Table of Contents

List of Figures and Tables

List of Appendices

14 Water and Hydrology

14.1 Introduction

This chapter describes the scope of works and methods applied in the identification and assessment of the potential effects of the construction and operation of the Glenamuck District Roads Scheme (GDRS) upon the receiving water environment and its effects on hydrology, hydrogeology and water quality.

The assessment techniques used are aimed at identifying constraints on the layout, design and construction methods of the proposed development as a result of the water environment, including areas in which development should be avoided and areas in which mitigation measures are required.

The objectives of this assessment are to:

- Undertake a field and desktop study to describe existing surface water & groundwater features within the study area;
- Assess the surface water drainage system proposals with regard to adequate capacity to collect, treat and discharge run-off generated by the proposed GDRS project;
- Assess the impact of climate change in the drainage design;
- Review the drainage system design such that it will protect both human health and the aquatic environment by minimising adverse impact on the quality of natural waters;
- Assess potential flood risk within the study area and ensure the proposals and its drainage system will not increase the risk of flooding;
- Establish the predicted effect of the works on groundwater quality and quantity; and
- Identify and incorporate appropriate mitigation measures, where required.

14.1.1 Impact Assessment - Scope of Works

The report identifies and assesses the potential effects on the following:

- Existing natural drainage patterns;
- Runoff rates and volumes;
- Flooding and impediments to flows;
- Water quality of receiving waters;
- Aquifer systems and their vulnerability.

To quantifiably assess the preceding, this chapter will:

- Outline relevant policy and legislation relating to the water environment.

- Summarise consultation responses in relation to this assessment.
- Provide baseline information and identify sensitive receptors.
- Identify potential effects, including potential cumulative effects.
- Assess the significance of any adverse impacts and resulting effects based on the magnitude of the impact and the sensitivity of the receptors.
- Outline detailed mitigation measures where required.
- Provide a residual impact assessment.

14.1.2 European, National and Regional Policy

Key European and National legislative policy relating to the water environment have been considered within this assessment and are contained within Table 14.1.

Table 14.1: Key Legislation

Policy	Legislation
EU	Water Framework Directive (2000/60/EC)
	Freshwater Fish Directive (2006/44/EC, replacing 78/659/EEC)
	Environmental Liability Directive (2004/35/EC)
National	Local Government (Water Pollution) Acts 1977 and1999 - 2007
	European Communities Environmental Objectives (Surface Waters) Regulations 2009
	Local Government (Water Pollution) Act, 1977 (Water Quality Standards For Phosphorus) Regulations, 1998
	European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations, 2009

Further to the above legislation, Irish National bodies including Transport Infrastructure Ireland (TII, formally National Roads Authority), the Office of Public Works (OPW) and the Environmental Protection Agency (EPA) provide detailed guidance to the preparation and content required for an EIAR in relation to the water environment. In addition, other regional and leading supplementary industry guidance referred to as part of this assessment are as outlined in Table 14.2.

Table 14.2: Key Supplementary Guidance

Body	Guidance
Transport Infrastructure Ireland (TII)	Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA , 2009)
	Environmental Impact Assessment of National Road Schemes – A Practical Guide (NRA, 2008)
	Guidelines for The Crossing of Watercourses During the Construction of National Road Schemes (NRA, 2008)

	Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan (NRA 2007)
	Road Drainage and the Water Environment (DN-DNG-03065)
	Design of Earthworks Drainage, Network Drainage, Attenuation & Pollution Control (DN-DNG-03066)
	Drainage Design For National Road Schemes - Sustainable Drainage Options (RE-CPI-07001)
	Drainage Systems For National Roads [DN-DNG--03022]
Office of Public Works (OPW)	The Planning System and Flood Risk Management (OPW, 2009)
	OPW Flood Maps (http://www.floodinfo.ie/)
Environmental Protection Agency (EPA)	Guidelines On The Information To Be Contained In Environmental Impact Assessment Reports (Draft, EPA,August 2017)
	EPA Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) (EPA, Sept. 2003)
	Geo Portal (https://gis.epa.ie/EPAMaps/)
Department of Housing Planning and Local Government	River Basin Management Plan for Ireland 2018 – 2021
Inland Fisheries Ireland (IFI)	Guidelines on protection of fisheries during construction works in and adjacent to waters (Inland Fisheries Ireland 2016)
CIRIA	The SUDS Manual (CIRIA C753)
	Control of Water Pollution from Construction Sites. Guidance for Consultants and Contractors (CIRIA C532)
	Control of Water Pollution from Linear Construction Sites (CIRIA C648)
	Development and Flood Risk – Guidance for the Construction Industry (CIRIA 624)
	The Control of Water Pollution from Construction Sites. Guidance for Consultants and Contractors (C532) (2001)
	Environmental Good Practice on Site Guide (C741) (2015)
Dublin City Council (DCC)	The Greater Dublin Strategic Drainage Study [GDSDS] (Dublin City Council et al., 2005)
DLRCC	Dun Laoghaire and Rathdown County Council Planning (http://dlrcoco.ie/en/planning)
Institute of Geologists Ireland (IGI)	Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements (2013)
Environment Agency (UK) EA	PPG1: General Guide to the Prevention of Pollution (UK Guidance Note)
	GPP 5 Works and Maintenance in or near Water (UK Guidance Note)
	PPG6 Working at Construction and Demolition Sites (UK Guidance Note)

14.2 Assessment Methodology

This assessment has been undertaken using a qualitative assessment based on experienced professional judgement and assessment of compliance with statutory and industry guidance, including several site visits.

14.2.1 Desktop Study

The desktop study involved collation and assessment of the relevant information from the following information sources.

- Consultation responses.
- Mapping and aerial photography to assess land usage on the site and its environs and to identify water features and watercourse catchments.
- Site surveys including topographic, underground utilities, orthophotography and site geotechnical investigations.
- Utility and Local Authority infrastructure record drawings.
- EPA Geo Portal (https://gis.epa.ie/EPAMaps/).
- Office of Public Works National Flood Hazard Mapping (http://www.floodinfo.ie/).
- Water Quality Monitoring Databases and Reports.
- Information of the hydrology and drainage of the study area from EPA www.epa.ie.
- Glenamuck District Distributor Road, Environmental Study (Vol 1-3), 2007, RPS;
- Glenamuck District Distributor Road, Preliminary Design Report, 2007, RPS;
- Glenamuck District Distributor Road, Feasibility Study & Route Selection Report, 2007, RPS;
- Glenamuck District Distributor Road, Constraints Study, 2007, RPS.
- Geological Survey Ireland Data Viewer (https://www.gsi.ie).

14.2.2 Site Walkover Assessment

Several site walkover surveys were undertaken from November 2017 to March 2018 with the purpose of identifying / verifying existing site drainage characteristics and water features.

The site walkover surveys encompassed the whole site area, with emphasis placed upon areas likely to be affected by proposed access road alignments in order to fully assess potential issues with regards to:

- Water crossings (culverts / bridges) required;
- Flooding;

- Existing runoff patterns;
- Existing groundwater levels and flow paths;
- New outfalls (discharges) required;
- Potential for impact on surface water quality due to construction and operation of the new carriageway.

14.2.3 Scoring Matrix for Impact Assessment

Impact assessment was carried out with reference to the EPA's Guidelines On The Information To Be Contained In Environmental Impact Assessment Reports (Draft August 2017) and the TII "Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes".

The significance of the identified potential impacts is acknowledged by the combination of the sensitivity of the receptor and the magnitude of the potential impact.

Receptor Sensitivity

The sensitivity of the receiving environment has been categorised on a scale from "high" to "negligible" as defined in Table 14.3.

Sensitivity criteria is based on:

- Vulnerability of a receptor to a particular pressure (degree of environmental response to any particular impact); and
- The 'value' of the receptor (e.g. an area of international importance should be considered more sensitive to the impact than an area of little or no conservation value).

