8 HYDROLOGY & HYDROGEOLOGY

8.1 Introduction

8.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by Milford Quarries Ltd to carry out an assessment of the residual direct and indirect effects of the quarrying activities at Red Rock Quarry, Clogrennane, Co. Carlow on the hydrological and hydrogeological environments (water environment).

1995 is the baseline environment as this year is known to predate all works associated with the Development. Note that 1988 is the year in which the EIA Directive (Directive 85/337/EEC) was required to be transposed into Irish Law. The baseline hydrological and hydrogeological environment in the year 1995 is described in detail along with a description of quarrying activities from the 1995 baseline to the cessation of quarrying in 2014, the consolidation of the Development Site between 2014 and 2023 and the management of the Development Site since the Applicant took ownership in 2023.

This chapter of the Remedial Environmental Impact Assessment Report (rEIAR) presents:

- An assessment of the effects on the quarrying activities on the hydrological and hydrogeological environment;
- The baseline sensitivity of the receiving hydrological and hydrogeological environment has been assessed based on the baseline conditions occurring in 1995;
- The effects on the receiving hydrological and hydrogeological environment have been assessed over several phases. These phases include the Extraction Phase (1995 baseline to 2023), and the Current Phase (2023 to the present day);
- The monitoring and control measures that were implemented during the Extraction Phase and the Current Phase; and,
- The residual effects along with any cumulative effects with other project in the vicinity of the Development Site.

Please note that the purposes of this chapter, where:

- The 'Development' is referred to, this related to all the project components described in Chapter 3; and,
- The 'Development Site' is referred to, this relates to the primary study area for the rEIAR, as delineated by the rEIAR Site Boundary and corresponds to the overall landholding.

8.1.2 Quality Assurance and Competence

Hydro-Environmental Services ("HES") are a specialist geological, hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford.

Our core area of expertise and experience is hydrology and hydrogeology, including flooding assessment and surface water modelling. We routinely work on surface water monitoring and modelling and prepare flood risk assessment reports.

This chapter of rEIAR was prepared by Michael Gill, Adam Keegan, Conor McGettigan and Nitesh Dalal.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is a Civil/Environmental Engineer, Hydrologist and Hydrogeologist with 22 years' environmental consultancy experience in Ireland. Michael has a degree in Civil and Environmental Engineering, a MSc in Engineering hydrology from TCD and a MSc in Applied Hydrogeology from Newcastle University. Michael has completed numerous (60+) hydrological and hydrogeological assessments relating to bedrock quarries and sand and gravel pits. Recent examples include Ardfert quarry in County Kerry, Middleton Quarry in County Cork, and Rathcore and Clonard Quarries in County Meath.

Adam Keegan PGeo (B.Sc., M.Sc.) is a hydrogeologist with 7 years environmental consultancy experience in Ireland. Adam has worked on numerous Environmental Impact Assessments for infrastructure projects, such as wind farms, strategic housing developments and quarries. Adam has experience in intrusive site investigation works within sand and gravel environments, primarily relating to quarry developments. Adam has worked on numerous quarry EIAR projects including Mallow quarry, Barrigone quarry, Kilmeague quarry, and Killarney East quarry.

Conor McGettigan (BSc, MSc) is an Environmental Scientist, with over 5 years' experience in the environmental sector in Ireland. Conor holds an MSc in Applied Environmental Science and a BSc in Geology from University College Dublin. Conor routinely completes hydrological and hydrogeological assessments for a wide range of developments including sand and gravel pits and bedrock quarries. Conor has worked on numerous quarry EIAR project including Rathcore quarry, Old Leighlin quarry and Kilchreest quarry.

Nitesh Dalal (B.Tech, PG Dip., MSc) is an Environmental Scientist with over 7 years' experience in environmental consultancy and environmental management in India. Nitesh holds a M.Sc. in Environmental Science from University College Dublin (2024), a PG Diploma in Health, Safety and Environment from Annamalai University, India (2021) and B.Tech. in Environmental Engineering (2016) from Guru Gobind Singh Indraprastha University, India (2016).

8.1.3 Scoping and Consultation

As detailed in Section 1.6 of the rEIAR a non-statutory scoping exercise was conducted by TPA to establish what format the rEIAR would take and the range and aspects of the environment to be considered.

A scoping response was issued to Carlow County Council but no response was received following this request.

HES submitted an information request to Uisce Éireann on 13th October 2025 to identify any UÉ public water supplies within 5km of the site. A response was received on 15th October 2025, and the information is presented in Section 8.3.4.10.

8.1.4 Relevant Legislation

The rEIAR is prepared in accordance with the requirements of European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive') as amended by Directive 2014/52/EU.

The requirements of the following legislation are complied with:

- Planning and Development Acts, 2000 (as amended);
- Planning and Development Regulations, 2001 (as amended);
- S.I. No. 477/2011: European Communities (Birds and Natural Habitats) Regulations, implementing EU Directives 92/43/EEC on the conservation of natural habitats and of wild

fauna and flora (the Habitats Directive) and Directive 2009/147/EC on the conservation of wild birds (the Birds Directive);
- S.I. No. 293/1988: Quality of Salmon Water Regulations;
- Water Framework Directive (2000/60/EC) (as amended by Decision No. 2455/2011/EC; Directive 2008/32/EC; Directive 2008/105/EC; Directive 2009/31/EC; Directive 2013/39/EU; Council Directive 2013/64/EU; and Commission Directive 2014/101/EU ("WFD").
- S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009, as amended, and S.I. No. 722/2003 European Communities (Water Policy) Regulations, as amended, which implement EU Water Framework Directive (2000/60/EC) and provide for the implementation of 'daughter' Groundwater Directive (2006/118/EC);
- S.I. No. 122/2014: European Union (Drinking Water) Regulations, arising from EU Directive 98/83/EC on the quality of water intended for human consumption (the Drinking Water Directive) and WFD 2000/60/EC (the Water Framework Directive);
- S.I. No. 684/2007: Waste Water Discharge (Authorisation) Regulations;
- S.I. No. 9/2010: European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended;
- S.I. No. 296/2009: European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009, as amended; and,
- S.I. No. 99/2023: European Union (Drinking Water) Regulations.

8.1.5 Relevant Guidance

The hydrology and hydrogeology chapter of this rEIAR was carried out in accordance with the guidance contained in the following:

- Circular Letter PL 1/2017: Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive);
- Department of the Environment, Heritage and Local Government (2004) 'Quarries and Ancillary Activities, Guidelines for Planning Authorities';
- European Commission (2017): Environmental impact assessment of projects – Guidance on the preparation of the environmental impact assessment report (Directive 2011/90/EU as amended by 2014/52/EU);
- Environmental Protection Agency (2022): Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- Environmental Protection Agency (2006): Environmental Management in the Extractive Industry;
- Institute of Geologists Ireland (2013) Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- National Roads Authority (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Watercourses;
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Water Courses (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006);
- Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2001;
- OPW (2009): The Planning System and Flood Risk Management;
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018); and,

- Carlow County Council (2022): Carlow County Development Plan (2022-2028).

8.2 Study Methodology

8.2.1 Desk Study

A desk study of the Development Site and surrounding area was carried out in March 2024 to collect all relevant meteorological, hydrological and hydrogeological data. The initial desk study was completed in advance of site walkover surveys and site investigations. The desk study information has been checked and updated, where necessary, in December 2025.

The desk study involved consultation with the following sources:

- Environmental Protection Agency databases (www.epa.ie);
- Geological Survey of Ireland - groundwater databases (www.gsi.ie);
- Met Éireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directive "catchments.ie" Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 19; Geology of Carlow-Wexford;
- Geological Survey of Ireland - Groundwater Body Characterisation Reports;
- Cycle 3 (HA 14) Barrow Catchment Report (EPA, 2024);
- Cycle 3 (HA 15) Nore Catchment Report (EPA, 2024);
- OPWs National Flood Information Portal (www.floodinfo.ie);
- EPA Hydrotool Databases (www.catchment.ie); and,
- Aerial Photography, 1:5,000 and 6" base mapping.

8.2.2 Baseline Monitoring and Site Investigations

Michael Gill of HES completed an initial visit and walkover survey of the Development Site on 09th May 2024. Site investigations comprising of borehole drilling were completed by Peterson Drilling Ltd, under the supervision of Adam Keegan of HES, on 26th, 27th and 28th June 2024. Additional walkover surveys and geological mapping were completed by Michael Gill, Conor McGettigan and Nitesh Dalal on 13th December 2024, 18th February, 25th March 29th April, 29th May, 25th June, 23rd July, 14th August, 25th September and 13th November 2025.

A comprehensive geological, hydrological and hydrogeological dataset has been collected as part of this rEIAR study.

In summary, the site investigations to address the hydrology and hydrogeology chapter of the rEIAR included the following:

- HES completed walkover surveys of the Development Site 26th, 27th, 28th June 2024 13th December 2024, 18th February, 25th March, 29th April, 29th May, 25th June, 23rd July, 14th August, 25th September and 13th November 2025. During these walkover surveys water flow directions and drainage patterns were recorded and ground conditions assessed;
- HES completed detailed logging of exposed subsoil profiles and existing bedrock quarry side walls (~1.5km of side wall);
- Mineral soils, subsoils and bedrock were logged according to BS: 5930:2015 Code of Practice for Ground Investigations;
- Apex Geophysics completed geophysical surveys at the Development Site between 11th and 15th March 2024;
- HES supervised the drilling of 5 no. boreholes at the Development Site by Peterson Drilling Ltd on 26th, 27th and 28th June 2024. These boreholes extended to a maximum depth of 40mbgl (metres below ground level);

- Groundwater levels in the 5 no. onsite boreholes were manually recorded on a monthly basis from January to November 2025;
- In addition to the manual water level monitoring, continuous water level monitoring was completed in the 5 no. onsite boreholes over a period of 15 no. months from August 2024 to November 2025. This monitoring was completed through the installation of 5 no. water level monitoring devices and 1 no. barometric monitoring device;
- Groundwater sampling was completed at 2 no. locations on 23rd July and 14th August 2025; and,
- A total of 4 no. rounds of surface water sampling, field hydrochemistry and flow monitoring were completed on the discharge from the Development Site between 3rd April and 25th June 2025.

8.2.3 Impact Assessment Methodology

The importance / sensitivity of the hydrogeological and hydrological receptors was assessed on completion of the desk study and baseline assessment. Using the NRA Guidance (NRA, 2008), an estimation of the importance / sensitivity of the hydrogeological and hydrological environments within the study area, as set out in **Table 8-1** for hydrology and **Table 8-2** for hydrogeology, are used to assess the potential effect that the Proposed Development may have on them.

Table 8-1: Estimation of Importance of Hydrology Criteria (NRA, 2008)

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation, e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very High	Attribute has a high quality or value on a regional or national scale	River, wetland or surface water body ecosystem protected by national legislation – NHA status. Regionally important potable water source supplying >2500 homes. Quality Class A (Biotic Index Q4, Q5). Flood plain protecting more than 50 residential or commercial properties from flooding. Nationally important amenity site for a wide range of leisure activities.
High	Attribute has a high quality or value on a local scale	Salmon fishery locally important potable water source supplying >1000 homes. Quality Class B (Biotic Index Q3-4). Flood plain protecting between 5 and 50 residential or commercial properties from flooding.

Importance	Criteria	Typical Example
Medium	Attribute has a medium quality or value on a local scale	Coarse fishery. Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q2-3). Flood plain protecting between 1 and 5 residential or commercial properties from flooding.
Low	Attribute has a low quality or value on a local scale	Locally important amenity site for small range of leisure activities. Local potable water source supplying <50 homes. Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding. Amenity site used by small numbers of local people.

Table 8-2: Estimation of Importance of Hydrogeology Criteria (NRA, 2008)

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation, e.g. SAC or SPA status.
Very High	Attribute has a high quality or value on a regional or national scale	Regionally Important Aquifer with multiple wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation - NHA status. Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source.
High	Attribute has a high quality or value on a local scale	Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers. Locally important potable water source supplying >1000 homes. Outer source protection area for regionally important water source. Inner source protection area for locally important water source.

Importance	Criteria	Typical Example
Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer. Potable water source supplying >50 homes. Outer source protection area for locally important water source.
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer Potable water source supplying <50 homes.

Once the importance and sensitivity of the geological, hydrological and hydrogeological attribute is established, the conventional source-pathway-receptor model for groundwater / surface water protection was applied to assess impacts on geology, groundwater and surface water specifically on downstream sensitive ecological receptors and local groundwater supplies.

Where potential impacts are identified, the classification of impacts in the assessment follows the descriptors provided in the Glossary of Impacts contained in EPA (2022) guidance. The description process clearly and consistently identifies the key aspects of any potential impact source, namely its character, magnitude, duration, likelihood and whether it is of a direct or indirect nature.

In order to provide an understanding of the stepwise impact assessment process applied below, we have firstly presented below a summary guide that defines the steps (1 to 7) taken in each element of the impact assessment process in below. The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

Using this defined approach, this impact assessment process is then applied to continued activities which have the potential to generate a source of significant adverse impact on the hydrological/hydrogeological (including wells, streams and water quality) environments.

Table 8-3: Impact Assessment Process Steps

Attribute	Status / Occurrence		Importance
Step 1	Identification and Description of Potential Impact Source This section presents and describes the activity that brings about the potential impact or the potential source of pollution. The significance of effects is briefly described.		
Step 2	Pathway / Mechanism:	The route by which a potential source of impact can transfer or migrate to an identified receptor. In terms of sand and gravel extraction, surface water and groundwater flows are the primary pathways.	
Step 3	Receptor:	A receptor is a part of the natural environment which could potentially be impacted upon, e.g. human health, plant / animal species, aquatic habitats, soils/geology, water resources, water sources. The potential impact can only arise as a result of a source and pathway being present.	

Step 4	Pre-mitigation Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.
Step 5	Proposed Mitigation Measures:	Control measures that will be put in place to prevent or reduce all identified significant adverse impacts. These measures are generally provided in two types: (1) mitigation by avoidance, and (2) mitigation by best practice engineering design.
Step 6	Post Mitigation Residual Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impacts after mitigation is put in place.
Step 7	Significance of Effects:	Describes the likely significant post mitigation effects of the identified potential impact source on the receiving environment.

8.2.4 Limitations and Difficulties Encountered

No Annual Environmental Reports (AERs) are available relating to the discharge licence which was granted in 2012. Therefore, no site specific water quality data is available for the Extraction Phase. The assessment presented in this chapter relies upon downstream biological Q-monitoring completed by the EPA.

8.2.5 Study Area

The Water Study Area for the hydrological and hydrogeological impact assessment is defined by the regional surface water catchments and groundwater body within which the Development Site is located.

A regional hydrology map showing the Water Framework Directive (WFD) surface water catchments and sub-catchments is included as **Figure 8-1**. Details regarding the regional hydrological setting of the Development Site are provided in Section 8.3.3.1. In addition, the bedrock aquifer and groundwater body (GWB) which underlie the Development Site are detailed in Section 8.3.4.1. The bedrock aquifers in the local area are shown in **Figure 8-9**.

8.3 Receiving Environment

8.3.1 Land

8.3.1.1 Site Landuse History Summary

The primary change to land at the Development Site occurred in 2005 when quarrying activities commenced.

Land take and any land changes at the Development Site have been investigated using aerial imagery. Records from the applicant were also consulted to help develop the timeline of changes.

Maps for the local area, dating from 1913, indicate the presence of a small gravel (borrow) pit at the Development Site. It is estimated that this gravel pit had an area of ~0.16ha (hectares). This borrow pit was soon abandoned with inspection of aerial imagery from 1973, 1995 and 2000 not showing any ground disturbance or quarrying works.

