existing main site entrance and a proposed construction entrance off Pigeon House Road on the northern boundary; an existing construction entrance off Pigeon House Road / Shellybanks Road on the eastern boundary; and a pedestrian construction access located at the southwest corner of the WwTP site. The construction of the new entrance off Pigeon House Road will necessitate the removal of a limited section of a belt of existing semi-mature planting. Given its limited presence, the sensitivity of existing planting in this area is high, but the sensitivity of views along Pigeon House Road are low. The magnitude of the limited removal of vegetation is medium. The landscape impact is moderate and the visual impact is slight.

14.5.5 Summary

Initial site disturbance and general construction activity will be most prominent from areas adjoining the site, such as from Shellybanks Beach and from Irishtown Nature Park. The Proposed WwTP Component is located within the site of an existing major utility and the Proposed WwTP Component works do not impact directly on sensitive landscape or visual aspects. In addition, the nature of the works for the Proposed WwTP Component are not considered out of place on the site or in the context of the site on Poolbeg Peninsula. Therefore, notwithstanding the localised impacts and the likely duration of construction, from an overall consideration, the construction stage will not give rise to significant landscape and visual effects, either locally or on a wider context.

Away from the peninsula, views of construction stage works will generally be to construction cranes and higher-level construction works, which are limited. Views of the site from the south, which are amongst the most open towards the wider peninsula, are well screened by the elevated landform of Irishtown Nature Park, and where visible, are at such distance and integrated within the existing context, as to have only imperceptible or slight landscape and visual effects.

14.5.6 Operational Stage

14.5.6.1 Impact on Landscape / Townscape Character

The Proposed WwTP Component is located within the site of the existing Ringsend WwTP. Once completed, the Proposed WwTP Component will be visually consistent in character, height and finish with existing structures both at the Ringsend WwTP site and in the wider immediate context of the site.

The Proposed WwTP Component will give rise to some intensification of development on the site - mainly when viewed from the south (e.g. Irishtown Nature Park). However, the sense of intensification is moderate and given the location and nature of the existing site and its context, and the low magnitude of change within the site, the operational stage of the Proposed WwTP Component will result in no significant overall change to the existing landscape and visual character of the site or its surrounds. Any operational stage landscape and visual effects are considered to be imperceptible or slight and neutral in nature.

Post-construction, there will be a slight local short-term effect on the character of views from the more proximate locations of Irishtown Nature Park and from Shellybanks Road/Beach, where the extended SBR tanks and reduction in extent of planting along east side of the WwTP will increase the sense of open viewing of development on site. However, with the continued maturing of retained planting and of reinstated planting, screening will be enhanced over time and the overall medium and longer-term effect on the character of the area will be imperceptible and neutral.

The post-construction/operation stage effect of the Proposed WwTP Component on the character and views of the wider Poolbeg Peninsula, including those from the area of the Draft Poolbeg West Planning Scheme as well as from the wider setting of views to the peninsula, will be imperceptible and neutral, with no discernible change arising from the majority of locations. Where some degree of visual change is discernible, the view will continue to be consistent with the existing visual environment.

14.5.6.2 Impact on Views

Post-construction, the Proposed WwTP Component results in minimal landscape and visual change. Where new development and structures are visible, these will be consistent with the character and nature of existing development and structures on the Ringsend WwTP site. Taken together with the existing context of the site, the Proposed WwTP Component will have no impact on views from wider areas, *i.e.* from Sandymount, Irishtown and Ringsend.

Operational effects on views from adjoining areas are primarily limited to Shellybanks Road and Beach, where removal of existing planting will allow for more open views of the east elevation of the treatment works; and from Irishtown Nature Park, where the extended SBR tanks will be most visible. While these locations are of a medium to high sensitivity, the magnitude of change is low, and the landscape and visual impacts are only slight or moderate.

Photomontages have been prepared showing the visual nature of the Proposed WwTP Component from viewpoints in the surrounding and wider environment, as shown in Figure 14-6. The photomontages are included in Appendix 14A of Volume 3B of this EIAR. The views corresponding to the photomontages in Appendix 14A are summarised in Table 14-2. Where the Proposed WwTP Component is not visible in a particular view, a red outline of the Proposed WwTP Component is indicated on the views for ease of locating.

Figure 14-6: Location and Viewpoint of Photomontages

Table 14-2: Photomontage References

View	Description	Photomontage Reference (Appendix 14A)	
		As Existing	As Proposed
View 1	From Pigeon House Road Northwest of the Site	Figure: 1.1.1	Figure: 1.1.2
View 2	From Pigeon House Road Northwest of the Site	Figure: 1.2.1	Figure: 1.2.2
View 3	From Pigeon House Road Northeast corner of the Site	Figure: 1.3.1	Figure: 1.3.2
View 4	From Pigeon House Road East of the Site	Figure: 1.4.1	Figure: 1.4.2
View 5	From Pigeon House Road East of the Site	Figure: 1.5.1	Figure: 1.5.2
View 6	From Southeast corner of the Site	Figure: 1.6.1	Figure: 1.6.2
View 7	From Southwest corner of the Site	Figure: 1.7.1	Figure: 1.7.2
View 8	From Beach Road Southwest of the Site	Figure: 1.8.1	Figure: 1.8.2
View 9	From Sandymount Strand	Figure: 1.9.1	Figure: 1.9.2

Views 1 and View 2

Views 1 and View 2 are eastwards along Pigeon House Road from locations west / northwest of the site. The sensitivity of the views is low.

Neither the existing Ringsend WwTP nor the Proposed WwTP Component are visible from the more westerly location of View 1. Travelling further east (towards View 2), the existing SBR tanks gradually come into view on the right-hand side (south) of the road, however, they are not prominent. In the As Proposed view (Figure 1.1.2, Appendix 14A), the majority of the Proposed WwTP Component is screened by intervening development, however, the proposed P-Fixation Recovery Facility will be visible, but not prominent, in between existing development in the middle-ground of views south (right) to the WwTP site.

The landscape and visual effect on views from Pigeon House Road and areas north of the site are assessed as being imperceptible/slight and neutral.

Views 3

View 3 is south along Pigeon House Road to the immediate east of the site. The sensitivity of the view is moderate/low.

Much of the existing planted mound located to the east of the Ringsend WwTP site will be removed, however, the majority of the existing and Proposed WwTP Component will continue to be screened by the retained planted edge of the mound located along the edge of Pigeon House Road.

The visual impact along Pigeon House Road is assessed as being moderate and locally negative in the short-term; and slight and neutral in the medium and longer-term, as the planting continues to mature.

Views 4 and View 5

Views 4 and 5 are west along Shellybanks Road and directly towards the eastern elevation of the WwTP. The sensitivity of the views is moderate.

The principal change in views relates to the partial removal of the planted mound along the east side of the site. In View 5, from further east, the change in the view is slight - with some loss of existing screen vegetation. The effect of the loss of the existing vegetation becomes increasingly noticeable on approaching the WwTP as in View 4. At proximity, the scale of the existing SBR tanks can be readily appreciated - albeit where retained and replacement planting will increasingly screen lower levels of the structures. While the degree of change is appreciable, the area affected is localised - as can be seen from the limited nature of the impact in View 5.

The visual impact on views from Shellybanks Road, Shellybanks Beach and from east of the site generally, are assessed as being moderate and negative in the short-term and slight and neutral in the medium and longer-term.

Views 6

View 6 is north along the east side of the Ringsend WwTP site. The sensitivity of the view is moderate. The view is along a promoted coastal walking route. The greatest impact will result from the removal of existing planting and the opening of views towards Pigeon House Power Station in the background.

The visual effects on the view north along the east side of the Proposed WwTP Component is assessed as being moderate, localised and neutral or positive in that views of the Pigeon House Power Station will be available.

Views 7

View 7 is north/northeast from the southern edge of Irishtown Nature Park. The sensitivity of the view is moderate.

The existing view is dominated by the proximity to the site of an existing major industrial utility. The westward extension of the existing concrete SBR building/tank is a prominent new feature of the view, however, the Proposed WwTP Component does not block or intrude upon open or attractive views or other landscape views. In addition, the change in the existing view is not significant in the context of the nature of existing views and the full expanse of view available from this vantage. The principal and scenic views from Irish Nature Park are west to the wider city skyline; south over Sandymount Strand; and east towards the Great South Wall and Dublin Bay.

The visual effect on views from Irishtown Nature Park is assessed as being not significant or slight in the short term and imperceptible and neutral in the medium and longer-term.

Views 8 and View 9

Views 8 and 9 are northeast and north across Sandymount Strand from Irishtown and Sandymount. The sensitivity of the view is high.

Given the context of the existing view and the intervening presence of the elevated landform of Irishtown Nature Park, there is limited potential for viewing of the Proposed WwTP Component. In addition, where visible, the Proposed WwTP Component is consistent with existing development on the site.

The visual effect on views from Irishtown/Sandymount, and from other areas south of the Bay, is assessed as being Imperceptible and neutral.

14.5.7 Impacts on Landscape and Visual Policy

The Proposed WwTP Component is an extension to an existing major utility. In addition, the proposed new elements are of a physical and visual nature that is considered consistent with the scale and character of the existing land uses and structures. The site is zoned Z7 for industrial uses and is not zoned for amenity, landscape or visual considerations.

The easternmost roadside edge of the planted mound on the east of the site is zoned Z9 for open space. This landscape edge will be protected and retained during the construction works - however, the adjoining mound and planting on the site will be removed during the construction stage. As noted previously, the removal of most of the planted mound is viewed as being a locally moderate or significant negative impact. However, the Z9 edge of the landscape buffer shall be retained and/or reinstated with new planting after construction, and therefore, any impact is considered to be short-term.

While the Proposed WwTP Component will not have any other direct impacts on landscape or visual zonings or designations, the works do fall within the context of views from Irishtown Nature Park, Shellybanks Beach, coastal walks and adjoining areas. Views of construction on the peninsula, and elsewhere, from such areas are commonplace and typical of the area and will not give rise to negative landscape or visual impacts on the open space zoning or designation - other than on views as previously discussed.

14.5.8 Summary of Impact Assessment

A full summary of the landscape / townscape and visual assessment is provided in Table 14-3.

Table 14-3: Summary of Landscape / Townscape and Visual Effects / Impacts

Description	Sensitivity	Character (of Effects)	Magnitude (of Effects)	Assessment (of Effects)	Duration (of Effects)	Consequence (of Effects)	Probability (of Effects)
Landscape / Townscape and Visual Effects: Construction							
Immediate Landscape / Townscape Setting - Poolbeg Peninsula, including Irishtown Nature Park	High	Major construction activity in the form of development / redevelopment works on the WwTP site and in terms of construction-related compound activity on lands north of Pigeon House Road and south of the Waste to Energy Facility. Construction traffic on Pigeon House Road. Potential effects extending along Pigeon House Road to north, Shellybanks Beach and Irishtown Nature Park and adjoining areas of Sandymount Strand to east and south.	Low	Moderate / locally significant negative	Temporary and short-term Adverse nature of effects will vary over time with work stages.	Initial works will involve locally intensive construction activity, access, traffic, compounds, on-site cranes, erection of hoarding/screening, and removal of part of existing planted mound located to east of the WwTP site. Such construction activity, as also recently completed on the adjoining Waste to Energy Facility, is a common feature of the existing character of the peninsula.	High
Wider Landscape / Townscape Setting - Context within south City / Dublin Bay area	Medium	Construction activity and primarily the use of cranes on Poolbeg Peninsula.	Low	Moderate / slight negative	Short-term The nature of effect will vary over time with work stages.	Initial works will involve the use of on-site cranes. Construction activity and the use of cranes, as also recently completed on the adjoining Waste to Energy Facility, is a common feature of the existing character of the peninsula.	High
Landscape / Townscape Effects: Post-Construction							
Immediate Landscape / Townscape Setting - Poolbeg Peninsula, including Irishtown Nature Park	High	Appearance of more developed site with extended buildings / structures along the southern boundary and with reduced landscape / planted zone to east. Effects primarily limited to Shellybanks Beach and Irishtown Nature Park and	Low/ Negligible	Slight to moderate negative	Short-term	Post-construction scenario will result in extended building along the southern boundary and reduced extent of planting on eastern boundary. Otherwise post-construction consequences do not have significant landscape or visual effects and are	High

Description	Sensitivity	Character (of Effects)	Magnitude (of Effects)	Assessment (of Effects)	Duration (of Effects)	Consequence (of Effects)	Probability (of Effects)
		immediately adjoining areas to east and south of site.				consistent with the character of the existing site.	
Wider Landscape / Townscape Setting - Context within south City / Dublin Bay area	Medium	No discernible change	Negligible	Imperceptible	N/A	No change	High
Landscape / Townscape and Visual Effects: Residual							
Immediate Landscape / Townscape Setting - Poolbeg Peninsula, including Irishtown Nature Park	High	More developed site.	Low/ Negligible	Imperceptible/slight	Long-term/ permanent and neutral	Residual consequences do not have a significant landscape or visual effect and are consistent with the character of the existing site.	High
Wider Landscape / Townscape Setting - Context within south City / Dublin Bay area	Medium	No discernible change	Negligible	Imperceptible	N/A	No change	High

14.6 Mitigation Measures

The Proposed WwTP Component is located within an area of established industrial/utility use and the site of the Proposed WwTP Component is an existing wastewater treatment facility. Therefore, the main impacts are construction-related and the mitigation measures focus on minimising associated landscape and visual impacts.

14.6.1 Construction Phase

The following construction-related mitigation measures are proposed:

- Existing belt of tree and shrub planting located along Pigeon House Road (refer to Figure 14-5) will be retained and protected in line with BS 5837 2012: Trees in relation to design, demolition and construction - Recommendations;
- The existing construction compound previously used for the construction of the Waste to Energy Facility, will be used, in part, for the initial more intensive phase of site construction. Screening (min 2.0 m high) is to be provided on western, southern and eastern boundaries of the compound;
- Screening will be erected along the southern and eastern site boundaries of the existing WwTP / works site;
- Screening will be erected for temporary construction compound sites; and
- Following decommissioning, all compound areas will be fully reinstated to pre-compound use finish (i.e. mainly grassland).