Table 14.3: Receptor Sensitivity

Sensitivity of Environment	Criteria	Examples
High	Attribute has a high quality and rarity	Surface waterbody supporting aquatic site/species protected under EC and Irish legislation. Watercourse with High water quality supporting very sensitive aquatic resource. Principal aquifer providing a regionally important drinking water resource. Aquifer in drinking water protection area.
Medium	Attribute has a medium quality and rarity	Surface waterbody with Good/Moderate water quality supporting a locally important fishery resource or ecosystem. Principal aquifer providing a regionally important drinking water resource. Locally Important Aquifer. Surface waterbody supporting salmonid resource.

Low	Attribute has a low quality and rarity	Surface waterbody with Low water quality. Surface waterbody supporting low value aquatic resource. Poor Aquifer which is Generally Unproductive except for Local Zones. Surface waterbody whose environmental equilibrium copes well with all natural fluctuations but cannot absorb some changes greater than this without alteration of its present character.
Negligible	Attribute resilient to environmental change	Surface waterbody with poor water quality. Surface waterbody whose environmental equilibrium is resilient to changes greater than natural fluctuations without detriment to its natural hydrological morphology and water quality characteristics. Heavily engineered or artificially modified; may dry up during dry spells (no base flow). Poor Aquifer which is Generally Unproductive.

Impact Magnitude

The Impact Magnitude has been categorised on a scale from "high" to "negligible" as defined in Table 14.4.

Table 14.4 Impact Magnitude Criteria

Magnitude of Impact	Criteria	Examples (non-exhaustive)
High	Results in permanent impact to attribute and/or quality and integrity of attribute.	Loss or extensive change to a water body or water dependant habitat. Large change in Predicted Flood Level (>100mm). Impact to designated groundwater dependant habitat. Large change in regional aquifer properties. Reduction in quality or amenity value. Extensive loss of fishery. Changes to stream morphology preventing fish/ mammal movement.
Medium	Results in temporary or minor impact to attribute and/or quality and integrity of attribute.	Change in predicted peak flood level >50mm. Impact to locally important groundwater dependant habitat. Temporary reduction in quality or amenity value. Temporary impact to fishery.
Low	An impact that causes slight measurable changes to the environment or temporary	Minor change in predicted peak flood level <50mm. Minor deterioration in environmental water quality unlikely to affect the most sensitive receptor.

	changes to small portion of attribute	Local changes to groundwater levels.
Negligible	An Impact without measurable or noticeable consequences	Negligible Change in predicted peak flood level (<10mm). Temporary insignificant change in hydrological/ hydrogeological and water quality conditions not exceeding those expected due to naturally occurring fluctuations

Factors which influence the Impact magnitude include the type of impact and duration. These aspects are considered with reference to the TII and EPA guidance as detailed in Table 14.5 below.

Table 14.5 Types of Impact

Potential Impact	Description
Direct Impact	The existing geological, hydrological or hydrogeological environment is altered in whole or in part as a consequence of road construction or operations.
Indirect Impact	The existing geological, hydrological or hydrogeological environment beyond the proposed route corridors is altered by activities related to road construction and/or operation.
No predicted impact	The proposed route corridor has neither a negative nor a positive impact on the geological, hydrological or hydrogeological environment.

Table 14.6 – Impact Duration (EPA 2017)

Duration	Description
Momentary	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	Lasting seven to fifteen years.
Long Term	Lasting fifteen to sixty years.
Permanent	Lasting over sixty years
Reversible	Impacts that can be undone, for example through remediation or restoration

Impact Significance

The significance of the identified potential impacts is acknowledged by the combination of the magnitude of the potential impact (Table 14.4) and sensitivity of the receptor (Table 14.3). The generalised significance terms used in this assessment is in line with the EPA guidance reproduced in Figure 14.1 below

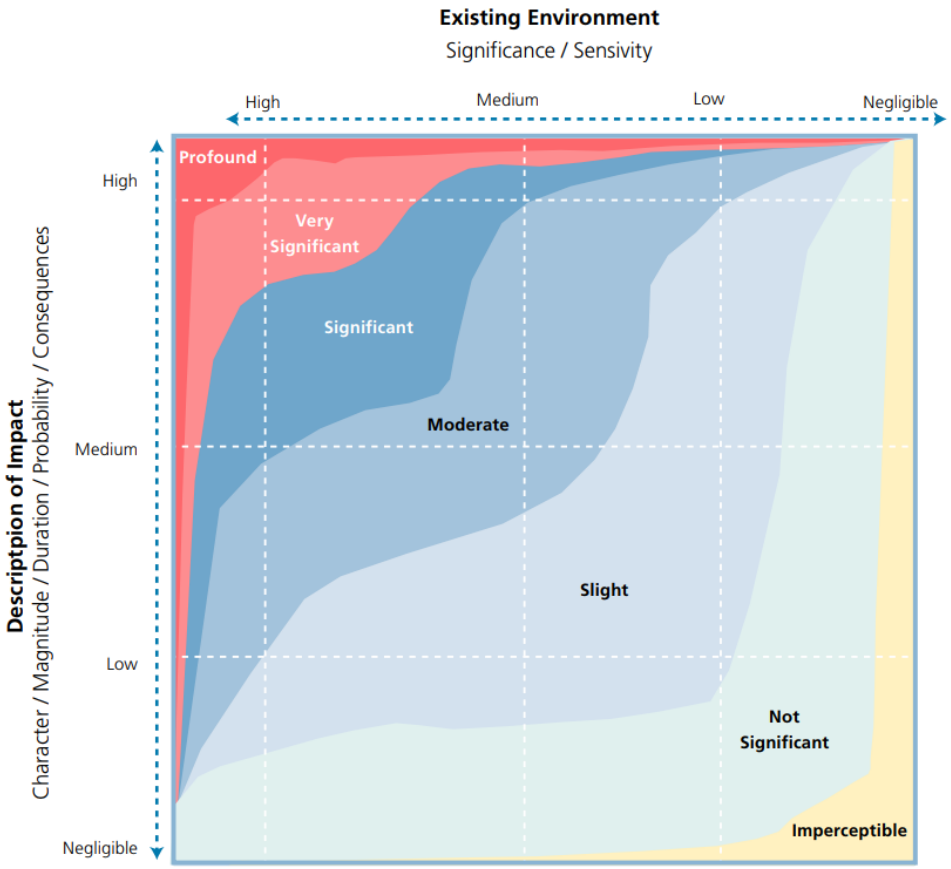

Figure 14.1: Significance Effect Matrix

In addition to significance, the effect on the receiving environment may be Positive, Neutral or Adverse.

14.3 Baseline Environment

14.3.1 Hydrological Setting

The Glenamuck District Roads Scheme (GDRS) lies entirely within the catchment of the Loughlinstown River (also known as the Shanganagh River and Bridesglen River). The study area affects two primary hydrological sub-catchments. Southern portions of the scheme are within the "Shanganagh" Sub-catchment (*EPA Ref: IE/EA/10S010600)* and northern portions are within the "Carrickmines Stream" sub-catchment (*EPA Ref:* IE/*EA/10C040350)*. The Carrickmines Stream merges with the Loughlinstown River upstream of its discharge to the Irish Sea at Shanganagh (Figure 14.2).