Aerial imagery indicates that extraction operations re-commenced at the Development Site in the early to mid-2000s (*i.e.* the Extraction Phase). The extraction area in 2005 is estimated to be ~3.61ha. Quarrying operations intensified at the Development Site between 2005 and 2010 with the extraction area estimated to have been ~6.29ha in 2010. Quarrying operations continued at the Development Site until 2014 following the outcome of the S. 261A proceedings. During the later stages of the Extraction Phase (2014-2023) some works were completed in order to consolidate the site. The Applicant took ownership of the Development Site in 2023 and there have been no subsequent changes to the land environment. The existing quarry void now covers an area of ~8.66ha.

8.3.1.2 Existing Site Description

The Development Site of 41.86Ha is located in the townland of Clongrenan, Co. Carlow, and lies immediately to the south of the Laois – Carlow county border. The Development Site is located ~1.5km east of the small village of Bilboa, Co. Laois which was historically a coal-mining settlement. The Development Site also lies ~5km southwest of Carlow Town and ~7.5km northwest of the town of Leighlinbridge, Co. Carlow. The overall landholding has a total area of 45.68hectares (ha). The substitute consent application area is 41.86Ha, of which 14.22Ha has been subject to historic development, and within that area 8.66Ha forms the existing extraction footprint.

The Development Site can be accessed via the L3896/L7134 which is located ~300m to the east. An existing access road branches off this local road to the east and runs along the northern boundary of the quarry, providing access to the existing quarry void.

Inspection of aerial photographs and site walkover surveys completed by HES have provided greater detail regarding the landuse and landcover at the Development Site and across the surrounding lands. The Development Site is comprised of an existing quarry void (8.66ha) which was associated with the previous extraction of bedrock from the Development Site. Several large stockpiles of spoil material are present both within the quarry void and in the surrounding lands, many of which are now vegetated. An access track passes through the centre of the existing void. Some old plant, machinery and workshops are located to the east of the Development Site, adjacent to the L3896/L7134. Landuse on the surrounding lands is comprised of agricultural pastures, with an area of coniferous forestry to the west. Clongrenan Woods exist to the east of the L3896/L7134 with one-off housing also located along the local roads in the area.

8.3.1.3 Site Topography

The Development Site currently comprises of an existing quarry void which is surrounded by agricultural lands. The Development Site was previously used to extract sandstone bedrock, with much of the extraction ceasing in 2014 (all activities ceased in 2023). The floor of the existing quarry void stands at ~304mOD (metres above Ordnance Datum).

The Development Site is located on the eastern edge of the Castlecomer Plateau, an upland area in north Co. Kilkenny which also extends into Co. Laois and Co. Carlow at its northern edge. Locally, natural ground elevations within the Development Site range from ~319mOD in the west to ~310mOD in the east. Natural ground elevations have been altered in the existing quarry void due to the previous removal of overburden, extraction of bedrock and stockpiling of spoil material.

8.3.2 Water Balance

Long term rainfall and evaporation data were sourced Met Éireann (www.met.ie).

The nearest rainfall station is at Coon, located ~7.5km west-southwest of the Development Site and has an Average Annual Rainfall (AAR) of 1,056.2mm. However, the AAR at Coon may underestimate the actual AAR at the Development Site due to the significant topographic differences which exist between the Development Site and Coon rainfall station. Ground elevations at Coon rainfall station stand at ~176mOD while at the Development Site, the local natural ground elevations vary from ~310mOD to ~319mOD.

Met Éireann also provide a grid of modelled AAR for the entire country for the period of 1991 to 2020. Based on this more site-specific modelled rainfall values, the 30-year AAR (1991-2020) at the Development Site, assigned to location E267000, N173000 are presented in **Table 8-4**. The AAR at the Development Site is modelled to be 1,118mm/yr. This is considered to be the most accurate estimate of AAR from the available sources.

Table 8-4: Modelled Monthly Rainfall Averages (mm) 1991 – 2020

Location: Development Site						**X-Coord: 267000**				**Y-Coord: 173000**		
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
109	87	81	74	73	80	76	88	90	121	119	121	1,118

The closest synoptic[1] station where the average Potential Evapotranspiration (PE) is recorded is at Kilkenny, ~22km southwest of the Development Site. The long-term average PE for this station is 458.8mm/year. This value is used as a best estimate of the site PE. Actual Evaporation (AE) at the Development Site is estimated as 435.9mm/year (which is 0.95 × PE).

The Effective Rainfall (ER)[2] represents the water available for runoff and groundwater recharge. The ER for the Development Site is calculated as follows:

Effective Rainfall (ER) = Average Annual Rainfall (AAR) – Actual Evaporation (AE)

= 1,118mm/year – 435.9mm/year

ER = 682.1mm/year

Based on groundwater recharge coefficient estimates from the GSI (www.gsi.ie), groundwater recharge coefficients at the Development Site range from 22 to 85%. The estimates are based on the presence of poorly drained mineral soils (22% groundwater recharge), with higher recharge rates in the areas where bedrock is close to the ground surface (85% groundwater recharge). The vast majority of the Development Site is mapped as having a recharge coefficient of 85%. Therefore, based on this recharge coefficient, annual recharge and runoff rates for the Development Site are estimated to be 579.8mm/year and 102.3mm/year respectively. However, the GSI state that the bedrock in this area is noted to be of low permeability and has a maximum recharge capacity of 100mm/yr. Therefore, a high proportion of this potential recharge is rejected by the underlying bedrock and will discharge into local streams and watercourses. This is supported by observations made during site walkover surveys whereby water was noted to have pooled on the floor of the quarry rather than infiltrated into the underlying bedrock aquifer.

Met Éireann's Translate Project (https://www.met.ie/science/translate) provides projections for a range of future climate change scenarios, as Ireland's future climate will depend on global greenhouse gas emissions reductions. The severity of any future climate change will depend on the degree of future warming. In a 1.5°C world, average winter and summer precipitation rates are projected to be 3.39mm/day and 2.07mm/day respectively in Co. Carlow. Meanwhile, in a 4°C world, the average winter and summer precipitation rates in Co. Carlow are projected to be 3.70mm/day and 1.85mm/day respectively.

[1] *Meteorological station at which observations are made for synoptic meteorology and at the standard synoptic hours of 00:00, 06:00, 12:00, and 18:00.*

[2] *ER – Effective Rainfall is the excess rainfall after evaporation which produces overland flow and recharge to groundwater.*

In addition to average rainfall data, extreme value rainfall depths are available from Met Eireann. **Table 8-5** below presents return period rainfall depths for the area of the Development Site. These data are taken from https://www.met.ie/climate/services/rainfall-return-periods and they provide rainfall depths for various storm durations and sample return periods (1-year, 5-year, 30-year, 100-year).

Table 8-5: Red Rock Quarry – Return Period Rainfall Depths (mm)

	Return Period (Years)			
Duration	**1**	**5**	**30**	**100**
5 mins	3.4	5.5	9.0	12.1
15 mins	5.6	9.0	14.7	19.8
30 mins	7.3	11.5	18.2	24.3
1 hours	9.6	14.7	22.7	29.7
6 hours	19.1	27.5	39.8	50.1
12 hours	25.0	35.0	49.5	61.3
24 hours	32.6	44.6	61.5	75.0
2 days	40.1	53.6	72.1	86.6

8.3.3 Surface Water - Hydrology

8.3.3.1 Regional and Local Hydrology

Regionally, the majority of the Development Site, including the historic extraction area, is located within the River Barrow surface water catchment and Hydrometric Area 14 of the Southeastern River Basin District. Meanwhile, the southwest of the overall landholding is located within the River Nore surface water catchment and Hydrometric Area 15 of the Southeastern River Basin District.

The Barrow Catchment includes the area drained by the River Barrow upstream of the River Nore confluence and all streams entering tidal water between the Barrow railway bridge at Great Island and Ringwood, Co. Kilkenny, draining a total area of 3,025km². The largest urban centre in the catchment is Carlow town (EPA, 2024).

More locally within the River Barrow surface water catchment, the Development Site, is mapped within the Barrow_SC_110 sub-catchment and Barrow_170 WFD river sub-basin. Within the Barrow_170 WFD river sub-basin, the EPA map a small 1st order stream, referred to by the EPA as the Raheendoran Stream (EPA Code: 14R41) to flow through the centre of the Development Site. This stream is also recorded on local historic 6" and 25" basemaps. The stream is mapped to flow from northwest to southeast across the existing quarry void before continuing to the south, crossing the L7134, flowing to the east through Clogrennane Woods for ~3km, before discharging into the River Barrow. However, based on site walkover surveys and drainage mapping, the course of this stream, within the Development Site, has been altered by the previous quarrying activities (Further details are provided in Section 8.3.3.1.1 below).

Meanwhile, the River Nore Catchment includes the area drained by the River Nore and all streams entering tidal water between its confluence with the River Barrow at Ringwood, and the Barrow railway bridge at Drumdowney, Co. Kilkenny, draining a total area of 2,595km². The largest urban centre in the catchment is Kilkenny (EPA, 2024).

More locally within the River Nore surface water catchment, the Development Site is mapped within Dinin[South]_SC_010 sub-catchment and Dinin (South)_010 WFD river sub-basin. Within the Dinin (South)_010 WFD river sub-basin the closest EPA mapped stream is an unnamed stream located ~1.3km west of the Development Site. This stream flows for ~1km before discharging into Dinin (South) River (EPA Code: 15D08). Inspection of local 6" and 25" basemaps for the local area shows that this watercourse, referred to on these maps as the Dinin River, rises ~500m west of the Development Site. There is no existing discharge from the quarry within the River Nore catchment. The existing extraction area is located entirely within the River Barrow catchment. Therefore, the Development had no potential to cause effects in the River Nore catchment.

A regional hydrology map is attached as **Figure 8-1** below.

A local hydrology map is shown as **Figure 8-2**.

8.3.3.1.1 Site Drainage

The course of the Raheendoran Stream has been altered by the historic quarrying activities. Within the extraction area the headwaters of this stream (~120m in length) have been removed and are no longer present. Water which used to make its way into the stream now gathers on the floor of the quarry and outfalls from the existing quarry void via 2 no. separate outfall locations as discussed below.

A large, flooded area is present in the northeast of the existing quarry void. This flooded area outfalls to a small drain which is located along an access track in the northeast of the Development Site. Meanwhile, some settlement ponds and flooded areas located towards the centre of the existing quarry void and outfall to the southeast. This outfall flows through a narrow, deeply incised gully before it discharges into a larger settlement pond in the east of the overall landholding. This settlement pond, and the wet flooded areas in the quarry void, provide treatment in the form of attenuation and settlement of suspended solids. The treated water flows from the settlement pond to the northeast and joins with the discharge from the northern outfall which flows along the existing access track. The combined discharge then flows to the east for ~630m before it discharges into the EPA mapped Mortarstown Stream (EPA Code: 14M40). This stream is a tributary of the Fushoge River (EPA Code: 14F03), discharging into the Fushoge River just upstream of its confluence with the River Barrow.

The Development has therefore altered the hydrology at the Development Site by removing the upper reaches of the Raheendoran Stream and redirecting water which used to flow in the Raheendoran Stream to the Mortarstown Stream.

Figure 8-3 below presents a map of the existing site drainage.