Given the low level of landscape and visual impact anticipated from the completed Proposed WwTP Component the key mitigation measures will involve good construction site management, full decommissioning of construction elements and compounds, and appropriate reinstatement of disturbed site and compound areas. New tree planting is to be reinstated along the eastern boundary of the existing WwTP site.

The reinstated landscape buffer to the east of the Wastewater Treatment Plant will be approximately 3 m wide. Planting will be a diverse mix of evergreen conifers such as Pine, and evergreen shrubs such as Sea-buckthorn and Oleasters inter-planted and under-planted with Alder, Sycamore, Dog-rose, Hawthorn and Blackthorn.

The stained concrete elevations of the existing SBR tanks will be cleaned to present an overall consistent visual appearance in-line with new structures to be provided. Refer to the 'as existing' and 'as proposed' photomontage images for View 4 and View 5 for illustration of this cleaning effect.

14.6.2 Operational Phase

The following operation-related mitigation measures are proposed:

- Proposed landscape works will be maintained in line with standard landscape maintenance practice so as to ensure establishment. Failed or dead plants will be replaced in the planting season following identification of any such defects; and
- Any new lighting standards will be fitted with horizontal cut-off fittings to avoid light spill.

14.7 Residual Impacts

The Proposed WwTP Component, when completed, will form part of the existing general pattern and grain of utility and industrial activities which currently exist on the peninsula. The Proposed WwTP Component will not give rise to any significant residual landscape or visual impact on the character or visual environment of the peninsula or on the wider bay area (refer to Table 14-3 above also).

14.7.1 Construction Phase

No residual landscape and visual effects arise from the construction phase.

14.7.2 Operational Phase

Following completion of construction and reinstatement works, it is considered that no significant residual landscape or visual impact will remain on amenities, activities, character, uses or views within either the Poolbeg or wider Dublin Bay areas.

14.7.3 Interactions

Interactions between the Landscape assessment and other topics has been considered in Section 16: Environmental Interactions.

The landscape and visual assessment was considered in terms of impacts on the wintering Brent Geese population and appropriate mitigation measures proposed in Section 6: Biodiversity - Terrestrial. The potential impact of visual disturbance to the geese is mitigated by construction of visual barriers between the WwTP and the grassland area where the wintering geese feed.

The removal of existing bunds and soils can remove screening properties and influence the visual impact of the Proposed WwTP Component. The impact of this has been previously assessed in this Section. Mitigation in the form of planting on the boundary is proposed and the long-term impact is predicted to be imperceptible.

14.7.4 Cumulative Impacts

The proposed Draft Poolbeg West Planning Scheme is amongst the most significant planned project (consent pending - An Bord Pleanála ref.:29S.ZD2013) in the surrounding area. The potential landscape and visual effects of the Proposed WwTP Component on the planning scheme have already been considered in the above assessments. However, it is considered that some potential exists for cumulative landscape and visual effects to arise, in particular during the construction phases of the two projects. Both construction phases are also likely to overlap and extend over many years with the use of high-level cranes and the presence of general construction activity. Cumulative visibility of the construction of both projects would be most prominent from the south, including from Irishtown Nature Park and from further south on Sandymount Strand, Strand Road and Sandymount generally. Sensitivity from these viewpoints is high, however, the magnitude of the landscape and visual changes from construction is likely to be low, with consequent slight to moderate landscape and visual effects.

Cumulative landscape and visual effects are unlikely to arise with the Poolbeg West Planning Scheme during the operational phase, as the Proposed WwTP Component will not have significant operational stage landscape and visual effects.

Hammond Lane Metal Company Ltd. has also received permission (DCC planning reg. ref. no.: 2130/18) for the demolition of an existing two-storey administration building (534 sq.m); and construction of a new two-storey building (563 sq.m) containing an administration area, staff facilities and a non-ferrous metals recovery area; 2 no. 18 m long weighbridges; 1 no. dry wheelwash; car parking; all associated site development works all on a site of 1.79 Ha. This is a small-scale development on an existing industrial site located to the immediate northwest of the existing Ringsend WwTP site, which will not result in any significant landscape or visual cumulative impact with the Proposed WwTP Component.

14.8 Monitoring

Monitoring of landscape-related works is an integral aspect of the Proposed WwTP Component, and includes monitoring of:

- Tree and hedgerow removal, retention and protection;
- Topsoil stripping and storage;
- Disturbance by site works, services etc.;
- Excavation / alteration of ground levels;
- Landscape build-up; profiling and cultivation;
- Landscape finishing and implementation;
- Proposed planting and grass seeding; and
- 12 months aftercare of landscape measures.

All works associated with soil stripping and movement; landscape build-up and finishing and landscape implementation shall be approved and monitored by a qualified Landscape Architect.

14.9 Difficulties Encountered

The As-Existing views presented in the photomontages provided in Appendix 14A (Volume 3B) show a baseline scenario from January 2018. As outlined in Volume 2, Section 2 the baseline for the existing environment for this EIAR is the environment prior to the 2012 Approval. However, the presentation of this baseline in the assessment and photomontages was not practicable and could also be considered misleading, given the addition of the nearby Dublin Waste to Energy facility, which was completed in the early part of 2017, to the landscape environment. The approach taken has had no material effect on the landscape and visual assessment.

14.10 References

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Section 15: Risk Management

15.1 Introduction

This Section of the EIAR identifies how the potential for accidents and disasters relevant to the Ringsend WwTP component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component") have been identified and how those risks have been managed.

The Section considers:

- Major accidents and/or natural disasters that the Proposed WwTP Component may be vulnerable to;
- The potential for significant adverse environmental effect(s) resulting from such a major accident and/or disaster; and
- Existing and proposed mitigation measures to prevent or mitigate the likely significant adverse effects of such events on the environment.

Full details of the Proposed Upgrade Project and the Ringsend WwTP component can be found in Volume 2, Section 3: Description of Proposed Upgrade Project.

Article 3 of the amended Environmental Impact Assessment (EIA) Directive 2014/52/EU, requires the assessment of expected effects of major accidents and/or disasters within an EIA. Article 3(2) of the Directive states that *"The effects referred to in paragraph 1 on the factors set out therein shall include the expected effects deriving from the vulnerability of the project to risks of major accidents and/or disasters that are relevant to the project concerned".*

The Draft EPA Guidelines (2015) refer to accidents and recommend that *"Aspects of the proposal that could cause accidents with a likelihood of creating significant environmental impacts should be considered"* and the Draft EPA Guidelines (2017) elaborates on the assessment further under Section 3.7.3: *"To address unforeseen or unplanned effects the Directive further requires that the EIAR takes account of the vulnerability of the project to risk of major accidents and/or disasters relevant to the project concerned and that the EIAR therefore explicitly addresses this issue. The extent to which the effects of major accidents and/or disasters are examined in the EIAR should be guided by an assessment of the likelihood of their occurrence (risk)".*

For the purposes of this assessment, the following definitions have been adopted:

- Major Accident - incidents or events that threaten immediate or chronic serious damage to human health, welfare and/or the environment;
- Natural Disaster - naturally occurring extreme weather events (e.g. storm, flood, temperature) with the potential to cause an event or incident;
- Risk - defined as the likelihood of an incident occurring, combined with magnitude effect or consequence(s) of the impact on a receptor or surrounding area; and
- Significance - Significant effect resulting from Major Accidents or Natural Disasters are adverse effects if they meet the criteria for 'Significant', 'Very Significant' or 'Profound' under the Draft EPA Guidelines (2017) and Volume 2, Section 2 of this report.

15.2 Methodology

15.2.1 Scope and Context

It is noted that the identification, control and management of risk is an integral part of the design and assessment process throughout all stages of a project lifecycle. The Proposed WwTP Component will be designed, built and operated in line with current international best practice and guidelines.

The Proposed WwTP Component incorporates technologies and measures that are designed to reduce and eliminate the occurrence of accidents. Measures to control risks associated with construction and operation activities are incorporated into the Construction Environmental Management Plan and the Operational Stage Environmental Management Plans that will be developed for the Proposed WwTP Component.

It is also noted that the design of the Proposed WwTP Component has been already informed by risk assessments undertaken as part of the EIA process. This includes the Flood Risk Assessment which has been submitted as part of the planning application.

The scope of this risk assessment is to:

- Identify Major Accidents and /or Disasters (i.e. unplanned incidents) where there is a risk that the Proposed WwTP Component may be vulnerable to; and
- Assess the consequent effects and significance of such incidents have in relation to environmental, social and economic receptors where they to occur.

Such risks may be present at the construction, operation and decommissioning phases of the Proposed WwTP Component.

15.2.2 Guidelines and Reference Material

The development of the risk assessment methodology has been informed by the following Guidelines:

- Advice notes for preparing an Environmental Statement - Draft (EPA, 2015);
- Guidelines on the Information to be contained in Environmental Impact Assessment Reports - Draft (EPA, 2017);
- National Risk Assessment 2017 Overview of Strategic Risks (Department of Taoiseach, 2017);
- A Guide to the Control of Major Accident Hazards Involving Dangerous Substances) Regulations 2015 (HSA, 2017);
- Guidance on assessing and costing environmental liabilities (EPA, 2014);
- A guide to risk assessment in Major Emergency Management (DoEHLG, 2010); and
- A National Risk Assessment for Ireland 2017 (Department of Defence, 2017).

The following published plans and consultations have also informed the assessment:

- Major Emergency Plan (DCC, 2015);
- Emergency Management Plan (Dublin Port, 2013);
- Dublin Waste to Energy - Accident and Emergency Response Procedures;
- Ringsend WwTP Emergency Response Plan;
- Irish Water Incident Response Team (consultation); and
- Celtic Anglian Water HSE Manager(consultation).

15.2.3 Risk Assessment Methodology

The assessment is set out in three stages:

- Identification and Screening
- Risk Classification
- Risk Evaluation

15.2.3.1 Identification and Screening

The first stage of the assessment is to identify potential unplanned risks that the Proposed WwTP Component may be vulnerable to. It was clarified that the current Ringsend WwTP and the site following the Proposed WwTP Component will not be classified as either an 'upper-tier' or 'lower-tier' establishment under the Control of Major Accident Hazards Involving Dangerous Substances Regulations, 2015. Ringsend WwTP is also not currently considered to be a 'Domino' facility of either (i) the Dublin Bay Power Ltd. Facility based at Pigeon House Road, which is designated as a lower-tier establishment, or (ii) the National Oil Reserve Agency based at Pigeon House Road which is classified as an upper-tier establishment according to the Health and Safety Authority (HSA, Jan. 2018).

An initial list of Major Accidents and/or Disasters (MANDs) were sourced through consultation with third parties, the project team and by utilising the guidelines and reference documentation and other information currently available in the public domain.

The list of potential MANDs was subjected to an initial screening assessment, to identify potential risks that met the scoping criteria. The risks were screened out of the assessment according to the following criteria:

- MANDs addressed in the Design Risk Assessment for design and planning phase of the Proposed WwTP Component;
- MANDs that have already been assessed in other areas of this EIA;
- MANDs associated with construction and operational activities that fall within the scope of Health and Safety legislation and associated obligations;
- MANDs where there is no 'Source-pathway-receptor linkage' exists. Examples include incidents that cannot be plausibly associated with the Proposed WwTP Component, such as volcanic activity, earthquakes and risk of nuclear accidents; and
- MANDs that process low likelihood and low consequence, as they do not meet criteria of assessment.

15.2.3.2 Risk Classification

Following the initial identification and screening process, remaining MANDs were evaluated with regard to the likelihood of occurrence and the potential for consequence of impact. The rating criteria adopted for the assessment follows that used in the *Guide to risk assessment in Major Emergency Management* (DoEHLG, 2010). The 2017 EIAR Guidelines state that the risk assessment be based on a "worst case" approach, therefore the consequent rating assumes that all proposed mitigation measures and safety procedures have failed to prevent the major accident and/or disaster.

The classification and rating of likelihood and consequence are provided in Table 15-1 and Table 15-2 below:

Table 15-1: Classification of Likelihood

Rating	Classification	Effect Description
1	Extremely Unlikely	May occur only in exceptional circumstances; once every 500 or more years
2	Very Unlikely	Is not expected to occur; and/or no recorded incidents or anecdotal evidence; and/or very few incidents in associated organisations, facilities or communicates; and / or little opportunity, reason or means to occur; May occur once every 100-500 years.
3	Unlikely	May occur at some time; and /or few, infrequent, random recorded incidents or little anecdotal evidence; some incidents in associated or comparable organisations worldwide; some opportunity, reason or means to occur; may occur once per 10-100 years.
4	Likely	Likely to or may occur; regular recorded incidents and strong anecdotal evidence and will probably occur once per 1-10 years
5	Very Likely	Very likely to occur; high level of recorded incidents and/or strong anecdotal evidence. Will probably occur more than once a year.

Table 15-2: Classification of Impact

Rating	Classification	Impact	Description
1	Minor	Life, Health, Welfare	Small number of people affected; no fatalities and small number of minor injuries with first aid treatment.
		Environment	No contamination, localised effects
		Infrastructure	<0.5 M Euros
		Social	Minor localised disruption to community services or infrastructure (<6 hours).
2	Limited	Life, Health, Welfare,	Single fatality; limited number of people affected; a few serious injuries with hospitalisation and medical treatment required. Localised displacement of a small number of people for 6-24 hours. Personal support satisfied through local arrangements
		Environment	Simple contamination, localised effects of short duration
		Infrastructure	0.5-3 M Euros
		Social	Normal community functioning with some inconvenience
3	Serious	Life, Health. Welfare	Significant number of people in affected area impacted with multiple fatalities (<5), multiple serious or extensive injuries (20), significant hospitalisation. Large number of people displaced for 6-24 hours or possibly beyond; up to 500 evacuated. External resources required for personal support.
		Environment	Simple contamination, widespread effects or extended duration
		Infrastructure	3-10 M Euros
		Social	Community only partially functioning, some services available
4	Very Serious	Life, Health. Welfare	5 to 50 fatalities, up to 100 serious injuries, up to 2000 evacuated

Rating	Classification	Impact	Description
		Environment Infrastructure Social	Heavy contamination, localised effects or extended duration 10-25 M Euros Community functioning poorly, minimal services available
5	Catastrophic	Life, Health. Welfare Environment Infrastructure Social	Large numbers of people impacted with significant numbers of fatalities (>50), injuries in the hundreds, more than 2000 evacuated. Very heavy contamination, widespread effects of extended duration. >25 M Euros Serious damage to infrastructure causing significant disruption to, or loss of, key services for prolonged period. Community unable to function without significant support.