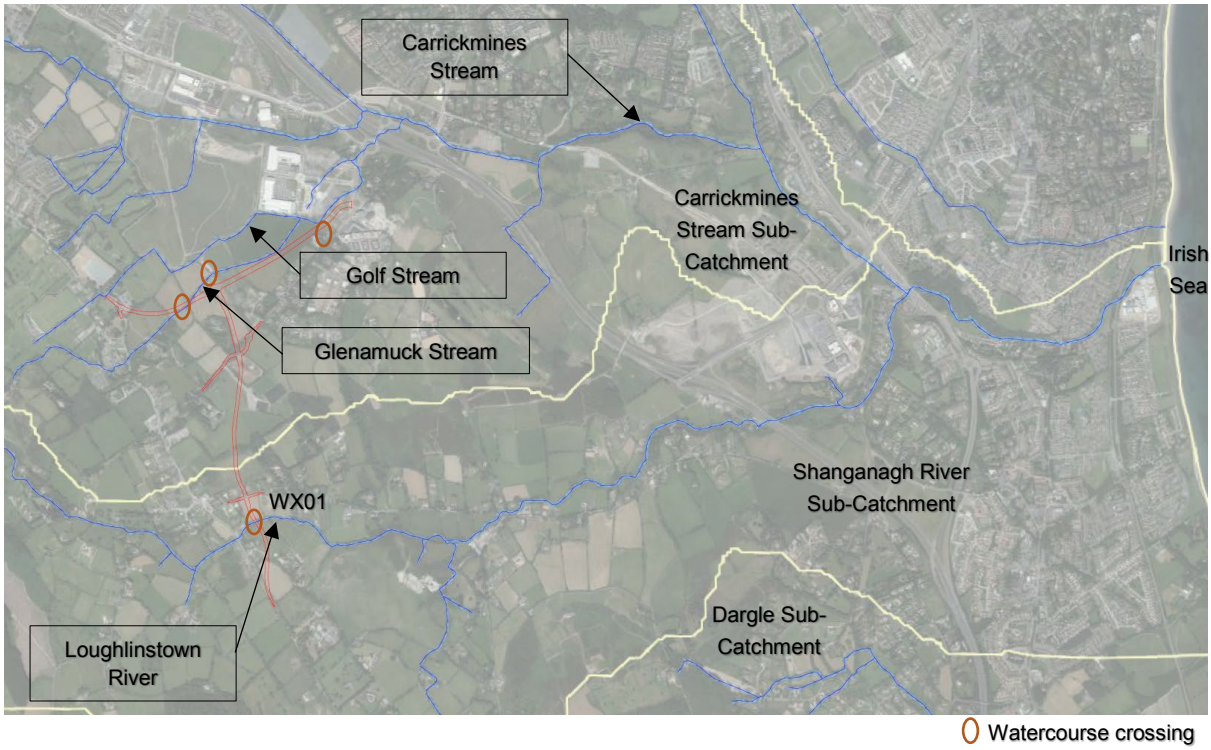

Figure 14.2: Hydrological Catchments

14.3.2 Watercouses

In the direct vicinity of the roads scheme there are several minor tributaries of the Loughlinstown River. These include the headwater channel of the Loughlinstown River, Glenamuck Stream, Golf Stream and some minor field and roadside drainage channels. The main local hydrological features are presented in Figure 14.2 and Figure 14.1 (in Volume 3). Local watercourses generally rise on the eastern slopes of Two Rock and Three Rock Mountains to the west of the development and generally flow in an easterly direction in the vicinity the proposed development. The tributaries merge to supply Carrickmines Stream / Loughlinstown/Shanganagh River before eventually discharging to the Irish Sea.

The proposed scheme will require a new crossing of a branch of the Loughlinstown River, two crossings of the Glenamuck Stream and a crossing of an unnamed watercourse. Locations and preliminary details of proposed watercourse crossings are shown in Figure 14.2 and as per Table 14.7 Details are also shown in Volume 3 Figures 14-1 to 14-5.

Table 14.7: Watercourse Crossing Schedule

Crossing Ref	Type	Watercourse	Status
WX-01	Box Culvert	Glenamuck Stream	New
WX-02	Box Culvert	Glenamuck Stream	Replacement
WX-03	Box Culvert	Unnamed Drain	New
WX-04	Bridge	Loughlinstown Rover	New

All new culverts are required to facilitate road construction and have been designed in accordance with the mitigation measures in Section 14.5 to ensure impacts are minimised and stream morphology / wildlife passage are maintained. WX-03 is required to replace an existing culvert on the access road to Bective Rangers RFC grounds, this access road will be subject to accommodation works. The existing culvert is a poorly constructed series of pipes with varying levels and lengths and replacement of this culvert with a suitably designed new structure will have positive effects on the local hydrological environment.

EPA mapping indicates that the Shanganagh and Carrickmines Stream catchments are not designated Salmonid watercourses. Previous aquatic surveys (outlined below) have however identified that the streams support trout. The Dargle River Sub-Catchment (EPS Ref: 040/10D010300) which is located to south-east of the proposed road development is the nearest waterbody governed by salmonid regulations – no portion of the proposed scheme is within the Dargle Sub-catchment.

14.3.3 Hydrogeological Setting

Granite Bedrock underlies the entire scheme. The bedrock is described in geological mapping as a Caledonian Age Granite with muscovite phenocrysts. This is part of a formation known as the Northern and Upper Liffey Valley Plutons. The bedrock aquifer underlying the entire site is classified by Geological Survey Ireland as a *"Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones".*

Site investigation information and anecdotal local information indicates that subsurface flows can occur within local zones of fractured bedrock at the bedrock/soil interface in the vicinity of the site. These shallow flows typically follow topographical gradients and are typically intercepted by surface/agricultural drainage at topographic low points.

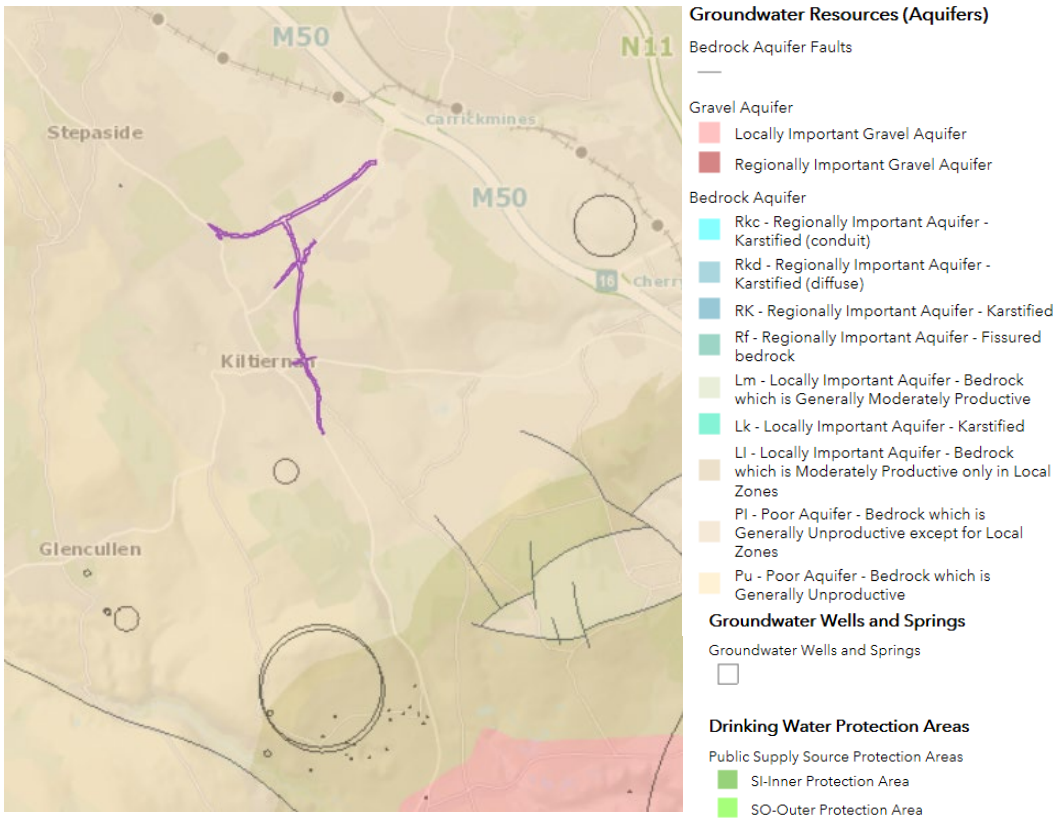

Figure 14.3: Hydrogeological Setting

Groundwater Vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities. Groundwater vulnerability is classed as "High" or greater across the entire project extents due to the shallow depth to bedrock and relatively permeable soils. Areas of highest vulnerability correspond to areas of near surface bedrock and thin soil depths. It is noted that the aquifer vulnerability classification does not consider the nature of the underlying 'receiving' aquifer with respect to resource value or significance of pollution occurring and is only a reflection on the protection afforded to the aquifer by overlying deposits.