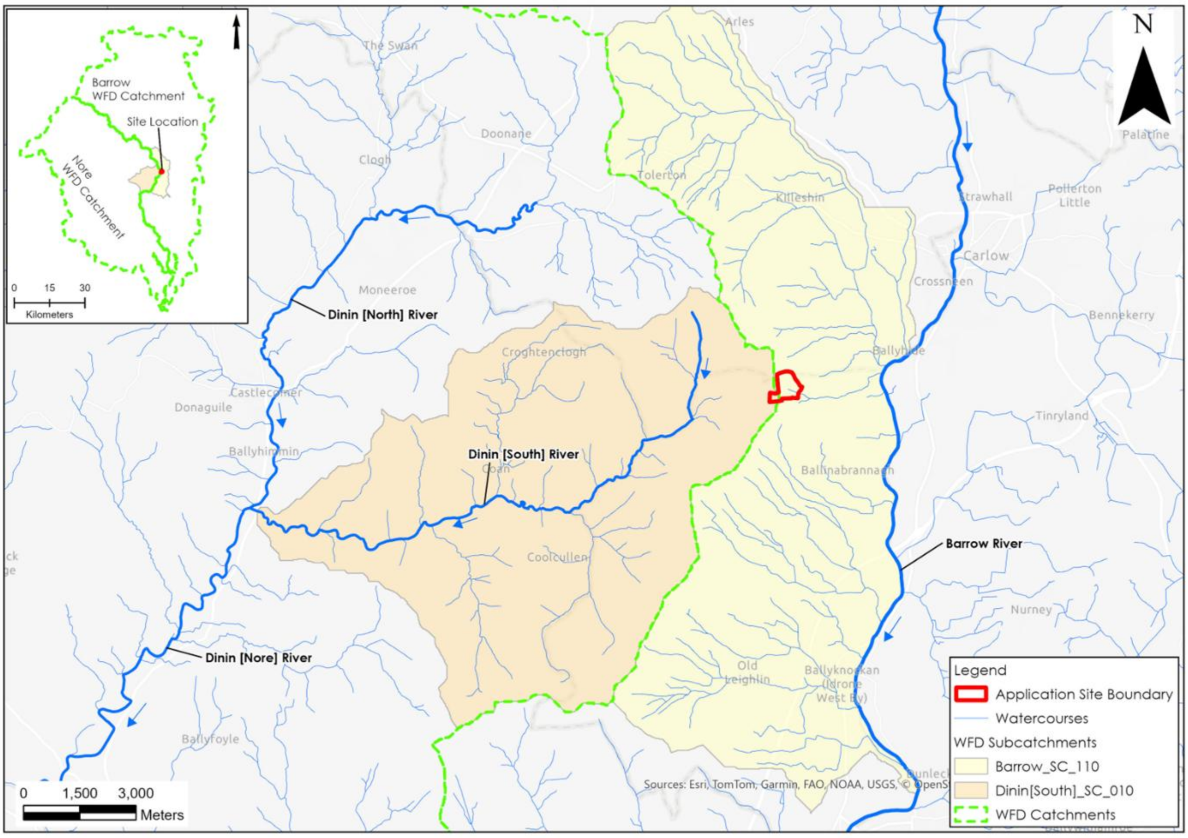

Figure 8-1: Regional Hydrology Map

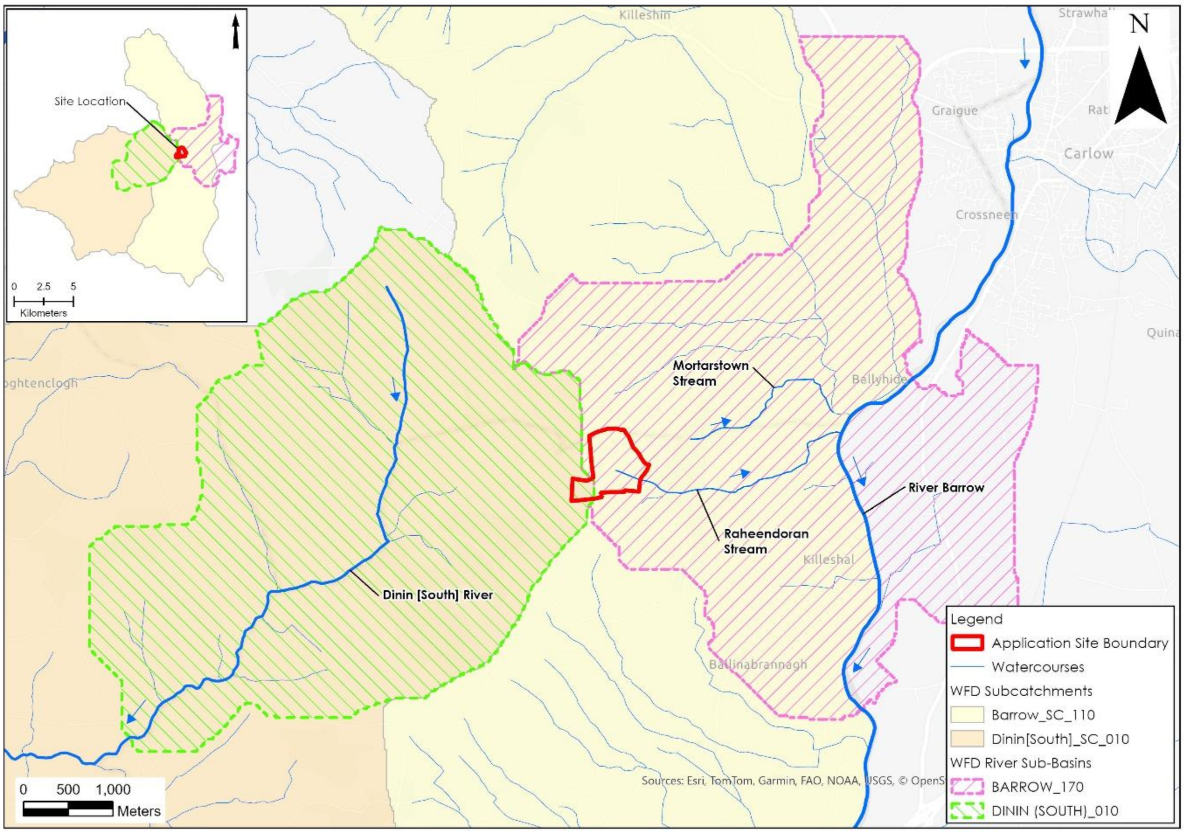

Figure 8-2: Local Hydrology Map

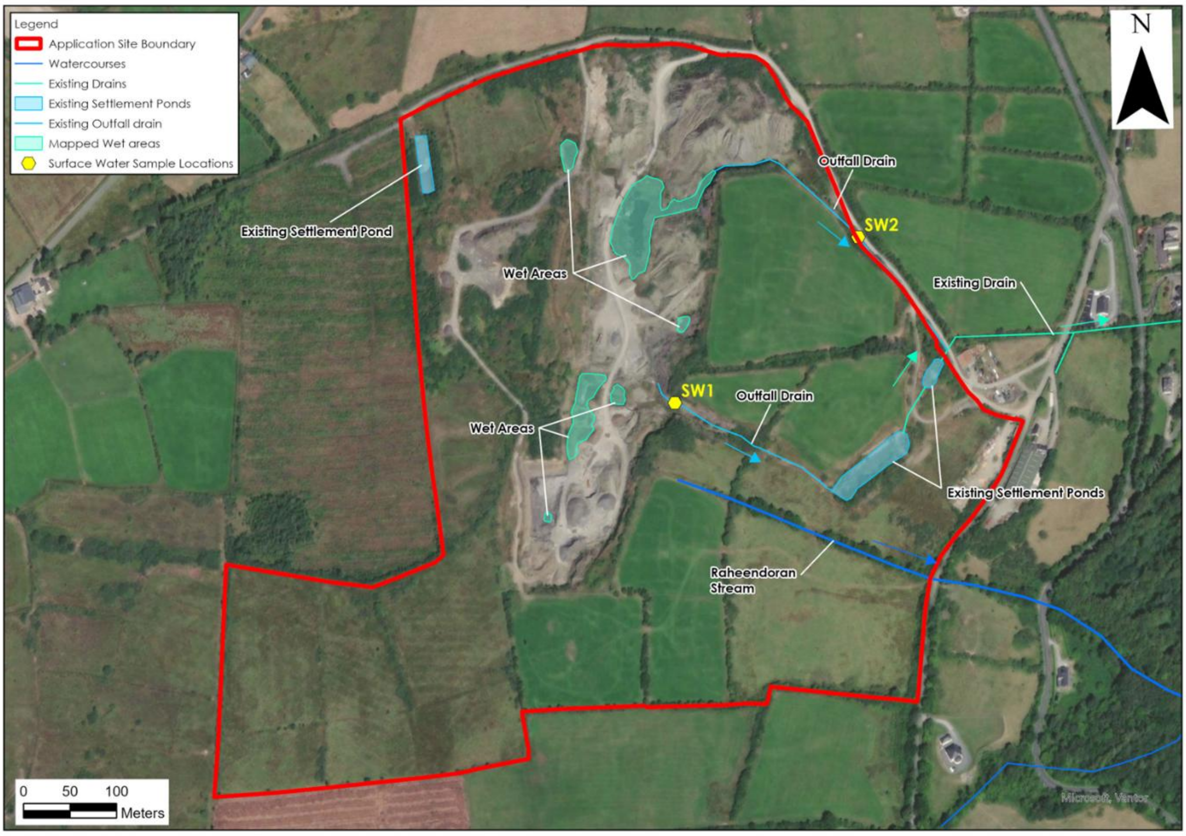

Figure 8-3: Site Drainage Map

8.3.3.2 Surface Water Flows

<u>Existing Quarry Discharge</u>

HES completed flow monitoring of the existing surface water discharges from the quarry void (both the discharge to the roadside drain and the discharge to the large settlement pond) on 4 no. occasions between 3rd April and 25th June 2025. The current discharge volumes for both are small, ranging from ~0.3l/s to ~1.2l/s. The combined discharge volume is ~2l/s.

<u>Downstream Flow Volumes</u>

There are no OPW gauging stations located in the immediate vicinity of the Development Site. The closest OPW gauging station downstream of the Development Site within River Barrow catchment is located on the River Barrow at Royal Oak (Station Code: 14018). Here the 95%tile (95th percentile) flow is estimated to be 3.21m^3/s. This means that 95% of the time the flow in the River Barrow at this location will equal or exceed 3.21m^3/s (3,210l/s). Meanwhile, within the River Nore catchment, the nearest OPW gauging station is located on the Dinin River at Dinin Bridge (Station Code: 15003). Here the 95%tile flow is estimated to be 0.284m^3/s. This means that 95% of the time the flow in the Dinin River at this location will equal or exceed 0.284m^3/s (284l/s).

The EPA's Hydrotool, available on www.catchments.ie, was consulted in order to estimate baseline flow volumes in the local area of the Development Site. The Hydrotool dataset contains estimates of naturalised river flow duration percentiles. Several nodes were consulted in the vicinity and downstream of the Development Site.

Figure 8-4 below presents the estimated flow duration curves for each of the consulted Hydrotool Nodes downstream of the Development Site in the River Barrow catchment. Note that no Hydrotool nodes are available for the EPA named Raheendoran or the Mortarstown streams.

The 95%tile flow at Node 14_190 on the River Barrow, downstream of the Development Site and downstream of the EPA named Raheendoran Stream, is estimated to be 6.061m^3/s (6,061l/s). Meanwhile, the 95%tile flow on the Fushoge River downstream of the Mortarstown Stream, and upstream of its confluence with the River Barrow is 0.042m^3/s (42l/s). Due to the increasing catchment size, the 95%tile flow at nodes along the River Barrow further downstream get progressively larger. For example, at Node 14_217 on the River Barrow upstream of Goresbridge, the 95%tile flow is estimated to be 6.521m^3/s (6,521l/s). Further downstream, the 95%tile flow in the River Barrow, upstream of the Upper Barrow Estuary transitional waterbody at Node 14_1909, is estimated to be 10.859m^3/s (10,859l/s). The progressively increasing flow volumes downstream of the Development Site are associated with the increased upstream catchment of the respective waterbodies.

Note that the recorded (OPW gauging station) and modelled flow volumes (Hydrotool) in the River Barrow are significant and several orders of magnitude greater than the existing discharge volumes from the Development Site. Therefore, the potential for effects is limited. Nevertheless, the Development does not in any way rely upon the dilution or assimilative capacity of any downstream watercourse. The mitigation measures prescribed in Section 8.6 will ensure the protection of the receiving watercourses, including those in close proximity to the Development Site.

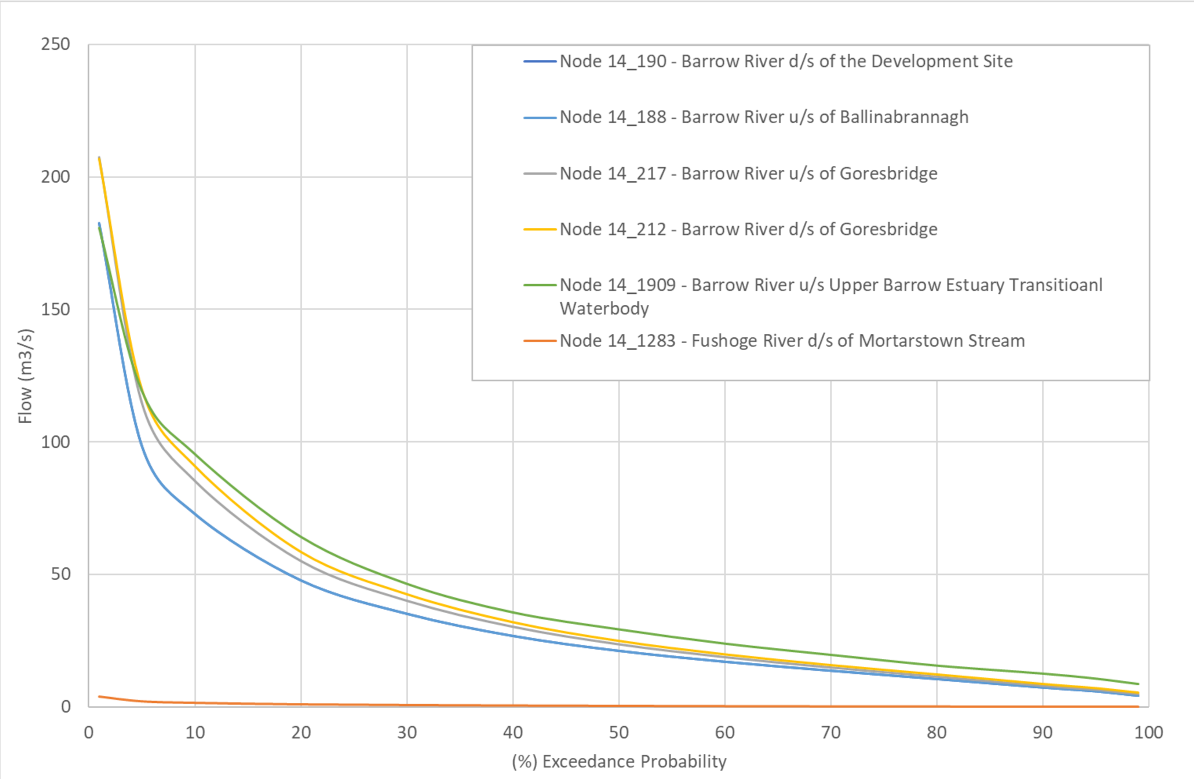

Figure 8-4: EPA Hydrotool Node Flow Duration Curve (Barrow WFD Catchment)

Figure 8-5 below presents the estimated flow duration curves for each of the consulted Hydrotool Nodes downstream of the Development Site in the River Nore surface water catchment.

The 95%tile flow at Node 15_1 on the Dinin (South) River, downstream of the southwest of the Development Site, is estimated to be 0.01m^3/s (10l/s). Due to the increasing catchment size, the 95%tile flow at the nodes along the Dinin (Main Channel) and Nore rivers are progressively larger. For example, at Node 15_1955 on the Dinin (Main Channel) River upstream of its confluence with the

River Nore, the 95%tile flow is estimated to be 0.374m^3/s (374l/s). Further downstream, the 95%tile flow in the River Nore, upstream of the Nore Estuary transitional waterbody at Node 15_1994, is estimated to be 7.56m^3/s (7,560l/s). The progressively increasing flow volumes downstream of the Development Site are associated with the increased upstream catchment of the respective waterbodies.

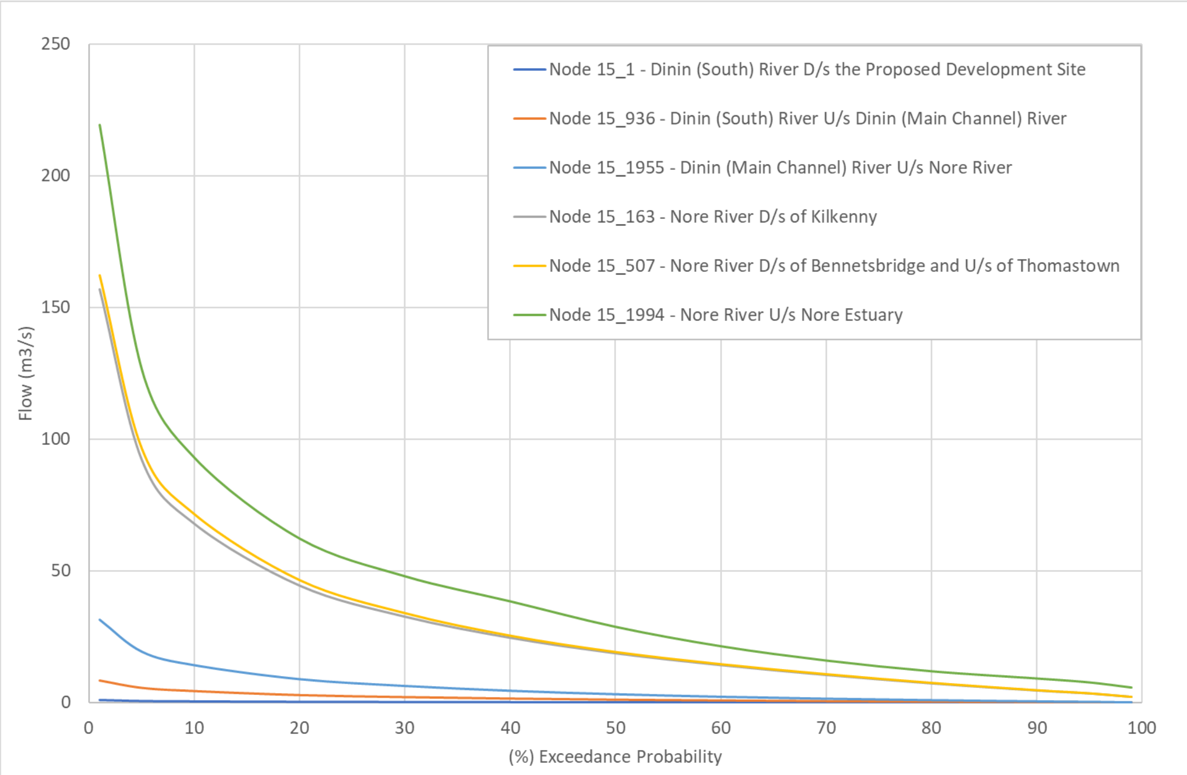

Figure 8-5: EPA Hydrotool Node Flow Duration Curve (Nore WFD Catchment)

8.3.3.3 Surface Water Quality

8.3.3.3.1 EPA Biological Monitoring

The Biological Q-Rating is a water quality rating system based on both the habitat and the invertebrate community assessment and is divided into status categories ranging from 0-1 (Poor) to 4-5 (Good/High). EPA Q-rating monitoring (i.e. biological monitoring data) of river waterbodies began in the early 1970s and continues to the present day.

