Greater Dublin Drainage Project

Irish Water

Environmental Impact Assessment Report: Volume 3 Part A of 6

Chapter 17 Hydrology and Hydrogeology

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17. Hydrology and Hydrogeology

The construction and operation of the Greater Dublin Drainage Project (hereafter referred to as the Proposed Project) has been reviewed in relation to the impacts on the hydrological and hydrogeological environments, and includes:

Hydrology:
The principal potential impacts of the construction and operation of the Proposed Project concern flooding (proposed Wastewater Treatment Plant and Abbotstown pumping station sites and increased risk of flooding in the surface water network) and the deterioration of water quality due to runoff containing polluting substances. The hydrological attributes of the baseline environment are of low/medium importance, with the exception of the Baldoyle Estuary Special Area of Conservation which is regarded as having high importance.

The Proposed Project has been designed to ensure that the risk of these impacts is minimised. The proposed Abbotstown pumping station site and the proposed Wastewater Treatment Plant will be built on sites that fall within the Flood Zone C category (low risk). Sustainable Drainage Systems principles to attenuate surface water runoff will be incorporated at the proposed Wastewater Treatment Plant site and the proposed Abbotstown pumping station, thus limiting the peak runoff to greenfield rates. There will be no interference or development in the floodplain adjoining these sites. A Construction Environmental Management Plan, including Pollution Control Plans, Emergency Response Plans and Method Statements, will be agreed with the appointed contractor(s), enforcing the CIRIA Guidelines on the control of water from linear construction projects (CIRIA 2006).

Hydrogeology:
The principal potential impacts of the Proposed Project on the hydrogeological environment concern the alteration of the groundwater flow regime (potential deterioration in well yields) and deterioration in groundwater quality. There will be no discharge to, or abstraction of, groundwater apart from possible temporary dewatering to enable construction. The aquifers underlying the Proposed Project are locally important and poor. There are no public water supply wells in the vicinity. The surrounding area is served by water mains and domestic groundwater users are few. The golf clubs on the Portmarnock Peninsula use shallow groundwater wells for irrigation.

The principal risk is due to fugitive emissions of contaminants (accidental spillages/leaks). The risk to the groundwater environment is mitigated in the design of the Proposed Project. The proposed pipeline routes will be constructed and designed to reduce the risk of leaks and failure. Strict compliance with the CIRIA Guidelines on the control of water from linear construction projects (CIRIA 2006) will be enforced. A Construction Environmental Management Plan including Pollution Control Plans, Emergency Response Plans and Method Statements will be agreed with the appointed contractor(s). Potential impacts on the irrigation wells of on the Portmarnock Peninsula will be mitigated by avoidance in the design of the proposed outfall pipeline route (marine section). This will be tunnelled in bedrock beneath Baldoyle Estuary and Portmarnock Peninsula. The stiff boulder clay in the overburden will act as a barrier between the groundwater in the rock and the groundwater in the dune sands from which the irrigation wells draw their water.

The construction and operation of the Proposed Project (incorporating design embedded and prescribed mitigation measures) will have a Neutral imperceptible impact on the hydrogeological and hydrological environments.

17.1 Introduction

This Chapter considers and assesses the potential for likely significant impacts on hydrology and hydrogeology arising from the proposed Greater Dublin Drainage Project (hereafter referred to as the Proposed Project) anticipated to occur during the Construction Phase and the Operational Phase.

The Proposed Project will form a significant component of a wider strategy to meet future wastewater treatment requirements within the Greater Dublin Area as identified in a number of national, regional and local planning policy documents. The plant, equipment, buildings and systems associated with the Proposed Project will be designed, equipped, operated and maintained in such a manner to ensure a high level of energy performance and energy efficiency.

The table below includes a summary of the Proposed Project elements. A full description of the Proposed Project is detailed within Volume 2 Part A, Chapter 4 Description of the Proposed Project and Figure 4.1 of Volume 5 of this Environmental Impact Assessment Report (EIAR).

Proposed Project Element	Outline Description of Proposed Project Element
Proposed Wastewater Treatment Plant (WwTP)	• WwTP to be located on a 29.8 hectare (ha) site in the townland of Clonshagh (Clonshaugh) in Fingal. • 500,000 population equivalent wastewater treatment capacity. • Maximum building height of 18m. • Sludge Hub Centre (SHC) to be co-located on the same site as the WwTP with a sludge handling and treatment capacity of 18,500 tonnes of dry solids per annum. • SHC will provide sustainable treatment of municipal wastewater sludge and domestic septic tank sludges generated in Fingal to produce a biosolid end-product. • Biogas produced during the sludge treatment process will be utilised as an energy source. • Access road from the R139 Road, approximately 400m to the southern boundary of the site. • Egress road, approximately 230m from the western boundary of the site, to Clonshaugh Road. • A proposed temporary construction compound to be located within the site boundary.
Proposed Abbotstown pumping station	• Abbotstown pumping station to be located on a 0.4ha site in the grounds of the National Sports Campus at Abbotstown. • Abbotstown pumping station will consist of a single 2-storey building with a ground level floor area of 305m^2 and maximum height of 10m and a below ground basement 17m in depth with floor area of 524m^2 incorporating the wet/dry wells. • The plan area of the above ground structure will be 305m^2 and this will have a maximum height of 10m. • A proposed temporary construction compound to be located adjacent to the Abbotstown pumping station site.
Proposed orbital sewer route	• The orbital sewer route will intercept an existing sewer at Blanchardstown and will divert it from this point to the WwTP at Clonshagh. • Constructed within the boundary of a temporary construction corridor. • 13.7km in length; 5.2km of a 1.4m diameter rising main and 8.5km of a 1.8m diameter gravity sewer. • Manholes/service shafts/vents along the route. • Odour Control Unit at the rising main/gravity sewer interface. • Proposed temporary construction compounds at Abbotstown, Cappoge, east of Silloge, Dardistown and west of Collinstown Cross to be located within the proposed construction corridor.
Proposed North Fringe Sewer (NFS) diversion sewer	• The NFS will be intercepted in the vicinity of the junction of the access road to the WwTP with the R139 Road in lands within the administrative area of Dublin City Council. • NFS diversion sewer will divert flows in the NFS upstream of the point of interception to the WwTP. • 600m in length and 1.5m in diameter. • Operate as a gravity sewer between the point of interception and the WwTP site.
Proposed outfall pipeline route (land based section)	• Outfall pipeline route (land based section) will commence from the northern boundary of the WwTP and will run to the R106 Coast Road. • 5.4km in length and 1.8m in diameter. • Pressurised gravity sewer. • Manholes/service shafts/vents along the route. • Proposed temporary construction compounds (east of R107 Malahide Road and east of Saintdoolaghs) located within the proposed construction corridor.
Proposed outfall pipeline route (marine section)	• Outfall pipeline route (marine section) will commence at the R106 Coast Road and will terminate at a discharge location approximately 1km north-east of Ireland's Eye. • 5.9km in length and 2m in diameter. • Pressurised gravity tunnel/subsea (dredged) pipeline. • Multiport marine diffuser to be located on the final section. • Proposed temporary construction compounds (west and east of Baldoyle Bay) to be located within the proposed construction corridor.
Proposed Regional Biosolids Storage Facility	• Located on an 11ha site at Newtown, Dublin 11. • Maximum building height of 15m. • Further details and full impact assessment are provided in Volume 4 Part A of this EIAR.

The total Construction Phase will be approximately 48 months, including a 12 month commissioning period to the final Operational Phase. The Proposed Project will serve the projected wastewater treatment requirements of existing and future drainage catchments in the north and north-west of the Dublin agglomeration, up to the Proposed Project's 2050 design horizon.

Please note that the hydrology and hydrogeology impact assessment of the proposed RBSF aspect of the Proposed Project is addressed in Chapter 4 Water in Volume 4, Part A of this EIAR.

The proposed WwTP, SHC, orbital sewer route, Abbotstown pumping station, NFS diversion sewer and outfall pipeline route (land based section), shall be collectively referred to as the proposed WwTP and associated pipeline routes (refer to Figure 17.1 Proposed Pipeline Routes (Sub Divided)), unless specific reference is required for a particular Proposed Project element.

The proposed outfall pipeline route (marine section) and marine diffuser shall be collectively referred to as the proposed outfall pipeline route (marine section). This element is not assessed in this Chapter, but is assessed in Chapter 8 Marine Water Quality.

The proposed orbital sewer route and outfall pipeline route (land based section) will generally be constructed using open cut methods, with the exception of a tunnelled section in the vicinity of Connolly Hospital which will be routed to the proposed Abbotstown pumping station. Trenchless techniques will be used at road and watercourse crossing points. The proposed Abbotstown pumping station and proposed WwTP will consist of buildings, tanks for retaining water, pipelines and process/mechanical equipment. Construction will include general excavations, some deep excavations with appropriate supports, and general civil, mechanical and electrical works.

A Flood Risk Assessment (FRA) has been prepared for the permanent works. This has been carried out in accordance with *The Planning System and Flood Risk Management* (FRM) guidelines (hereafter referred to the FRM Guidelines) published in November 2009 jointly by the Department of the Environment, Heritage and Local Government (DoEHLG) (this has since changed to the Department of the Environment, Community and Local Government) and the Office of Public Works (OPW) (DoEHLG and OPW 2009). The FRA is included in Appendix A17.1.

There will be no discharges to, or abstraction from, groundwater for the Proposed Project, apart from possible temporary dewatering to enable construction.

17.2 Methodology

The methodology employed in compiling this Chapter of the EIAR incorporates the *Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports* by the Environmental Protection Agency (EPA) (EPA 2017), the *Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements* by the Institute of Geologists of Ireland (2013) and *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes* (National Roads Authority (NRA) (NRA 2009)[1]).