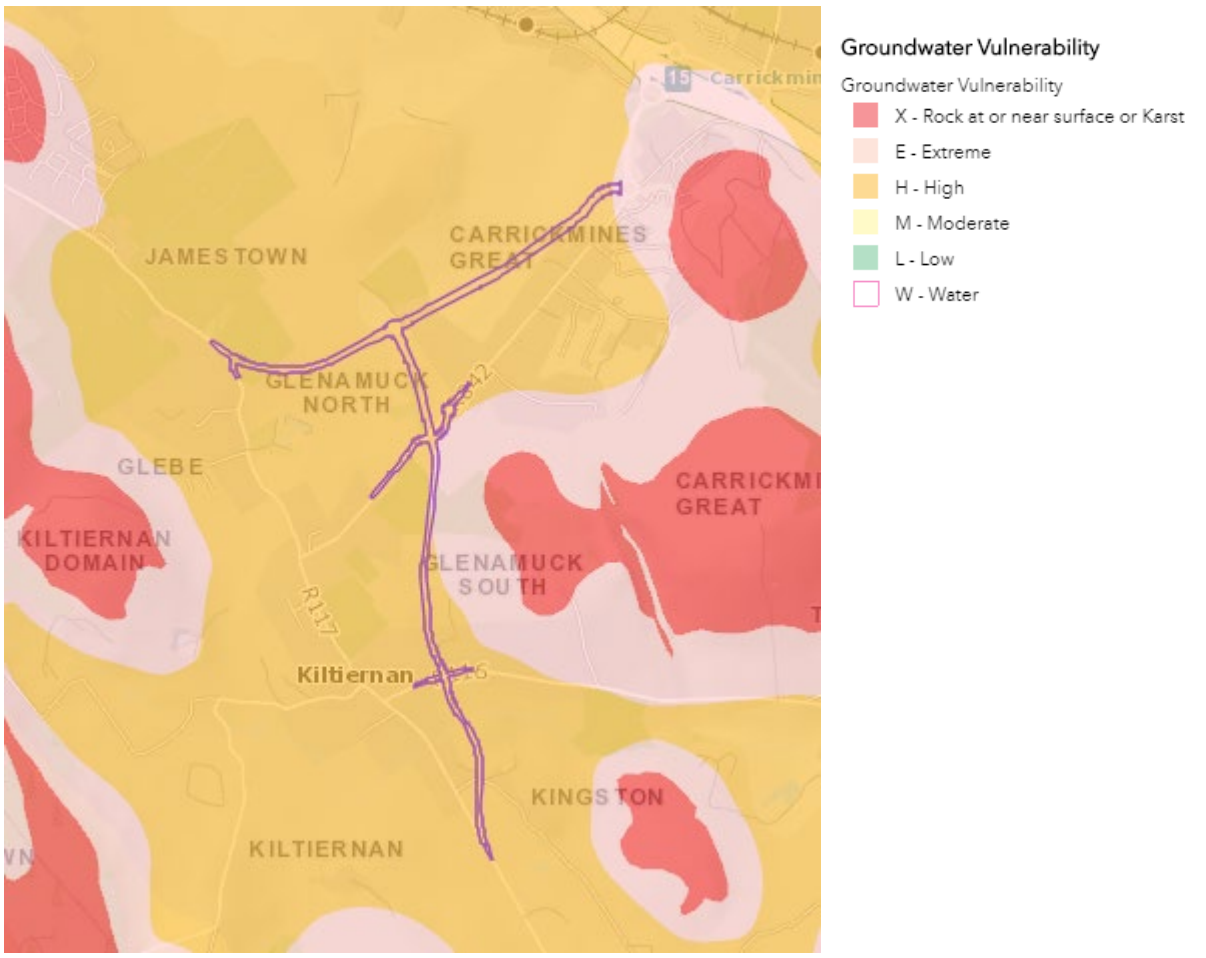

Figure 14.4: Groundwater Vulnerability

14.3.4 Water Quality

EPA Q Rating

The EPA operate a biological river quality (Q or biotic index) classification system based on biological sampling at water monitoring stations. These values are based primarily on the relative proportions of pollution sensitive to pollution tolerant macroinvertebrates resident at a river site, refer to Table 14.8.

Table 14.8 Q Biotic Indices - Interpretation

Q Value	WFD Status	Pollution Status
Q5, Q4-5	High	Unpolluted
Q4	Good	Unpolluted
Q3-4	Moderate	Slightly polluted
Q3, Q2-3	Poor	Moderately polluted
Q2, Q1-2, Q1	Bad	Seriously polluted

Q-rating data is available for the Loughlinstown River upstream and downstream of the proposed road development. and for the Carrickmines Stream downstream of the proposed development, refer to Table 14.9 for results.

Table 14.9 EPA Water Quality Monitoring Q-Rating Values

Waterbody	Station	Location E/N	EPA Q-Rating
Loughlinstown / Shanganagh River	RS10S010440 (upstream-160m)	320889 / 221871	3-4 (Moderate)
Loughlinstown / Shanganagh River	RS10S010450 (Downstream - 1.5km)	322348 / 222008	4 (Good)
Carrickmines Stream	RS10C040200 (Downstream -800m)	322006 / 224095	3 (Moderate)

WFD Classification -Surface Water

The Glenamuck Stream lies within the "Carrickmines Stream" waterbody and has been assigned as "Moderate" status under WFD classifications. The Loughlinstown River is in the Shanganagh sub-catchment and is classified as "Good" status.

WFD Classification -Groundwater

The groundwater body underlying the scheme extents is the Wicklow East waterbody which is classed as "Good" status under the Water Framework Directive (WFD).

Independent Water Quality Assessment

In addition to a review of water quality data held by statutory agencies, additional independent water quality sampling was undertaken as part of the project to determine baseline water quality standards prior to any development at the site.

The objective of the baseline sampling was to collect and assess representative samples of water from rivers and streams in the vicinity of the site to enable affected downstream catchments to be monitored. Upstream control points have also been sampled of part of the monitoring regime.

Sampling was undertaken at five sites and all samples were subject to physico-chemical analysis to establish baseline water quality. These sites will continue to be monitored at regular intervals during the project for a period of at least one year to establish seasonal variations.

Locations of surface water monitoring points are presented in Figure 14.1 in Volume 3. Results received to date have indicated that the measured parameters are generally within guideline values for surface water.

Ballyogan Landfill

Ballyogan landfill is situated to the north of Golf Stream to the north of the proposed scheme extents. Although no portion of the scheme is within the landfill footprint there may be potential for an impact

on surface water quality upstream of the proposed development as a result of landfill leachate. It is noted that Ballyogan Landfill no longer operates as a landfill and is no longer accepting landfill waste.

Monitoring results on the Golf Stream downstream of the landfill are available from the EPA associated with EPA license W0015-01. Most recent results (2018) indicate elevated readings of Ammoniacal Nitrogen in the Golf stream and Biological assessment delivered a Q rating of Q3 (Poor).

Independent Aquatic Surveys

A previous environmental study (RPS 2007) for the scheme included an aquatic ecology assessment of affected watercourses (Conservation Services 2006). The assessment covered the affected portions of the Glenamuck Stream and the Loughlinstown River. A summary of the study is presented in Table 14.10 below.

Table 14.10: Summary of Previous Aquatic Ecology Study (2007)

Location	Q-rating	Pollution Status in Vicinity of Potential Impact Location	Salmonid Habitat Recorded at Impact Point	Salmonids Recorded at Sampling Site	Best Salmonid Habitat Recorded and Distance Downstream
Glenamuck Stream	3-4	Slightly Polluted	Good	Brown Trout	Good at location
Shanganagh River	4	Unpolluted	Very Good	Brown Trout (possible juvenile sea trout)	Very Good at location

14.3.5 Meteorological Data Summary

Rainfall data for the area has been extracted from Met Eireann Data Charts, the annual rainfall data from 1981-2010 indicates the long term average annual rainfall in the vicinity of the scheme is between 900-1000mm.