15.2.3.3 Risk Evaluation

In accordance with the DoEHLG 2010 guidelines, the evaluated MANDs will be subject to a risk matrix to determine the level of significance of each risk for each scenario. These have been grouped according to 3 categories:

High Risk
Scenarios that have an evaluation score of 12-25, as indicated by the Red Zones in Table 15-3.

Medium Risk
Scenarios that have an evaluation score of 8 -11 as indicated by the Amber Zone in Table 15-3.

Low Risk
Scenarios that have an evaluation score 1-7, as indicated by the Green Zones in Table 15-3.

Significant effects resulting from major accidents or disasters are considered to be adverse effects that are described as 'Significant', 'Very Significant' or 'Profound' under the Draft EPA Guidelines (2017) and Volume 2, Section 3 of this EIAR. Consequently, major accidents or disasters that fall within Amber or Red Zones ('Medium' or 'High' Risk Scenarios) are brought forward for further consideration and assessment for further mitigation.

Table 15-3: Levels of Significance

Likelihood	5 – V. Likely					
	4 – Likely					
	3 – Unlikely					
	2 – V. Unlikely					
	1 – Ext. Unlikely					
		1 - Minor	2 - Limited	3 – Serious	4 – V. Serious	5 - Catastrophic
	Consequence of Impact					

15.3 Predicted Impacts

As mentioned in Section 15.2, the predicted impacts in this Section assume a worst-case scenario, which does not consider the implementation of mitigation measures or Emergency Plans that are implemented to reduce the effect of any major accident or disaster.

A Risk Register has been developed which contains all the plausible scenarios identified with the construction and operation of the Proposed WwTP Component, and has been evaluated using the criteria in Section 15.2. This is provided in Table 15-4.

Table 15-4: Rating of Major Accidents and Disasters without mitigation

Risk ID	Event	Likelihood	Rating	Consequence	Rating
	Construction Phase				
A	Damage to major underground utility services leading to WwTP shutdown	Likely	4	Direct untreated effluent discharge to sensitive waters Limited - Simple contamination, localised effects of short duration	2
B	Fire or explosion resulting in significant or widespread damage on site (can include fire or explosion in nearby facilities)	Unlikely	3	Potentially Serious with potential fatalities and injuries Potential contamination through effluent discharge to sensitive waters	3
C	Coastal flooding of the WwTP site	Refer to Flood Risk Assessment (Vol. 3)	2	Refer to Flood Risk Assessment	2
D	Road Traffic Accidents on site or resulting from traffic with construction activities	Likely	4	Potentially Serious, resulting in a number of fatalities Simple localized contamination of area or minor structural damage	3
E	Incident at adjacent Seveso or IED sites leading to shutdown of WwTP	Unlikely	3	Potentially Serious - Simple contamination, widespread effects or extended duration Cumulative impacts with Seveso incident could lead to Very Serious	5
	Operation Phase				
F	Inlet Screens blinded / clogged - resulting in direct untreated effluent discharge to ``sensitive waters''	Likely	4	Potentially serious - Potential discharge of untreated effluent to sensitive waters of Liffey, resulting in simple contamination, widespread effect or extended duration	2
G	Major equipment failure resulting in direct untreated effluent discharge to ``sensitive waters''	Unlikely.	3	Limited - Simple contamination, localised effects of short duration resulting from discharge of untreated effluent to sensitive waters of Liffey, or Odour impacts on nearby sensitive locations	2
H	Power failure, leading to WwTP shutdown resulting in direct untreated effluent discharge to ``sensitive waters''	Unlikely	3	Limited - Simple contamination, localised effects of short duration resulting from discharge of untreated effluent to sensitive waters of Liffey, or Odour impacts on nearby sensitive locations	2

Risk ID	Event	Likelihood	Rating	Consequence	Rating
I	Highly concentrated toxic influent discharged into Ringsend WwTP Network resulting in WwTP shutdown due to breakdown of biological treatment process	Very Unlikely	2	Potentially serious resulting in Heavy contamination, localised effects or extended duration	4
J	Fire or explosion resulting in significant or widespread damage on site	Unlikely	3	Potentially Serious with potential fatalities and injuries Potential contamination through effluent discharge to sensitive waters	3
K	Coastal flooding of the WwTP site	Refer to Flood Risk Assessment (Vol. 3)	2	Refer to Flood Risk Assessment	2
L	Road Traffic Accidents on site or resulting from traffic with operational activities	Likely	4	Potentially Serious, resulting in a number of fatalities Simple localized contamination of area or minor structural damage	3
M	Incident at adjacent Seveso or IED sites leading to shutdown of WwTP	Unlikely	3	Potentially Serious - Simple contamination, widespread effects or extended duration Cumulative impacts with Seveso incident could lead to Catastrophic events.	5

The results from the evaluation have been applied to Table 15-5 below to determine the Levels of Significance.

Table 15-5: Evaluation of Levels of Significance without Mitigation

Likelihood						
	5 – V. Likely					
	4 – Likely		[A] [F]	[I][L]		
	3 – Unlikely		[G][H]	[B][J]	[D]	[E][M]
	2 – V. Unlikely		[C][K]			
	1 – Ext. Unlikely					
		1 - Minor	2 - Limited	3 – Serious	4 – V. Serious	5 - Catastrophic
	Consequence of Impact					

From examining the plausible risks presented in Table 15-4, Risk ID's C, G, K and J are considered to be of Low Risk / Low Consequence and are below the threshold of Significance set for the purposes of this assessment. The scenario with the highest risk score in terms of a major accident and/or disaster was identified as being an 'Incident at adjacent Seveso Sites leading to shutdown of WwTP', both at the construction and operation stages.

Risk ID's A, B, D, E, F, H, I, J, L and M are subject to further assessment and consideration of Mitigation Measures.

15.4 Mitigation Measures

The design of the WwTP and the Proposed WwTP Component incorporates mitigation measures that have been embedded into the design of the plant. Examples include the provision of storm tanks (capacity 62,100 m^3) to provide short term storage for water discharge, fire suppressant and hydrant systems, and design measures for traffic control within the site.

The site is currently operated by a DBO contractor who maintain a safety management system registered to the health and safety standard (ISO 18001) and as part of this system, operate an Emergency Response Plan (ERP). The ERP considers a number of emergency scenarios and provides contact details for emergency services. At any point, when new works are proposed, such as the Proposed WwTP Component, and where alternative contractors enter the site, a piece of the site may be cordoned off and handed over to the new contractor. At this point, a separate safety file and emergency plan is generated by the new contractor. Following any works and return of the new works to the operational phase, the safety file is updated and handed back to the site operator. The ERP is then revised to take account of the handover of the new works.

Mitigation Measures that are external to the site but are relevant to this assessment include the Dublin City Council 'Major Emergency Plan' (2010), Dublin Port Emergency Management Plan (2013) which if implemented as intended, will limit the loss of life or injury to employees, contractors, visitors and local residents, damage to facilities and damage to the environment.

Risk ID's A, B, D, E, F, H, I, J, L and M have all been identified as being of 'Medium' or 'High' Risk, and are as such are subject to further assessment and determination of risk post-implementation of mitigation measures. The results are presented in Table 15-6 and Table 15-7.

Table 15-6: Major Accidents and/or Disasters - Assessment of Mitigation Measures

Risk ID.	Project Risk	Pre-Mitigation Risk Score	Mitigation Measures [including confirmatory studies]	Post Mitigation Likelihood level of significance	Post Mitigation Consequence
A	Damage to major underground utility services leading to WwTP shutdown resulting in direct untreated effluent discharge to ``sensitive waters''.	Medium	Site investigation, slit trenching on all major utility services and underground services detection surveys to be undertaken. Hand excavation in close proximity to major services. Liaison with stakeholders.	2 Very Unlikely	2 Limited
B	Fire or explosion resulting in significant or widespread damage on site.	Medium	Development of an Emergency Response Plan for site.	3 Unlikely	2 Limited
D	Road Traffic Accidents on site or resulting from traffic associated with construction activities.	Medium	Development of Traffic Management Plan. Site Specific Risk Assessment.	2 Very unlikely	3 Serious
E	Incident at adjacent Seveso sites or caused by activities in the harbour and port area leading to shutdown of WwTP during construction stage.	Medium	Emergency Response Plans to be further developed. CoMAH (Control of Major Accident Hazards Involving Dangerous Substances).	2 Very unlikely	4 Very Serious

Risk ID.	Project Risk	Pre-Mitigation Risk Score	Mitigation Measures [including confirmatory studies]	Post Mitigation Likelihood level of significance	Post Mitigation Consequence
			Mitigation measures have been implemented on adjacent Seveso sites.		
F	Inlet Screens blinded / clogged - resulting in direct untreated effluent discharge to ``sensitive waters''.	Medium	Operating procedures to be implemented to ensure regular cleaning of inlet mains and trunk sewers. The Storm Tanks (Capacity 62,100 cu m) provide short term storage.	2 Very unlikely	2 Limited
I	Highly concentrated toxic influent discharged into Ringsend WwTP Network resulting in WwTP shutdown due to breakdown of biological treatment process.	Medium	The sheer volume of influent in the Ringsend WwTP network is likely to dilute any toxic influent to a treatable concentration, thus minimising the potential impact on the biological treatment process.	2 Very unlikely	2 Limited
J	Fire or explosion resulting in significant or widespread damage on site.	Medium	Emergency Response Plans to be continually developed over the lifetime of the Proposed WwTP Component.	2 Very unlikely	3 Serious
L	Road Traffic accidents on site or resulting from traffic associated with operational activities.	Medium	Traffic Management Plan.	2 Very Unlikely	3 Serious
M	Incident at adjacent Seveso Sites or caused by activities in the harbour and port area leading to shutdown of WwTP.	Medium	Emergency Response Plans to be continually developed over the lifetime of the Proposed WwTP Component. CoMAH (Control of Major Accident Hazards Involving Dangerous Substances). Mitigation measures have been implemented on adjacent Seveso sites.	2 Very Unlikely	4 Very Serious

Table 15-7: Evaluation of Levels of Significance post Mitigation

Likelihood						
	5 – V. Likely					
	4 – Likely					
	3 – Unlikely	[F]	[B]			
	2 – V. Unlikely		[A][I]	[D][J][L]	[E][M]	
	1 – Ext. Unlikely					
		1 - Minor	2 - Limited	3 – Serious	4 – V. Serious	5 - Catastrophic
	Consequence of Impact					

15.5 Management Plans

15.5.1 Emergency Response Plans and Safety Files

The existing ERP will be updated by the contractor/operator of the facility. In line with the existing safety management system, the contractor consults formally and informally with stakeholders, Irish Water, neighbours and emergency services. Safety files generated through construction works are considered by the PSDS and PSDP as part of statutory safety management considerations and handed back to the operator so that the ERP can be updated. In certain cases, the findings of risk assessments, including HAZAN or HAZOP exercises may also be incorporated into future safety plans.

The updated ERP will contain response procedures for dealing with emergency types and shall typically include the following;

- Initial response procedures by scenario type;
- List of emergency numbers and required notifications;
- Records and procedures for sharing of records with listed stakeholders;
- Training to be provided; and
- Emergency response equipment list to be provided and maintained on site.

The ERP will ensure that resources necessary to make safe and/or deal with situations in the first instance are available to respond to Emergencies at all times during construction and operation. It will also ensure that suitably qualified personnel ("Duty Officers") will be available at all times to manage the response of the contractor/operator to Emergencies. A schedule of the telephone numbers for Duty Officers shall be provided to the Gardaí and other Relevant Authorities so that contact can be made with the Duty Officers at all times.

15.5.2 Traffic Management Plan

A Preliminary Traffic Management Plan will be drafted by the Project Supervisor Design Process for the Proposed WwTP Component in full consultation with Dublin City Council, An Garda Síochána, the Fire Service and the Ambulance service. When the works are awarded to a contractor, the Preliminary Traffic Management Plan will be developed by the Project Supervisor Construction Phase into a Detailed Traffic Management Plan in full consultation with the same stakeholders. All traffic management plans, including working times, shall be agreed with and approved by Dublin City Council Transportation Department in advance of implementation.

15.6 Residual Impact

The detailed risk assessment of a major accident and/or disaster occurring to which the Proposed WwTP Component may be vulnerable is considered 'Medium', due to the present risk of a major incident at an adjacent Seveso establishment or EPA licensed site. However, it is noted that this risk is present in the baseline environmental scenario and it is not expected that the application of this Proposed WwTP Component will contribute further to the existing risk profile. Furthermore, external Emergency Response Plans have been developed to adequately control this risk to acceptable levels, in accordance with COMAH Regulations.

15.7 Monitoring

The Environmental Incident Response Plan is a live document that undergoes periodic monitoring, review and update throughout the lifetime of a project. The risk management and assessment of major accidents and/or disasters will be continued on an ongoing basis throughout the planning, design, construction and operational phases of the Proposed WwTP Component. Activities on site will be monitored to ensure risk does of major accidents does not increase over time on the site.

15.8 Conclusion

Table 15-4 lists thirteen plausible MAND events that have the potential to occur during both the construction and operation phases of the Proposed WwTP Component. In a worst-case scenario (i.e. without the implementation of mitigation measures), four were determined to be of 'Low' Risk, seven were determined to be of 'Medium' Risk and two were determined to be of 'High' risk.

The two potentially high-risk scenarios resulted from the cumulative impact of an incident at an adjacent Seveso site that would necessitate the shut-down of the WwTP. It is noted that this MAND is present in the existing or baseline environment, and would continue to be present in a Do-nothing scenario.