The proposed orbital sewer route and outfall pipeline route (land based section) as well as the proposed WwTP and Abbotstown pumping station are shown in Figure 17.1 Proposed Pipeline Routes (Sub-Divided).

The assessment was undertaken as follows:

- The existing baseline environment was described in terms of its attributes. Data were gathered from desk studies, site visits, public consultation and domestic well surveys;

[1] Now Transport Infrastructure Ireland (TII)

- Importance criteria were selected for attributes that reflect the hydrological and hydrogeological environments. These are listed in Table 17.1;
- The attribute importance was evaluated on the basis of the existing baseline data and the criteria in Table 17.1;
- The impacts of the Proposed Project (during both the Construction Phase and Operational Phase) on these attributes were described and considered in terms of duration, the proportion of the attribute that was impacted (magnitude) and the likely significance of the impact; and
- Mitigation measures to minimise these impacts were proposed. The residual impacts were then reassessed.

17.2.1 Desktop Study

Information on the Proposed Project, in the form of maps, databases and reports, was provided by the design team throughout the development of the Proposed Project. Hydrological data were supplemented by the following online data from various websites and other sources:

- Hydrometric data from the OPW website (OPW 2018a);
- Historical flood data were obtained from the National Flood Hazard Mapping website (OPW 2018b);
- Flood extent maps (0.1% Annual Exceedance Probability (AEP) fluvial and tidal flood extent) from the *Fingal East Meath Flood Risk Assessment and Management Study* (FEM-FRAMS) (Halcrow Barry Consultants 2011);
- *Greater Dublin Drainage Study – Regional Wastewater Treatment Plant, Marine Outfall and Orbital Drainage System project, Flood Risk Assessment Report* (J.B. Barry and Partners 2014);
- Information on predicted fluvial and tidal flood levels was obtained from the FEM-FRAMS carried out by Halcrow Barry (Halcrow Barry Consultants 2011);
- The Preliminary Flood Risk Assessment maps were obtained from the Eastern Catchment Flood Risk Assessment and Management Study website (OPW 2018c);
- Tolka River flood maps were provided by DCC/RPS;
- Historical river data were obtained from *The Rivers of Dublin* (Sweeney 2017);
- *Greater Dublin Drainage Scheme Phase 1 Ground Investigation – Geotechnical Interpretative Report* (Arup 2013);
- *Greater Dublin Drainage Scheme Preliminary Ground Investigation Contract Phase 1 Ground Investigation* (IGSL 2013);
- *Greater Dublin Drainage Ground Investigation – Phase 2 Terrestrial Investigation* (Causeway Geotech 2016);
- Water quality data, River Basin Management Plans, Catchments and Designated Biodiversity sites were sourced from http://maps.epa.ie/internetmapviewer/mapviewer.aspx on the EPA website; and
- Site visits were undertaken which entailed visual inspections of the watercourses.

Information on the Hydrogeology has been obtained from the following sources:

- Geological Survey of Ireland (GSI);
- Zones of Contribution and Groundwater Source Wells from the EPA website (EPA 2018a);
- *Greater Dublin Drainage Scheme Preliminary Ground Investigation Contract Phase 1 Ground Investigation* (IGSL 2013);

- *Greater Dublin Drainage Scheme Phase 1 Ground Investigation – Geotechnical Interpretative Report* (Arup 2013);
- *Greater Dublin Drainage Ground Investigation – Phase 2 Terrestrial Investigation* (Causeway Geotech 2016);
- Report on the *Geophysical Investigation for GDDP Portmarnock Golf Course* (Apex 2016);
- Fingal County Council's (FCC's) data on groundwater wells and abstraction points; and
- Feedback from consultations with statutory consultees, interested organisations and affected third parties (see *Public Consultation Report on the Issues to be Considered in the Environmental Impact Statement* (RPS 2013).

17.2.2 Legislation

The following legislation has been considered during the preparation of this Chapter of the EIAR:

- Directive 2000/60/EC of 23 October 2000 of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy (Water Framework Directive (WFD));
- European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003) and amendments;
- European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272 of 2009);
- Local Government (Water Pollution) Acts 1977 to 1990;
- Directive 2006/118/EC of 12 December 2006 of the European Parliament and of the Council on the protection of groundwater against pollution and deterioration (Groundwater Directive);
- European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9 of 2010); and
- European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (S.I. No. 366 of 2016).

17.2.3 Stakeholder Consultation

During the public consultation period, a number of queries were raised in relation to hydrology and hydrogeology issues, including the flood risk to the proposed WwTP site, the effect of climate change on flood risk and groundwater quality (see *Public Consultation Report on the Issues to be Considered in the Environmental Impact Statement* (RPS 2013)). These issues are discussed in the FRA Report (Appendix A17.1) and summarised within the text below.

Portmarnock Golf Club expressed concerns regarding the impact of the proposed tunnelled outfall on their irrigation wells. The proposed outfall pipeline route (marine section) will be tunnelled beneath Portmarnock Golf Club.

17.2.4 Groundwater Supplies – Surveys and Questionnaires

The Proposed Project invited owners of groundwater wells to identify themselves via a designated website. The properties identified from the process as having wells which were located within a 1km radius of the proposed WwTP were visited to confirm the presence and location of the groundwater wells and to establish the purpose of these wells (i.e. for potable water supply or for irrigation/agriculture) (refer to Figure 17.2 Groundwater Supply Well Information Supplied by the Public).

Furthermore, groundwater questionnaires were provided to the property owners which were used to ascertain the purpose of the wells. The results of this questionnaire are tabulated in Appendix A17.2. The entire area near the proposed WwTP and proposed Abbotstown pumping station and associated pipeline routes is serviced by mains water.

17.3 Attributes

The baseline environment is described in terms of the hydrological and hydrogeological attributes.

17.3.1 Hydrological Attributes

In considering the impact of the Proposed Project on the hydrological environment, the proposed WwTP site, Abbotstown pumping station and associated pipeline routes and their environs should be considered in terms of sensitive surface water receptors and potential impacts upon them. This hydrological assessment is concerned with potential impacts on the surface water regime.

The baseline hydrological environment was reviewed on the basis of the following attributes:

- **Water Quality** – The WFD water quality status provides an indication of the importance of the water body and its biological health;
- **Potable Water Supplies from Surface Water Abstractions** – There are no potable water supply abstractions from the surface water bodies near the proposed WwTP and associated pipeline routes;
- **Area Prone to Flooding** – The review of existing datasets to determine if the site is prone to flooding. The OPW records of historical floods and the flood extent maps produced under Fingal East Meath (FEM) Catchment Flood Risk Assessment and Management Study (CFRAMS)[2] and other CFRAMS projects were used to assess whether the Proposed Project sites and pipeline route options are at risk of flooding and whether extensive flooding (historical and/or predicted) occurs immediately upstream or downstream; and
- **Ecologically Important Surface Water Ecosystems** – European sites, such as Special Protection Areas (SPAs) and Special Areas of Conservation (SACs), and nationally designated sites, such as Natural Heritage Areas (NHA) and proposed Natural Heritage Areas (pNHA). These are discussed in more detail in Chapter 9 Biodiversity (Marine), Chapter 10 Biodiversity (Marine Ornithology) and Chapter 11 Biodiversity (Terrestrial and Freshwater Aquatic) in Volume 3 Part A of this EIAR.

17.3.2 Hydrogeological Attributes

In considering the impact of the Proposed Project on the hydrogeological environment, the proposed WwTP and associated pipeline routes and their environs were considered in terms of sensitive groundwater receptors and potential impacts upon them. The hydrogeological element is concerned with potential impacts on the groundwater regime (flow, yield and quality) and the effects these impacts may have on groundwater dependent receptors.

The baseline hydrogeological environment was reviewed on the basis of the following attributes:

- **Aquifer Classification** – Aquifer Classification is based on the hydrogeological characteristics and the value/importance of the groundwater resource in a given area. The GSI have classified all the aquifers in Ireland into three main categories: regionally important, locally important or poor aquifers. This information, including the extent of the aquifer, is provided on the GSI aquifer classification maps;
- **Groundwater Vulnerability** – Groundwater Vulnerability determines the ease with which groundwater in a given area may be contaminated. The GSI has classified groundwater vulnerability into ‘low’, ‘moderate’, ‘high’, ‘extreme’ and ‘rock near the surface’ categories. This information is provided on the GSI groundwater vulnerability maps;
- **Groundwater Supplies** – The identification of water supply springs and bored wells near the Proposed Project. These include supplies for public, domestic, agricultural or industrial use. This information is taken from the

[2] *The FEM-FRAMS project included the hydraulic modelling and mapping of flood risk of various rivers in the Fingal and East Meath catchment.*

GSI database and, where available, Local Authority records. The importance is a function of the number of people dependent on the supply;

- **Source Protection Areas and Zones of Contribution** – The objective of source protection areas (GSI mapping) and zones of contribution (EPA mapping) is to provide protection to groundwater sources by placing tighter controls on activities within all or part of the area that contributes to the groundwater source. These therefore provide information on the location and importance of groundwater sources; and
- **Identification of Hydrogeological Features from the Karst Database** – Karst features are natural hydrogeological features. These are formed in areas of limestone or other highly soluble rock, in which the landforms are of dominantly solution origin, and in which the drainage is usually underground in solutionally enlarged fissures and conduits. Karst features include caves, swallow holes, turloughs and springs. Information on the location of all known karst features in Ireland is provided on the GSI karst data maps (GSI 2018a).