The site is in a transitional zone between higher rainfall areas in the Dublin mountains and lower rainfall in lower elevation areas alongside the east coast.

14.3.6 Flooding

Historical Flood Data

As part of the desktop study, historic and predicted flood risk mapping published by the OPW on the Flood Hazard Mapping Website http://www.floodinfo.ie/ was reviewed.

The Eastern CFRAM (Catchment Flood Risk Assessment and Management) study details the predicted risk for a variety of fluvial and coastal flood scenarios. The mapping does not include the watercourse reaches affected by the proposed scheme and only maps downstream flooding.

Historical flood maps/data indicate there are no recorded flood events within the proposed road corridor. There is a recorded 2002 flood event associated with the Carrickmines River however this is well outside the road corridor on the eastern side on the M50. Further records exist of a recurring flood

event on the Glenamuck Road outside the scheme extents. This flooding appears to be associated with local road drainage deficiencies rather than fluvial or coastal flood risk

There are no areas within the site or immediately downstream of it mapped as "Benefiting Lands". These are defined by the OPW as lands that might benefit from the implementation of Arterial (Major) Drainage Schemes (under the Arterial Drainage Act 1945) and can indicate areas of land subject to flooding or poor drainage.

To adequately assess the potential impact of the scheme on flood risk a separate site specific flood risk assessment (SSFRA) has been prepared for the scheme and is included in Appendix 14-1. The SSFRA determined the following;

- The proposed road main footprint is outside the Q100 and Q1000 flood extents and is therefore in Flood Zone C (low risk of flooding) except for at localised stream crossings where flood risk is bridged.
- The proposed culverts/bridges have capacity to convey the required design flows without increasing flood risk. (Detailed design of watercourse crossings will be subject to future agreement with OPW as part of a Section 50 agreement).
- Subject to mitigation measures outlined in the report, the proposed scheme will not increase flood risk.

River Flows

River flows at the proposed crossing locations were derived as part of the SSFRA. The derived flows at the proposed watercourse crossings are detailed in Table 14.11 below.

Table 14.11: River Flows

Location	Q100 Flow (m^3/s)	Q1000 Flow (m^3/s)
Glenamuck Stream Crossing	1.46	1.93
Un-named Drain Crossing	1.13	1.50
Loughlinstown River Crossing	5.73	7.60

14.3.7 Surface Water Abstractions

As part of the desktop study for this assessment EPA mapping indicates there are no registered surface water abstractions within the downstream hydrological catchment of the site.

The EPA holds information relating to private water supplies registered in accordance with the European Communities (Drinking Water) (No.2) regulations 2007. The online maps available indicate no private water supplies abstracting downstream of the scheme.

14.3.8 Groundwater Abstractions

GSI hold datasets on Drinking Water Protections areas and National Federation Group Water schemes, neither dataset showed records in the vicinity of the site. The GSI dataset for groundwater wells and springs indicates one borehole which is potentially downgradient of the site (3221NWW003). This dates from 1994 and its use is recorded as unknown. The borehole appears to be within the Cherrywood SDZ which is serviced by mains supply and is considered unlikely to be used as a drinking water source.

14.3.9 Topography

The proposed road route traverses an area of undulating lands generally falling from west to east from the Dublin mountains towards the coast.

A detailed topographical survey of all lands, watercourses, and existing infrastructure affected by the proposed works has been carried out to inform the design for the scheme. In addition to this, LIDAR topographical data has been used to determine the topography beyond the proposed road corridor.

Survey data indicates the highest elevations on the scheme are at the southern tie in to the Enniskerry Road (approx. 138mAoD) and lowest elevations at the tie in to the Glenamuck Road South Roundabout at Carrickmines (approx. 85mAoD)

14.3.10 Designated sites

Designated sites (sites designated as conservation areas under Irish or EU legislation) within 5km of the proposed scheme or within the hydrological catchment of the scheme are indicated in Table 14.12 below.

Table 14.12: Designated Sites

Station ID	Name	Designation	Distance	Commentary
001207	Dingle Glen	Proposed NHA	0.6 km	Dry valley formed by a glacial lake overflow channel. Proposed designation based on variety of habitats within a small area. Located east of the subject site within the Loughlinstown stream catchment however does not have a direct hydrological connection to the site. Therefore not sensitive to hydrological/ hydrogeological impacts from the subject site.
001202	Ballybetagh Bog	Proposed NHA	1.3 km	Fen area with proposed designation primarily based on fossil remains. Located within separate hydrological catchment to the scheme and not sensitive to hydrological/ hydrogeological impacts from the subject site.
000725	Knocksink Wood	Proposed NHA, SAC	4.6 km	Designation based on petrifying Spring and Alluvial Forest habitat. Located within separate hydrological catchment to the scheme and not sensitive to hydrological/ hydrogeological impacts from the subject site.
000713	Ballyman Glen	Proposed NHA, SAC	2.8 km	Designation based on petrifying Spring and Alkaline Fen habitat. Located within separate hydrological catchment to the scheme and not sensitive to hydrological/ hydrogeological impacts from the subject site.
001211	Loughlinstown Woods	Proposed NHA	3.0 km	Proposed designation based on mixed woodland species and habitat of natural character. Site primarily used for amenity purposes. The pNHA is downstream of the proposed site and the Loughlinstown River flows through it. Given the designation is based on woodland species present it is not considered sensitive to hydrological/ hydrogeological impacts from the subject site.
001768	Powerscourt Woodland	Proposed NHA	4.3km	Proposed designation based on mixed woodland species and habitat. Located within separate hydrological catchment to the scheme and not sensitive to hydrological/ hydrogeological impacts from the subject site.
001206	Dalkey Coastal Zone And Killiney Hill	Proposed NHA	4.4 km	Coastal site spanning from Dun Laoghaire Harbour to Shankhill. Proposed designation based on varied habitats from sub-littoral to coastal heath. Also supports variety of bird and crustation species and contains rock exposures of geological interest. Located within separate hydrological catchment to the scheme and not sensitive to hydrological/hydrogeological impacts from the subject site.

Based on the above review no designated sites are considered to be sensitive to hydrological hydrological/hydrogeological impacts at the subject site.

14.3.11 Baseline Summary and Sensitivities

The baseline assessment identified several of hydrological receptors that have the potential to demonstrate sensitivity to the development proposed at the site. These are:

- Glenamuck Stream and tributaries ;
- Loughlinstown/Shanganagh River
- Bedrock Aquifer

The Sensitivity of these receptors identified is determined in accordance with the rationale described in Section 14.2.3.