The nine 'Medium' or 'High' risk scenarios were subsequently assessed with regard to the embedded mitigation measures. The implementation of internal and external Emergency Response Plans that contain mitigation measures and action plans are designed to limit the loss of life or injury to employees, contractors, visitors and local residents, damage to facilities and damage to the environment.

The results of this stage of the assessment determined that eleven of the thirteen risks are determined to be 'Low' and two were determined to be 'Medium'.

Section 16: Environmental Interactions

16.1 Introduction

This Section of the EIAR addresses the interactions between the various environmental aspects of the Ringsend WwTP component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component"), covered in Sections 3 - 14.

The following Section is directed by Article 3 section 1 (e) of DIRECTIVE 2014/52/EU on the Assessment of the Effects of Certain Public and Private Projects on the Environment. The EPA *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (Draft, 2017) and *Advice Notes for Preparing Environmental Impact Statements* (Draft, September 2015) were also considered.

Article 3 of the Directive states:

1. The environmental impact assessment shall identify, describe and assess in an appropriate manner, in the light of each individual case, the direct and indirect significant effects of a project on the following factors:

(a) population and human health;

(b) biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC;

(c) land, soil, water, air and climate;

(d) material assets, cultural heritage and the landscape;

(e) ***the interaction between the factors referred to in points (a) to (d)***

This Volume of the EIAR has considered the effects of the Proposed WwTP Component on the various aspects of the receiving environment. There are cases where an effect on one element of the environment results in an effect on another element. In most cases the effect is automatically considered. For example, noise is assessed based on the effect of the Proposed WwTP Component on traffic and the noise that the predicted traffic will generate which is compared with acceptable environmental standards which in turn are based on human health considerations.

To facilitate the understanding of, and interactions between, the various environmental disciplines, a workshop was convened for the environmental specialists and the design team. This workshop identified areas of interaction and the information exchange required to predict the direct and indirect effects of the Proposed WwTP Component.

The interactions and interrelationships involved knowledge sharing and information exchange in relation to the following elements:

- Design and Construction Details: The design team provided project specific details to the specialist environmental team to ensure that they had sufficient information to determine the effects on the receiving environment;
- Sensitive receptors: Each specialist provided information on the receptors within their study area and their vulnerability to particular effects arising from the Proposed WwTP Component;

- Baseline and Modelling Data: For example, predicted traffic volumes provided by the traffic specialist were provided to the Noise and Vibration and Air specialists to predict the effects of the Proposed WwTP Component on the noise and air environments. Similarly, water quality modelling results were provided to the Marine Ecologist to assess the potential impacts on the benthic fauna and the consequential effects on the food chain; and
- Impacts and mitigation measures: Each specialist assessed the effect of the other disciplines on the sensitive receptors within his / her discipline and where necessary recommended that mitigation was provided to meet the necessary environmental standards (where available). For example, the Cultural Heritage Specialist identified sensitive protected structures in the area and that they could be vulnerable to vibration. The noise and vibration specialist then assessed the effect on these structures and imposed vibration limits to mitigate the risk of damage.

As a result of this collaboration, the interactions and interdependent impacts/effects are addressed in the respective sections within the EIAR and appropriate mitigation and environmental standards recommended. The residual Impacts (which consider interactions) are summarised in Section 18: Summary of Residual Impacts.

The various interdisciplinary interactions are summarised in Table 16-1.

Table 16-1: Summary of Interactions

	Water	Biodiversity (Terrestrial)	Biodiversity (Marine)	Land and Soils	Air and Climate	Noise and Vibration	Odour	Cultural Heritage	Material Assets	Traffic	Landscape and Visual	Population and Human Health
Water		✓	✓	✗	✗	✗	✗	✗	✓	✗	✗	✓
Biodiversity (Terrestrial)			✓	✓	✓	✓	✗	✗	✗	✗	✓	✗
Biodiversity (Marine)				✗	✗	✗	✗	✗	✗	✗	✗	✗
Land and Soils					✓	✓	✗	✓	✓	✓	✓	✓
Air and Climate						✗	✓	✗	✗	✓	✗	✓
Noise and Vibration								✓	✗	✓	✗	✓
Odour								✗	✗	✗	✗	✓
Cultural Heritage									✓	✓	✗	✗
Material Assets										✓	✗	✗
Traffic											✗	✓
Landscape and Visual												✗
Population and Human Health												

✓ = Interaction ✗ = No interaction

16.2 Interdisciplinary Interactions

The principal interactions requiring information exchange between the environmental specialists and the design team are summarised below. The impacts determined in Sections 3 to 14 have taken into account the interactions listed below.

16.2.1 Water

The operation of the Proposed WwTP Component will result in a change in the quality of the discharged effluent. The effect of this on the quality of the receiving waters was modelled and the change in the quality status assessed.

16.2.1.1 Biodiversity

The change in the water quality of the receiving waters has the potential to impact macroalgae, zostera, photoplankton growth and intertidal invertebrate fauna which in turn has the potential to impact on the food chain and marine fauna and birds. The water quality modelling results of the change in water quality were reviewed to enable impacts to be assessed. The potential impacts and mitigation measures are addressed and described in Section 5: Biodiversity - Marine and Section 6: Biodiversity - Terrestrial. No significant impact on biodiversity is predicted as a result of changes in water quality.

16.2.1.2 Material Assets

Changes in water quality of bathing waters can impact on Material Assets, such as beaches. The potential impacts and mitigation measures are addressed in Section 12: Material Assets. The modelling of the discharge has predicted that there will be no significant impacts on the water quality at bathing water beaches.

16.2.1.3 Population and Human Health

The presence of pathogens and bacteria in bathing water can impact on Human Health. Potential impacts were assessed by water quality modelling. The potential impacts and mitigation measures are addressed in Section 3: Population and Human Health. No potential impacts on human health as a result of changes in water quality at bathing water beaches are predicted.

16.2.2 Biodiversity

The assessment of impacts on biodiversity is addressed in Section 5: Biodiversity - Marine and Section 6: Biodiversity - Terrestrial. The effects of the Proposed WwTP Component on water, air quality, noise and land and soils interact with the assessment of the impacts on the Biodiversity environment.

16.2.2.1 Water

See Section 16.2.1.

16.2.2.2 Land and Soils

The ecological survey of the site established the presence of the invasive species Japanese Knotweed. Section 7: Land and Soils addresses the disposal of contaminated soils. Interaction between the Land and Soils specialist and the Biodiversity specialist was required to determine the location and volumes of soils contaminated with Japanese Knotweed and the disposal route and methodology. The removal of Japanese Knotweed will result in slight permanent positive impact.

16.2.2.3 Air and Climate

The air quality data was assessed to establish the impact on terrestrial flora and fauna (Brent Geese). Emissions to the atmosphere associated the Proposed WwTP Component have potential to impact on sensitive terrestrial flora and fauna receptors. The impacts of air quality on terrestrial flora and fauna is addressed in Section 6: Biodiversity - Terrestrial. No significant impact on biodiversity is predicted as a result of a change in air quality.

16.2.2.4 Noise and Vibration

The results of the noise modelling and surveys were used to assess the impacts on birds (Brent Geese and nesting terns). The noise specialist provided the biodiversity specialist with predicted noise levels resulting from the construction and operational phases. No significant impact on the sensitive receptors is predicted.

16.2.2.5 Landscape and Visual

The landscape and visual assessment was considered in terms of impacts on the wintering Brent Geese population and appropriate mitigation measures proposed in Section 6: Biodiversity - Terrestrial. The potential impact of visual disturbance to the geese is mitigated by construction of visual barriers between the WwTP and the grassland area where the wintering geese feed. No significant impact on the biodiversity is predicted.

16.2.3 Land and Soils

The earthworks associated with the construction of the Proposed WwTP Component interact with several disciplines. The earthworks will entail the removal of existing landscaping bunds, excavations and disposal of contaminated soils.

16.2.3.1 Biodiversity

See Section 16.2.2.

16.2.3.2 Traffic

The volume of contaminated soil (including Japanese Knotweed infested soil) to be disposed of offsite will influence traffic volume prediction by the traffic specialist and the consequent impacts. The potential impacts and mitigation measures relating to traffic are addressed in Section 13: Traffic.

16.2.3.3 Landscape and Visual

The removal of existing bunds and soils can remove screening properties and influence the visual impact of the Proposed WwTP Component. The impact of this has been assessed in Section 14: Landscape and Visual. Mitigation in the form of planting on the boundary is proposed and the long-term impact is predicted to be imperceptible.

16.2.3.4 Air and Climate

The construction activities will generate dust. Impacts and mitigation of dust generation are addressed in Section 8: Air and Climate. The impacts of dust associated with the construction phase are predicted to be imperceptible following implementation of the proposed mitigation measures.

16.2.3.5 Noise and Vibration

The activities associated with the Land and Soils environment (earthworks and piling) will contribute to the noise emissions from the site. The noise and vibration impacts associated with earthworks and piling are included in the assessment addressed in Section 9: Noise and Vibration.

16.2.3.6 Cultural Heritage

Information on the depths of made ground and subsurface conditions were provided to the Cultural Heritage specialist to assist in determining the likelihood of encountering buried archaeology during earthworks and excavations. Excavations within the made ground (< 6.3 metres below ground) will have no Impact on buried cultural heritage. Monitoring will be undertaken for any excavation beyond 6.3 metres.

16.2.3.7 Material Assets

Land-use is addressed in Section 12: Material Assets. Geological Heritage site assessments are required for the assessment of impacts on Material Assets. Quarries and their reserves are assessed as part of Material Assets section. Land and soils related impacts on Material Assets are predicted to be neutral.

16.2.3.8 Population and Human Health

Details of contaminated soil and its composition and disposal were provided to enable the assessment of impacts on human health (Section 3: Population and Human Health). No significant impacts on human health associated with the land and soils environment are predicted.

16.2.4 Air and Climate

The assessment of impacts on air quality and the climate is addressed in Section 8: Air and Climate. The Proposed WwTP Component will cause a change in the air quality resulting from traffic emissions and the generation of dust. It should be noted that impacts due to odour are assessed separately in Section 10: Odour.

16.2.4.1 Biodiversity

See Section 16.2.2.3

16.2.4.2 Land and soils

See Section 16.2.3.4

16.2.4.3 Traffic

The future traffic volumes were required to predict the associated change in the air quality. The change in air quality was assessed against standard thresholds required to avoid impacts on public health. The impacts of traffic on air quality are addressed in Section 8: Air and Climate and are predicted to be imperceptible (following the implementation of proposed mitigation measures).

16.2.4.4 Population and Human Health

The future traffic volumes were required to predict the associated change in the air quality. The change in air quality was assessed against standard thresholds required to avoid impacts on public health. The impacts of air quality on human health are addressed in Section 3: Population and Human Health. The changes in air quality and dust generated will not give rise to significant adverse effects on human health, following the implementation of mitigation measures and best practice standards and guidelines as detailed in Section 8: Air and Climate.

16.2.5 Noise and Vibration

The assessment of impacts due to noise and vibration impacts were addressed in Section 9: Noise and Vibration. Noise and vibration levels and limits from traffic, construction machinery and plant has been communicated to other disciplines to facilitate their impact assessment.

16.2.5.1 Biodiversity

See Section 16.2.2.4

16.2.5.2 Land and soils

See Section 16.2.3.5

16.2.5.3 Cultural Heritage

Archaeological monuments were identified as being vulnerable to damage by vibration. The noise and vibration specialist provided vibration limits for sensitive receptors that would mitigate damage due to vibration. Provided the vibration limits are met, the impacts on sensitive structures will be imperceptible.

16.2.5.4 Traffic

Through modelling, future traffic volumes associated with both construction and operation were estimated. The future traffic volumes were reviewed to predict the noise levels during construction and operation. These predicted traffic volumes were input to the noise model to predict the future noise levels.

16.2.5.5 Population and Human Health

The predicted noise levels were assessed for impacts on human health. There can be nuisance impacts associated with noise that impact on the local population. The noise model and assessment determines that construction activities at the site will not give rise to significant noise levels and will comply with standards and threshold noise limits (BS8223:2014), which are set to protect human health and exposure to undue noise levels. Therefore, it can be concluded that construction noise will not give rise to significant adverse effects on human health.

16.2.6 Odour

The assessment of impacts of odour levels are addressed in Section 10: Odour.

16.2.6.1 Population and Human Health

The principal impacts of odour are nuisance to the local population. The implications of the predicted odour levels on human health are assessed in Section 3: Population and Human Health. As long as the odour limits set out in the EIAR are adhered to there will be no residual impact.

16.2.7 Cultural Heritage

16.2.7.1 Land and soils

See Section 16.2.3.6

16.2.7.2 Noise and Vibration

See Section 16.2.5.3

16.2.7.3 Traffic

Construction traffic can potentially damage existing monuments. Protection measures to protect the monuments (Pigeon House Fort) from impact by construction traffic will be implemented.

16.2.8 Material Assets

The assessment of impacts on material assets was completed by reviewing the residual impacts predicted in Sections 3 to 14.

16.2.8.1 Land and soils

See Section 16.2.3.7

16.2.8.2 Traffic

Increases in traffic volumes have the potential to damage the road network.

16.2.9 Traffic

16.2.9.1 Land and soils

See Section 16.2.3.2

16.2.9.2 Air and Climate

See Section 16.2.4.3

16.2.9.3 Noise and Vibration

See Section 16.2.5.4

16.2.9.4 Cultural Heritage

See Section 16.2.7.3

16.2.9.5 Material Assets

See Section 16.2.8.2

16.2.9.6 Population

There will be a potential nuisance to the local population resulting from possible traffic delays due to increased traffic.

16.2.10Landscape

16.2.10.1 Biodiversity

See Section 16.2.2.5

16.2.10.2 Land and soils

See Section 16.2.3.3

16.2.11 Human Health

Each of the impacts from Land and Soils, Air and Climate, Noise and Vibration, Odour and Traffic are assessed in terms of the potential impacts on human health.

The commitment to meeting environmental limits will mitigate impacts on human health. For example, if air quality or noise standards are adhered to then no impact on human health is expected. Similarly, the health implications of bathing water quality are considered acceptable if the bathing water standards are achieved.