The results of these monitoring provides an indication of water quality trends in the streams and rivers downstream of the Development Site. However, the EPA have not completed recent or historic monitoring on the Raheendoran or Mortarstown streams in the vicinity of the Development Site. The closest available downstream monitoring data is on the Fushoge River and the River Barrow.

EPA monitoring locations are shown on **Figure 8-7**.

<u>1995 Baseline</u>

Biological Q-rating data for EPA monitoring points upstream and downstream of the Development Site for the 1995 baseline environment are detailed in **Table 8-6** below.

Prior to the quarrying activities at the Development Site, historic Q-data is available for the Fushoge River and the River Barrow, both upstream and downstream of the Development Site. Upstream of the Mortarstown Stream, at a bridge south of Crockaun, the Fushoge River achieved a Q3-4 rating (*i.e.* Moderate Q-status) in 1993. Meanwhile, downstream of the Development Site and the Mortarstown

Stream, the Fushoge River achieved a Q4 rating (*i.e.* Good Q-status) upstream of its confluence with the River Barrow in 1993. Upstream of the Fushoge River, the River Barrow achieved a Q3 rating (*i.e.* Poor Q-status) at the Dolmen Hotel. Downstream of the Development Site at Milford Bridge, the Barrow achieved a Q3-4 rating in 1994.

Within the River Nore surface water catchment, there are no EPA Q monitoring stations located upstream of the Development Site. Downstream, the Dinin (South) River achieved a Q4 status in 1995 at Black Bridge.

Table 8-6: Baseline EPA Water Quality Monitoring Q-Rating Values

River Name	Station Name and ID	Year	Easting	Northing	EPA Q-Rating (Status)
River Barrow Surface Water Catchment					
Fushoge River	Bridge South of Crockaun (RS14F030250)	1993	269149	175639	Q3-4 (Moderate)
Fushoge River	Bridge upstream of Barrow confluence (RS14F030300)	1993	269841	173715	Q4 (Good)
River Barrow	Dolmen Hotel (RS14B012450)	1994	270653	174173	Q3 (Poor)
River Barrow	Milford Bridge (RS14B012600)	1994	269975	170430	Q3-4 (Moderate)
River Nore Surface Water Catchment					
Dinin (South) River	Black Bridge (RS15D080450)	1995	261802	170092	Q4 (Good)
Dinin (South) River	Dysart Bridge (RS15D080600)	1995	253090	169833	Q3-4 (Moderate)

Early Extraction Phase (1995-2014)

Biological Q-rating data for EPA monitoring points upstream and downstream of the Development Site during the early Extraction Phase are detailed in **Table 8-7** below.

Upstream of the Mortarstown Stream, the Fushoge River achieved a Q4-rating at Fushoge Bridge across 3 no. monitoring rounds (2003, 2006 and 2011). Further upstream at Crockaun Bridge the Fushoge River was also generally of Good Q-status but achieved Moderate status in 2011. Meanwhile, downstream of the Development Site at Milford Bridge, the Q-status of the River Barrow ranged from Poor to Moderate Q-status throughout this phase.

In the River Nore surface water catchment, the Dinin (South) River generally achieved a Q4 rating at Black Bridge. However in 2010, the Dinin River achieved a Q4-5 rating at this location.

Table 8-7: Early Extraction Phase EPA Water Quality Monitoring Q-Rating Values

River Name	Station Name and ID	Year Range	Easting	Northing	EPA Q-Rating (Status) Range
River Barrow Surface Water Catchment					
Fushoge River	Bridge South of Crockaun (RS14F030250)	2009 – 2014 (3 no. monitoring events)	269149	175639	Q3-4 – Q4 (Moderate to Good)
Fushoge River	Fushoge Bridge (RS14F030290)	2003 – 2001 (3 no. monitoring events)	269679	173964	Q4 (Good)
Fushoge River	Bridge upstream of Barrow confluence (RS14F030300)	2003-2011 (3 no. monitoring events)	269841	173715	Q4
River Barrow	Dolmen Hotel (RS14B012450)	1997 – 2003 (3 no. monitoring events)	270653	174173	Q3
River Barrow	Milford Bridge (RS14B012600)	1997 – 2014 (3 no. monitoring events)	269975	170430	Q3 to Q3-4 (Poor to Moderate)
River Nore Surface Water Catchment					
Dinin (South) River	Black Bridge (RS15D080450)	1998 - 2013 (6 no. monitoring events)	261802	170092	Q3-4 – Q4-5 (Moderate to High)
Dinin (South) River	Dysart Bridge (RS15D080600)	1995 to 2013 (7 no. monitoring events)	253090	169833	Q3.5 - Q4 (Moderate to Good)

Later Extraction Phase (2014-2023)

The most recent biological Q-rating data for EPA monitoring points in the vicinity of the Development Site are shown in **Table 8-8** below.

Within the River Barrow catchment, no recent biological monitoring has been completed on the Mortarstown Stream or the Fushoge River downstream of the Development Site. Meanwhile, the River Barrow downstream of the Development Site achieved a Q3-4 rating (‘Moderate’ Q-status) at Milford Bridge in 2018, 2020 and 2023. Upstream of the Development Site, the River Barrow also achieved a Q3-4 rating at the Dolmen Hotel in 2023.

Within the River Nore catchment, the Dinin (South) River at Black Bridge and at Dysart Bridge achieved a Q4 rating ('Good' Q-status) in 2022.

Table 8-8: Later Extraction Phase and Latest EPA Water Quality Monitoring Q-Rating Values

River Name	Station Name and ID	Year	Easting	Northing	EPA Q-Rating (Status)
River Barrow Surface Water Catchment					
River Barrow	Dolmen Hotel (RS14B012450)	2023	270653	174173	Q3-4
River Barrow	Milford Bridge (RS14B012600)	2018 – 2023 (3 no. monitoring rounds)	269975	170430	Q3.5 (Moderate)
River Nore Surface Water Catchment					
Dinin (South) River	Black Bridge (RS15D080450)	2016 - 2022 (3 no. monitoring events)	261802.93	170092	Q3.5 to Q4 (Moderate to Good)
Dinin (South) River	Dysart Bridge (RS15D080600)	2016 – 2022 (3 no. monitoring events)	253090.78	169833	Q4 (Good)

Current Phase (2023 to Present)

No EPA monitoring data is available for the Current Phase apart from the 2023 monitoring presented above. No impacts would have been anticipated due to the limited activity at the Development Site which was limited to environmental monitoring. The quarry remained inactive throughout this phase.

EPA Monitoring Summary

Historic Q-values for SWBs upstream and downstream of the Development Site are presented graphically in **Figure 8-6**.

In summary:

- Biological Q-monitoring was only completed by the EPA on the River Fushoge downstream of the Development Site up until 2000. This monitoring pre-dated the majority of the works associated with the Extraction Phase, alteration of the hydrological regime at the Development Site and the diversion of water from the Development Site towards this Mortarstown Stream, a tributary of the Fushoge River.
- No biological Q-monitoring has been completed on the Raheendoran Stream downstream of the Development Site.
- The closest downstream EPA monitoring station for which data is available is along the River Barrow at Milford Bridge. The baseline Q-rating at the River Barrow at this location was Q3-4 (i.e. Moderate Q-status). There was a brief deterioration in Q-rating during the Initial Phase (Pre-2005) (note that there was limited activity at the Development Site during this phase). A similar pattern of Q-ratings was also recorded upstream of the Development Site on the River Barrow near the Dolmen Hotel. Therefore, this slight deterioration in water quality during the

late 1990s can be attributed to more widespread issues in the Barrow catchment rather than a localised quarry.

- The Q-rating of the River Barrow at Milford Bridge throughout the Extraction Phase ranged between Q3 and Q3-4 (i.e. Poor to Moderate Q-status). There was no deterioration in the Q-rating status of the River Barrow downstream of the Development Site during or post-dating the extraction activities.
- Based on the Q-ratings the River Barrow is therefore considered to be of unsatisfactory condition downstream of the Development Site during the Extraction Phase. However, this condition cannot be attributed to the Development for the following reasons:
  - Similar Q-ratings were recorded upstream of the Development Site.
  - The Q-ratings during the Extraction Phase are the same or greater than those recorded during the Baseline when there was no or very limited activity at the site.
  - The Q-ratings in the River Barrow reflect wider issues within the Barrow Catchment rather than those associated with a very small quarry which accounts for less than 0.004% of the catchment of the Barrow River at Milford Bridge (~2,314km^2).

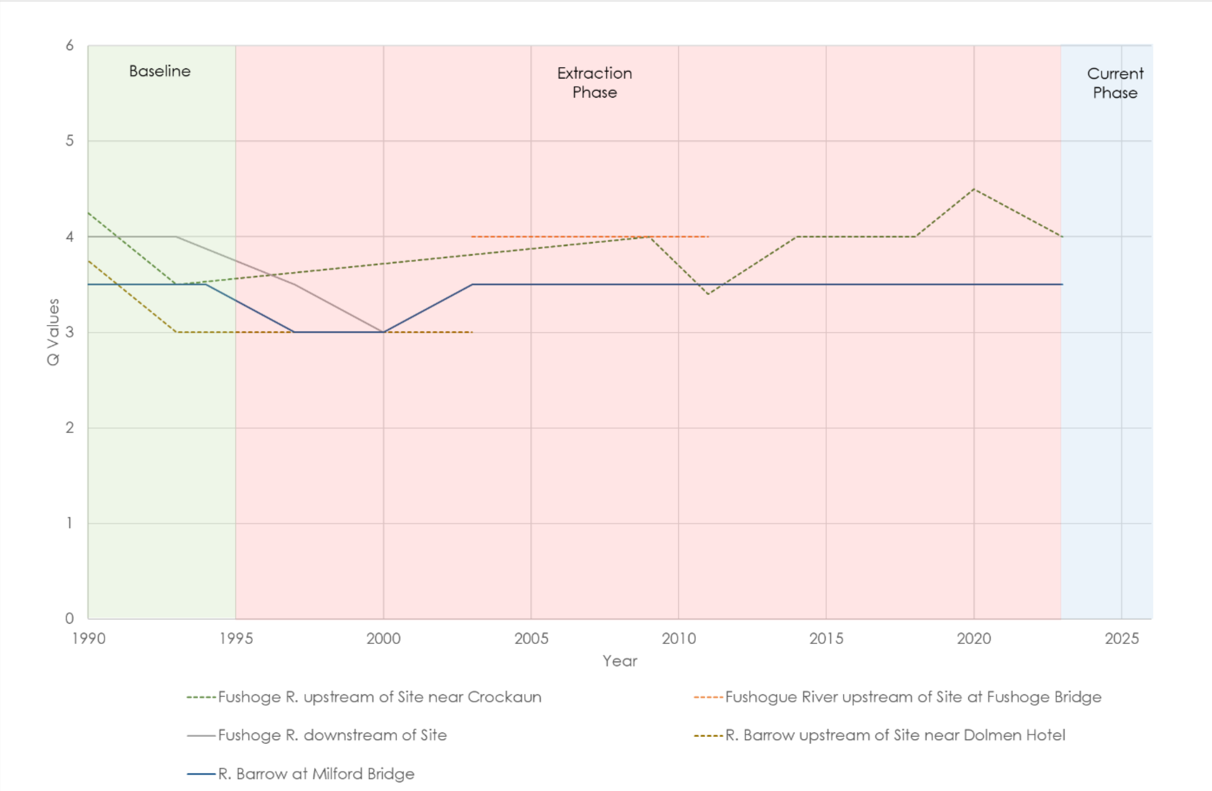

Figure 8-6: EPA Biological Q-Monitoring Monitoring in the vicinity of the Development Site

8.3.3.3.2 HES Water Quality Monitoring

Field hydrochemistry measurements of unstable parameters, electrical conductivity (µS/cm), pH (pH units) and temperature (°C) were taken at the existing outfall locations on 5 no. occasions from the quarry on 3rd April 2025 to 23rd July 2025. SW1 is located at the main outfall location which flows from the existing quarry void through the deeply incised gully before entering a large settlement pond. Meanwhile, SW2 is located along the access track in the northeast of the Development Site (refer to **Figure 8-3**). The results of the field hydrochemistry are listed in **Table 8-9**.

The surface water samples indicate a neutral to very slightly basic type surface water, with pH ranging from 7.47 to 8.2. Dissolved oxygen ranged from 8.1 to 10.61mg/l, specific electrical conductivity ranged from 251 to 678µS/cm. Turbidity ranged from 0.82 to 15.4NTU while temperate ranged from 10.5 to 18°C.

Table 8-9: Field Hydrochemistry Measurements in Discharge (03/04/2025 to 23/07/2025)

Parameters	SW1	SW2
Temperature (°C)	10.5 – 18	16.7 – 17.1
pH	7.47 – 8.07	7.99 – 8.2
DO (mg/l)	8.1 - 10.61	9.18 – 9.47
Specific Conductivity (µS/cm)	251 - 678	580 – 643
Turbidity	0.82 - 4.04	1.07 – 15.4
Flow (l/s)	0.3 – 1.0	0.5 – 1.2

Surface water grab samples were also taken for laboratory analysis on 5 no. occasions from the quarry between 3rd April 2025 and 23rd July 2025. SW1 was sampled during all 4 no. monitoring rounds (3rd April, 29th April, 29th May, 25th June and 23rd July 2025) whilst SW2 was sampled on 3 no. occasions (29th May, 25th June and 23rd July). Results of the laboratory analysis are shown alongside relevant water quality regulations in **Table 8-10** below. The laboratory reports are attached as **Appendix 8-1**.

Suspended solid concentrations ranged from <5 to 10mg/l. Suspended solid concentrations were below the S.I 293/1988 threshold limit of 25mg/l in all samples.

BOD concentrations were of 'High' status in all samples with respect to S.I. 272/2009 (≤1.3mg/l) except for the 2 samples obtained on 23rd July. The BOD in both of these samples (2mg/l) exceeded the 'Good' status threshold of <1.3mg/l. Ammonia concentrations were below the limit of detection of the laboratory in all samples (i.e. <0.02mg/l). These samples therefore achieved 'High' status with respect to ammonia and S.I. 272/2009 (≤0.04mg/l). Meanwhile, the orthophosphate concentrations were generally of 'High' status (≤0.02mg/l). However, the concentration of orthophosphate at SW1 exceeded the 'Good' status threshold of ≤0.035mg/l on 29th April 2025. Nitrate concentrations were below the limit of detection of the laboratory in all samples. Chloride concentrations ranged from 5.6 to 7.7mg/l.

Table 8-10: Summary Laboratory Data (03/04/2025 to 23/07/2025)

Parameters	EQS	SW1	SW2
Suspended Solids (mg/l)	≤25$^{(-)}$	<5 - 10	<5
Ammonia (mg/l)	Good Status: ≤0.065, High Status ≤ 0.04$^{(*)}$	<0.02	<0.02
Ortho-Phosphate – P (mg/l)	Good Status ≤ 0.035 to High Status: ≤0.025$^{(*)}$	<0.02 – 0.53	<0.02
Nitrate - NO^3 (mg/l)	-	<5	<5

Parameters	EQS	SW1	SW2
Chloride (mg/l)	-	5.6 - 7.7	4.1 - 5.6
BOD (mg/l)	Good Status: ≤ 1.5, High Status: ≤ 1.3(*)	<1 - 2	<1 – 2

(-) S.I. No. 293/1988: European Communities (Quality of Salmonid Waters) Regulations, 1988.

(*) S.I. No. 272/2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended).