Table 14.13 Baseline Summary

Type	Receptor	Sensitivity	Rationale
Hydrological (Watercourse)	Glenamuck Stream and their tributaries	Medium	Water Framework Directive water quality classification of Moderate (C) Not governed by Salmonid Regulations, however has been identified as supporting brown trout
Hydrological (Watercourse)	Loughlinstown / Shanganagh River	Medium	Water Framework Directive water quality classification of Good (B) Not governed by Salmonid Regulations, however has been identified as supporting brown trout
Hydrogeological (Aquifer)	Bedrock Granite Aquifer	Low	Poor Aquifer which is Generally Unproductive. No significant abstractions

14.4 Predicted Impacts

14.4.1 Construction Phase

Construction activities can pose a significant risk to the watercourse receptors identified and comprise impacts associated with the significant excavations, soil movement, aggregate import and construction plant usage. (Reference should be made to Chapter 5 "Description of Project" where the construction activities have been outlined in detail.) Tables 14.14 and 14.15 below present the likely potential impacts of the construction activities on the Hydrological environment, in the absence of mitigation. Mitigation measures to reduce the impact of these are discussed in Section 14.6

Table 14.14: Predicted Impacts - Construction Phase

Impact	Source	Consequence
Chemical Pollution of Water Environment	• Temporary presence of chemicals, fuels, and other oils associated with construction activities on the site have potential to enter the water environment through accidental spillages, improper transport and refuelling, or inappropriate storage and disposal procedures, by gradual leakage or single failure of storage tanks or refuelling mechanisms • Temporary and permanent wastewater effluent from temporary construction phase welfare facilities and permanent substation building welfare facilities has potential to enter surface water or shallow groundwater. • Concrete, bentonite and other cement-based products will be used during construction activities. These materials are highly alkaline and corrosive and can have significant negative effects on surface water quality if improperly handled. Cement based products can also be detrimental to waterbody environs by altering the waters pH	• Oils and chemicals entering water environment have the potential to adversely affect water quality, with associated effects to fish and aquatic ecology.
Pollution of watercourses by silt / suspended solids	• Temporary construction activities would require excavations, ground disturbance, stripping of soils, and temporary spoil deposition. Exposed soils have potential to release sediments in surface water • Construction of access tracks and other hard standing areas would require importing, handling, and placement of aggregate, with potential to release sediments in surface water • Construction plant movements across disturbed soils and access tracks have potential to release silts and sediments to surface water runoff • Temporary surface water or shallow groundwater gathering in significant excavations has potential to be significantly polluted due to contact with excavated surfaces and aggregates. Discharging of untreated water by pump or gravity would cause release of potentially heavily polluted effluent to watercourses • Construction of culverts and stream realignments can disturb stream sediments and increase turbidity	• Sediments and debris entering watercourses have the potential to adversely modify stream morphologies, smother habitats, harm aquatic flora and fauna with particular risk to salmonid spawning areas; and increase risk of blockage to culverts and drainage channels.
Changes to Stream Channels	• Construction works will involve the construction of new watercourse crossings and realignment works. In-stream and bank side construction works can alter the morphology, river banks and in-stream ecology	• Unsuitable culvert/channel sizing or installation can affect conveyance and flood risk • Unsuitable culvert/channel sizing or installation can affect movement of fish or mammals along the watercourse corridor

		• Loss of habitat by direct disturbance
Changes to runoff, and flow patterns	• Earthworks for the road will result in cuttings, embankments or spoil heaps that have the potential to modify drainage routes • Changes in surfacing caused by vegetation stripping or gravel placement may also affect runoff or rates • Changes in surfacing or drainage approach may affect groundwater recharge patterns • Pumping or deep excavations may affect groundwater levels	• Increases in surface water runoff rates and volumes, leading to increased flood risk and increased effects of erosion and scour in down gradient watercourses. • Diversion of flows from the natural catchment which could affect dependant habitats and flood risk. • Changes to recharge patterns or groundwater levels may affect groundwater levels and yields

14.4.2 Unmitigated Significance -Construction Phase

Magnitudes of identified impacts, and associated unmitigated significance of those impacts, are determined in accordance with the rationale previously described and are presented in the following table.

Mitigated significance is presented in Table 14.18.

Table 14.15: Unmitigated Significance – Construction Phase

Receptor	Receptor Sensitivity	Potential Impact	Impact Magnitude	Impact Significance (pre-mitigation)
Glenamuck Stream / Loughlinstown River	Medium	Chemical Pollution of Water Environment	Medium – Potential for temporary reduction in water quality and fishery value	Moderate
Glenamuck Stream / Loughlinstown River	Medium	Pollution of watercourses by silt / suspended solids	Medium – Potential for temporary reduction in water quality and fishery value	Moderate
Glenamuck Stream / Loughlinstown River	Medium	Changes to Stream Channels	High – Unsuitable watercourse crossings have potential for large change in flood levels or loss of significant upstream habitat due to movement barriers	High

Glenamuck Stream / Loughlinstown River	Medium	Changes to runoff and flow patterns	Medium – Temporary or minor impact to local drainage or flood levels caused by earthworks and construction surfacing	Moderate
Bedrock Aquifer	Low	Chemical Pollution of Water Environment	Medium – Potential for temporary reduction in water quality	Slight
Bedrock Aquifer	Low	Changes to runoff and flow patterns	Low -Local change to groundwater levels	Not Significant

14.4.3 Operational Phase

The predicted impacts of the operational phase are those associated with the completed road including final surface treatments, conveyance of traffic flows and all operation and maintenance activities of the road and associated works including the road drainage system. The main impacts arising from operational activities include:

Table 14.16: Predicted Impact - Operational Phase

Impact	Source	Consequence
Chemical Pollution of Water Environment	• Road Runoff can contain several contaminants. These arise from the degradation of road surfaces, tyres and vehicle emissions. The primary contaminants known to occur in routine runoff include hydrocarbons and heavy metals. • The application of salt to road surfaces as part of winter road maintenance will result in an increase in salinity, conductivity and total dissolved solid concentrations to the receiving aquatic system.	• Oils and chemicals entering Water Environment have the potential to adversely affect water quality, with associated effects to fish and aquatic ecology.
Pollution of watercourses by silt / suspended solids	• Erosion associated with the drainage network or unvegetated areas may have the potential to release suspended solids. The potential for silt/suspended solids is however greatly reduced when compared to construction phase.	• Sediments and debris entering watercourses have the potential to adversely modify stream morphologies, smother habitats, harm aquatic flora and fauna with particular risk to salmonid spawning areas; and increase risk of blockage to culverts and drainage channels.
Changes to Stream Channels	• Any construction stage deficiencies with watercourse crossings and realignment works will continue throughout operation phase • Outfalls to stream channels may cause erosion and deterioration of stream channel if improperly detailed •	• Unsuitable culvert/channel sizing or installation can affect conveyance and flood risk • Unsuitable culvert/channel sizing or installation can affect movement of fish or mammals along the watercourse corridor • Erosion at stream outfalls
Changes to runoff and flow patterns	• The Construction of a structure within a flood plain results in the loss of an area that could have been used to store water. This results in increased flows downstream and increased risk of flooding • Increased hard surfacing combined with a piped drainage network can cause increases in surface water runoff rates and volumes • Constructed drainage networks have the potential to modify drainage routes • Increases in runoff and flows associated with climate change may lead to flows in excess of those designed for which overwhelm drainage infrastructure	• Increases in surface water runoff rates and volumes, leading to increased flood risk and increased effects of erosion and scour in down gradient watercourses. • Diversion of flows from the natural catchment which could affect dependant habitats and flood risk. • Changes to recharge patterns or groundwater levels may

	• Changes to runoff patterns caused during construction will continue throughout operation phase	affect groundwater levels and yields

14.4.4 Unmitigated Significance -Operational Phase

Magnitudes of identified impacts, and associated unmitigated significance of those impacts, are determined in accordance with the rationale previously described and are presented in the following table.

Mitigated significance is presented in Table 14.18.

Table 14.17: Unmitigated Significance - Operational Phase

Receptor	Receptor Sensitivity	Potential Impact	Impact Magnitude	Impact Significance (pre mitigation)
Glenamuck Stream / Loughlinstown River	Medium	Chemical Pollution of Water Environment	Medium – Potential for temporary reduction in water quality and fishery value	Moderate
Glenamuck Stream / Loughlinstown River	Medium	Pollution of watercourses by silt / suspended solids	Medium – Potential for temporary reduction in water quality and fishery value	Moderate
Glenamuck Stream / Loughlinstown River	Medium	Changes to Stream Channels	High – Unsuitable watercourse crossings have potential for large change in flood levels or loss of significant upstream habitat due to movement barriers	High
Glenamuck Stream / Loughlinstown River	Medium	Changes to runoff and flow patterns	High – Unmitigated increases in runoff rates have potential to significantly affect flood levels	High
Bedrock Aquifer	Low	Chemical Pollution of Water Environment	Medium – Potential for temporary reduction in water quality	Slight

Bedrock Aquifer	Low	Changes to runoff and flow patterns	Low -Local change to groundwater levels	Not Significant

14.5 Mitigation Measures

14.5.1 Mitigation Measures – Preamble

From the assessment of potential impacts during construction and operation and decommissioning, the following key issues have demonstrated potential impact significance and so require particular attention for mitigation and management:

- Chemical Pollution of Watercourses
- Pollution of watercourses by silt / suspended solids
- Changes to Stream Channels
- Changes to runoff and flow patterns

The greatest risk to the environment is during the construction period, coinciding with the greatest amount of activity on site. Furthermore, effects unmitigated during construction have the potential to extend into the operational phase.