The overall assessment of impacts on human health are summarised in Section 3: Population and Human Health. The human health impacts predicted take into account the interactions with the disciplines referred to above.

Section 17: Summary of Mitigation

This Volume of the EIAR has assessed the impacts and resulting effects likely to occur as a result of the Ringsend WwTP component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component") on the various aspects of the receiving environment.

The Proposed WwTP Component has been designed and will be constructed in a manner that will ensure that the potential impacts on the receiving environment are avoided where possible. Full details of the Proposed WwTP Component can be found in Volume 2, Section 3: Description of Proposed Upgrade Project. In cases where impacts or potential impacts have been identified, mitigation has been proposed to reduce the significance of particular impacts. These mitigation recommendations are contained in the specific environmental sections within this document.

This Section proposes to collate and summarise the mitigation commitments made in Section 3 to Section 15 of this Volume of the EIAR. In addition to the mitigation measures proposed, appropriate management practices and commitments relating to construction activities are also provided.

Mitigation of environmental impacts are described as follows:

Mitigation by Design

The design of the Proposed WwTP Component has incorporated many inherent elements to minimise undesirable environmental impacts. The treatment system will produce an effluent standard that will comply with the UWWT regulations and thus mitigate adverse impacts on the receiving waters. Odour control units, disinfection, and sludge treatment measures are other environmental design considerations. This EIAR has assessed the environmental effects of the construction and operation of the Proposed WwTP Component. Where impacts were identified, a commitment is made to incorporate appropriate mitigation by design, as described in the various sections of the EIAR.

Mitigation by Management

Many potential environmental impacts have been identified that are associated with construction activity and methodology. Consequently, a contract specific Construction Environmental Management Plan (CEMP) will put in place for the various contracts that will be undertaken (an outline CEMP is included in Appendix 17A). This CEMP will incorporate the environmental commitments and mitigation contained in the EIAR as well as any conditions that may be attached to a planning permission. Likewise, an Environmental Management Plan will be put in place post construction, in the operational phase, which shall also address environmental monitoring procedures. The mitigation commitments are summarised in Table 17-1.

Note that in the table below, mitigation measures are itemised and numbered based on the stage that they are relevant to (i.e. construction or operational - C or O) and the Section that they come from. For example, mitigation measure C.7.1 relates to construction mitigation measure no. 1 from the Land and Soils Section 7.

Monitoring

Monitoring is also listed under each Section title in Table 17-2 in order to summarise any monitoring requirements identified within this Volume of the EIAR. Monitoring items are numbered in the same way as mitigation measures.

Table 17-1: Summary of Mitigation and Environmental Commitments

Mitigation Measure No.	Construction / Operational Stage	Impact / Topic	Mitigation and Environmental Commitments
			General
C.Gen.1	Construction	Construction Impacts General	A contract specific Outline CEMP has been prepared by IW. Detailed CEMPs will be developed for individual contracts and implemented by the various contractors The individual CEMPs will have regard to the guidance contained in the handbook published by Construction Industry Research and Information Association (CIRIA) in the UK, *Environmental Good Practice on Site*, CIRIA 2005, as well as the Outline CEMP document. The CEMPs shall have individual project specific Management Plans appended relating to Waste Management, Invasive Species Management, Traffic Management, Monitoring Plans, and Emergency Response Plans. Any planning conditions imposed by the planning authority shall be strictly observed and monitoring requirements shall be observed as conditioned.
-	Operational	-	None
			Section 3: Population and Human Health
C.3.5	Construction	Human Health	It is recommended that a rodent and pest control plan is put in place so as to manage and limit any potential disturbance to populations that may utilise the site. The pest control plan should be in accordance with the Chartered Institute of Environmental Health's "*Pest minimisation Best practice for the construction industry"* guidelines or a similar appropriate standard.
-	Operational	Human Health	It is recommended that a rodent and pest control plan is put in place so as to manage and limit any potential disturbance to populations that may utilise the site. The pest control plan should be in accordance with the Chartered Institute of Environmental Health's "Pest minimisation Best practice for the construction industry" guidelines or a similar appropriate standard.
			Section 4: Water
C.4.1	Construction	-	None
C.4.2	Operations	-	None
			Section 5: Biodiversity - Marine
-	Construction	-	None
-		-	None

Mitigation Measure No.	Construction / Operational Stage	Impact / Topic	Mitigation and Environmental Commitments
Section 6: Biodiversity - Terrestrial			
C.6.1	Construction	Visual Disturbance of Birds on Grassland	To mitigate against disturbance of birds on the grassland, solid screening will be erected prior to construction to reduce or eliminate any visual disturbance (this is already in place as part of the capacity upgrade contract).
C.6.2	Construction	Japanese Knotweed	An Invasive Species Management Plan and method statement will be prepared (as part of the contract specific CEMP) for the control of disturbance to soils containing Japanese Knotweed and the movement and disposal of soils and vegetation from the site. The method statement will follow "*Irish Water Information and Guidance Document on Japanese Knotweed*". The implementation of the invasive species management plan shall be overseen by a suitably qualified ecologist/botanist familiar with Japanese Knotweed. An Outline Invasive Species Management Plan has been prepared, see Appendix 6A.
-	Operational	-	None
Section 7: Land and Soils (Including Waste)			
C.7.1	Construction	Environmental Management Plans - Including Invasive Species and Waste Management	The construction contracts will require that the contractor produce a contract specific Construction Environmental Management Plan and waste and invasive species management plans will form part of this document. An Outline Invasive Species Management Plan has been produced and is contained in Appendix 6A. The project specific Waste Management Plan shall include for the disposal of contaminated soil.
C.7.2	Construction	Excavation and Waste Disposal	All unsuitable (contaminated) material shall be disposed of in accordance with all relevant legislation including the Department of the Environment and Local Government (DoELG) (1996 to 2008), Waste Management Acts, the DoELG (1998) Waste Management (Permit) Regulations and the NRA (2008) Guidelines for the Management of Waste from National Road Construction Projects. Material that cannot be re-used will be handled in accordance with the Landfill Directive (2003/33/EC).
C.7.3	Construction	Excavation and Waste Disposal	All waste shall be removed by waste contractors authorised under the Waste Management (Collection Permit) Regulations, 2007 and the Waste Management (Collection Permit) (Amendment) Regulations, 2008.
C.7.4	Construction	Excavation and Waste Disposal	The waste collected shall be delivered to authorised waste facilities in accordance with the Waste Management Acts 1996-2010.
C.7.5	Construction	Excavation and Waste Disposal	The contractor is required to prepare a Waste Management Plan for the Proposed WwTP Component in accordance with "Best Practice Guidelines on the Preparation of Waste Management Plans for

Mitigation Measure No.	Construction / Operational Stage	Impact / Topic	Mitigation and Environmental Commitments
			Construction and Demolition Projects". This will provide details of the exact methods it is proposed to employ to manage excavated soil on site and to remove spoil from the site and will include details of the location and end use of the spoil.
C.7.6	Construction	Excavation and Waste Disposal	As soil characteristics will vary during the construction operations, the contractor will be required to implement, prior to the commencement of construction works, and thereafter maintain throughout the construction phase, a comprehensive environmental monitoring programme in respect of the soil characteristics. If necessary, disposal outlets will be modified to ensure continuous compliance with all relevant regulations and with this EIAR.
C.7.7	Construction	Excavation and Waste Disposal	A Project Waste Manager will be appointed by the contractor to oversee the implementation and adherence to the plan during the construction phase of the Proposed WwTP Component.
C.7.8	Construction	Management of Construction Induced Ground Movements	In order to mitigate potential impacts associated with construction induced settlement, the following will be implemented: Condition surveys of the adjacent structures will be carried out prior to construction to provide a baseline for excavation monitoring and piling works; Appropriate batters or appropriate temporary works solutions such as sheet piling and trench boxes will be adopted during excavations above groundwater to ensure cut face stability; Where excavations extend below groundwater, appropriate retention and construction dewatering systems will be adopted to mitigate the potential effects of drawdown on nearby structures, roads and major services; Appropriate foundation construction techniques will be adopted to ensure settlements are within tolerable limits; and Settlement monitoring will be carried out during construction to ensure settlements are within tolerable limits.
C.7.9	Construction	Construction Dewatering	Management of temporary construction dewatering and abstracted groundwater discharge will be required for the Proposed WwTP Component. Sheet piling will be required to seal out groundwater inflows from excavations below the groundwater table. The contractor will be required to provide a method statement for the dewatering of excavations below the water table.
C.7.10	Construction	Construction Dewatering	Where construction dewatering is undertaken, a consent/licence issued under Section 16 of the Local Government (Water Pollution) Acts and Regulations must be obtained by the contractor. The discharge licence is likely to be subject to conditions governing: the measurement of flow; effluent quality prior to

Mitigation Measure No.	Construction / Operational Stage	Impact / Topic	Mitigation and Environmental Commitments
			discharge; pre-treatment (e.g. settlement/filtration, hydrocarbon separation, pH adjustment, etc.); rates of discharge and permitted volumes; provisions for monitoring, and the requirement and frequency of sampling. All groundwater discharges shall strictly comply with all conditions, constraints and requirements imposed under the discharge licence.
C.7.11	Construction	Construction Dewatering	In order to mitigate potential impacts associated with the management of groundwater and water the contract documents for the Proposed WwTP Component will include the following provisions: Discharge control will be modified as necessary to ensure continuous compliance with all relevant regulations and with this EIAR; All discharges arising from the construction phase shall incorporate silt removal and hydrocarbon removal using a hydrocarbon interceptor (which will comply with current European Standard EN858); If required, some on-site storage can be provided to allow discharge to sewer over non-peak times each day; and If required, some on-site storage can be provided to allow discharge to sewer over non-peak times each day.
C.7.12	Construction	Management of Invasive Species	Treatment of the Japanese Knotweed will be undertaken in-situ for the bund in the northeast corner of the site. In order to mitigate potential impacts associated with spread of invasive species, the contract documents for the Proposed WwTP Component will include the following provisions: The contractor will employ a qualified ecologist or botanist or horticulturalist to verify if Japanese Knotweed is present prior to carrying out any earthworks. A method statement and contract specific Invasive Species Management Plan will be prepared for the control of disturbance to soils containing Japanese Knotweed and the movement and disposal of soils and vegetation from the site. The method statement shall follow the *"Irish Water Information and Guidance Document on Japanese Knotweed*"; A suitably qualified ecologist will oversee the implementation of the Invasive Species Management Plan and monitor the success of the mitigation measures post-construction; The area affected by the Japanese Knotweed will be marked with a temporary exclusion zone and there will be no working of vehicles with caterpillar tracks within this exclusion zone; The removal of soil or vegetation from the area affected by the Japanese Knotweed will be carried out separately from other site clearance. Soil and vegetation removed will be stockpiled in a separate bunded area, at least 50 meters from high water mark and where there is no risk of accidental transfer or spreading of vegetation or soil onto adjacent areas;

Mitigation Measure No.	Construction / Operational Stage	Impact / Topic	Mitigation and Environmental Commitments
			The soil or vegetation removed from the affected area will be transported to a suitably licensed Landfill Facility for 'deep burial' which comprises immediate cover of 1 m to 2 m with final burial/cover of a minimum of 5 m within 2-4 weeks of initial placement. The full depth of cover will comprise material which is not infected with Japanese Knotweed. These burial/cover requirements are strict and not achievable at all licensed landfill facilities and each Landfill Operator's attention must be drawn to them prior to determining whether the waste can be accepted at any individual facility; and Material infected with Japanese Knotweed is deemed to be 'non-hazardous waste' during transportation to a licensed landfill facility and therefore, is subject to the Waste Management Acts and Regulations. The classification of the material at the Landfill Facility is determined by the Landfill Operator. Note: Where Japanese Knotweed is present but is greater than 7 metres from any area to be excavated, in-situ treatment using herbicides will be undertaken.
C.7.13	Construction	Accidental Spillage	Measures set out in the Construction Industry Research and Information Association (CIRIA) on the "*control and management of water pollution from construction sites*" shall be adhered to by the contractor. Good construction management practices will be employed.
C.7.14	Construction	Accidental Spillage	During the construction stage, all potentially harmful substances (e.g. oils, diesel, herbicides, pesticides, concrete etc.) will be stored in accordance with the manufacturer's guidelines regarding safe and secure buildings/compounds. The contractor will ensure that adequate means to absorb or contain any spillages of these chemicals are available at all times. Suitable measures will be taken to minimise the potential for pollution arising from accidental spillage.
-	Operational	-	None
Section 8: Air and Climate			
C.8.1	Construction	Construction Phase - Air Quality	The dust minimisation measures specified in Appendix 8B will be incorporated into a contract-specific CEMP and implemented during the construction phase of the Proposed WwTP Component.
-	Operational	-	None
Section 9: Noise and Vibration			
C.9.1	Construction	Construction Noise and Vibration	It will be a requirement for the contractor to employ and implement best practice construction noise and vibration management techniques throughout the construction phase in order to further reduce the noise and vibration impact to nearby noise sensitive receptors. In the first instance, the contractor will compile a Noise and Vibration Management Plan (NVMP) which will deal specifically with management processes and strategic mitigation measures to remove or reduce

Mitigation Measure No.	Construction / Operational Stage	Impact / Topic	Mitigation and Environmental Commitments
			significant noise and vibration impacts, and cumulative noise and vibration impacts from the construction works. The NVMP will also define noise and vibration monitoring and reporting. The NVMP will also include method statements for each phase of the works, the associated specific measures to minimise noise and vibration in so far as is reasonably practicable for the specific works covered by each plan and a detailed appraisal of the resultant construction noise and vibration generated.
C.9.2	Construction	Construction Noise and Vibration	The contractor will provide proactive community relations and will notify the public and vibration sensitive premises before the commencement of any works forecast to generate appreciable levels of noise or vibration, explaining the nature and duration of the works. The contractor will distribute information circulars informing people of the progress of works and any likely periods of significant noise and vibration.
C.9.3	Construction	Construction Noise and Vibration	During the construction and demolition phases, the Proposed WwTP Component shall comply with British Standard 5228 *Noise Control on Construction and open sites Part 1. Code of practice for basic information and procedures for noise control*. The BS5228 standards include guidance on several aspects of construction site mitigation measures, including, but not limited to: selection of quiet and or low vibration emitting plant; control of noise sources; screening; hours of work; liaison with the public; and monitoring. Detailed comment is offered on these items in Appendix 9C.
O.9.1	Operational	Additional Wastewater Treatment Mechanical Plant	Noise from onsite will be minimised through the selection of 'low noise' equipment where required, as well as the incorporation of appropriate attenuation in the form of: Acoustic enclosures for blower fans and compressors; Provision of silencers for blower fan intake and extract points; Vibration isolation mounts for all proposed internal and external plant items; Use of acoustic rated doors on all relevant enclosures and plant room access points; and Appropriate siting of all fixed plant.