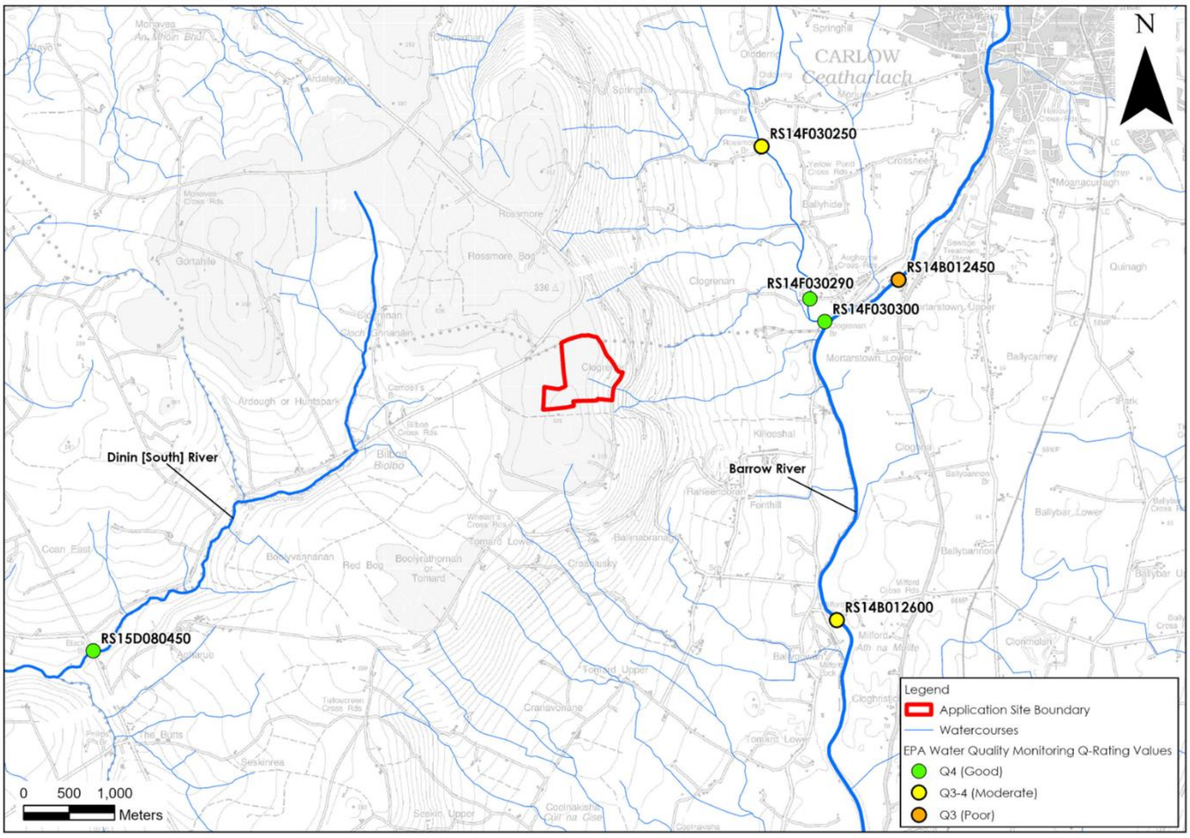

Figure 8-7: EPA Monitoring Locations

8.3.3.4 Flood Risk Assessment

HES completed a flood risk assessment which is included as **Appendix 8-2**.

OPW's River Flood Extents Mapping, National Indicative Fluvial Mapping, Past Flood Event mapping (https://www.floodinfo.ie/map/floodmaps/) and historical mapping (i.e. 6" & 25" base maps) were consulted.

There is no text on local available historical 6" or 25" mapping for the local area which identifies areas that are "prone to flooding" within the Development Site, or in the surrounding lands.

Based on the EPA/GSI soil map there are no regions of alluvium mapped within the Development Site boundaries. The closest downstream alluvium deposits are located ~2km to the east of the Development Site along the River Barrow. Within the River Nore Catchment, alluvium deposits are mapped ~2.2km to the west along the Dinin River.

OPW's Past Flood Event Mapping was consulted to identify those areas as being at risk of flooding. No historic or recurring flooding incidents are mapped within the Development Site or in the surrounding lands. The nearest OPW mapped past flood event (Flood ID:12779) is located at Fonthill, ~1.45km southeast of the Development Site (www.floodinfo.ie). This flood event is undated, and no details are provided on www.floodinfo.ie. Another past flood event (Flood ID: 11338) dated from 15th November 2009 is located at Fonthill, Raheendoran, Co Carlow, ~2.6km southeast of the Development Site. A recurring flood event (Flood ID: 2742) is mapped on the Fushoge River upstream of its confluence with the Mortarstown Stream. Meanwhile, further to the southeast and downstream of the Development Site, several recurring flood incidents are mapped along the Barrow River. **Figure 8-8** below presents a map of local OPW mapped historic and recurring flood event locations.

CFRAM mapping has not been completed for the area of the Development Site. There is no CFRAM Fluvial Flood Zones mapped in the vicinity of the Development Site. The nearest downstream CFRAM fluvial flood zones are mapped along the River Barrow, ~1.75km to the east of the Development Site.

The National Indicative Flood Mapping (NIFM) shows modelled flood zones for catchments greater than 5km^2 for which flood maps were not produced under the National CFRAM Programme. For the Present-Day Scenario, no medium (1 in 100) or low probability (1 in 1,000) fluvial flood zones are mapped in the local area. No NIFM flood zones are mapped along the Raheendoran or Mortarstown streams. The Development Site is mapped entirely within Fluvial Flood Zone C and is considered to be at low risk of fluvial flooding.

The GSI Winter (2015/2016) Surface Water Flooding Map shows flood zones for the winter 2015/2016 flood event which was considered to be the largest recorded flood event in many areas. This flood map does not record any flood zones within the Development Site. The closest GSI Winter Surface Water Flooding is recorded ~900m northwest of the Development Site and is associated with a surface water lake in Rossmore Bog.

In terms of the potential effects of climate change on fluvial flooding in the local area, the NIFM Mid-Range Future Scenario models flood extents based on a 20% increase in rainfall. Similarly, the NIFM High-End Future Scenario models flood extends based on a 30% increase in rainfall. Both of these modelled flood extents show similar flood zones to the Present-Day Scenario. Therefore, flood zones at the Development Site are unlikely to be significantly impacted by future climate change.

In terms of historic groundwater flooding, the GSI's Maximum Historic Groundwater Flood Map (www.gsi.ie) does not show any groundwater flood zones within the Development Site. The closest historic groundwater flooding is located ~3.36km east of the Development Site.

Based on the information gained through the flood identification process, no parts of the Development Site are mapped within any fluvial flood zones (Flood Zones A or B). The Development Site is located above the mapped 1,000-year flood level and is therefore located in Flood Zone C (Low Risk).

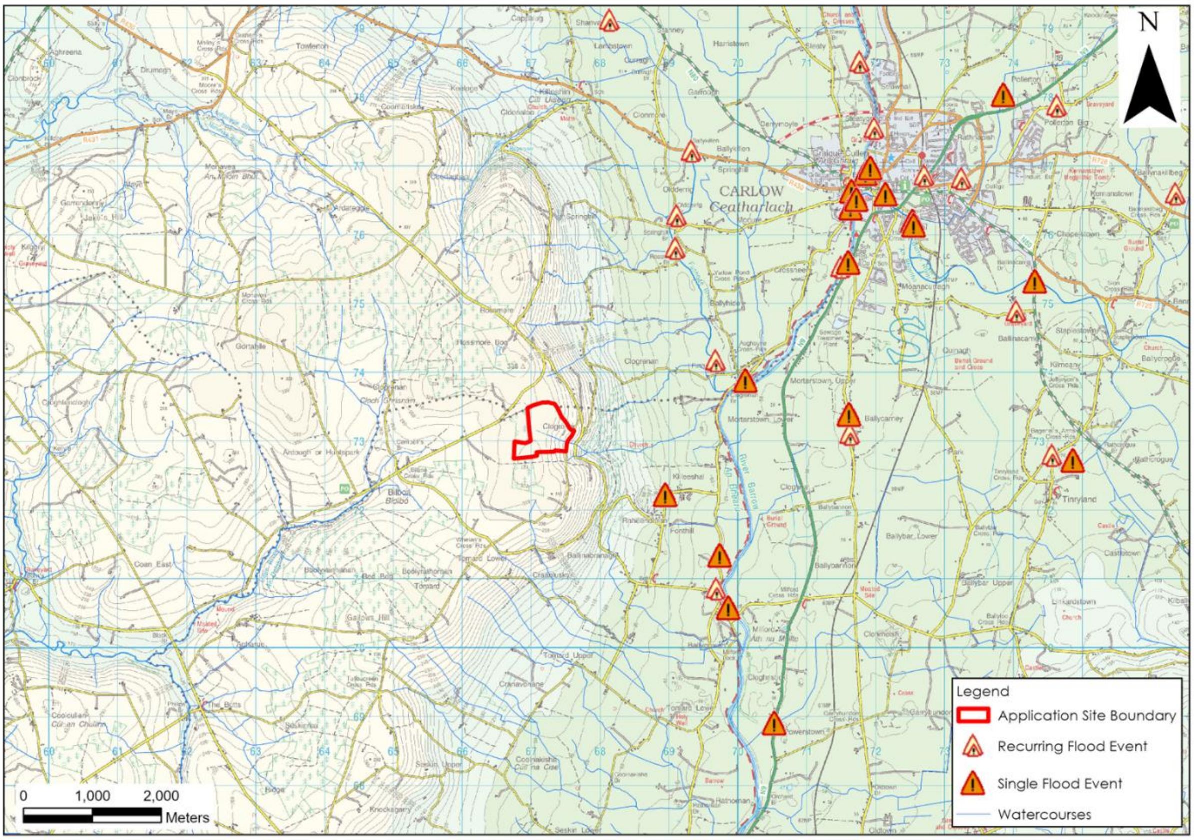

Figure 8-8: OPW Past Flood Events (www.floodinfo.ie)

8.3.3.5 Water Framework Directive

The Water Action Plan 2024 was published in September 2023 and is Ireland's 3rd River Basin Management Plan. It's objectives include the following:

- Ensure full compliance with relevant EU legislation;
- Prevent deterioration;
- Meet the water standards and objectives for designated protected areas;
- Protect high-status waters; and,
- Implement targeted actions and pilot schemes in focus sub-catchments aimed at (i) targeting waterbodies close to meeting their objectives and (ii) addressing more complex issues that will build knowledge for future cycles.

8.3.3.5.1 Surface Water Body Status

A summary of the Water Framework Directive (WFD) status and risk result for Surface Water Bodies (SWBs) immediately downstream of the Development Site is shown in **Table 8-11**.

As stated above in Section 8.3.3.1, the vast majority of the Development Site is located within the River Barrow catchment. The River Barrow in the vicinity and downstream of the Development Site (Barrow_170 to Barrow_200 SWBs) achieved 'Moderate' status in the latest WFD cycle (2019-2024). Indeed, the Barrow_170 and Barrow_180 SWBs achieved 'Moderate' status in the 3 no. most recent WFD cycles. The River Barrow between the Proposed Development Site and Bagenalstown is generally 'at risk' of failing to meet their WFD objectives except for Barrow_190 SWB whose risk status is "under review".

Agriculture is listed as a significant pressure on 3 no. SWBs between the Development Site and Bagenalstown (Barrow_170, 180 and 200 SWBs). Urban run-off is a significant pressure on two of these SWBs (Barrow_180 and 200 SWBs). Hydromorphology is also identified as a significant pressure on the Barrow_170 SWB. Urban wastewater is listed as a significant pressure on the Barrow_200 SWB.

A small area of the Development Site is located within the River Nore catchment. The Dinin (South)_010 and Dinin (South)_020 SWBs have achieved 'Good' status in the latest 2 no. WFD cycles. The Dinin(South)_010 experienced an improvement in WFD status from the 'Moderate' status it achieved in the 2nd Cycle. Further downstream the Dinin (Main Channel)_010 and Dinin (Main Channel)_020 SWBs achieved 'Good' and 'Moderate' status respectively in the latest WFD cycle. In terms of risk status, the Dinin (South)_010 and Dinin (South)_020 SWBs are 'not at risk' whilst the Dinin (Main Channel)_010 and Dinin (Main Channel)_020 SWBs are 'at risk' of failing to meet their respective WFD objectives.

Within the River Nore WFD catchment, agriculture is the significant pressure identified on the Dinin (Main Channel)_010 and 020 SWBs. Meanwhile, abstractions and mines and quarries are also listed as significant pressures on the Dinin (Main Channel)_020 SWB.

Table 8-11: Summary WFD Information for SWBs

SWB	Overall Status (2013-2018)	Overall Status (2016-2021)	Overall Status (2019-2024)	Risk Status (3rd Cycle)	Pressures
River Barrow Surface Water Catchment					
Barrow_170	Moderate	Moderate	Moderate	At risk	Hydromorphology and agriculture
Barrow_180	Moderate	Moderate	Moderate	At risk	Urban run-off and agriculture
Barrow_190	Unassigned	Moderate	Moderate	Under review	None
Barrow_200	Good	Moderate	Moderate	At risk	Urban run-off, agriculture and urban wastewater
River Nore Surface Water Catchment					
Dinin (South)_010	Moderate	Good	Good	Not at risk	None
Dinin (South)_020	Good	Good	Good	Not at risk	None
Dinin (Main Channel)_010	Moderate	Moderate	Good	At risk	Agriculture
Dinin (Main Channel)_020	Moderate	Moderate	Moderate	At risk	Agriculture, abstractions and mines and quarries

8.3.3.6 Surface Water Abstractions for Drinking Water

No sections of the River Barrow downstream of the Development Site are identified as Drinking Water Protected Areas (DWPAs) (www.catchments.ie).

Meanwhile, within the River Nore catchment, the closest downstream DWPA is located on the Dinin (Main Channel)_020 SWB. This surface water abstraction is associated with the Public Water Scheme

Supply for Kilkenny City. This DWPA is distant from the Development Site. Whilst a section of the overall landholding is located in the River Nore catchment, the extraction areas did not encroach into the River Nore catchment, nor was there any discharge of surface water within this catchment. Therefore, the Development would have had no potential to impact this DWPA.

8.3.3.7 Surface Water Discharges

A discharge licence was granted by Carlow County Council in November 2011 (DL/S4/2011/2) for the Development. However, Annual Environmental Reports associated with the Licence are not available.

The EPA do not map the presence of any Section 4 discharges to surface waters within the Barrow_170 WFD river sub-basin. The closest mapped Section 4 discharge is associated with Clonmelsh Quarry which is located ~5.5km to the southeast of the Development Site. Clonmelsh Quarry is located to the east of the River Barrow.

There is no Urban Waste Water Treatment Plant (UWWTP) in the vicinity of the Development Site. The closest UWWTP (Licence No.: D0028-01) is located in Carlow town, ~3.7km to the east/northeast.

8.3.4 Groundwater – Hydrogeology

8.3.4.1 Regional Bedrock Aquifer

The GSI's bedrock geology map for the local area (www.gsi.ie) shows that the majority of the Development Site is underlain by the Westphalian Shales of the Moyadd Coal Formation described as shale, siltstone and minor sandstone. Meanwhile, the southwest of the Development Site, and some small areas in the east, are mapped to be underlain by the Namurian sandstones of the Bregaun Flagstone Formation. The Bregaun Flagstone Formation is described by the GSI as being comprised of thick flaggy sandstone and siltstone.

The Bregaun Flagstone Formation is classified by the GSI as a Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones (PI). Meanwhile, the Moyadd Coal Formation is described as a Poor Aquifer - Bedrock which is Generally Unproductive (Pu).