Details of additional mitigation measures proposed are included in the following sections. It is noted that all identified effects have been mitigated via prevention and reduction, and that impact offsetting is not proposed

14.5.2 Mitigation Through Design

The project layout has evolved in order that the design avoids conflict with the water environment. Design evolution to minimise environmental impact has been prioritised throughout the various design stages. This is detailed in the Environmental Report which supported the LAP road route selection and has been continued throughout the planning stage and design phases.

The alignment of the road at watercourse crossings facilitate the shortest possible crossing lengths and facilitates the construction of the crossing structures outside the active stream channel either by utilising clear span crossing (bridge) or offline culverts which can be constructed in the dry in advance of stream diversions

The scheme also avoids areas identified as Flood Zone A and B to minimise impact on flood conveyance and floodplain storage.

The drainage system allows recharge to groundwater at all attenuation and open channel locations

The scheme design facilitates the retention of vegetated buffer strips at all locations other than crossing points and isolated pinch points. Retention of intact vegetated buffer zones between infrastructure and water features allows:

- Improved / protected water quality by filtering runoff within riparian vegetation before it enters the watercourse.

- Space for natural fluvial processes which help restore and maintain the natural dynamic balance of river systems and associated habitats.
- Vegetation stabilises banks and reduces soil erosion.
- Access for the maintenance and inspection of watercourses, and for dealing with pollution incidents.
- Habitat for plants and animals

14.5.3 Mitigation Through Procedures

In order to facilitate the integration of environmental issues into road scheme planning, construction and operation, an Environmental Operating Plan (EOP) shall be produced, implemented and maintained by the contractor. This represents a best practice guide for considering the environment for the construction life cycle of a road scheme project.

The EOP shall be designed to assist the main contractor in preventing, managing and/or minimising significant environmental impacts during the construction phase. To achieve this objective the EOP shall:

- Comprehensively incorporate all Environmental Commitments set out in the Contract documents, Planning Documents (including EIAR), any conditions and/or modifications imposed by An Bord Pleanála or the Local Authority.
- Provide a method of documenting compliance with these Environmental Commitments and conditions/modifications.
- Itemise relevant environmental legislative requirements and best practice guidance. The EOP should also provide a method of documenting compliance with these requirements.
- Outline methods by which construction work will be managed to prevent, reduce or compensate for potential adverse impacts on the environment.
- Incorporate procedures for communicating with the public, statutory consultees, Local Authority and relevant site-personnel.
- Incorporate procedures for Environmental Awareness Training for the main contractor's staff.
- Incorporate monitoring procedures and responses to monitoring results, where contractually required.
- Provide for a system of audit with regard to the effectiveness of the EOP during the construction life cycle of the project.
- Include an Emergency Response Plan (ERP) detailing the procedures to be undertaken in the event of a spillage of chemical, fuel or hazardous wastes, fires or flood events.

TII have published "Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan" which should be used as a basis for the creation of the EOP.

The EOP shall be co-ordinated with all other environmental procedural documents required which may include a Construction Management Plan and a Pollution Prevention Plan.

14.5.4 Specific Mitigation Measures – Pollution Control

This section outlines the mitigation measures that will be required to minimise pollution impact to the water environment during both the construction and operational phase of the development.

Construction stage drainage shall be encompassed by a robust Sustainable Drainage System (SuDS) design which will be used to control drainage and silt management on the site. Drainage measures to include

- Maintaining existing overland flow routes and channels. All existing natural flow paths across the works area will be maintained through the use of interception drainage. Intercepted "clean" runoff will be captured upstream of works and conveyed to a suitable discharge point without being affected by flowing though the works area. Minimisation of offsite flows through the works area reduces the quantity of water which may require treatment
- All discharges from the works area will be routed through a "treatment train" of SuDS components to aid pollutant removal. No outflows or dewatering flows from the works area should discharge directly into watercourses
- Construction drainage ditches should take the form of wide, flat bottomed swales designed to convey flows at a low velocity
- Reducing surface water flow rates and volumes by providing check-dams in swales, whereby the flow velocity and rate of discharge is reduced to mimic natural properties and maximise filtration and settlement of suspended particles
- Providing settlement ponds where runoff from the works area areas is attenuated and treated prior to discharge to watercourses. Permanent ponds are proposed to cater for the operational phase drainage and the areas acquired for these areas can be used for temporary settlement ponds
- Discharges should travel over vegetated buffer strip at low velocities prior to discharge to maximise filtration and settlement
- All swales, crossings and other hydraulic features will be engineered to ensure that dimensions etc. are suitable to convey predicted flows and so prevent build-up of surface water and / or flooding.
- Silt fencing or other appropriate measures shall be put in place downstream of exposed soils or soil stockpiles
- Vegetation should be established as soon as possible on all exposed soils

Other measures to be employed throughout the construction and operational phases to minimise pollution risk include;

- Due consideration will be given to the prevailing ground and weather conditions when programming the execution of the works.
- Foul Drainage from all site offices and facilities will be contained and disposed of in an appropriate matter to prevent pollution of rivers and local watercourses in accordance with the relevant statutory bodies.
- Operational (permanent) drainage design shall comply with the requirements of the Greater Dublin Strategic Drainage Study (GDSDS)
- Suds features to be in place prior to the main construction works
- Ponds which incorporate a permanent water volume shall be put in place on all outfalls where space permits. A treatment volume shall be provided in which dilution and partial treatment (by physical, chemical and biological means) of runoff can take place. These will serve to both retain and treat contaminants generated during construction and operational phases
- A shut off valve shall be incorporated into the permanent drainage at all outfalls so that oil spills can be contained and collected before discharge to watercourses
- SuDS features shall be designed in general conformance with best practice guidance in the SuDS Manual (Ciria C753)
- Refuelling of construction machinery shall be undertaken in designated areas located away from surface water drainage in order to minimise potential contamination impacts on the water environment. Spill kits shall be kept in these areas in the event of spillages.
- Oil and fuel stored on site for construction should be stored in designated areas. These areas shall be bunded (to min 110% of chemical volume) and should be located away from surface water drainage.
- Pouring of concrete including wash down and washout of concrete from delivery vehicles to be controlled in an appropriate facility to prevent contaminating run-off and groundwater.
- All batching and mixing activities shall be located in areas well away from watercourses and drains.
- Any surface water abstracted from a river for use during construction will have an applicable licence agreement in place and will be fitted with a filter to prevent the intake of fish.

For any construction work within or directly adjacent to the water the following mitigation measures will apply

- Use of precast elements to be maximised to avoid wet concrete works in vicinity of water
- Works to be carried out in the dry (offline of outside the river channel) where possible. Suitable bunding, over-pumping, or temporary cofferdams to be put in place where required

- Relevant fisheries authorities shall be informed of all in-stream construction work scheduled to take place. Any in-stream or culverting works shall be undertaken in consultation and with the agreement of the relevant statutory body and during the permitted times of the year.
- Hydrophilic grout / quick setting mixes / rapid hardener additives shall be used to promote the early set of any wet concrete required. Other materials such as biodegradable shutter oils should be considered.
- There shall be no use of persistent pesticides, herbicides or artificial fertilisers in any landscaping or subsequent maintenance within a 10m buffer of a watercourse.