Mitigation Measure No.	Construction / Operational Stage	Impact / Topic	Mitigation and Environmental Commitments
Section 10: Odour			
C.10.1	Construction	Odour Control	The principles of the site Odour Management Procedures (OMP) will be followed to include odour management of the construction phase of the new processes. The OMP will also detail the operational, management and maintenance procedures to minimise emissions including during the construction phase. This includes a daily condition and operation check, weekly marker compound surveys and biannual olfactometry testing for all OCUs.
O.10.1	Operational	Odour Control	The site Odour Management Procedures (OMP) will be updated to include odour management of the new processes. This will include updating the OMP to identify all potential new odour emission sources. The OMP will also detail the operational, management and maintenance procedures to minimise emissions including during plant failure or emergency situations. The operator has an established management procedure for reporting and investigating public odour complaints and this procedure will be maintained. This includes a daily condition and operation check, weekly marker compound surveys and biannual olfactometry testing for all OCUs. The specific monitoring obligations within the current OMP are detailed in Table 10-10 of this Volume of the EIAR, which will, as a minimum, be retained in future versions.
O.10.2	Operational	Odour Control	The OMP will also form the management process to ensure that process sources and OCUs are operated correctly and do not fall into disrepair. In accordance with the OMP, regular flow and olfactometry testing would be used to quantify the odour removal performance. Although not suggested in the current OMP, it is suggested that any odour monitoring result in excess of the model input levels detailed in Section 10.2.7 of this Volume of the EIAR should be confirmed, investigated and rectified.
Section 11: Cultural Heritage			
C.11.1	Construction	Damage to Protected Structures by Vibration	See noise and vibration mitigations.
C.11.2	Construction	Construction Machinery and HGVs	Construction machinery has the potential to damage the upstanding parts of the Pigeon House Fort such as the south wall and the north wall and these areas should be protected with concrete traffic barriers during construction to prevent any impacts. The structure of the old Pigeon House Power Station shall also be protected with concrete traffic barriers during construction to prevent any impacts.
C.11.3	Construction	Construction Machinery and HGVs	A smooth and level haul road surface will be maintained such that the levels of vibration likely to be generated in close proximity to the proposed haul roads would be expected to be below the 3 mm/s peak particle velocity (PPV) recommended for the protected structure forming part of the old Ringsend fort and significantly below the 15 mm/s PPV recommended otherwise for the prevention of cosmetic damage to buildings.

Mitigation Measure No.	Construction / Operational Stage	Impact / Topic	Mitigation and Environmental Commitments
C.11.4	Construction	Site Specific Piling Measures	Where Continuous Flight Auger (CFA) piles are bored through the made ground and may impact potential archaeology associated with the old ground beneath, they will be archaeologically monitored.
-	Operational	-	None
Section 12: Material Assets			
C.12.1	Construction	Road Network	A Traffic Management Plan, together with safety management plans will be developed for the construction phase. See Volume 3, Section 13: Traffic. Any damage arising to the road network will be addressed in conjunction with Dublin City Council Roads Dept.
C.12.2	Construction	Land Utilisation	Screening will be erected along the southern and eastern site boundary of the treatment plant / works site; Screening will be erected around construction compound sites; and A project specific Construction Environmental Management plan will be agreed with DCC and implemented.
C.12.3	Construction	Public Utilities	Communication and consultation will be conducted with public utility providers ahead of construction commencement; Underground surveying techniques are a key method of understanding the below ground conditions and confirming the presence of utility services. A Cable Avoidance Tool and a Signal Generator (CAT & Genny) are used to scan the surface of the ground with an audible signal being developed where underground utilities are detected. Surface radar scanning shall also be used to locate underground services before commencement of any mechanical excavation in the vicinity of underground services. These detection surveys shall be undertaken by the contractor; Method Statements shall be developed for the construction phase by the contractor to ensure that all underground services are located manually and carefully protected. The CEMP, prepared by the contractor and approved by IW shall outline a methodology and procedure for carrying out such detection surveys; An avoidance policy shall be adopted where possible in relation to all services and appropriate protection shall be provided for all above and below ground services as necessary; and Connection to the ESB high voltage cable shall be undertaken in summer months to avoid disruption to over wintering Brent Geese.

Mitigation Measure No.	Construction / Operational Stage	Impact / Topic	Mitigation and Environmental Commitments
C.12.4	Construction	Natural Amenities	The potential disruption to the usage of the grasslands by over wintering Brent Geese can be mitigated by completing the connection to the ESBN cable during non-winter months of May-October, as outlined in the EIAR Volume 3, Section 6: Biodiversity - Terrestrial, Section 6.7: Residual Impacts.
O.12.1	Operational	Public Utilities	Method Statements shall be developed during the operational phase to ensure that any underground services are located manually and carefully protected during any onsite maintenance work requiring excavation works in the vicinity of the underground utilities.
Section 13: Traffic			
C.13.1	Construction	Traffic Management	Construction related HGV trips will adhere rigidly to the Dublin City Council HGV Management Strategy and associated cordon
C.13.2	Construction	Traffic Management	A Preliminary Traffic Management Plan will be drafted by the Project Supervisor Design Process for the works in full consultation with Dublin City Council, An Garda Síochána, the Fire Service and the Ambulance service. When the works are awarded to a contractor, the Preliminary Traffic Management Plan will be developed by the Project Supervisor Construction Phase into a Detailed Traffic Management Plan in full consultation with the same stakeholders. All traffic management plans, including working times, shall be agreed with and approved by Dublin City County Council Transportation Department in advance of implementation.
C.13.3	Construction	Sensitive Structures	Protection measures are to be provided at sensitive archaeology sites as noted in Section 11: Cultural Heritage.
C.13.4	Construction	Equipment Management	Tracked excavators will be moved to and from the site on low-loaders and will not be permitted to drive on the street pavements
C.13.5	Construction	Staff Parking	The contractor is to arrange for staff parking at an off-site location. Contractor's, Subcontractor's or Supplier's vehicles or staff vehicles, or any vehicles associated with the works are not permitted to park, idle or queue on the public road network. The car park to the east of Pigeon House Road will be maintained for public use only. No works vehicles or site staff private vehicles will be permitted to use this facility.
C.13.6	Construction	Wheel Washers	Wheel washers / judder bars will be placed at all site access points to minimise the migration of detritus onto the public roads. The roads will be inspected and cleaned on a regular basis.
C.13.7	Construction	Falling construction material from haul vehicles	Haul vehicles must be covered after loading to ensure there is no risk of construction material falling.

Mitigation Measure No.	Construction / Operational Stage	Impact / Topic	Mitigation and Environmental Commitments
C.13.8	Construction	Dust Suppression	Water bowsers will be deployed within the sites during periods of hot weather to damp down potential dust generation from unbound surfaces.
C.13.9	Construction	Abnormal Loads	An Application for an Abnormal Load Permit will be made to DCC in advance for any abnormal loads exceeding the thresholds laid out in the Road Traffic (Construction and Use of Vehicles) Regulations 2003. Where possible, abnormal load movements will be restricted to evening or night time to minimise disruption to local traffic and traffic on strategic routes.
-	Operational	-	None
Section 14: Landscape			
C.14.1	Construction	Protection of Trees	Existing belt of tree and shrub planting located along Pigeon House Road (refer to Figure 14.6) will be retained and protected in line with *BS 5837 2012: Trees in relation to design, demolition and construction - Recommendations.*
C.14.2	Construction	Construction Compound	The existing construction compound previously used for the construction of the Waste to Energy Facility, will be used, in part, for the initial more intensive phase of site construction. Screening (min 2.0 m high) is to be provided on western, southern and eastern boundaries of the compound.
C.14.3	Construction	Screening	Screening will be erected along the southern and eastern site boundaries of the existing WwTP / works site.
C.14.4	Construction	Screening	Screening will be erected around temporary construction compound sites.
C.14.5	Construction	Reinstatement of compound areas	Following decommissioning, all compound areas will be fully reinstated to pre-compound use finish (i.e. mainly grassland).
C.14.6	Construction	Reinstatement of Landscape	Given the low level of landscape and visual impact anticipated from the completed Proposed WwTP Component the key mitigation measures will involve good construction site management, full decommissioning of construction elements and compounds, and appropriate reinstatement of disturbed site and compound areas. New tree planting is to be reinstated along the eastern boundary of the existing WwTP site.
C.14.7	Construction	Reinstatement of Landscape	The reinstated landscape buffer to the east of the Wastewater Treatment Plant will be approximately 3 m wide. Planting will be a diverse mix of evergreen conifers such as Pine, and evergreen shrubs such as Sea-buckthorn and Oleasters inter-planted and under-planted with Alder, Sycamore, Dog-rose, Hawthorn and Blackthorn.

Mitigation Measure No.	Construction / Operational Stage	Impact / Topic	Mitigation and Environmental Commitments
C.14.8	Construction	Concrete Cleaning	The stained concrete elevations of the existing SBR tanks will be cleaned to present an overall consistent visual appearance in-line with new structures to be provided. Refer to the 'as existing' and 'as proposed' photomontage images for View 4 and View 5 for illustration of this cleaning effect.
O.14.1	Operational	Landscape Works	Proposed landscape works will be maintained in line with standard landscape maintenance practice so as to ensure establishment. Failed or dead plants will be replaced in the planting season following identification of any such defects.
O.14.2	Operational	Lighting Standards	Any new lighting standards will be fitted with horizontal cut-off fittings to avoid light spill.
Section 15: Risk Management			
C/O.15.1	Construction and Operational	Management Plans	The Construction Environmental Management Plan (CEMP) and the Operational Stage Environmental Management Plan (OSEMP) will be developed, which will outline the site safety procedures that will be implemented during the lifecycle of the Proposed WwTP Component, as well as the site Emergency Response Plan (ERP). The Emergency Response Plan is to be continually developed over the lifetime of the Proposed WwTP Component. A Traffic Management Plan (construction and operational) will also be developed.
C/O.15.2	Construction and Operational	External Management Plans	Mitigation Measures that are external to the site but are relevant to this assessment include the Dublin City Council 'Major Emergency Plan' (2010), Dublin Port Emergency Management Plan (2013) which if implemented as intended, will limit the loss of life or injury to employees, contractors, visitors and local residents, damage to facilities and damage to the environment.
C.15.3	Construction	Damage to major underground utility services	Site investigation, slit trenching on all major utility services and underground services detection surveys to be undertaken. Hand excavation in close proximity to major services. Liaison with stakeholders.
C.15.4	Construction	Road Traffic Accidents	A Traffic Management Plan will be developed, along with a Site-Specific Risk Assessment.
O.15.3	Operational	Inlet Screens	Operating procedures to be implemented to ensure regular cleaning of inlet mains and trunk sewers. The Storm Tanks (Capacity 62,100 cu m) provide short term storage.

Table 17-2: Summary of Monitoring Requirements

Monitoring Measure No.	Construction / Operational Stage	Impact / Topic	Monitoring Requirements
General			
C.Gen.1	Construction	General Construction	Any planning conditions imposed by the planning authority shall be strictly observed and monitoring requirements shall be observed as conditioned.
O.Gen.1	Operational	General Operational	Any planning conditions imposed by the planning authority shall be strictly observed and monitoring requirements shall be observed as conditioned.
Section 3: Population and Human Health			
-	Construction	-	None
-	Operation	-	None
Section 4: Water			
C.4.1	Construction	Final Effluent Quality	The final effluent will be required to be monitored in accordance with the terms of the Wastewater Discharge Authorisation.
O.4.1	Operational	Final Effluent Quality	The final effluent will be required to be monitored in accordance with the terms of the Wastewater Discharge Authorisation.
C.4.2	Construction	Receiving Water Quality	The receiving waters will continue to be monitored in accordance with the requirements of the different directive and statutory instruments, by the relevant public authorities.
O.4.2	Operational	Receiving Water Quality	The receiving waters will continue to be monitored in accordance with the requirements of the different directive and statutory instruments, by the relevant public authorities.
Section 5: Biodiversity - Marine			
O.5.1	Operational	Changes in composition and abundance of macroinvertebrate communities	Post-construction monitoring of macroinvertebrate communities will be carried out to detect any changes in the composition and abundance of the constituent taxa.
O.5.2	Operational	Receiving Water Quality	Post-construction water quality surveys will be carried out to validate the model output.
Section 6: Biodiversity - Terrestrial			
C.6.1	Construction	Disturbance to Waterbirds	A series of monthly surveys of waterbirds on the grassland, immediately south of the Proposed WwTP Component, will be carried out each winter between October and April for the period of construction of the

Monitoring Measure No.	Construction / Operational Stage	Impact / Topic	Monitoring Requirements
			Proposed WwTP Component. When compared with the baseline period and general population trends, this will allow assessment of the efficacy of the mitigation measures on potential disturbance. A record will be maintained of any disturbance incidents to the waterbirds on this site where these are connected with the construction works.
O.6.1	Operational	Disturbance to Waterbirds	A comprehensive monitoring programme currently being undertaken by BirdWatch Ireland for all of Dublin Bay, which can be used to allow assessment of the efficacy of potential changes in waterbird populations related to effluent discharge.
C.6.2	Construction	Potential changes in waterbird population related to effluent discharge	A series of monthly surveys will be carried out to monitor population levels of waterbirds in Dublin Bay (including South Dublin Bay and River Tolka Estuary SPA and North Bull Island SPA) in all months for the period of construction of the Proposed WwTP Component. This monitoring could be integrated with a comprehensive monitoring programme currently being undertaken by BirdWatch Ireland for all of Dublin Bay but must be accompanied by appropriate funding commitments.
O.6.2	Operational	Potential changes in waterbird population related to effluent discharge	A series of monthly surveys will be carried out to monitor population levels of waterbirds in Dublin Bay (including South Dublin Bay and River Tolka Estuary SPA and North Bull Island SPA) for the first five years following completion of the Proposed WwTP Component. This monitoring could be integrated with a comprehensive monitoring programme currently being undertaken by BirdWatch Ireland for all of Dublin Bay but must be accompanied by appropriate funding commitments.
C.6.3	Construction	Invasive plant species	Annual monitoring of potentially invasive plant species in the immediate vicinity of the Proposed WwTP Component will be undertaken to assess the efficacy of control measures proposed in the Invasive Species Management Plan. Where necessary, further control measures may be required.
Section 7: Land and Soils (Including Waste)			
-	Construction	-	None
-	Operational	-	None
Section 8: Air and Climate			
	Construction	Dust Monitoring	During the construction phase, dust deposition monitoring will be put in place to ensure dust mitigation measures are adequately controlling emissions. Dust monitoring will be conducted using the Bergerhoff method in accordance with the requirements of the German Standard VDI 2119. The Bergerhoff Gauge consists of a collecting vessel and a stand with a protecting gauge. The collecting vessel is secured to the stand with the opening of the collecting vessel located approximately 2 m above ground level. The TA Luft limit value is 350 mg/(m^2*day) during the monitoring period which is between 28 - 32 days.