Table 17.1: Criteria Rating for Attribute Importance – Hydrology and Hydrogeology

Hydrology					
Criteria	**Extremely High**	**Very High**	**High**	**Medium**	**Low**
Baseline Water Quality	Natura 2000 designated river, wetland or surface water body ecosystem	Natura 2000 designated river, wetland or surface water body ecosystem Biotic index: Q4-Q5 WFD Status: 'Good' - 'High'	Biotic Index: Q3-Q4 WFD Status: "Moderate"	Biotic Index: Q3, Q2-Q3 WFD Status: "Poor"	Biotic Index: Q1, Q2 WFD Status: "Bad"
Potable Water Supply Abstractions from Surface Waters	–	Potable water source supplying >2,500 homes	Potable water source supplying >1,000 homes	Potable water source supplying >50 homes	Potable water source supplying <50 homes
Area Prone to Flooding (based on historical data and predicted flood extents adjacent to the site as well as up and downstream locations)	Flood Zone A	Flood Zone A	Flood Zone A	Flood Zone B	Flood Zone C
Hydrogeology					
Aquifer Classification – importance of the groundwater resource to a given area	–	Regionally important aquifer with multiple wellfields	Regionally important aquifer	Locally important aquifer	Poor bedrock aquifer
Vulnerability Classification – potential for groundwater contamination	Rock at or near surface	Extreme	High	Moderate	Low
Groundwater Supplies – identification of water supply springs and bored wells based on GSI, EPA and FCC records	–	Potable water source supplying >2,500 homes	Potable water source supplying >1,000 homes	Potable water source supplying >50 homes	Potable water source supplying <50 homes
Groundwater Source Protection Areas and Zones of Contribution as per available GSI & EPA data	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation, e.g. SAC or SPA status	Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status or inner source protection area for regionally important water source	Outer source protection area for regionally important water source	Within 500m of outer source protection area for regionally important water source	Within 2km of outer source protection area for regionally important water source
Identification of Hydrogeological features from the GSI karst database	Within 10m	Within 50m	Within 100m	Within 500m	Within 2km

Table 17.2: Criteria for Rating Impact (*Draft Guidelines on the Information to be Contained in Environmental Impacts Assessment Reports* (EPA 2017))

Impact Assessment	
Quality	Positive
	Neutral
	Negative/Adverse
Duration	Momentary: Effects lasting from seconds to minutes
	Brief: Effects lasting less than a day
	Temporary: Effects lasting less than a year
	Short-term: Effects lasting one to seven years
	Medium-term: Effects lasting seven to 15 years
	Long-term: Effects lasting fifteen to 60 years
	Permanent: Effects lasting over 60 years
Extent	The proportion of the attribute affected (size of the area, the number of sites and the proportion of a population affected by an effect).
Significance	Imperceptible: An effect capable of measurement but without noticeable consequences
	Not significant: An effect which causes noticeable changes in the character of the environment but without noticeable 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 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

Table 17.3: Estimation of Magnitude of Impact (Institute of Geologists of Ireland 2013)

Magnitude of Impact	Criteria
Large adverse	Results in loss of attribute and/or quality and integrity of attribute
Moderate adverse	Results in impact on integrity of attribute or loss of part of attribute
Small adverse	Results in minor impact on integrity of attribute or loss of small part of attribute
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity

Table 17.4: Rating Significance of Impacts (Institute of Geologists of Ireland 2013)

Importance of Attribute	Magnitude of Impact			
	Negligible	Small adverse	Moderate adverse	Large adverse
Extremely high	Imperceptible	Significant	Profound	Profound
Very high	Imperceptible	Significant/Moderate	Profound/Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/Moderate	Profound/Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

17.4 Baseline Environment

The existing baseline hydrological and hydrogeological environment was determined from the sources outlined in Section 17.2 above and is summarised in the following sections. The baseline environment was considered in terms of the attribute importance described in Table 17.1.

17.4.1 Study Area

For the hydrological impact assessment, the surface water catchments of the Tolka River, Santry River, Mayne River (and its tributary the Cuckoo Stream) and the Sluice River were assessed (refer to Figure 17.3 Hydrological Study Area).

The hydrogeological well survey focused on the area within 500m of the proposed WwTP, Abbotstown pumping station and the orbital sewer route. The aquifer characteristics and vulnerability covered a broader area as shown in Figure 17.5 Aquifer Classification and Figure 17.6 Groundwater Vulnerability. The hydrogeological assessment also considers the impacts of the tunnelled section of the proposed outfall pipeline route (marine section) on the sand gravel aquifer at Portmarnock.

17.4.2 General Hydrology

There are four main rivers that are adjacent to the Proposed Project. These are the Tolka River, Santry River, Mayne River (and its tributary the Cuckoo Stream) and the Sluice River. The Tolka River and Santry River discharge to Dublin Bay, whilst the Mayne River and Sluice River discharge to Baldoyle Estuary, which then discharges to the Irish Sea. (refer to Figure 17.3 Hydrological Study Area).

17.4.3 Rivers

The EPA surveys and assesses approximately one-third of Ireland's principal rivers and their associated more important tributaries annually, which complies with the WFD Monitoring Programme (EPA 2018b). The results of the most current biological surveys are available as interactive maps on the EPA website (EPA 2018c).

The EPA assessment procedure examines four biological water quality classes, A, B, C and D, where the water quality ranges from the best or 'unpolluted' (A) to the worst or 'seriously polluted' (D. These classes, and their relationships with the Biotic Index (Q values), are presented in Table 17.5. Biotic indices ("Q Values") reflect average water quality at any location.

Table 17.5: EPA Scheme of Biotic Indices or Quality (Q) Values and its Relationship to Water Quality (EPA 2018d)

Biotic Index 'Q' Value*	WFD Status	Pollution Status	Condition**	Quality Class
Q5, Q4-5	High	Unpolluted	Satisfactory	Class A
Q4	Good	Unpolluted	Satisfactory	Class A
Q3-4	Moderate	Slightly Polluted	Unsatisfactory	Class B
Q3, Q2-3	Poor	Moderately Polluted	Unsatisfactory	Class C
Q2, Q1-2, Q1	Bad	Seriously Polluted	Unsatisfactory	Class D

* These Values are based primarily on the relative proportions of pollution sensitive to tolerant macroinvertebrates (the young stages of insects primarily but also snails, worms, shrimps, etc.) resident at a river site.

** 'Condition' refers to the likelihood of interference or potential beneficial uses.

The WFD came into force in 2000. The WFD was enacted into Irish Law through the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003) and amendments. The WFD established a framework for the protection of all waterbodies including, rivers, lakes, groundwater, estuarine and coastal waters and their dependent wildlife/habitats. Some key objectives of the WFD are to:

- Protect all waters, including rivers, lakes, groundwater, estuarine and coastal waters;
- Achieve "Good" status in all waters by 2015, and maintain "High" status where the status already exists; and
- Manage water bodies based on the River Basin Districts (catchments).

The EPA mapping tool, catchments website (EPA Catchments 2018), provides data on the current quality and status of the water bodies.

Tolka River

The Tolka River rises near Culmullin Crossroads and with a network of small tributaries flows through Batterstown, Black Bull, Dunboyne, Clonee, Mulhuddart, Abbotstown, Finglas Bridge, Glasnevin, Drumcondra, North Strand and East Wall to enter Dublin Bay at Fairview Park. The proposed Abbotstown pumping station site is located approximately 100m north of the Tolka River just before the Tolka River flows under the M50 Motorway.

The overall WFD status of the Tolka_040 River Water Body is "Poor" and "at risk" of not achieving "Good" status.

Santry River

The Santry River has its origins at Harristown and Dubber, south of St. Margarets. It flows to the west of Dublin Airport and parallel to the main runway. From there, it flows through Silloge, under the M50 Motorway at Ballymun,

through Santry Demesne. It then passes under the M1/M50 Motorway at Santry, through Kilmore, Edenmore, Raheny and under the Dublin/Belfast railway line before discharging to Dublin Bay at North Bull Island. The proposed orbital sewer route from the proposed Abbotstown pumping station to the proposed WwTP will intercept the Santry River at Silloge (just outside the M50 Motorway).

The WFD Status for the Santry_010 River Water Body is "Poor" and "at risk" of not achieving "Good" status.

Mayne River

The Mayne River commences at Dardistown (west of the M50/M1 Motorway interchange). It flows under this interchange, along the R139 Road (through Belcamp, Balgriffin, Snugborough, and under the Dublin/Belfast railway line), and discharges to the Baldoyle Estuary. The Cuckoo Stream, which is a tributary of the Mayne River, commences at Dublin Airport, flows under the M1 Motorway at Toberbunny and joins the Mayne River just upstream of Wellfield Bridge. There is a significant floodplain for the Mayne River just downstream of the railway line, which provides essential storage of the Mayne River during high tides. The proposed WwTP will be adjacent to the Cuckoo Stream and approximately 400m north of the Mayne River. Finally, the route of the proposed outfall pipeline route (land based section) will be located to the north of the Mayne River floodplain.

The WFD Status for the Mayne_010 River Water Body is "Poor" and "at risk" of not achieving "Good" status.

Sluice River

The Sluice River rises in Kinsealy and flows in an easterly direction passing under the railway line before discharging to the Baldoyle Estuary at Portmarnock Bridge. The proposed outfall pipeline route (land based section) will be approximately 300m south of the Sluice River.

There is no WFD status for the Sluice River.

17.4.4 Coastal and Estuary Areas

Baldoyle Estuary (the Estuary) is tidal and is sheltered by an extensive sand dune system. The Estuary has large areas of intertidal sands and some muds. Eel grass beds are present in the bay. The Estuary supports internationally important populations of brent geese and nationally important populations of a further seven waterfowl species. Baldoyle Estuary is an SAC, SPA, pNHA, and Ramsar site. It is also a Statutory Nature Reserve. It should be noted that the water quality of the Estuary is classified (by the EPA) as Eutrophic. Its status and risk under the WFD is presently under review. The Mayne River and Sluice River both discharge to the Estuary. While the Estuary is considered to have extremely high ecological importance, it should be noted that the surface water pathway to the Estuary from the elements of the Proposed Project is via a watercourse that has a quality status of "Poor".