A local bedrock aquifer map is shown as **Figure 8-9**.

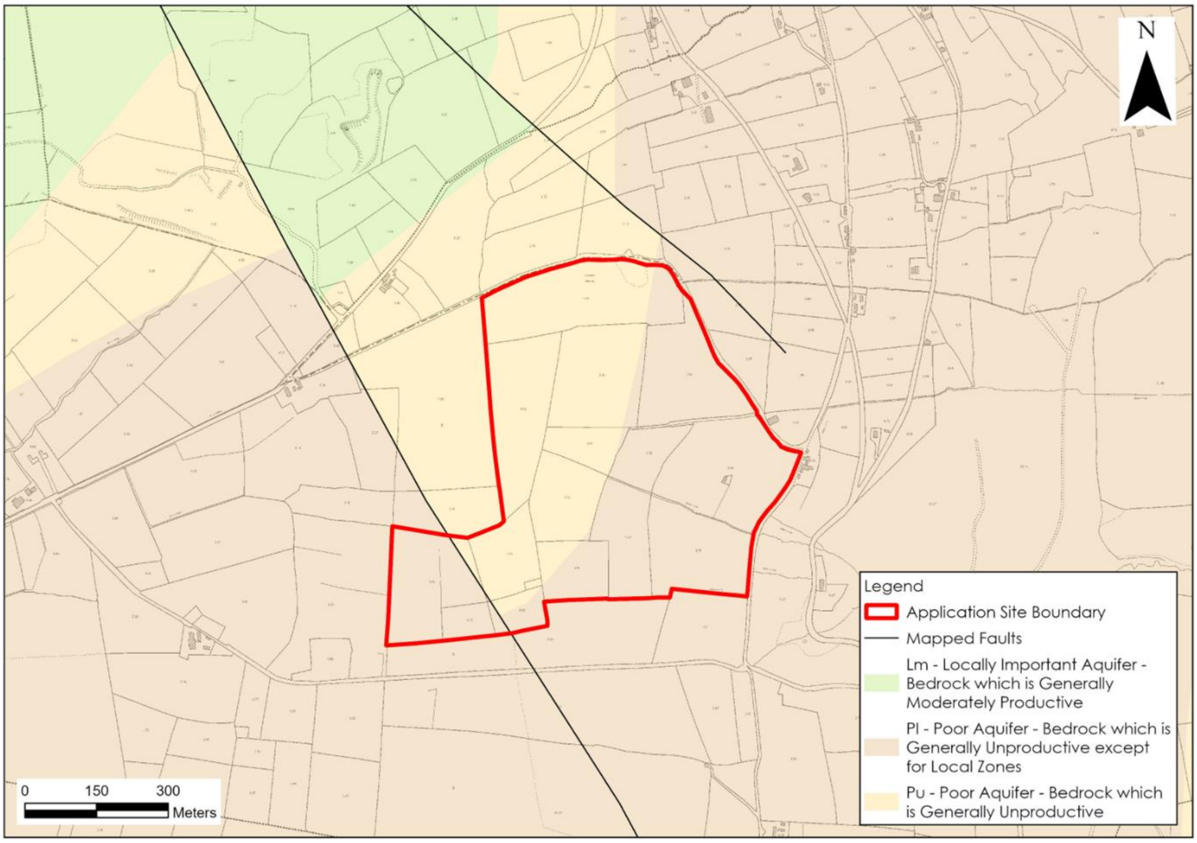

Figure 8-9: Local Bedrock Aquifer Map

8.3.4.2 Groundwater Body

In terms of Groundwater Bodies (GWBs), the Development Site is underlain by the Shanragh GWB (IE_SE_G_124). According to the GSI's Shanragh GWB Characterisation Report (GSI, 2004), this GWB consists of the Westphalian Shales of the Castlecomer Plateau that lie within the River Barrow catchment. This GWB is not considered to be an important aquifer. Recharge will occur at the elevated eastern peaks of the Castlecomer Plateau. Groundwater will flow be concentrated in the shallow weathered bedrock, and will flow downhill, following the surface topography and it will discharge, sometimes via springs at the base of the hills, into the Barrow Valley.

Groundwater flowpaths in this area are considered to be short, because the bedrock is not considered to constitute a major aquifer. Therefore, it is likely that the majority of groundwater flow circulated in the upper tens of metres, recharging and discharging in local zones.

8.3.4.3 Groundwater Vulnerability

The GSI describe groundwater vulnerability as a term used to represent the natural ground characteristics that determine the ease with which groundwater may be contaminated by human activities. Groundwater vulnerability embodies the characteristics of the intrinsic geological and hydrogeological features at a site that determine the ease of groundwater contamination. Groundwater vulnerability is related to recharge acceptance, whereby in areas where recharge occurs more readily, a higher quantity of contaminants will have access to groundwater.

Based on the groundwater vulnerability maps published on the GSI website (www.gsi.ie), the majority of the Development Site is mapped in areas of 'X' groundwater vulnerability (i.e. rock at or near the surface) with some small areas in the northwest mapped as having 'Extreme-E' groundwater vulnerability.

Based on the site investigation data (5 no. boreholes and walkover surveys) the depth to the bedrock is shallow across the majority of the Development Site i.e. 0-1.2mbgl. The groundwater vulnerability in these areas will be 'Extreme' (refer to ***Table 8-12***)[3]. Meanwhile, MW2 in the west of the quarry encountered thicker sub-soils, comprising of made ground and clay (associated with spoil heaps associated with the historic extraction activities), with depth to rock in this area recorded as 9.7mbgl. The groundwater vulnerability in this area is currently 'Moderate' but has been altered due to the previous quarrying activities.

The 1995 baseline groundwater vulnerability rating would also have been 'Extreme' due to the thin coverage of soils/subsoils at the Development Site.

[3] Environmental Protection Agency (EPA) (2008) Strive Report Series No. 6, Water Framework Directive – Recharge and Groundwater Vulnerability [Accessed: 25/07/2024]

Table 8-12: Groundwater Vulnerability and Subsoil Permeability and Thickness

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Karst Features
	High permeability (sand/gravel)	Moderate permeability (e.g. Sandy subsoil)	Low permeability (e.g. Clayey subsoil, clay, peat)	(Sand/gravel aquifers only)	(<30 m radius)
Extreme (E)	0 - 3.0m	0 - 3.0m	0 - 3.0m	0 - 3.0m	-
High (H)	>3.0m	3.0 - 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

Notes: (1) N/A = not applicable.
(2) Precise permeability values cannot be given at present.
(3) Release point of contaminants is assumed to be 1-2 m below ground surface.

8.3.4.4 Groundwater Recharge

Based on GSI mapping (www.gsi.ie), the groundwater recharge coefficient at the Development Site ranges from 22 to 85% with average recharge ranging from 51-100mm/year. The recharge capacity of the bedrock in this area is 100mm/yr and therefore a high proportion of potential recharge will be rejected by the bedrock and discharges into nearly surface water features (i.e. surface water is the primary sensitive receptor in this area).

8.3.4.5 Site Specific Geology

A detailed description of the geology of the Development Site is provided in Chapter 7. The following is a brief summary of the relevant geological information that has a bearing on the hydrogeology of the Development Site.

- 5 no. monitoring wells were drilled at the Development Site in June 2024. The bedrock encountered during these investigations was described mostly as shale, siltstone and sandstone.
- HES also examined the existing quarry faces at Red Rock Quarry and found that the bedrock comprises of sandstone and shale.
- The monitoring well logs show water inflows at depths ranging from 2.5m to 23.5m. The groundwater strikes encountered during the drilling were described as seepages or very slow to minor water strikes.
- There is no inflow of groundwater to the existing quarry void.

8.3.4.6 Local Groundwater Levels

Groundwater monitoring has been completed in the 5 no. groundwater monitoring wells drilled by Petersen Drilling Services Ltd. in June 2024. The location of the groundwater monitoring wells are shown in **Figure 8-10**.

Water level monitoring devices were installed in 4 no. onsite boreholes (MW02, MW03S, MW03D and MW04) on 1st August 2024. A datalogger was subsequently installed at MW01 on 4th March 2025. MW1 is located in the floor of the existing quarry void. MW2 is located immediately to the west of the quarry void, along an agricultural track. MW3s and MW3d are located in rough agricultural pasture in the southwest of the Development Site, and MW4 is located in agricultural land to the southeast of the quarry void.

In addition to the continuous monitoring, the boreholes have been manually dipped on a monthly basis between February and November 2025. This monthly monitoring was preceded by manual dip measurements completed on 13th December 2024. The minimum, maximum and average recorded water levels are presented in **Table 8-13**. The continuous water level data is presented graphically in **Figure 8-11.**

During the monitoring period groundwater elevations ranged from a maximum of 317.65mOD at MW03S to a minimum of ~291.06mOD at MW04. The recorded groundwater levels at each monitoring location do not exhibit a significant range and remain relatively constant throughout the year. The water level range varied between 0.64m at MW01 to 1.68m at MW03S. The variation of the elevation of the local groundwater table is a function of surface topography with the highest groundwater elevations recorded in the southwest of the Development Site (MW03s and MW03d) where the greatest ground elevations are recorded. Groundwater flow will follow surface topography and flow to the east. A plot of the groundwater levels during the monitoring period is shown as **Table 8-13**.

As seen in **Table 8-13**, the groundwater levels in the extraction area are greater than the final floor level of the quarry void (~300mOD) except for MW4 which is located on lower ground to the southeast of the quarry. Therefore, an assessment of potential groundwater inflows is required, and this is addressed in Section 8.5.2.1.5.

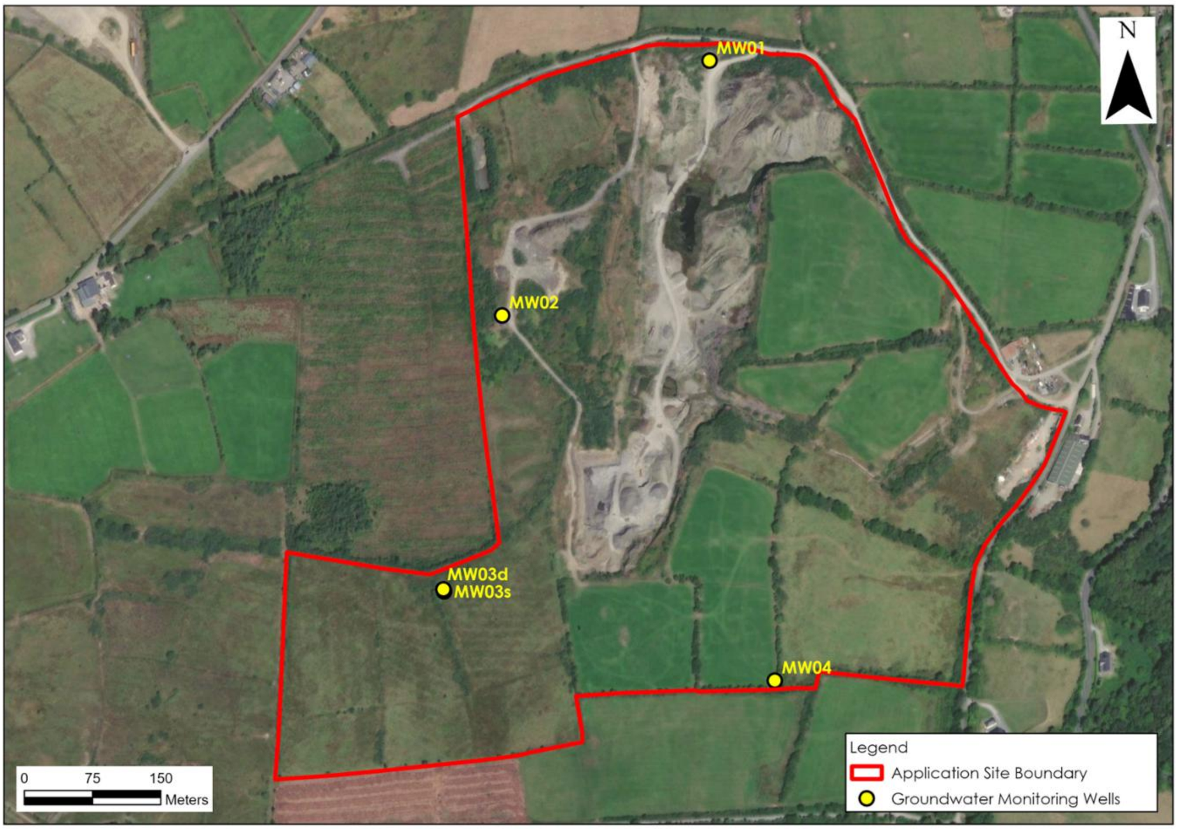

Figure 8-10: Groundwater Monitoring Wells

Table 8-13: Groundwater Levels

Monitoring Well	Ground Elevation (mOD)	Water Level (mOD)		
		Minimum	Maximum	Range
MW1	304.719	300.62	301.27	0.64
MW2	325.171	311.9	313.23	1.33
MW3s	318.116	315.97	317.65	1.68
MW3d	318.108	315.68	317.15	1.47
MW4	296.342	291.06	299.92	0.86

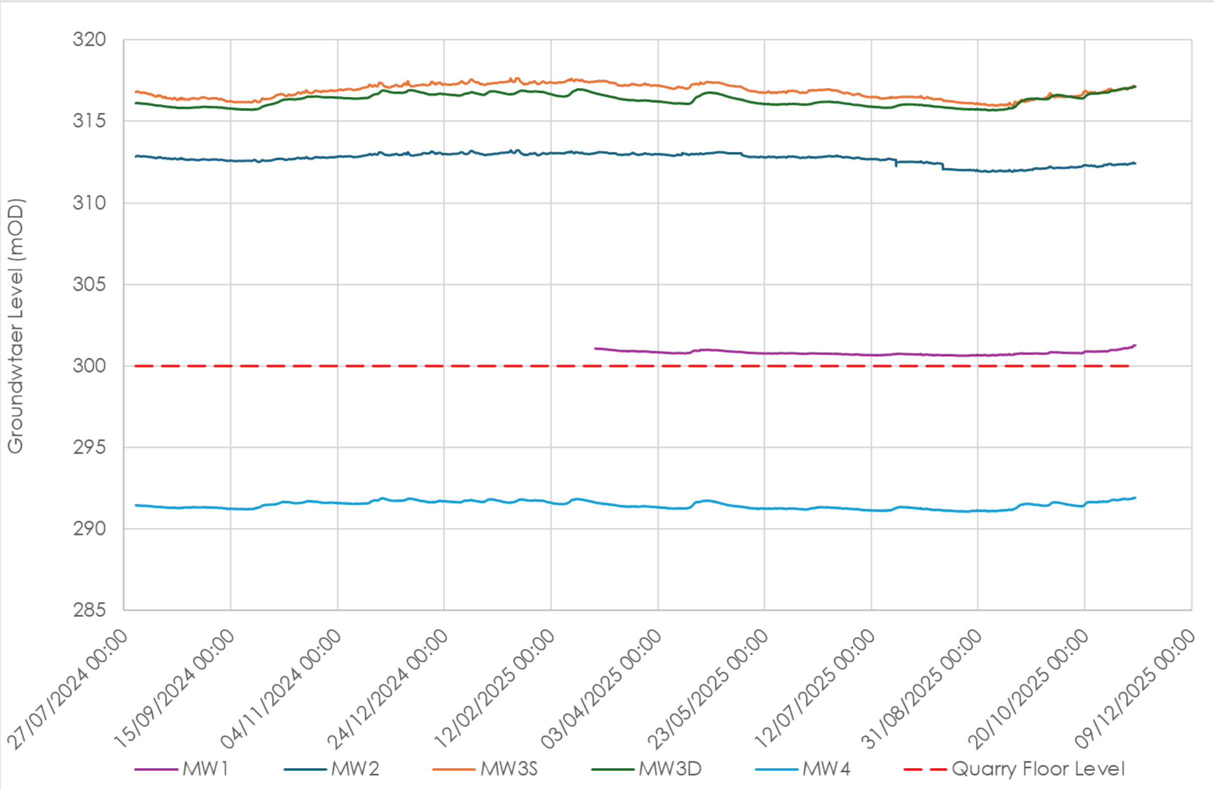

Figure 8-11: Continuous Groundwater Levels

8.3.4.7 Groundwater Hydrochemistry

Recent groundwater sampling was completed at 2 no. locations (MW1 and MW2) on 23rd July and 14th August 2025. During the sampling, hydrochemical parameters were recorded using a calibrated YSI multimeter probe. Electrical conductivity ranged from 424 to 473µS/cm and dissolved oxygen ranged from 3.55 to 4.45mg/L. pH was neutral to slightly basic, ranging from 7.18 to 7.4.