Routine monitoring of water quality will be carried out at appropriate upstream and downstream locations prior, during and post construction. The baseline surface water monitoring points (per 14.3.4) shall be used at a minimum. The water monitoring will be compared against the baseline results and current Environmental Quality Standards (EQS). Threshold levels should be identified during the construction phase and additional mitigation measures or should be employed if exceeded.

14.5.5 Specific Mitigation Measures – Channel/Culvert Works

To minimise the impact of culvert, bridge and channel works on hydrological receptors and flood risk, the following mitigation measures will be implemented.

- Design and construction of watercourse crossings shall be in accordance with best practice guidance and in particular with "Guidelines On Protection Of Fisheries During Construction Works In And Adjacent To Waters " (Inland Fisheries Ireland) and "Guidelines For The Crossing Of Watercourses During The Construction Of National Road Schemes" (NRA).
- All watercourse crossings shall be subject to OPW Section 50 agreement
- Mammal passage though all culverts will be maintained whether via retention of riparian banks (bridge) or provision of a mammal ledge (culverts)
- Culvert inverts will be set below the channel bed level to facilitate a natural bed of river material along the culvert base
- Culverts have been designed so that they can be constructed offline in the dry and with the shortest possible length. Short lengths of stream diversion will then be constructed to route the stream through the completed culvert
- Construction of watercourse crossings and stream works shall be programmed to coincide with periods of predicted low flow in the affected channel, and shall take notice of other working period restrictions imposed. Construction will be strictly as per the design for each identified watercourse crossing, and will fully implement all SuDS and additional mitigating measures proposed at detailed design stage
- All watercourses realignment work shall be designed with input from the project ecologist to achieve maximum ecological benefits and improve on the existing hydrological environment.
- All Culverts and bridges will be designed to convey the Q1000 flood flows
- Suitable excavated bed material and riparian vegetation shall be stockpiled for use in the reformed/new channel

14.5.6 Specific Mitigation Measures – Runoff and Flow Patterns

To minimise the impact of the development on runoff, flow patterns and flood risk, the following mitigation measures will be implemented;

- Surface water system shall incorporate SUDS and designed in accordance with the supplementary industry guidance as detailed in Table 14.18 to reduce impact of the development on the existing environment.
- Surface water discharge rates shall be limited to existing greenfield run-off rates as a minimum to prevent increased flood risk. Associated attenuation storage shall be provided upstream of flow controls. Information on surface water controls and attenuation measures are included in Chapter 5.

- The drainage system shall allow recharge to groundwater at all appropriate attenuation, interception drainage and open channel locations
- Pumping of groundwater shall be limited in duration and volume
- Permanent excavations (for ponds or areas of cut) should not be deeper than local watercourses to limit impact on local groundwater levels
- A regular maintenance and inspection programme of the flow control devices, attenuation storage facilities, gullies and SuDS features will be required during the Operational Phase to ensure the proper working of the development's networks and discharges.
- Collection networks should be regularly monitored, maintained and serviced within the context of an overall development and environmental management plan.
- Drainage design for permanent drainage to incorporate a 10% allowance for the effects of climate change
- Boulder riprap to be added at outside of bends in realigned stream channels
- Diversion channels shall generally match the width and gradient of the existing stream channel
- Existing catchment boundaries to be maintained in all stages of development (no diversion of flows to adjacent catchments)

14.5.7 Mitigated Significance

Magnitudes of identified impacts, and associated significance of remaining Construction and Operational impacts, following adoption of the preceding mitigation measures have been determined. This assessment is in accordance with the rationale previously described and is presented in the following table.

Table 14.18: Mitigated Significance

Receptor	Receptor Sensitivity	Potential Impact	Impact Magnitude	Impact Significance (post mitigation)
Glenamuck Stream / Loughlinstown River	Medium	Chemical Pollution of Water Environment	Low / Negligible: Implementation of best practice measures to control hazardous substances mitigates impact. Measures include controls on use and storage of hazardous materials, controls on construction works and materials in watercourses and SuDS Treatment train.	Not Significant
Glenamuck Stream /	Medium	Pollution of watercourses by	Low / Negligible: Implementation of best practice measures to control silt pollution mitigates impact. Measures include implementation of robust	Not Significant

Loughlinstown River		silt / suspended solids	construction stage SuDS measures, treatment off all surface water discharges from site and implementation of ponds with treatment volume	
Glenamuck Stream / Loughlinstown River	Medium	Changes to Stream Channels	Low / Negligible: Implementation of best practice measures for watercourse crossing and stream works mitigates impact. Measures include clear span or offline crossings, consideration of fish and mammal passage and design for conveyance of extreme floods.	Not Significant
Glenamuck Stream / Loughlinstown River	Medium	Changes to runoff and flow patterns	Low / Negligible: Implementation of best practice measures for drainage design mitigates impact. Measures include flow controls to greenfield rate, attenuation storage, consideration of climate change and maintenance of existing catchments.	Not Significant
Bedrock Aquifer	Low	Chemical Pollution of Water Environment	Low / Negligible: Implementation of best practice measures to control hazardous substances mitigates impact. Measures include controls on use and storage of hazardous materials, controls on construction works and materials in watercourses and Suds Treatment train	Not Significant
Bedrock Aquifer	Low	Changes to runoff and flow patterns	Low / Negligible: Implementation of best practice measures to maintain flow patterns mitigates impact. Measures include facilitation of recharge from drainage system and controls on depths of excavations .	Not Significant

Post mitigation impact significance for all identified impacts has been determined as Not Significant.

14.6 Residual Impacts

It is considered that by implementing the proposed construction and operational phase mitigation measures above, that the significance of the identified impacts will be reduce to a "Not significant" residual impact on the identified hydrological/ hydrogeological receptors.

14.7 Difficulties Encountered

No significant difficulties were encountered during the assessment.

A small area consisting of a single grassed field north of the Loughlinstown River was unable to be accessed due to landowner restrictions, the land was however visible from both boundaries and LIDAR, mapping and orthophotography data was available so an adequate assessment of the baseline conditions was possible.

14.8 References

- Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA , 2009);
- Environmental Impact Assessment of National Road Schemes – A Practical Guide (NRA, 2008);
- Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan (TII);
- Design of Earthworks Drainage, Network Drainage, Attenuation & Pollution Control (DN-DNG-03066) (TII);
- Drainage Design For National Road Schemes - Sustainable Drainage Options (TII);
- Guidelines for The Crossing of Watercourses During the Construction of National Road Schemes (NRA, 2008);
- Drainage Systems For National Roads [NRA HD 33/15] (TII);
- The Planning System and Flood Risk Management (OPW, 2009);
- Draft River Basin Management Plan 2018 – 2021. Department of Housing Planning and Local Government;
- Guidelines on protection of fisheries during construction works in and adjacent to waters 2016. Inland Fisheries Ireland (IFI);
- Guidelines On The Information To Be Contained In Environmental Impact Assessment Reports (Draft August 2017) (EPA);
- EPA Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) Sept. 2003;
- Geo Portal (https://gis.epa.ie/EPAMaps/) (EPA);
- The SUDS Manual (CIRIA C753) (CIRIA);
- Control of Water Pollution from Construction Sites. Guidance for Consultants and Contractors (CIRIA C532);
- Control of Water Pollution from Linear Construction Sites (CIRIA C648);
- Development and Flood Risk – Guidance for the Construction Industry (CIRIA 624);
- PPG01: General Guide to the Prevention of Pollution (UK Guidance Note);
- GPP 5 Works and Maintenance in or near Water (UK Guidance Note);
- PPG06 Working at Construction and Demolition Sites (UK Guidance Note);
- Environmental Good Practice on Site (C692) (2010) (CIRIA);
- Dun Laoghaire and Rathdown County Council Planning (http://dlrcoco.ie/en/planning);
- Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements. (2013) Institute of Geologists of Ireland (IGI);

- Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects, Dept of the Environment Heritage and Local Government;
- Construction Code of Practice for the Sustainable Use of Soils on Construction Sites, Department for Environment, Food and Rural Affairs (UK); and
- Geological Survey Ireland Spatial Resources https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228 .