The Tolka River discharges to Dublin Bay at Fairview. This part of Dublin Bay is part of the South Dublin Bay and Tolka Valley Estuary SPA. The Tolka Estuary WFD quality status is "Moderate". The Santry River discharges near to North Bull Island SPA. North and South Dublin Bay are both classified as SACs and pNHAs. According to the Eastern River Basin District Management Plan (2009-2015) (DoEHLG 2010), Dublin Bay is achieving "Good" status.

17.4.5 Flood Risk

An FRA has been prepared for the Proposed Project in accordance with the FRM Guidelines (DoEHLG and OPW 2009). A copy of this report is included in Appendix A17.1 and summarised below.

The FRM Guidelines define three Flood Zones (refer to Diagram 17.1), namely:

- **Flood Zone A** – where the probability of flooding from rivers and the sea is highest (greater than 1% AEP or 1 in 100 year for river flooding or 0.5% AEP or 1 in 200 for coastal flooding);
- **Flood Zone B** – where the probability of flooding from rivers and the sea is moderate (between 0.1% AEP or 1 in 1,000 year and 1% AEP or 1 in 100 year for river flooding and between 0.1% AEP or 1 in 1,000 year and 0.5% AEP or 1 in 200 year for coastal flooding); and
- **Flood Zone C** – where the probability of flooding from rivers and the sea is low (less than 0.1% AEP or 1 in 1,000 for both river and coastal flooding).

It is important to note that Flood Zone C covers all areas which are not in Flood Zones A and B.

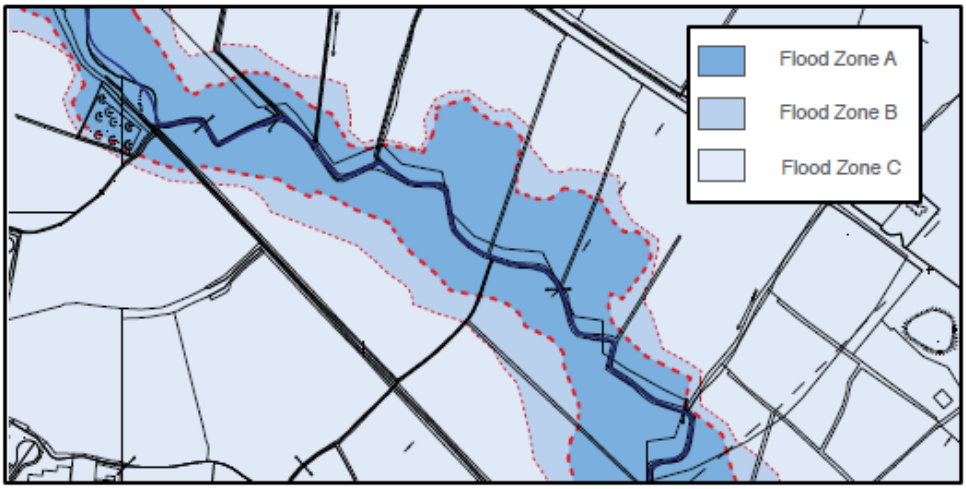

Diagram 17.1: Indicative Flood Zone Map (Extract from the FRM Guidelines)

The proposed WwTP site is bounded by the Cuckoo Stream to the north and the Mayne River to the south. The nearest recurring historical flooding location is approximately 1.1km to the north-west of the proposed WwTP site, at Stockhole Lane (near Dublin Airport). Fluvial modelling results from the FEM-FRAMS Project indicate that the area immediately beside the Cuckoo Stream is at flood risk. No disturbance or infilling will take place in Flood Zone A or Flood Zone B areas. The proposed WwTP site is in Flood Zone C – low risk (see Figure 3.6 of the FRA Report, Appendix A17.1).

The proposed Abbotstown pumping station site is located to the north of the Tolka River and is situated approximately 6m above river bank level. The National Flood Hazard Mapping website (OPW 2018b) shows no records of historical flooding at the proposed Abbotstown pumping station site. The closest historical flood event occurred on the M50 Motorway at the N3 National Road interchange in November 2002. Whilst detailed flood risk mapping is not available for this area, the Preliminary Flood Risk Assessment maps and the topography indicate that this site is in Flood Zone C – low risk.

In accordance with the FRM Guidelines, the proposed WwTP and proposed Abbotstown pumping station sites are considered to be 'highly vulnerable development (including essential infrastructure)', and these types of developments are considered to be 'appropriate' for Flood Zone C – low risk.

The proposed orbital sewer route and outfall pipeline route pipework, by its nature, will pass through a variety of flood zone areas. However, pipelines are not considered to be vulnerable to flooding and it is not inappropriate to

locate pipelines in flood risk areas, under rivers, through floodplains, etc., subject to appropriate design modifications to cater for construction and long-term durability issues. The fluvial and tidal flood risk maps, which are appended to the FRA Report, outline the proposed orbital sewer route and highlight the areas where the proposed orbital sewer route enters flood risk areas. The only areas where the proposed orbital sewer route enters flood risk areas is at watercourse crossing locations. Trenchless construction techniques employed at watercourse crossings will ensure that the flood risk will not be considered significant. To further reduce the flood risk at these locations, the construction sites/launch pits will be located beyond the floodplain of the summer peak flood of 1:20 return period.

17.4.6 General Hydrogeology

The bedrock geology of the region, mapped by the GSI, is indicated on Sheet 13 of the 1:100,000 Bedrock Geology series (GSI 2018b). The geological aspect of the Proposed Project relative to its regional setting is illustrated in Figure 17.4 Geology. The solid (bedrock) geology of the region comprises a sequence of sedimentary rocks that are assigned to the Lower Carboniferous dominated by limestones of varying ages and compositions that form the Dublin Basin. The geology is discussed in more detail in Chapter 18 Soils and Geology.

The primary hydrogeological receptor is the groundwater in the aquifers.

17.4.7 Aquifer Classification

The underlying aquifers (GSI online Maps) are identified in Figure 17.5 Aquifer Classification. The type of rock determines the aquifer classification. The GSI classifies aquifers on the basis of their potential yields and importance. The aquifers underlying the proposed orbital sewer route are classified as locally important (bedrock which is moderately productive only in local zones) and poor (bedrock which is generally unproductive except for local zones). The proposed WwTP site is underlain predominantly by poor aquifer with a locally important aquifer in the eastern portion of the proposed WwTP site. The proposed Abbotstown pumping station site is underlain by a poor aquifer.

17.4.8 Aquifer Vulnerability

The vulnerability provides an indication of the ease with which potential contaminants can migrate downwards from the surface to the underlying aquifer. The GSI classification of the vulnerability of an aquifer is based on the thickness and the permeability of overburden. The greater the thickness and permeability, the greater the protection to the groundwater in the underlying aquifer. The classification system is shown in Table 17.6. The vulnerability mapping produced by the GSI is shown in Figure 17.6 Groundwater Vulnerability in the context of the Proposed Project. Vulnerability is also dependent upon the overlying soil composition, which is shown in Figure 17.7 Soils.

A site investigation programme for the Proposed Project was undertaken in early 2013 (*Greater Dublin Drainage Scheme Phase 1 Ground Investigation – Geotechnical Interpretative Report* (Arup 2013)). A phase 2 site investigation programme was undertaken between November 2014 and February 2015. The borehole data collected as part of the site investigation was reviewed. Borehole logs provided site-specific details on the overburden composition. This provides a more definitive understanding of the overburden conditions from which a more accurate vulnerability assessment can be made by applying the GSI vulnerability mapping guidelines. The logs of the boreholes are contained in the Geotechnical Interpretative Report. This report and the locations of the site investigation boreholes are shown in Appendix A17.3.

The vulnerability mapping produced by the GSI is shown in Figure 17.6 Groundwater Vulnerability in the context of the Proposed Project. Due to the length of the proposed pipeline routes, the aquifer vulnerability varies. At the location of the proposed Abbotstown pumping station site, the vulnerability rating is described as E (rock near the surface). This is confirmed by the soils mapping which indicates rock outcrop or sub crop. This is surrounded by an area that is classified as extreme and high vulnerability. The soils mapping shows the rock is overlain by tills derived chiefly from limestone.

As the route passes through Silloge, the vulnerability classification is low.

The aquifer vulnerability at the proposed WwTP site is low. This has been confirmed by site investigation information at the proposed WwTP site. Rotary-cored boreholes were drilled to a maximum depth of 18m below ground level and rock was not encountered. The overburden comprises brown and black boulder clay with water bearing gravel lenses (Borehole (BH01), 7.3 metres below ground level (mbgl); BH03, 5.8mbgl) and sand lenses (BH02, 17.4mbgl). Borehole locations are shown in Figure 17.12 Location of Site Investigation Boreholes.

The proposed orbital sewer route enters a region of moderate vulnerability at Springhill and again is classified as low from Drumnigh to the coast. BH26 was excavated between Drumnigh and the railway line and has in excess of 10m of black and brown boulder clay, confirming the low vulnerability classification.

The vulnerability at Velvet Strand, Portmarnock, is described as high. The overburden at this location is beach sand and gravels and windblown sands. This is confirmed by BH14 and Trial Pit (TP12). However, it should be noted that there is layer of impermeable boulder clay between the sand/gravels and the underlying bedrock aquifer.

Table 17.6: GSI Groundwater Vulnerability Mapping Guidelines (Source: Daly Warren 1998; NRA 2009)

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability			Unsaturated Zone	Karst Features
	High permeability (e.g. sand/gravel)	Moderate permeability (e.g. sandy subsoil)	Low permeability (e.g. clayey subsoil, clay, peat)	Sand/gravel aquifers only	(<30m radius)
Extreme (E)	0m – 3.0m	0m – 3.0m	0m – 3.0m	0m – 3.0m	
High (H)	>3.0m	3.0m – 10.0m	3.0 – 5.0m	>3.0m	N/A
Moderate (M)	N/A	>10.0m	5.0 – 10.0m	N/A	N/A
Low (L)	N/A	N/A	>10.0m	N/A	N/A

17.4.9 Groundwater Supplies

The Proposed Project area in north Dublin is served by public water mains.