The laboratory data of the samples recorded from MW1 and MW2 indicates that the water is typically of an acceptable chemical quality relative to the Groundwater Regulation (S.I. 9/2010). Ammonia

(NH_3-N) ranged between 0.054 and 0.068mg/L at MW1 and 1.54 and 3.23mg/L at MW2. Nitrate (NO_3) was below the laboratory limit of detection in all samples (<4.4mg/L) and is well below the drinking water threshold value for groundwaters of 37.5mg/L. Chloride ranged between 8.69 and 13.8mg/L, well below the EQS threshold of 24mg/L (S.I. 9/2010). The concentrations of Total Petroleum Hydrocarbons (TPH) were below the laboratory limit of detection in all samples.

Iron and manganese concentrations were elevated at both MW1 and MW2 on 23rd July 2025. The concentrations of these parameters were lower, and well below the guideline values on 14th August 2025. It is noted that Namurian rocks can have high concentrations of iron and manganese due to the dissolution of iron and manganese rich minerals.

Summary results are presented in **Table 8-14** whilst the full laboratory reports are included in **Appendix 8-3**.

Table 8-14: Groundwater Sampling Laboratory Results (23/07/2025 and 14/08/2025)

Parameter	EQS	Sample ID			
		MW1		MW2	
		23/07/2025	14/08/2025	23/07/2025	14/08/2025
Ammonia-N (mg/l)		0.054	0.068	3.23	1.54
Nitrite – N (mg/l)	0.5*/0.1⁺	<0.01	<0.01	<0.01	<0.01
Ortho-phosphate (mg/l)	0.035*	0.01	0.01	0.06	0.034
Nitrate – NO_3 (mg/l)	37.5⁺	<4.4	<4.4	<4.4	<4.4
Chloride (mg/l)	24*/250⁺	8.69	8.86	13.8	12.9
BOD (mg/l)		1.2	<1	5.7	<1
TPH Total (µg/l)		<0.1	<0.1	<0.1	<0.1
Iron (µg/L)	200*⁺	1,650	<0.005	135	0.054
Magnesium (mg/L)	50*	29.2	26.4	7.53	10.7
Manganese (µg/L)	50*⁺	545	0.342	1,630	2.2
TDS (mg/L)	-	311	17	305	299
TSS (mg/L)	-	5	307	4,790	1,500
Sulphate (mg/L)	187.5*/250⁺	5.58	3.97	18.7	9.62

(*) S.I. No. 9/2010 – Groundwater Regulations

(⁺) S.I. 99/2023 – Drinking Water Regulations

8.3.4.8 Karst Features

Karst features are mapped by the GSI and are available to view through the GSI online viewer (www.gsi.ie).

The GSI do not map the presence of any karst features within or in the vicinity of the Development Site.

The closest mapped karst feature is an enclosed depression (GSI Karst Feature ID: 2617NWK001) which is mapped ~7.5km northeast of the Development Site in the townland of Cappanaboe, Co. Laois. Another karst feature, recorded in a borehole, is located ~8.7km north/northeast of the Development Site in the townland of Hollymount, Co. Laois.

Based on the site walkover and site investigations, the bedrock at the Development Site consists of shale, siltstone and sandstone which are not susceptible to karstification. Due to the siliclastic nature of the mapped bedrock, karst features would not be anticipated in this area as they are associated with the dissolution of limestone. No limestone bedrock is mapped in the local area.

8.3.4.9 Groundwater Body Status

A summary of the WFD status and risk result for the Ground Water Body (GWB) in the vicinity of the Development Site is shown in **Table 8-15**.

The Development Site is underlain by the Shanragh GWB. This GWB achieved 'Good' status in all 3 no. WFD cycles (2010-2015, 2013-2018 and 2016-2021). This GWB is currently deemed to be 'not at risk' of failing to meet its WFD objectives. No significant pressures have been identified to be impacting this GWB.

Table 8-15: Summary WFD Information for GWBs

GWB	Overall Status (2013-2018)	Overall Status (2016-2021)	Overall Status (2019-2024)	Risk Status (3rd Cycle)	Pressures
Shanragh	Good	Good	Good	Not at risk	None

8.3.4.10 Groundwater Resources

According to GSI Online Mapping (wwwgsi.ie), there are no Group Water Schemes (GWS) or Public Water Supply Schemes (PWS) located within the Development Site.

The closest GSI mapped GWS is the Ballinabranna GWS. The Source Protection Area associated with this GWS is located ~600m south of the Development Site. Meanwhile, the boreholes associated with this GWS are located ~2.4km to the east/southeast. Ballinabranna Water Cooperative Society supplies water to about 400 members. The scheme uses about 170m^3 of water every day (http://ballinabrannawater.ie/).

Meanwhile, the closest GSI mapped PWS is the Paulstown PWS. The Source Protection Area associated with this PWS is located ~8.7km southwest of the Development Site.

A search of private well locations (wells with location accuracy of 1–100m were only sought) was undertaken using the GSI well database (www.gsi.ie). The GSI national well database (www.gsi.ie) records two dug wells (GSI Name: 2617SWW409 and 2617SWW410) to the east of the Development Site and ~230 and ~370m to the east of the extraction area. These wells have a locational accuracy of 10m and are listed as having agricultural and domestic uses. A spring (GSI Name: 2617SWW064) is also mapped ~300m northeast of the Development Site while a dug well (GSI Name: 2617SWW078) is mapped ~140m to the northwest.

We accept that the GSI well database does not include all potential water wells. As such, and in order to be conservative, for the purposes of assessment (as completed in Section 8.5.2.1.9) we assume that there is a groundwater well source at each local house/dwelling location in the vicinity of the Development Site. These are several dwellings located along the L3896/L7134 to the east of the Development Site. The closest dwelling along these local roads is ~184m to the northeast of the quarry void. Several dwellings are also located to the west of the Development Site. The closest dwellings to the extraction area are located ~730m to the southwest and ~420m to the west.

In addition, all GWBs have been identified as Drinking Water Protected Areas (DWPA) due to the potential for qualifying abstractions of water for human consumption as defined under Article 7 of the WFD. The DWPA designation applies to all groundwater bodies nationally, regardless of the productivity status of the underlying aquifer. The Shanragh GWB therefore is listed as a DWPA.

An information request was also submitted to Uisce Éireann for the location of all Uisce Éireann groundwater abstraction locations within 5km of the Development Site was submitted. No groundwater abstractions other than those listed above were identified.

All local groundwater resources are shown in **Figure 8-12**.

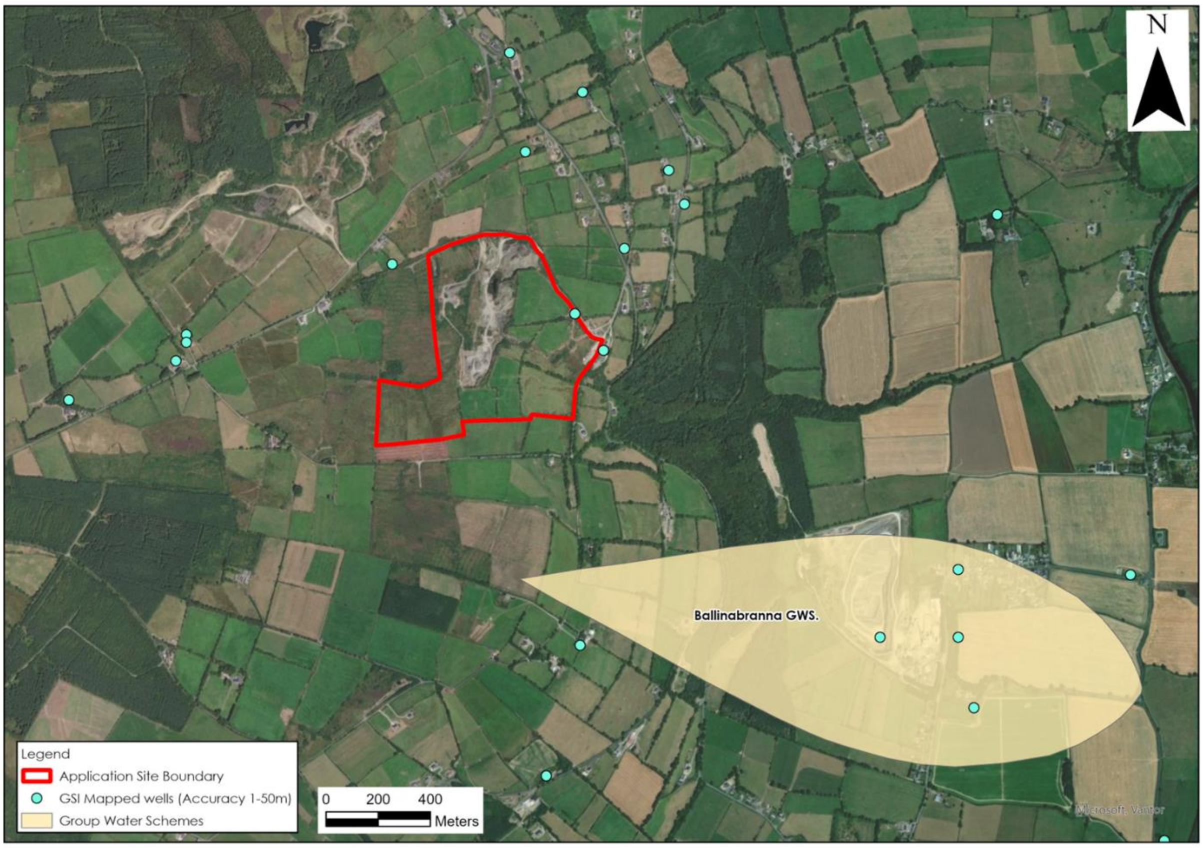

Figure 8-12: Local Groundwater Resources

8.3.5 Designated Sites

Within the Republic of Ireland designated sites include Natural Heritage Areas (NHAs), Proposed Natural Heritage Areas (pNHAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs).

Ramsar sites are wetlands of international importance designated under the Ramsar Convention (adopted in 1971 and came into force in 1975), providing a framework for the conservation and wise use of wetlands and their resources.

The Development Site is not located within a Ramsar site or a designated site of national (Natural Heritage Area (NHA) / Proposed Natural Heritage Area (pNHA)) or European importance (Special Area of Conservation (SAC) / Special Protection Area (SPA).

The designated sites hydrologically connected with the Development Site, or within 10km of the Development Site, are listed in **Table 8-16**. A map of designated sites is shown as **Figure 8-13** below.

Table 8-16: Designated Sites

Site Name	Site Code	Distance from Site	Hydrological / Hydrogeological Connection
River Barrow and River Nore SAC	002162	~1.8km east and ~5.6km southwest	The Development Site is hydrologically (~2.7km) connected with this SAC via the Mortarstown Stream which receives the discharge from the Development Site. The lower reaches of this stream and the Fushoge River form part of the SAC. There is no direct hydrogeological connection between the Development Site and the SAC due to the poor permeability of the underlying bedrock aquifer. Groundwater flowpaths will be short (0-300m) and groundwater will discharge into nearby streams such as the Raheendoran and Mortarstown Stream or at springs at the base of the hills. Therefore, in terms of groundwater flow and indirect connection exists, initially via groundwater flowpaths and then via surface water streams.
Cloghristick Wood pNHA	000806	~3.48km southeast	The Cloghristick Wood pNHA is located on the eastern banks of the River Barrow downstream of the Development Site. The length of the hydrological flowpath between the Development Site and this pNHA is~6.3km. The pNHA includes some wet woodland adjacent to the river. No direct hydrogeological connection exists between the Development Site and the pNHA due to the short groundwater flowpaths in the underlying aquifer.
River Nore SPA	004233	~22km southwest	Within the River Nore catchment, the River Nore SPA is located downgradient of the Development Site via the Dinin River. However, extraction did not encroach upon this catchment and there was no discharge within the River Nore catchment.

Site Name	Site Code	Distance from Site	Hydrological / Hydrogeological Connection
			The Development Site is not connected hydrogeologically with this SPA as the ground water is expected to flow to the east of the Development Site.
Coan Bogs NHA	002382	~5km west	There is no hydrological or hydrogeological connection between the Development Site and this NHA.

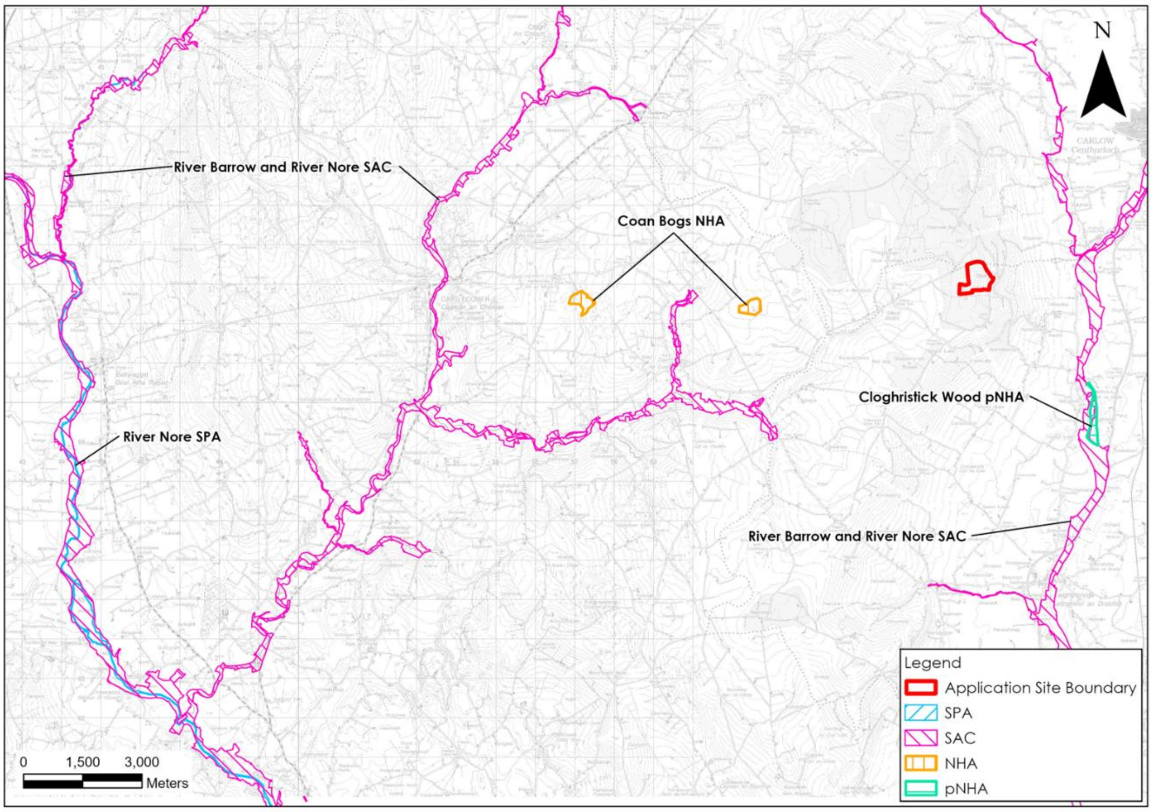

Figure 8-13: Designated Sites

8.3.6 Receptor Sensitivity

This section discusses the sensitivity of the receiving hydrological and hydrogeological environment in terms of the Development and identifies those receptors which will be included in the residual impact assessment.