Monitoring Measure No.	Construction / Operational Stage	Impact / Topic	Monitoring Requirements
-	Operational	-	None
Section 9: Noise and Vibration			
C.9.1	Construction	Noise and Vibration	It is recommended that the appointed contractor monitor levels of noise and vibration at nearby sensitive locations and/or development site boundaries.
O.9.1	Operational	Site operational noise	In the operational phase, and as part of the sites Licence to operate (i.e. IEL / IED), noise levels will be required to be monitored annually in accordance with the EPA *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities* (NG4).
Section 10: Odour			
O.10.1	Operational (post commissioning)	Odour Monitoring	Post commissioning olfactometry survey for the following sources Converted AGS reactor for all three operational phases; Secondary Treatment Upgrade; BnM OCU 1, 2 and 3, which were at the time of the most recent sampling, not fully commissioned or connected to all proposed odour sources; and Any existing OCU that is modified in any way as to accommodate processes forming part of the Proposed WwTP Component. All testing to be conducted on the following schedule/basis Survey to be undertaken after full commissioning of the source/OCU (maximum 6 months after commissioning); Surveys will persist on a 6 month basis until two concurrent tests are shown to be below the stated target level. Note: compliance required with both the outlet odour concentration $ou_{E.}m^{-3}$ and odour emission rate $ou_{E.}s^{-1}$ targets; Odour analysis undertaken by a nationally or internationally accredited laboratory including accreditation to the EN 13725 European standard for odour analysis; and Surveys would be considered void if conducted during periods of low odour generation, i.e. persistent cold weather and large-scale precipitation events.
O.10.2	Operational (post commissioning)	Odour Monitoring	Any breaches of target levels should be highlighted as an operation concern in line with a commitment to maintain and minimise odour emissions from the Ringsend WwTP on a long-term basis. The following operator responses are proposed based on the result of the post-commissioning testing (three cycles). In the event that the newly commissioned source meets the stipulated target level

Monitoring Measure No.	Construction / Operational Stage	Impact / Topic	Monitoring Requirements
			The source should be added to the odour monitoring schedule indicated in the current Ringsend OMP In the event that the newly commissioned source meets the target level Option a) an engineering or process solution should be sought to address the elevated emissions. Further monitoring would be required post improvement to confirm that the target levels are met. Option b) A full site odour modelling assessment is presented to show that an elevated emission from the source does not result in a predicted impact at any receptor location This post-commissioning monitoring is presented in addition to the schedule of monitoring proposed as part of the Ringsend WwTP OMP. The current testing schedule in relation to olfactometry analysis is summarised in Section 10.6.2 if this Volume of the EIAR.
Section 11: Cultural Heritage			
C.11.1	Construction	Piles	Where CFA piles are bored through the made ground and may impact potential archaeology associated with the old ground beneath, they will be archaeologically monitored.
C.11.2	Construction	Excavations	Where construction compounds requiring any sub-surface works to provide areas of hard standing are developed within the area of the Pigeon House Fort, Pigeon House Harbour and in the area with potential trash deposits to the south of the fort walls, any excavation work will be archaeologically monitored.
C.11.3	Construction	Excavations	The site preparation within the interior of the Pigeon House Fort will require topsoil stripping for the access road and has the potential to uncover material associated with the fort and will be monitored by a suitably qualified archaeologist.
C.11.4	Construction	Excavations	Where construction of hard standing for cranes requires any sub-surface works within the area of the Pigeon House Fort and in the area with potential trash deposits to the south of the fort walls, any excavation work will be archaeologically monitored.
-	Operational	-	None
Section 12: Material Assets			
-	Construction	-	None
-	Operational	-	None
Section 13: Traffic			
-	Construction	Traffic Flow and Construction Traffic	Traffic flow and vehicle queue lengths at the Sean Moore Junction and the Point Depot junction shall be monitored as part of the Detailed Traffic Management Plan process and restrictions shall be placed on the

Monitoring Measure No.	Construction / Operational Stage	Impact / Topic	Monitoring Requirements
			movement of construction related traffic if deemed necessary by Dublin City Council and/or an Garda Síochána.
-	Operational	-	None
Section 14: Landscape			
C.14.1	Construction	Landscape Related Works	Monitoring of landscape-related works is an integral aspect of the Proposed WwTP Component, and includes monitoring of: Tree and hedgerow removal, retention and protection; Topsoil stripping and storage; Disturbance by site works, services etc.; Excavation / alteration of ground levels; Landscape build-up; profiling and cultivation; Landscape finishing and implementation; Proposed planting and grass seeding; and 12 months aftercare of landscape measures. All works associated with soil stripping and movement; landscape build-up and finishing and landscape implementation shall be approved and monitored by a qualified Landscape Architect.
-	Operational	-	None
Section 15: Risk Management			
C/O.15.1	Construction and Operational	Risk Assessment	The Environmental Incident Response Plan is a live document that undergoes periodic monitoring, review and update throughout the lifetime of a project. The risk management and assessment of major accidents and/or disasters will be continued on an ongoing basis throughout the planning, design, construction and operational phases of the Proposed WwTP Component. Activities on site will be monitored to ensure risk does of major accidents does not increase over time on the site.

Section 18: Summary of Residual Impacts

This Section collates and summarises the residual impacts predicted in Section 3 to Section 14 of this Volume of the EIAR resulting from the Ringsend WwTP component of the Proposed Upgrade Project (hereinafter: “the Proposed WwTP Component”).

Full details of the Proposed Upgrade Project and the Ringsend WwTP component can be found in Volume 2, Section 3: Description of Proposed Upgrade Project.

The residual impacts are the impacts that remain following the implementation and incorporation of the mitigation measures and environmental commitments summarised in Section 17. Ideally, in cases where a negative impact has been predicted, the residual impact following the implementation of mitigation measures and good construction practice will be “Neutral”. However, in a few isolated cases, despite the fact that steps have been taken to minimise the impact, a residual negative impact remains. Where an impact is positive no mitigation is required.

The WwTP is currently operating over its capacity and the effluent quality is in breach of the European UWWT directive. Consequently, the completion of the Proposed WwTP Component will have a positive impact in terms of the surrounding environment and compliance with European Legislation.

On the basis of the assessment of potential impacts and the recommended mitigation measures in this EIAR, the Proposed WwTP Component is not likely to impose any significant adverse effects on the environment. Table 18-1 below lists the residual impacts (both positive and negative) of the Proposed WwTP Component following mitigation. The majority of impacts on the environment are either non-existent or of imperceptible/slight significance.

Table 18-1: Summary of Residual Impacts

Environmental Element	Stage	Residual Impact	Significance
Section 3: Population	Construction	Resident population: Nuisance associated with construction activities. (Note resident population are >650 metres from WwTP site.	No significant impact
		Working Population: Opportunities for up to an estimated 150 construction workers	Positive, Short-term
		Visiting Population: Nuisance associated with construction activity detracts from amenity value of public walkways close to the WwTP site.	Short-term, Slight Negative
	Operational	Resident population: The Proposed WwTP Component will facilitate the re-development of the Poolbeg West SDZ comprising of up to 3,000 - 3,500 new homes on a phased basis	Positive, Significant
		Working Population (local): 15 No. additional employees at the Ringsend WwTP facility Working Population (Regional): The targeted growth of population within the region will be facilitated by the Proposed WwTP Component.	Neutral Significant indirect and positive impact
		Visiting Population: Impact of altered boundary treatment at the southern and eastern boundaries of the Proposed WwTP Component on walkers and cyclists	Slight/neutral, Adverse, Long-term
		Overall: The increased treatment infrastructural capacity will facilitate growth within the catchment area, thus creating opportunities for employment and new housing	Significant, Positive, Long-term
Section 3: Human Health	Construction	No impacts predicted on Human Health associated with the construction Phase of the Proposed WwTP Component	Neutral
	Operational	No impacts predicted on Human Health associated with the operational Phase of the Proposed WwTP Component	Neutral
Section 4: Water	Construction	During the winter of 2019/2020 there will be minor disimprovement in the water quality of the receiving waters	Negative, Imperceptible, Temporary
	Operational	Improvement in effluent quality will result in an improvement in the receiving water quality	Positive, Slight, Long-term
Section 5: Biodiversity - Terrestrial	Construction	None	Neutral
	Operational	The removal of Invasive Species	Slight positive, long term

Environmental Element	Stage	Residual Impact	Significance
Section 6: Biodiversity - Marine	Construction	Inner Dublin Bay, (the Tolka estuary and the lagoons off North Bull Island): There will be a reduction in discharged nutrients and suspended solids and as a result, benthic diversity, will have a positive impact on bird and marine mammals that forage	Neutral, Positive, Imperceptible
	Operational	Outer Dublin Bay (the sandflats off Bull Island and those areas south of the Great South Wall): Habitats there will remain unaffected	Neutral, Imperceptible
Section 7: Land and Soils	Construction	Positive impacts from the removal of contaminated soils and invasive species	Neutral, Positive
	Operational	None	Neutral, Positive
Section 8: Air and Climate	Construction	Generation of dust and construction traffic emissions	Neutral, Imperceptible
	Operational	Impacts on Climate and Air quality	Neutral, Imperceptible, Long-term and therefore Not Significant
Section 9: Noise and Vibration	Construction	Impacts from simultaneous construction noise of the Proposed WwTP Component and any external developments in the immediate vicinity of the site	Negative, Slight, Short-term
	Operational	Noise models predict noise levels in the region of 15 dB to 35 dB at nearby residential receptors. Such levels are at or below existing background noise levels and well below the 45 dB threshold set out in the British Standard BS8223:2014	Insignificant
Section 10: Odour	Construction	None	None
	Operational	The predictive modelling exercise has shown that Odour levels will not be perceptible at the nearest Sensitive receptor	Neutral
Section 11: Cultural Heritage	Construction	No residual impacts predicted on the Cultural Heritage environment	Neutral
	Operational	No residual impacts predicted on the Cultural Heritage environment	Neutral
Section 12: Material Assets	Construction	There are no negative impacts predicted on Material Assets as part of the construction phase	Neutral
	Operational	Positive impacts are anticipated as development which would previously have been constrained due to a lack of wastewater treatment capacity will be possible	Significant, Positive, Permanent
Section 13: Traffic	Construction	Increase in traffic volumes on adjoining roads and junctions causing nuisance to road users during the peak construction period	Slight, Negative, Short-term

Environmental Element	Stage	Residual Impact	Significance
	Operational	Increase in traffic volumes on adjoining roads	Slight, Negative, Long-term
Section 14: Landscape	Construction	Immediate landscape: Major construction activity, bund removal (eastern boundary), cranes and earthworks	Moderate, Negative, Temporary/Short-term
		Wider landscape: Construction activity and primarily the use of cranes on Poolbeg Peninsula	Slight, Negative, Short-term
	Operational	Immediate landscape	Neutral, Imperceptible/Slight, Permanent
		Wider landscape	Neutral, Imperceptible, Permanent

Section 19: Cumulative Impacts

19.1 Introduction

This Section considers the potential cumulative impacts and resulting effects arising from the WwTP Component of the Proposed Upgrade Project (hereinafter: "the Proposed WwTP Component") when considered in combination with other existing and/or approved projects.

Full details of the Proposed Upgrade Project and the Ringsend WwTP component can be found in Volume 2, Section 3: Description of Proposed Upgrade Project.

This Section provides a summary description of cumulative impacts and/or effects identified within Sections 3 to 15 of this Volume of the EIAR and provides a reference to the relevant Section where the potential impact and/or effect has been assessed.

19.2 Methodology

19.2.1 Legislative Context and Guidelines

The cumulative impact assessments have been undertaken by each specialist, as outlined in each relevant Section of this EIAR. The assessments have been undertaken in accordance with the following legislation and guidelines:

19.2.1.1 Legislation

Article 3(1) and Annex III of the EIA Directive (2014/52/EU) confirms that the likely significant effects on the environment must be considered with regard to the impact of any project.

- Annex III (3)(g) includes for: "the cumulation of the impact with the impact of other existing and/or approved projects"; and
- Annex IV(5)(e) includes for a description of the likely significant effects of the project on the environment resulting from inter alia: "*the cumulation of effects with other existing and/or approved projects, taking into account any existing environmental problems relating to areas of particular environmental importance likely to be affected or the use of natural resources*".