The GSI groundwater mapping website was accessed to identify known wells near the Proposed Project area. The locations of these private wells are shown in Figure 17.8 Groundwater Supply Wells. The location accuracy varies from within 50m to within 500m. There are no public supply wells in the vicinity.

No wells have been identified within 500m of the proposed Abbotstown pumping station site.

A groundwater well questionnaire was circulated by maildrop during the Environmental Impact Assessment process to identify the location and type of groundwater wells near the proposed WwTP and Abbotstown pumping station sites and along the proposed orbital sewer route and NFS diversion sewer. The questionnaire was also uploaded to the project website. The GeoDirectory address point database was cross-referenced with the FCC and DCC potable water supply network to determine if there were properties within a 500m radius of the proposed WwTP and proposed Abbotstown pumping station site which may not be on the public water supply network and may potentially be dependent on groundwater wells:

- No properties with groundwater wells were identified within 500m of proposed Abbotstown pumping station site;
- Five properties with groundwater wells were identified within 500m of the proposed WwTP site and 10 properties within 1km of the proposed WwTP site (refer to Figure 17.2 Groundwater Supply Well Information Supplied by the Public); and
- A well was identified in the Karst database at the site of St. Doulagh's Church. This is referenced as St. Doolagh's or St. Catherine's Well and is located approximately 1km east of the proposed WwTP site and 550m south of the proposed orbital sewer route.

The 10 properties which were within 1km of the proposed WwTP site were visited, and residents confirmed that they have been on the public mains supply for a number of years. Some of the groundwater wells were being used for irrigation purposes, e.g. the groundwater wells at the Gaelic Athletic Association Club were being used for toilets and for irrigation of the football fields. Portmarnock Golf Club and Portmarnock Hotel and Golf Links use shallow water wells to provide for their irrigation needs.

None of the wells described here are public supply wells.

17.4.10 Portmarnock Peninsula Irrigation Wells

In the course of the public consultation process, Portmarnock Golf Club sought assurance that the shallow groundwater wells they use to meet the irrigation requirements of the Golf Club during the summer months would not be affected by the construction of the tunnelled section of the proposed outfall pipeline route (marine section). The adjoining Portmarnock Hotel and Golf Links also uses shallow groundwater wells for irrigation. The principal concern was that the groundwater regime will be disturbed to the extent that the wells will draw in saline water.

The golf courses are located on a peninsula composed of dune sands and are bounded to the west by the Baldoyle Estuary SAC and the Irish Sea to the east.

The shallow sand gravel at Portmarnock is unconfined and recharged by rainfall. Site investigation and geophysical survey results (marine and land based) indicate the sand gravel aquifer is underlain by a layer of stiff boulder clay that lies on top of the bedrock. The bedrock is the Malahide Formation, which is composed of argillaceous bioclastic limestones and shales. The bedrock is competent with no evidence of major faults or karstification and, consequently, is suitable for tunnelling.

The irrigation wells are shallow wells that abstract fresh water from the shallow sands and gravels that underlie the peninsula. The location of the wells, the proposed outfall pipeline route (marine section) and the conceptual groundwater flow regime in the shallow sand gravel aquifer are shown in Figure 17.9 Portmarnock Golf Club Irrigation Wells and Flow Regime. The wells are not used for drinking water. Irrigation is only undertaken during the dry summer months. Freshwater is less dense than seawater, and the recharge percolates slowly downwards and will float on the saltwater and form a mound displacing the seawater. The groundwater forms a mound in the dune

sands and discharges radially to the sea due to the hydraulic gradient formed by the mound. Both the Portmarnock Golf Club and Portmarnock Hotel and Golf Links irrigation wells intercept this freshwater. If the wells over-abstract then the hydraulic gradient will be reversed, causing saline water to flow under the golf course. The potential impacts are discussed in Section 17.6.

17.4.11 Groundwater Quality

Samples were collected from 11 of the site investigation boreholes along the proposed pipeline routes to provide baseline groundwater chemical and bacteriological data. The sampling locations are shown on Figure 17.12 Location of Site Investigation Boreholes, and the analytical results are contained in Appendix A17.4. The samples were analysed for the full drinking water suite. The results are a reflection of the groundwater quality in an urban environment. BH109 and BH116 had E. coli. of 2 and 8 colony forming units (cfu)/100ml, indicating low-level faecal contamination. BH109, BH106, BH126 and BH134 had total coliforms present. BH139 was contaminated with hydrocarbons.

17.4.12 Groundwater Flow Direction and Water Levels

The Ground Investigations for the Proposed Project included monitoring boreholes. The groundwater levels along the proposed pipeline routes have been monitored and the levels are shown in Table 17.7. The regional groundwater flow direction will be in an easterly direction towards the Irish Sea, and the water level data from the monitoring boreholes reflect this.

Table 17.7: Groundwater Level Monitoring

		18/5/15		30/6/15		8/12/15		15/2/16		17/3/16		21/4/16		23/5/16		20/7/16		27/6/17	
BH	**mOD[3]**	**[4]W.L.**		**W.L.**		**W.L.**		**W.L.**		**W.L.**		**W.L.**		**W.L.**		**W.L.**		**W.L.**	
		mbgl	**mOD**	**mbgl**	**mOD**	**mbgl**	**mOD**	**mbgl**	**mOD**	**mbgl**	**mOD**	**mbgl**	**mOD**	**mbgl**	**mOD**	**mbgl**	**mOD**	**mbgl**	**mOD**
P2-BH106	**49.61**	0.7	48.91	0.84	48.77	0.7	48.91	0.7	48.91	0.73	48.88	0.76	48.85	0.8	48.81	0.87	48.74	-	-
P2-BH107	**54.19**	DRY	-	Dry	-	Dry		Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	-	-
P2-BH108	**59.37**	1.65	57.72	2.19	57.18	1.6	57.77	1.6	57.77	1.62	57.75	1.64	57.73	1.65	57.72	1.7	57.67	2.55	56.82
P2-BH109	**71.94**	2.03	69.91	2.47	69.47	2.17	69.77	2.2	69.74	2.2	69.74	2.22	69.72	2.25	69.69	2.3	69.64	2.32	69.62
P2-BH111	**76.63**	2	74.63	4.29	72.34	-	76.63	-	76.63	-	76.63	-	76.63	-	76.63	-	76.63	-	--
P2-BH112	**78.8**	3.8	75	5.07	73.73	-	-	-	-	-	-		-	-	-	-	-	-	-
P2-BH113	**78.77**	DRY	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	-	-
P2-BH114	**85.66**	5.8	79.86	7.21	78.45	5.78	79.88	5.9	79.76	5.85	79.81	5.87	79.79	5.9	79.76	5.96	79.7	10.3	75.36
P2-BH115	**78.92**	0.65	78.27	1.71	77.21	0.59	78.33	0.6	78.32	0.65	78.27	0.64	78.28	0.65	78.27	0.7	78.22		
P2-BH116	**75.64**	1.1	74.54	1.56	74.08	1.27	74.37	1.25	74.39	1.3	74.34	1.35	74.29	1.3	74.34	1.38	74.26	1.8	73.84
P2-BH117	**72.59**	0.6	71.99	1.12	71.47	0.75	71.84	0.8	71.79	0.79	71.8	0.8	71.79	0.8	71.79	0.85	71.74	1.235	71.355
P2-BH118	**70.22**	4	66.22	4.18	66.04	4	66.22	4.1	66.12	4.07	66.15	4.1	66.12	4.14	66.08	4.2	66.02	-	-
P2-BH119	**68.26**	3.55	64.71	6.44	61.82	3.35	64.91	3.45	64.81	3.51	64.75	3.5	64.76	3.49	64.77	3.55	64.71	-	-
P2-BH120	**65.99**	1.33	64.66	2.2	63.79	1.25	64.74	1.25	64.74	1.29	64.7	1.3	64.69	1.3	64.69	1.35	64.64	-	-
P2-BH121	**66.66**	0.35	66.31	1.56	65.1	0.4	66.26	0.35	66.31	0.4	66.26	0.42	66.24	0.4	66.26	0.45	66.21	1.54	65.12
P2-BH122	**64.22**	4.1	60.12	4.17	60.05	3.7	60.52	3.7	60.52	3.75	60.47	3.8	60.42	3.8	60.42	3.85	60.37	4.29	59.93
P2-BH123	**56.88**	0.8	56.08	1.1	55.78	1.05	55.83	1.05	55.83	1.08	55.8	1.1	55.78	1.11	55.77	1.15	55.73	-	-
P2-BH124	**57.53**	DRY	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	-	-
P2-BH125	**55.75**	5.7	50.05	5.79	49.96	5.2	50.55	5.2	50.55	5.24	50.51	5.25	50.5	5.29	50.46	5.35	50.4	5.29	50.46
P2-BH126	**51.32**	5	46.32	4.74	46.58	2.15	49.17	2.2	49.12	2.25	49.07	2.3	49.02	2.33	48.99	2.39	48.93	2.18	49.14
P2-BH127	**49.17**	1	48.17	-	-	1.05	48.12	1	48.17	1.09	48.08	1.1	48.07	1.12	48.05	1.15	48.02	-	-
P2-BH128	**45.95**	0.5	45.45	1.39	44.56	0.6	45.35	0.65	45.3	0.68	45.27	0.7	45.25	0.69	45.26	0.75	45.2	0.97	44.98
P2-BH130	**28.54**	2.25	26.29	2.93	25.61	2.2	26.34	2.2	26.34	2.24	26.3	2.25	26.29	2.23	26.31	2.25	26.29	2.75	25.79
P2-BH131	**22.7**	1.8	20.9	2.14	20.56	1.67	21.03	1.7	21	1.75	20.95	1.7	21	1.69	21.01	1.73	20.97	-	-
P2-BH132	**22.49**	1.3	21.19	1.96	20.53	1.55	20.94	1.6	20.89	1.63	20.86	1.65	20.84	1.65	20.84	1.7	20.79	-	-
P2-BH133	**18.76**	0.6	18.16	-	18.76	0.8	17.96	0.7	18.06	0.8	17.96	0.84	17.92	0.85	17.91	0.9	17.86	-	-
P2-BH134	**11.63**	1.3	10.33	2.17	9.46	1.23	10.4	1.3	10.33	1.25	10.38	1.3	10.33	1.31	10.32	1.35	10.28	1.84	9.79
P2-BH135	**11.18**	1.1	10.08	1.67	9.51	1.1	10.08	1.1	10.08	1.12	10.06	1.15	10.03	1.18	10	1.22	9.96	-	-
P2-BH137	**8.68**	1.4	7.28	-	-	1.5	7.18	1.5	7.18	1.55	7.13	1.58	7.1	1.6	7.08	1.65	7.03	-	-
P2-BH138	**4.22**	1	3.22	-	-	1.09	3.13	1.1	3.12	1.14	3.08	1.15	3.07	1.17	3.05	1.23	2.99	-	-
P2-BH139	**9.07**	6.45	2.62	6.53	2.54	6.24	2.83	6.3	2.77	6.3	2.77	6.3	2.77	6.32	2.75	6.38	2.69	7.34	1.73
P1-BH02	**41.55**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.04	40.51
P1 BH03	**42.52**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	--	0.78	41.74

[3] mOD relates to metres above Ordnance Datum
[4] W.L. is water level

17.5 Embedded Mitigation

Note that the design of various Proposed Project elements has considered the potential impacts, and mitigation has been embedded in the design.

17.5.1 Surface Water Drainage

Objective SW04 of the *Fingal Development Plan 2017-2023* (FCC 2017) requires:

'*the use of sustainable drainage systems (SuDS) to minimise and limit the extent of hard surfacing and paving and require the use of sustainable drainage techniques where appropriate, for new development or for extensions to existing developments, in order to reduce the potential impact of existing and predicted flooding risks*.'

The drainage systems will be designed in accordance with the FRM Guidelines (DoEHLG and OPW 2009). Surface drainage from the proposed WwTP and the proposed Abbotstown pumping station will be attenuated to greenfield runoff rates and will make allowance for climate change.

As a result of the Site Selection Process, the proposed WwTP and proposed Abbotstown pumping station sites have been selected in Flood Zone C – low risk areas.

17.5.2 Prevention of Pollution

All pipelines, tanks, storage containers and pump sumps will be designed to be watertight. The pipeline will be designed and constructed to minimise the possibility of any leaks, and concrete sewer will not be used. Reinforced concrete structures will be designed to be water retaining, and the use of bunds around any chemicals and oil storage areas will reduce the risk of any leaks or accidental spillages.

17.5.3 Culverting

Mitigation has been embedded in the choice of method for the culverting and crossing of rivers and streams. The main watercourse crossings will be completed using trenchless techniques. Details of the crossings are listed in Table 17.8. The use of trenchless technology for water crossings will ensure that the proposed orbital sewer route and outfall pipeline route (land based section) will be constructed below the river, stream or ditch bed levels. The appointed contractor(s) will locate proposed temporary construction compounds and launch pits in Flood Zone C – low risk areas for both the proposed orbital sewer route and the proposed outfall pipeline route (land based section).

Table 17.8: River and Stream Crossings

Crossing No.	Description	Pipeline Route	Proposed Methodology/Machinery
Watercourse Crossing 1	Tributary of Tolka River	Proposed orbital sewer route (Blanchardstown – Clonshagh)	Trenchless/tunnel
Watercourse Crossing 2	Santry River	Proposed orbital sewer route (Blanchardstown – Clonshagh)	Trenchless/tunnel
Watercourse Crossing 3	Mayne River	Proposed orbital sewer route (Blanchardstown – Clonshagh)	Trenchless/tunnel
Watercourse Crossing 4	Cuckoo Stream	Proposed outfall pipeline route (land based section)	Trenchless/tunnel
Watercourse Crossing 5	Mayne River	Proposed NFS diversion sewer	Trenchless/tunnel

17.5.4 Proposed Outfall Pipeline Route (Marine Section) – Microtunnelling

Microtunnelling techniques will be used for the proposed outfall pipeline route (marine section) from the open fields immediately west of the R106 Coast Road to approximately 600m offshore, terminating below mean low water level. The microtunnelled section will be of 1.80m to 2.0m internal diameter, constructed at depths ranging between 15m and 20m below ground level (in the bedrock) using a microtunnelling machine, with pipe sections installed as the tunnelling machine progresses.

An embedded mitigation by avoidance approach has been adopted in the tunnel design and route to eliminate any potential impacts on the Baldoyle Estuary SAC and the golf club irrigation wells on the Portmarnock Peninsula. The proposed outfall pipeline route (marine section) will be constructed in a manner that will remove the pathway between the hazard and the receptor. The proposed outfall pipeline route (marine section) will be tunnelled in bedrock beneath Baldoyle Estuary and Portmarnock Peninsula and will emerge below the low tide level on the eastern side of the Peninsula. The stiff boulder clay in the overburden will act as a barrier between the groundwater in the rock and in the shallow groundwater in the dune sands from which the irrigation wells abstract.

This methodology will ensure that the tunnelled section of the proposed outfall pipeline route (marine section) will have no hydraulic connection with the groundwater from the irrigation wells abstract.

The tunnel section will require drive/receptor shafts onshore, in the open field immediately west of the R106 Coast Road and in the open space adjacent to the public car park off the Golf Links Road, immediately north of Portmarnock Golf Club

The tunnelled pipeline will be grouted to eliminate the possibility of a preferential flow path in the annulus outside the pipe.

17.6 Predicted Impacts

The impact assessment examined the potential impacts of the Proposed Project on the different elements of the hydrological and hydrogeological environment. The impacts of tunnelling under the Portmarnock Peninsula has been included in this Section as it relates to irrigation wells and hydrogeology.

This assessment of hydrogeological impacts follows guidelines established in *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes* (NRA 2009).

The significance of impacts on specific receptors are considered in terms of the magnitude of the effect of an element of the Proposed Project on a receptor and the importance of that receptor.

The magnitude of the effect can be assessed based on the criteria shown in Table 17.3 and Table 17.4 in Section 17.3.

The potential hydrological impacts include:

- Risk of flooding to the Proposed Project site;
- Risk of flooding to surrounding area; and
- Impacts on the water quality of nearby watercourses.

The potential hydrogeological impacts include:

- Water supply wells and natural springs – quality and yield;
- Groundwater fed SAC/NHA wetland sites; and
- The dominant hydrogeological resource characteristics (aquifer and vulnerability classification) of the underlying strata.

17.6.1 Construction Phase Impacts – Hydrology

Flooding

There are no predicted impacts in relation to flooding of the proposed WwTP site, as all the works associated with the proposed WwTP will be located in Flood Zone C.

The proposed Abbotstown pumping station site is located to the north of the Tolka River and approximately 6m above river bank level. This site is in Flood Zone C - low risk. Therefore, there are no predicted impacts in relation to flooding of the proposed Abbotstown pumping station site.

Similarly, all the proposed temporary construction compounds, working and storage areas will be located in Flood Zone C. Therefore, there are no predicted impacts in relation to flooding of the proposed temporary construction compounds.

If the runoff from the proposed WwTP and Abbotstown pumping station sites is uncontrolled during the Construction Phase, there is a potential to increase the risk of flooding downstream. The magnitude of the impact is assessed to be small adverse on an attribute of medium importance. The significance of this potential impact is Slight.

Culverting and Crossing Watercourses

The proposed Abbotstown pumping station site is located north-west of the M50/M3 Motorway junction. It is located approximately 100m north of the Tolka River. Access to the site shall be through the grounds of the NSC and Ballycoolin Road. Culverts or bridge crossings will not be required to facilitate the construction of the proposed Abbotstown pumping station or the proposed access road.

The proposed orbital sewer route between the proposed Abbotstown pumping station and the proposed WwTP will cross the Santry River and Mayne River. The proposed orbital sewer route will also cross a number of minor ditches.

Trenchless construction techniques will be used for the installation of the proposed orbital sewer route at the three significant watercourse crossings along the proposed orbital sewer route (see Table 17.8).

No impact is predicted on the flow regime in the surface water drainage environment as a result of stream crossing.

As some of the watercourses (primarily the Mayne River and its tributary the Cuckoo Stream) crossed by the proposed orbital sewer route have a history of recurring flooding within the specified route, any excavation works or stockpiling of excavated material along the overland flow path could trigger flooding during moderate to severe rainfall periods. Such a flooding phenomenon is more likely in small streams with high gradients (low importance). The magnitude of the impact of such a scenario is considered to be small adverse and have Imperceptible significance.

Surface Water Contamination

The proposed WwTP site is located in the Mayne River catchment. The proposed site has a total area of approximately 29.8ha and is located in open agricultural land. The site is bounded by the Cuckoo Stream (a tributary of the Mayne River) immediately to the north. The Mayne River is located approximately 400m to the south of the proposed WwTP site. There is a small area to the north of the proposed WwTP site that lies in the flood plain of the Cuckoo Stream. There is landscaping proposed outside the northern area of the proposed WwTP site but not within the floodplain.