19.2.1.2 Guidelines

The cumulative impact assessments have been undertaken in accordance with the following guidelines:

- EPA (2017) Revised Guidelines on the Information to be contained in Environmental Impact Assessment Reports, (Draft);
- EPA (2015) Advice Notes on Current Practice in the Preparation of Environmental Impact Statements, (Draft);
- EC (1999) European Commission Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions; and
- EU (2017) Preparation of guidance documents for the implementation of EIA Directive 2011/92/EU as amended by 2014/52/EU.

The EU Guidelines (2017) define cumulative impacts as "*Changes to the environment that are caused by activities/projects in combination with other activities/projects.*" The EU 1999 guidelines provide further detail, describing cumulative impacts as "*Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project.*"

The EC Guidelines (1999) also considers 'Indirect Impacts' as well as 'Impact Interactions' in addition to 'Cumulative Impacts' and states that the three types of impact overlap. For the purposes of this assessment, these impacts were considered as follows:

- Indirect Impacts: Impacts on the environment that are not a direct result of the Proposed WwTP Component; and
- Impact Interactions: Where two impacts have the potential to interact to create a new type of impact.

Indirect Impacts and Impact Interactions have been considered in the cumulative impact assessments.

It is noted that both the Directive and the Guidelines refer to both 'impacts' and 'effects' and these terms can often be used interchangeably. For clarity, this section follows the general consensus in considering 'impacts' as the changes resulting from the provision of a project, and 'effects' are defined as the consequences of identified impacts.

19.2.2 Identification of other Plans/Projects

The Proposed WwTP Component has been described in detail in Volume 2, Section 3: Description of Proposed Upgrade Project of this EIAR. The nature of the existing environment that surrounds the Proposed WwTP Component is provided in Volume 3, Section 1: Existing Environment of this EIAR. Potential impacts associated with the Proposed WwTP Component have been identified and described under the relevant 'impact' sections of this Volume of the EIAR. In accordance with the EPA Draft 2017 Guidelines, a scoping exercise was undertaken to identify existing and/or approved projects with the potential for cumulative impacts, considering any existing environmental problems relating to areas of environmental importance likely to be affected or the use of natural resources.

The scoping process considered three categories of projects based on the following:

- Existing or commenced projects with a valid planning permission within the vicinity of the Proposed WwTP Component site that possess the potential for significant cumulative effects with the Proposed WwTP Component;
- Approved projects with a valid planning permission but have not commenced construction within the vicinity of the Proposed WwTP Component site with the potential for significant cumulative effects with the Proposed WwTP Component; and
- Proposed projects that do not have planning permission but are considered integral to the Proposed WwTP Component.

Examples of projects include power stations, industrial developments, Seveso sites, other major infrastructure developments, other Strategic Infrastructure Developments (SID), or public utilities and services within the vicinity of the Proposed WwTP Component.

There are a number of existing and/or approved third party projects in the vicinity which have been identified that have the potential to interact with the Proposed WwTP Component. These projects are being included here as they could result in cumulative impacts arising.

The scope of this cumulative impact assessment was informed by the Scoping Report prepared as part of this EIAR. Projects that have been identified for consideration include (see Table 19-1):

- Dublin Waste to Energy - ABP Reg. Ref. PL29S.EF2022;
- West of the Waste to Energy Site (ESB) - Reg. Ref. 2234/17;
- Alexandra Basin Redevelopment - ABP Reg. Ref. PL29N.PA0034;
- ESB Site Poolbeg Power Station, Pigeon House Road, Ringsend, Dublin 4;
- National Oil Reserves Agency, Reg. Ref. 2656/16;
- Greater Dublin Drainage - ABP Reg. Ref. PL06F.PC0152; and
- Poolbeg West SDZ (Currently on Appeal to An Bord Pleanála).

Table 19-1: Projects Considered in Cumulative Impact Assessment

Discipline	Projects						
	Dublin Waste to Energy	Alexandra Basin	Poolbeg West SDZ	GDD	Dublin Bay Power	Poolbeg Power Station	NORA
Traffic	✓	✓	✓	×	✓	✓	✓
Water	✓	✓	×	✓	✓	✓	✓
Landscape	✓	×	×	×	✓	×	✓
Biodiversity Marine	×	×	✓	✓	×	×	×
Biodiversity Terrestrial	✓	✓	✓	×	✓	✓	✓
Air and Climate	✓	✓	✓	×	✓	✓	✓
Noise and Vibration	✓	✓	×	×	✓	✓	✓
Odour	×	×	×	×	×	×	×
Cultural Heritage	×	×	×	×	×	×	×
Population and Human Health	✓	✓	✓	×	✓	✓	×
Land and Soils	×	×	×	×	×	×	×
Material Assets	×	×	×	×	×	×	×

✓ denotes potential cumulative impact
× denotes no potential cumulative impact

19.3 Assessment of Cumulative Impacts, Indirect Impacts and Impact Interactions

19.3.1 Population and Human Health

The cumulative impacts for Population and Human Health have been considered in Section 3.7 of this EIAR. The assessment confirms that the planned construction programme for the Proposed WwTP Component may overlap with works relating to elements of the Poolbeg West SDZ lands, if granted. It is not anticipated at this time that this will give rise to a direct impact on the growth of the residential working and visiting populations.

Indirectly however, the resident population, especially those along Beach Road/Strand Road and Sean Moore Road will be aware of this cumulative construction activity which is further discussed under the Traffic Assessments of this EIAR.

The likely cumulative impact of the Proposed WwTP Component during construction is, in general, that the local working population will benefit from the existing employment and services in the vicinity of the site creating a positive indirect impact for the local area.

The likely cumulative impact of the Proposed WwTP Component is that the resident population of the Greater Dublin Area will be capable of growing to its target population levels over time due to the increased capacity of the Ringsend WwTP. This will enable objectives at both national and regional level to be met. This is a significant indirect and positive impact of the Proposed WwTP Component.

No cumulative impacts with the potential to give rise to significant adverse effects on Human Health have been identified.

19.3.2 Water

The Scoping process for assessing water quality identified known projects that would need to be included as part of the cumulative impact assessment with wastewater discharge from the Ringsend Wastewater Treatment Plant. These are:

- Dublin Waste to Energy Plant, which has a cooling water discharge into the Lower Liffey Estuary;
- Greater Dublin Drainage Project, which is proposed to discharge another WwTP final effluent to the north-east of Ireland's Eye;
- Alexandra Basin Redevelopment, which is a redevelopment of a Dublin Port dock; and
- Poolbeg Cooling Water Channel - (Sheet-Pile Repairs), which is the discharge point for the Ringsend WwTP.

The nature and typical volume of each of these sources were integrated into the water model as detailed in Section 7.2.4 of Appendix 4A. The output of the model and subsequent analysis demonstrates that there is no significant difference between the future hydrodynamic environment as modelled and any of the 3 projects individually assessed for cumulative impacts. There is some minor interaction with the Poolbeg Cooling Water Channel project, whereby there appears to be a minor increase in the interaction with the Tolka Estuary, but it is not considered to be significant. The assessment concludes that there is no cumulative impact between the Proposed WwTP Component and the other three projects. There are no further plans or projects that are likely to give rise to significant environmental effects.

19.3.3 Biodiversity - Marine

The primary potential impact on marine ecology results from water quality, which as confirmed above, includes a cumulative impact in its overall assessment. No other cumulative impacts have been identified.

19.3.4 Biodiversity - Terrestrial

The Biodiversity Terrestrial assessment considers potential direct and indirect impacts resulting from the Proposed WwTP Component. There are no direct cumulative impacts associated with the Proposed WwTP Component. The assessment also considers potential effects resulting from Dust, Water Quality, Traffic - all of which have a cumulative impact integrated into the assessment.

The assessment does confirm that the Proposed WwTP Component will not give rise to impacts on water populations, however cumulative medium and long-term changes to waterbird numbers may become more difficult to discern, as they may become part of cumulative changes arising from other factors such as disturbance from non-related projects or climate change.

19.3.5 Land and Soils

The predicted overall residual impact of the Proposed WwTP Component on land, soils, geology and hydrogeology both during the construction and operational stages will be neutral or positive. As the impacts are neutral, there are no cumulative impacts with other projects predicted.

19.3.6 Air and Climate

There are a number of other significant developments in the vicinity of the Proposed WwTP Component which have been granted planning permission. These include large scale developments such as Dublin Port and the Poolbeg West Strategic Development Zone.

Should the construction phases of the Proposed WwTP Component overlap with these permitted developments, it is predicted that appropriate mitigation measures can be put in place to reduce any potential impacts such that they are considered to be not significant.

Cumulative effects of the operational phase have been assessed, as recommended in the EU Directive on EIA (Council Directive 97/11/EC) and using the methodology of the UK DEFRA. Any schemes that are predicted to be in place during the future year have been included in future traffic increases, as significant increases in vehicle emissions due to other developments have the potential to increase background concentrations and therefore raise the significance of impact due to the scheme.

There are no further cumulative impacts associated with Air and Climate.

19.3.7 Noise and Vibration

The noise impact assessment considers an existing baseline survey, which includes cumulative emissions from all sources in the local area. The assessment then compares predicted emissions to that cumulative baseline measurement. The assessment concludes that there are no cumulative impacts with other projects predicted. All residual impacts are predicted to be neutral or positive.

Construction Phase

As the predicted impacts to the environment are slight in the short term, the cumulative impacts from simultaneous construction of Proposed WwTP Component and any external developments in the immediate vicinity of the site are deemed to be short-term and slight with appropriate mitigation measures put into place.

Operational Phase

The potential cumulative impact of the Proposed WwTP Component, when considered in the context of proposed but not yet constructed developments is deemed to be insignificant once appropriate mitigation measures are put into place.

With respect to recently completed developments, it is noted that the baseline survey was completed in advance of the commissioning of the Dublin Waste to Energy facility (DWtE). Compliance monitoring data for this site has been reviewed to determine potential cumulative noise impacts. The monitoring report indicates the site is compliant with its permitted noise limits. As such, the cumulative impacts arising are deemed to be insignificant once appropriate mitigation measures are put into place.

19.3.8 Odour

As the site is an existing facility, the assessment has focused on the incremental change in odour conditions as a result of the changes to on-site processes. The assessment predicted that the Proposed WwTP Component is likely to result in a minor beneficial reduction of odour concentrations in the local area. As such, the impact of odours from other external sources was not specifically considered in this assessment.

The Proposed WwTP Component is however, located in an area designated for industrial and port uses. Upon review of the industrial facilities in the immediate vicinity of the Ringsend WwTP, there are facilities which could contribute to baseline odour concentrations at receptor locations.

One such facility is the DWtE facility which uses municipal waste as a feedstock for power generation. Without suitable odour containment and management procedures, odour can be emitted from the stockpiling and processing of wastes. The 2006 Environmental Impact Statement for the DWtE facility indicated that odours will be eliminated through the design of the facility.

The assessment also considered future baseline emissions from the Proposed WwTP Component, which will be an improvement on current levels due to the recent or soon to be completed programme of odour improvements and provision of three new OCUs. No specific cumulative impact assessment has been undertaken, however in the context of the assessment results, the amenity of areas of long-term public exposure will be no worse as a result of the Proposed WwTP Component.

The assessment team is unaware of any plans for new odour producing sources in the vicinity of the WwTP and as such, the future trends in baseline odour conditions, excluding the WwTP are likely be similar to current levels. There is also potential for natural odour sources in a marine environment including biodegradation of organic matter such seaweed or algae.

19.3.9 Cultural Heritage

No interactive or cumulative impacts on cultural heritage have been identified.

19.3.10 Material Assets

No interactive cumulative impacts on material assets have been identified.

19.3.11 Traffic

The assessments contained in Section 13, are based on the current traffic flow conditions with the cumulative impacts of Dublin WtE Facility (currently operational), Alexandra Basin Redevelopment and the Poolbeg West SDZ taken into account.

Both the construction phase and operational phase scenarios were developed by factoring up the baseline 2017 model to 2020, 2028 and 2035. Traffic associated with the Proposed WwTP Component, Dublin WtE Facility (currently operational), the Poolbeg West SDZ and the Alexandra Basin Redevelopment were also applied to the network. It has been assumed that the Poolbeg West SDZ will be under construction in the 2020 scenario and be fully operational during the 2028 scenario without any trip attenuation associated with public transport measures in the surrounding area. This presents a "Worst-Case" scenario; however, it is anticipated that in line with the Dublin City Council Development

Plan, 2016-2022, the development of this site will be undertaken in a phased manner, with early provision of public transport infrastructure which include the provision of a new public transport bridge crossing the Grand Canal/Dodder River on Sir John Rogerson's Quay and the extension of the Luas Red Line to Poolbeg. These interventions will reduce the impact of the adjoining developments on the local road network. It is anticipated that a limit will be placed on the amount of development allowable before the provision of the Dodder Public Transport Bridge, however the impact of these limits has not been assessed.

19.3.12 Landscape

The building of the new SBR tanks will change the existing views and landscape. The photomontages shown in Section 14: Landscape include the completed Dublin Waste to Energy (WtE) building and consequently it is the cumulative effect that is being addressed. The presence of the much larger WtE building alongside the proposed AGS Cells presents the cumulative effect. The assessment concludes that the Proposed WwTP Component is less significant when considered in the cumulative context.

19.3.13 Risk

Cumulative impacts have been integrated into the Risk Assessment section and are detailed in Section 15: Risk Management of this EIAR.

19.3.14 Cumulative Impacts with the Proposed RBSF Component and GDD Project

Cumulative impacts specific to the Proposed WwTP Component's relationship with the Proposed RBSF Component and the GDD project is considered in Volume 4, Section 19: Cumulative Impacts of this EIAR.

19.4 Conclusion

This EIAR has considered potential cumulative impacts arising from the construction and operation of the Proposed WwTP Component in accordance with the EIA Directive and corresponding guidelines. It has done so mainly through the integration of cumulative impacts in the undertaking of baseline surveys and the development of models that assess emissions that relate to Water, Odour, Noise, Air Quality and Traffic.

The Proposed WwTP Component is not likely to give rise to any significant or interactive cumulative impacts.

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TJ O'CONNOR & ASSOCIATES
CONSULTING ENGINEERS

BARRY & PARTNERS
consulting engineers

Royal HaskoningDHV
Enhancing Society Together