The topography of the proposed WwTP site suggests that surface waters will generally flow towards the Cuckoo Stream. As noted earlier, the WFD water quality status of the Mayne River and its tributary (the Cuckoo Stream) was categorised as “Poor”. The Mayne River discharges into Baldoyle Estuary (approximately 4km downstream), which is an SPA, SAC and pNHA (refer to Figure 17.3 Hydrological Study Area). During construction, suspended solids arising from ground disturbance, excavations and storage of spoil material could runoff to the Cuckoo Stream during rainfall events, causing increased sediment in the river. Potential contaminants include accidental spillages of fuel, oil and concrete/cement materials which could be part of any runoff from the construction sites to the watercourse. These could impact on water quality and could have a detrimental impact on surface water quality. Consequently, the magnitude of the impact is assessed to be moderate adverse on an attribute of low importance. The significance of this potential impact is Slight and temporary in duration.

The topography of the proposed Abbotstown pumping station site suggests that surface waters will generally flow towards the Tolka River (“Poor” status). There are a significant amount of trees and shrubs between the proposed Abbotstown pumping station site and the Tolka River which will significantly slow down this process. However, there remains a risk that, during rainfall events, silts and contaminants could runoff to the river, causing increased sediment and pollution of the river. The magnitude of the impact on the water quality in the adjoining watercourses is assessed to be moderate adverse on an attribute of low importance. The significance of this potential impact is Slight and temporary

Any direct discharge of water from excavation trenches and groundwater dewatering to the nearby watercourse could increase the flood risk of a stream with limited discharge capacity. If adequate mitigation measures are not applied, silt-laden surface water could flow to the river, which poses a risk to the river water quality. Large pipeline schemes laid in sloping areas with underlying clay can give rise to problems with silty runoff, particularly following topsoil stripping. During high intensity rainfall, the problems of silty runoff are exacerbated. If allowed to enter surface watercourses, this runoff can give rise to high suspended solids which can have a detrimental impact to the aquatic life. The magnitude of the impact is assessed to be moderate adverse on an attribute of low importance. The significance of this potential impact is Slight.

17.6.2 Construction Phase Impacts – Hydrogeology

Temporary Construction Dewatering – Well Yields

The proposed WwTP may require excavations below the water table. Groundwater was encountered in BH01 upon encountering a gravel layer at 7.30mbgl to 8.70mbgl and in BH03 within the gravel layer from 5.80mbgl to 6.10mbgl. This gravel has not been identified as an aquifer by the GSI. During construction, where excavations are below the water table, temporary dewatering measures may be required. There may be a slight temporary lowering of the water table. However, there are no public water supplies or domestic wells within 500m of the site. Consequently, there will be no impact on groundwater supplies.

It is expected that the proposed Abbotstown pumping station will be founded in rock. Temporary dewatering may be required to excavate the foundations. The nearest abstraction point is greater than 500m away and construction works will not affect the groundwater regime at this abstraction point. Consequently, there will be no impact on groundwater supplies.

Along the proposed orbital sewer route, there are a number of abstraction wells (low importance) identified (see Figure 17.2 Groundwater Supply Well Information Supplied by the Public and Figure 17.8 Groundwater Supply Wells). No public water supply wells have been identified in the vicinity of the proposed orbital sewer route. Along the western section of the proposed orbital sewer route, rock is identified as being near surface or extremely or highly vulnerable. The proposed orbital sewer route depth is generally between 2.5m and 3.5m. The base of these excavations may be in rock. Dewatering to ensure that the works are carried out in dry conditions will be required for the pipework or any deep excavations below the water table. The impact on groundwater supply wells can be classed as negligible in magnitude, Imperceptible in significance and temporary in duration.

Groundwater Contamination

Accidental spillages of chemicals and hazardous material may occur during the Construction Phase. However, the vulnerability beneath the proposed WwTP site is classed as low. Poor and locally important aquifers (low to medium importance) underlie the proposed WwTP site. In the event of an accidental spillage, the impact on groundwater quality would be negligible in magnitude, Imperceptible in significance and temporary in duration.

The proposed Abbotstown pumping station site is classified as having extreme vulnerability. There are no planned discharges to groundwater, and any risk to groundwater quality will be the result of accidental spillages of hazardous materials. However, there are no groundwater supplies within 500m of the site and the aquifer is poor with low attribute importance. Consequently, the potential impact on groundwater quality is considered to be temporary and small adverse in magnitude and Slight in significance.

The proposed orbital sewer route is designed to be watertight. It will be designed and constructed to minimise the risk of leakage. However, in the extremely unlikely event of a rupture or leak, the impact on the groundwater quality will depend on the vulnerability of the underlying strata and the importance of the aquifer and the presence/proximity of water supply wells. There are no public supply wells within the study area. The underlying aquifer is classified as either poor aquifer or locally important aquifer. No element of the Proposed Project is underlain by regionally important aquifers. Accidental spillages of chemicals and hazardous material may occur during the Construction Phase. Consequently, any leaks or spillages of hazardous materials during the Construction Phase could impact on the local groundwater quality. As the underlying aquifer is rated as poor to locally important, and there are no public supply wells and only one domestic well within 500m, the potential impact on groundwater quality will be temporary and small adverse in magnitude and Slight in significance.

Trenchless technologies and tunnelling can generate significant quantities of dust, suspended solids, materials and even tunnelling slurries/grouts which can find a route into the groundwater. The potential impact on groundwater quality will be temporary and small adverse in magnitude and Slight in significance.

Proposed Outfall Pipeline Route (Marine Section) Tunnelling Impact on Portmarnock Peninsula Irrigation Wells

A drive shaft for the tunnel boring will be located in the public car park area on the Portmarnock Peninsula (refer to Planning Drawing No. 32102902-2113). This shaft will be excavated to a depth of approximately 20m. If dewatering is used to assist in the excavation, there is a risk that the flow regime at Portmarnock will change and the risk of saline intrusion will increase.

The embedded mitigation incorporated into the microtunnelling methodology and design will ensure that the proposed outfall pipeline route (marine section) will be drilled beneath the Portmarnock Peninsula in bedrock below the boulder clay. This will ensure there is no hydraulic connection or impacts on the shallow groundwater regime of the Portmarnock Peninsula.

17.6.3 Operational Phase Impacts – Hydrology

Flooding

Pipelines, by their nature, will pass through a variety of flood zone areas. However, pipelines are not considered to be vulnerable to flooding and it is not inappropriate to locate pipework in flood risk areas, under rivers, through floodplains, etc., subject to appropriate design modifications to cater for construction and long-term durability issues. As the proposed pipeline routes will be underground, their impact on the existing surface water regime will be Imperceptible during the Operational Phase.

Consequently, there will be no flooding impact as a result of the installation of the proposed pipeline routes.

Vulnerable infrastructure (i.e. the proposed WwTP and proposed Abbotstown pumping station sites) will be located within Flood Zone C – low risk, and thus are not at flood risk.

Flooding due to Site Drainage

The drainage designs for the proposed Abbotstown pumping station and the proposed WwTP will incorporate SUDS measures (embedded mitigation) to ensure the runoff from the sites to the Tolka River and Cuckoo Stream, respectively, will not exceed greenfield runoff rates. Consequently, there will be no increase in risk of flooding in the receiving waters.

Surface Water Quality

The Proposed Project does not involve the discharge of any sewage to any watercourses.

The main impact on surface water and groundwater quality during the Operational Phase is the accidental spillage of sewage, accidental spillage of fuel oils and chemicals used for the treatment of sewage, improper handling of sludge and leakages or pipe bursts. The potential impact on surface water quality will be temporary and small adverse in magnitude and Slight in significance.

17.6.4 Operational Phase Impacts – Hydrogeology

Groundwater Quality

There are no proposed discharges to the groundwater regime. The main potential impact on groundwater quality during the Operational Phase is the accidental spillage of sewage, oil and hazardous chemicals used for the treatment of sewage, improper handling of sludge and leakages or pipe bursts. In the event of an accident, the potential impact on surface water quality over the general Proposed Project area and near the proposed Abbotstown pumping station, WwTP and orbital sewer route will be temporary and small adverse in magnitude and Slight in significance.

Groundwater Resources and Flow Regime

All pipelines and storage/treatment tanks will be designed to be watertight as far as is reasonably practicable, and there will be no need for any permanent dewatering. Consequently, there will be no impact on the groundwater regime (aquifer resource and wells) at the proposed WwTP and proposed Abbotstown pumping station sites and associated pipeline routes.

There is the potential to create new groundwater flow paths along the proposed pipeline routes if no remedial measures are applied. The impact on groundwater flow regime is negligible in magnitude and Imperceptible in significance.

Impact on Irrigation Wells, Portmarnock Peninsula

The tunnelled section of the proposed outfall pipeline route (marine section) has the potential to provide a preferential flow path in the vicinity of Portmarnock. If this is in hydraulic continuity with the groundwater in the dune sands and gravels, a preferential pathway to the sea could alter the flow regime and affect the performance and quality of the irrigation wells. Embedded mitigation has been adopted in the tunnel design and route to eliminate any potential impacts on the Baldoyle Estuary SAC and the golf club irrigation wells on the Portmarnock Peninsula. The tunnelled section of the proposed outfall pipeline route (marine section) will be constructed in a manner that will remove the pathway between the hazard and the receptor. Beneath the Baldoyle Estuary and the Portmarnock Peninsula, the proposed outfall pipeline route (marine section) will be drilled entirely through the Malahide limestone bedrock. The pipe in the limestones will lie under the stiff boulder clays. There will therefore be a disconnect between the proposed outfall pipeline route (marine section) and the overlying gravel aquifer. The barrier of clay and grout disconnects the pipe from the overlying shallow gravel aquifer.

The tunnelled pipeline will be grouted to eliminate the possibility of a preferential flow path in the annulus outside the pipe.

Due to the embedded mitigation in the design considerations of the tunnelled section of the proposed outfall pipeline route (marine section), no impact is predicted on the yield or quality of the irrigation wells on the Portmarnock Peninsula.

17.7 Mitigation Measures

Mitigation has been embedded in the design considerations (Section 17.5), and the potential impact of the Proposed Project as designed has been assessed. Additional mitigation which will be employed to reduce residual impacts is described below.

17.7.1 Mitigation – Hydrology Construction Phase

To prevent or reduce the amount of sediment or other polluting substances being released into watercourses, the following measures will be incorporated into the Construction Environmental Management Plan for the Proposed Project:

- All temporary construction compounds, storage areas and launch pits (for trenchless techniques) will be located within Flood Zone C – low risk;
- Immediate removal/disposal of surplus material off-site will be implemented;
- Drainage within soil bunds will be provided to reduce the influence upon the surface runoff pathways of flood water;
- Direct discharge of surface water from any temporary impervious area to the nearby watercourse without proper attenuation will be avoided;
- Temporary attenuation ponds will be provided if the stream to which surface water from the construction area is discharged has limited capacity;
- The shafts/construction fronts for any trenchless techniques will be located beyond the floodplain of the summer peak flood of an appropriate return period (i.e. 1 in 20 years). (For 10% risk over a two-year construction period, the required return interval for construction period flood is approximately 20 years, as per *Flood and Reservoir Safety* (Institute of Civil Engineers UK 2015));
- The surface water runoff at the construction sites will be managed to prevent flow of silt-laden surface water flowing into adjoining surface watercourses. To achieve this, the appointed contractor(s) must comply with the CIRIA publication *Control of water pollution from linear construction projects. Technical Guidance (C648)* (CIRIA 2006);
- For the construction on any watercourse crossings, a detailed Pollution Control Plan (PCP), Sediment and Erosion Control Plan (SECP), Emergency Response Plan (ERP) and Method Statements (MS) will be drafted and will have regard to relevant pollution prevention guidelines. All works in or adjacent to watercourses will comply with the EPA, Inland Fisheries Ireland and OPW requirements;
- Direct disposal of water from excavations and from temporary groundwater dewatering to the nearby watercourse will not be allowed, as these could both impact on water quality of the watercourse and increase flood risk. Any discharge of such water, after proper treating/de-silting will be discussed and agreed with the landowner, and if necessary, discharge consent will be acquired from the concerned authority (EPA, Inland Fisheries Ireland, etc.) prior to the commencement of work;
- On-site fuel storage and refuelling of plant and vehicles will be undertaken on impermeable and bunded areas and away from any rivers or other watercourses; and
- The appointed contractor(s) will inspect and monitor the water quality of surface waters near any works, particularly in relation to increased silt levels. This monitoring process will form part of the Construction Environmental Management Plan for the Construction Phase.

17.7.2 Mitigation – Hydrology Operational Phase

To prevent or reduce impacts on watercourses, the following measures will be implemented:

- Best practice for the handling of all chemicals, etc., will be used for the proposed WwTP and will mitigate the risk of surface water and groundwater pollution during the Operational Phase.

17.7.3 Mitigation – Hydrogeology Construction Phase

To prevent or reduce the impact on hydrogeological attributes, the following measures will be implemented by the appointed contractor(s):

- All potential harmful substances will be stored in accordance with the manufacturer's guidelines regarding safe and secure buildings/compounds;
- The appointed contractor(s) will ensure that adequate means to absorb or contain any spillages of these chemicals are available at all times; and
- The excavation of the tunnel drive/receptor shaft at the FCC public car park in Portmarnock will extend to about 20m in depth and will go through the shallow aquifer. This shaft will be excavated using piling techniques which will hydraulically seal off the shaft from the water bearing sands/gravels and will not involve any dewatering or pumping which could interfere with the existing groundwater flow regime and the irrigation wells' performance.

17.7.4 Mitigation – Hydrogeology Operational Phase

To prevent or reduce the impact on hydrogeological attributes, the following measures will be implemented:

- In order to prevent the development of preferential flow paths along the pipeline trench, remedial measures will be incorporated that will include the installation of puddle clay or other impermeable barrier at intervals along the proposed pipeline routes, particularly either side of a watercourse; and
- The tunnelled section of the proposed outfall pipeline route (marine section) will be grouted to eliminate the possibility of a preferential flow path in the annulus outside the pipe.

17.8 Residual Impacts

Residual impacts are presented in Table 17.9 and Table 17.10. With the embedded and proposed mitigation measures implemented, there will be no perceptible residual impacts in terms of hydrology and hydrogeology.

Table 17.9: Summary of Impacts and Mitigation – Hydrology

Impacts and Mitigation – Hydrology							
	Potential Impact	**Attribute Importance**	**Impact Duration and Quality**	**Impact Magnitude**	**Impact Significance**	**Mitigation Proposed**	**Residual Impact**
Proposed WwTP	Flooding of site	Low	-	None	None (site in Flood Zone C – low risk)	-	None
Proposed Abbotstown Pumping Station	Flooding of site	Low	-	None	None (site in Flood Zone C – low risk)	-	None
Proposed Orbital Sewer Route	Flooding of site	Low	-	None	None. Pipelines are not vulnerable to flooding	Construction sites/launch pits will be located beyond the floodplain of the summer peak flood of 1:20 return period.	None
Cuckoo Stream Tolka, Santry, Mayne and Sluice Rivers	Increased risk of flooding (Construction)	Medium	Negative temporary	Small adverse	Slight	During the Construction Phase, pipeline installation in known floodplains and near water courses will follow the below procedures: • Immediately remove/dispose of surplus material off-site, • Provide drainage within soil bunds to reduce the influence upon the surface runoff pathways of flood water, • Avoid direct discharge of surface water from any temporary impervious area to the nearby watercourse without proper attenuation, • Provide temporary attenuation ponds if the stream to which surface water from the construction area is discharged has limited capacity. • Not disturb ground or construction within Flood Zones A and B. Embedded mitigation: SUDS principles for management of surface water runoff at the proposed WwTP and Abbotstown pumping station sites will be located in Flood Zone C. Trenchless crossings of the main watercourses. Proposed pipeline routes located below river/stream bed levels so not to cause an obstruction to flow	Imperceptible
	Increased risk of flooding (Operational)	Medium	-	None (embedded mitigation)	None		None
Cuckoo Stream, Tolka, Santry, Mayne and Sluice Rivers	Possible surface water contamination due to accidental spillage or contaminated site runoff	Low	Negative permanent	Moderate adverse Increased risk of possible impact on part the attribute	Slight	Strict compliance with CIRIA's (2006) *Control of water pollution from linear construction projects. Technical Guidance (C648).* PCP, SECP, ERP and MS will be drafted in agreement with Inland Fisheries Ireland and other relevant authorities and having regard to relevant pollution prevention guidelines. Puddle clay or other impermeable barriers at intervals shall be installed along the proposed orbital sewer route, particularly either side of a watercourse and launch pit.	Imperceptible
Baldoyle Estuary SAC	Possible surface water contamination due to accidental spillage or contaminated site runoff	Very high	Negative permanent	Negligible	Imperceptible.	Strict compliance with CIRIA's (2006) *Control of water pollution from linear construction projects. Technical Guidance (C648).*	Imperceptible

Table 17.10: Summary of Impacts and Mitigation – Hydrogeology

Impacts and Mitigation – Hydrogeology							
	Potential Impact	**Attribute Importance**	**Impact Duration and Quality**	**Impact Magnitude**	**Impact Significance**	**Mitigation Proposed**	**Residual Impact**
Aquifer Classification – importance of the groundwater resource to a given area	Reduction in the resource available. Aquifer is poor or locally important throughout	Low to medium	None	None	None	-	None
Public Supply Wells	Deterioration of yield and quality	-	-	-	None. No public supply wells or Zones of Contribution nearby	-	None
Domestic and Private Wells	Deterioration of yield and quality due to alteration in the groundwater flow regime or accidental spillages migrating to aquifer due to construction dewatering (temporary) or the development of preferential pathways along proposed pipeline routes.	Low/very low	Negative and temporary	Negligible The area is supplied by mains water. Only a small proportion of the aquifer will be affected.	No permanent abstraction from or discharge to groundwater as part of proposed scheme. Slight/Imperceptible impact in the unlikely event of a domestic well being contaminated. However, domestic wells in the area are generally not used as there is mains water supply throughout.	Puddle clay or other impermeable barriers at intervals shall be installed along the proposed pipeline routes, particularly either side of a watercourse. Monitoring of local wells during any short-term construction dewatering during pipeline installation. Strict compliance with the CIRIA's (2006) *Control of water pollution from linear construction projects. Technical Guidance (C648)*. PCP, SECP, ERP and MS will be drafted in agreement with relevant authorities and having regard to relevant pollution prevention guidelines The pipeline will be constructed of ductile steel or high-density polyethylene with welded joints which will reduce the risk of leaks and failure. Concrete pipes will not be used.	Imperceptible
Portmarnock Peninsula Irrigation Wells	Saline intrusion compromising water quality. Interference with the flow regime and water table compromising yields.	Medium	Negative permanent	None (embedded mitigation)	None	Embedded mitigation by design (avoidance). Proposed outfall pipeline route (marine section) will be tunnelled beneath Baldoyle Estuary and Portmarnock Golf Club. Tunnelling will be carried out in the bedrock only. There is a layer of clay between the bedrock aquifer and the sand gravel aquifer from which the irrigation wells abstract. Pipe will be grouted to prevent the possibility of preferential flow pathways. As there will be no abstraction or discharge along the line of the pipe, there will be no alteration the flow regime or quality. Drive shaft at Portmarnock will be constructed using piling to avoid the necessity to dewater.	None
Baldoyle Estuary SAC	Contamination	Very high	-	-	None in terms of hydrogeology. Addressed under hydrology.	-	None

17.9 Difficulties Encountered in Compiling Information

No difficulties were encountered in compiling the information required for this Chapter of this EIAR.

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