Due to the nature of the Development and the local hydrogeological regime (Poor Bedrock Aquifer of low permeability with short groundwater flowpaths), surface water is considered to be the main receptor. Water currently falling within the existing quarry void currently gathers in ponds on the quarry floor and there is an existing surface water outfall which connects to the Mortarstown Stream. The low permeability of the underlying bedrock means that a significant proportion of potential groundwater recharge is rejected. Therefore, surface waters are considered to be the main sensitive receptor in the local area.

The following surface water receptors are identified for inclusion in the impact assessment:

- Water quality and flow volumes in the Mortarstown Stream as the quarry is currently hydrologically connected to this watercourse;
- Water quality and flow volumes in the Fushoge River and River Barrow which are located downstream of the Mortarstown Stream;
- Water quality and flow volumes in the Raheendoran Stream which is mapped by the EPA to dissect the Development Site; and,
- The WFD status of all downstream SWBs.

As stated in Section 8.3.3.1 a section of the overall landholding is located in the River Nore surface water catchment. However, the previous extraction activities did not encroach upon this catchment and there was no surface water discharge within the River Nore catchment. For these reasons, there was no effects in the River Nore catchment and all receptors (River Dinin, Dinin (Main Channel)_020 DWPA) within this catchment have been screened out of the remedial impact assessment. The River Nore SPA, Coan Bogs NHA, River Nore salmonid river (S.I. 293) within the River Nore catchment have been screened out of the remedial impact assessment.

Based on the criteria set out in **Table 8-2** above, the Poor Bedrock Aquifer which underlies the Proposed Development Site can be classed as being of Low Importance. The primary risks to groundwater would have been from hydrocarbon spillage and leakages from plant as well as the potential reduction in local groundwater levels as extraction progresses.

The following groundwater receptors are identified for inclusion in the impact assessment:

- The Poor Bedrock Aquifer underlying the Proposed Development Site;
- The WFD status of the underlying Shanragh GWB;
- The Ballinabranna GWS; and,
- Local private groundwater wells.

The Paulstown PWS has been screened out of the impact assessment. There is no hydrogeological connection between the Proposed Development Site and this PWS. There was no potential for effects on the Paulstown PWS.

Local downstream surface waters including the lower reaches of the Mortarstown Stream, the Fushoge River and River Barrow can be considered as being of Extremely High Importance due to their designation as part of the River Barrow and River Nore SAC (refer to **Table 8-1**). The primary potential for surface water contamination was via elevated concentrations of suspended solids and potential oil/fuel leaks and spills from plant and machinery making their way into local surface watercourses.

The following designated sites are included in the impact assessment:

- River Barrow and River Nore SAC; and,

- Cloghristick Wood pNHA.

All other designated sites have been screened out of the remedial impact assessment due to their distance location from the Development Site and the lack of hydrological and/or hydrogeological connectivity.

8.4 Characteristics of the Development

A full description of the Development and all works completed at the Development Site post-dating the 1995 baseline are described in full in Chapter 3 of this rEIAR.

8.4.1 Extraction Phase (1995 Baseline to 2023)

During the Extraction Phase quarrying, specifically the extraction of sandstone rock, occurred at the Development Site. Rock extraction was completed by rock breaking and no blasting was completed at the Development Site. All rock was crushed and processed with mobile plant on-site and spoil was stored in large spoil heaps within and surrounding the quarry void. The quarry included an extraction area of 8.66ha within a wider landholding of c.45.86 ha and involved extraction of c. 650,000 m³ of material over this period.

The extraction of bedrock in the greenfield areas was proceeded by site preparation works comprising of vegetation removal and soil/subsoils stripping. This material was used in the construction of boundary berms and will be used in the phased restoration of the Development Site.

During this period ancillary infrastructure was also constructed at the Development Site. This took the form of site offices and welfare buildings and site access roads. All drainage infrastructure including settlement ponds. A discharge licence was granted by Carlow Co. Co. in November 2011 (DL/S4/2011/2) and included conditions on emissions to water.

Large-scale quarrying activities ceased in c. 2014. Between 2014 and 2023 there was minor consolidation works completed at the Development Site. The final extraction area in 2023 was 8.66ha.

8.4.2 Current Phase (2023 to Present Day)

The Current Phase of the Development includes all activities carried out at the Development Site from the time that the Applicant took ownership of the Development Site in 2023 to the present day.

There was limited activity at the Development Site during this period, limited to environmental monitoring. The quarry has remained inactive throughout the duration of the Applicant's ownership. The drainage infrastructure, settlement pond, wet areas and discharge locations continue to be in operation.

8.4.3 Restoration Phase

The extraction area will be restored to agricultural grassland using material from an existing infill area in the west of the site. Revegetation will be allowed to occur naturally. The restoration plan also includes the planting of existing soil storage areas with woodland mosaic.

8.5 Assessment of Significant Effects and Mitigation Measures

8.5.1 Do Nothing Scenario

As outlined in the EPA Guidelines (May 2022), the description of the 'Do-Nothing Effects' relates to the environment as it would be in the future should the project not be carried out. As discussed above, the baseline for this project is considered to be 1995, a time which predates any extraction of bedrock at the Development Site. The 'Do-Nothing' Scenario is defined as scenario where quarrying at the Development Site never took place.

In the event that quarrying never took place at the Development Site, it is assumed that those lands would have continued as agricultural lands. Other land-use practices may also have taken place at the Development Site such as commercial forestry or other commercial or non-commercial uses. There would not have been any significant alteration to the drainage regime at the Development Site. The

Raheendoran Stream would have continued to flow through the Development Site and there would have been no diversion of waters from the site towards the Mortarstown Stream.

The Do-Nothing Scenario also considers the scenario whereby the proposed restoration plan will not be implemented. In this scenario, the existing drainage features, settlement ponds and discharge locations would continue to function as per the existing environment. The Development Site would continue to direct surface water towards the Mortarstown Stream. The positive effect associated with redirecting surface water back into the Raheendoran Stream, as proposed in the restoration plan, would be lost. The extraction area would remain as an abandoned quarry and the development site would not be restored to grassland/scrubland.

8.5.2 Identification of Effects

8.5.2.1 Extraction Phase (1995 Baseline-2023)

8.5.2.1.1 Effects on Local Groundwater Vulnerability Rating

Prior to the extraction of bedrock, a thin layer of soil and subsoil was removed to expose the underlying rock. Soil and subsoil were incrementally removed throughout the Extraction Phase of the Development as the quarrying operations expanded and extended to the southwest. The removal of the overburden, and the exposure of bedrock at the surface, increased the groundwater vulnerability of the underlying bedrock aquifer within the extraction area. The groundwater vulnerability within the extraction area is currently ‘X’ with rock exposed at the surface.

However, despite the removal of overburden, the Development did not result in any significant increase in the local groundwater vulnerability rating. Prior to any quarrying activities, the groundwater vulnerability rating was already predominantly ‘X’ due to the presence of thin subsoils (~1m in thickness). The presence of thin subsoils has been verified by site-specific investigation data (borehole drilling – refer to Section 8.3.4.5).

Therefore, based on the pre-existing geological and hydrogeological characteristics at the Development Site, changes in the groundwater vulnerability rating were minor and did not represent a significant increase in the groundwater vulnerability rating.

Pathways: Soil and subsoil removal and rock extraction.

Receptors: Groundwater vulnerability rating of the underlying bedrock aquifers and the Shanragh GWB.

Assessment of effects in the absence of mitigation measures: Due to the local hydrogeological regime, and the presence of thin soils/subsoils across the extraction area, the development did not significantly alter the local groundwater vulnerability rating which was ‘X’ prior to the removal of any soils/subsoils. The effect in the absence of mitigation measures could potentially have been similar to the residual effect described in Section 8.7.1.1 *i.e.* a negative, irreversible, slight, direct, permanent, likely effect on the local groundwater vulnerability rating.

8.5.2.1.2 Effects Due to the Alteration of Drainage Patterns

The Development has resulted in alteration of local drainage patterns. According to the EPA blueline database and historic 25” and 6” mapping, the Raheendoran Stream flowed through the Development Site prior to the quarrying activities. This stream drained the local area, including the Development Site, and discharged into the River Barrow ~2.25km east of the Development Site. Whilst the Raheendoran Stream is still present downstream of the site, the upper reaches of the stream (~120m in length) which overlapped with the extraction area have been removed. Water which used to flow in the Raheendoran Stream currently gathers in ponds and flooded areas on the quarry floor. Some of this water is directed to a large settlement pond, whilst some flows along an existing access track in the northeast of the Development Site. All surface water from the quarry merges downstream of the settlement pond and flows to the east towards the Mortarstown Stream. The Mortarstown Stream discharges into the Fushoge River, which in turn discharges into the River Barrow, ~220m upstream of where the Raheendoran Stream discharges into the River Barrow.

The Development has therefore removed the upper reaches (~150m in length) of the Raheendoran Stream. The stream in this area has been erased which represents a profound effect. However, this profound effect is localised to the extraction area and only impacts ~150m of the original stream channel. The total length of the Raheendoran Stream was 3.12km. The remaining 2.97km of the stream were not directly impacted (the effects associated with changes in flow volumes are discussed in Section 8.5.2.1.3 below. Therefore, the total length of the stream which has been lost equates to 4.8% of the total length of the Raheendoran Stream.

A profound negative effect has occurred to the morphology of the Raheendoran Stream locally within the Development Site which has been removed as a consequence of the Development. There was no changes to the morphology of other local watercourses or the Raheendoran Stream of the Development Site.

Pathways: Alteration of drainage patterns within the Development Site.

Receptors: Hydromorphology of downstream watercourses (Raheendoran Stream, Mortarstown Stream, Fushoge River and River Barrow).

Assessment of effects in the absence of mitigation measures: Due to the alteration of the hydromorphological regime at the Development Site, the effect in the absence of mitigation measures could potentially have been the same as the residual effect described in Section 8.7.1.2 *i.e.* a negative, direct, profound, permanent, effect on the hydromorphology of the Raheendoran Stream locally with the extraction area.

8.5.2.1.3 Effects on Downstream Surface Water Flow Volumes

Due to the alteration of the drainage patterns within the Development Site and the redirection of runoff to the Mortarstown Stream, the Development had the potential to alter surface water flow volumes in downstream watercourses. The alteration of drainage patterns resulted lower flow volumes in the Raheendoran Stream and increased flows in the Mortarstown Stream. Furthermore, the quarrying activity had the potential to increase the volume of water being discharge from the site due to increased volumes of surface and shallow groundwater being generated within the quarry void and leaving the site as surface water runoff. Any unmitigated or uncontrolled increase in discharge volumes had the potential to adversely impact downstream hydromorphology, water quality and increase the downstream flood risk.

However, the local hydrological and hydrogeological setting ensured that there was no significant effects on downstream surface water flow volumes in the Mortarstown Stream. Flow monitoring of the existing 2 no. surface water discharges from the Development Site show that the combined discharge flow volume is ~1-2l/s. This flow volume is small as the Development Site is located on a topographic high at the margin of the River Barrow catchment. Therefore, the Raheendoran Stream in the vicinity of the Development Site, prior to the quarrying activities had a very small upstream catchment area (~0.28km^2) which equates to 22% of the total catchment area to the Mortarstown Stream (~1.25km^2). Furthermore, due to the hydrogeological setting of the Development Site, located on a topographic high and underlain by Poor Bedrock Aquifers, little groundwater ingress will have occurred into the quarry void. Most of the water discharged from the quarry comprised of rainfall falling within the quarry void or on the adjacent upgradient lands. Also note that the flow volumes increased gradually as the extraction area expanded.

Similarly, the due to the local hydrological and hydrogeological setting of the Development Site, the Development will not have resulted in any significant change to downstream surface water flow volumes in the Raheendoran Stream. Furthermore, the total catchment area of the section of the Raheendoran Stream which was lost due to the Development was ~0.28km^2. As stated above, water in this catchment area is now directed towards the Mortarstown Stream. This area equates to ~10% of the total catchment area of the Raheendoran Stream. For this reason, and due to the small flow volume in the upper reaches of the catchment, there would have been limited potential for significant effects on downstream surface water flow volumes in the Raheendoran Stream.

There was no potential to alter flow volumes in the River Nore catchment as there was no discharge to surface waters within this catchment during the Extraction Phase.

Pathways: Surface water discharge.

Receptors: Surface water flow volumes in downstream watercourses (Mortarstown Stream, Fushoge River, the River Barrow and the Raheendoran Stream).

Assessment of effects in the absence of mitigation measures: In the absence of mitigation measures (i.e. no attenuation of water on the floor of the quarry or in the settlement ponds) the effect could potentially have been a negative, moderate, direct, long-term effect on surface water flow volumes in the Raheendoran Stream and the Mortarstown Stream. downstream watercourses. There would have been no potential for effects on the Fushoge River or the River Barrow due to the large volumes of water within these river waterbodies in comparison to any discharges from the Development Site.

8.5.2.1.4 Effects from the Entrainment of Suspended Solids in Surface Waters

Surface water was the main sensitive receptor associated with the Development due to the local hydrogeological regime, the low permeability of the underlying bedrock and the surface water outfall which is hydrologically connected to the Mortarstown Stream.

There was a requirement to strip and store overburden from the extraction area. Earthworks, the stripping of soil/subsoil, the creation of boundary berms, was a potential source of sediment laden water. This had the potential to impact water quality in both the Raheendoran Stream and the Mortarstown Stream. The potential for surface water quality effects on the Raheendoran Stream were only short-term and were associated with all works which preceded the alteration of the drainage regime. The Mortarstown Stream became a receptor once the drainage had been altered and redirected towards this watercourse.

Due to the large flow volumes in the Fushoge River and the River Barrow there was no potential for effects on these watercourses (even in the absence of mitigation measures). Note that the Development does not in any way rely upon the dilution/assimilative capacity of any watercourse. The mitigation measures prescribed in Section 8.6.1.4 ensured the protection of all watercourses in close proximity and further downstream of the Development Site.

During rock extraction and the subsequent processing of materials, there was the potential for the generation of suspended sediment in surface water runoff. Suspended sediment may have been entrained in surface waters on the floor of the quarry. In the absence of any mitigation measures, there would have been the potential for negative effects on downstream surface water quality.

Pathways: Surface water runoff, surface water discharge and lateral short groundwater flowpaths.

Receptors: Downstream surface water quality (Mortarstown Stream, Fushoge River, River Barrow and the Raheendoran Stream).

Assessment of Effects in the absence of mitigation measures: In the absence of mitigation measures the effect could potentially have been a negative, indirect, moderate, long-term, likely effect on downstream surface water quality in the Mortarstown Stream and a negative, indirect, moderate, short-term, likely effect on downstream surface water quality in the Raheendoran Stream. There was no potential for effects on the Fushoge River or the River Barrow due to the large volumes of water within these rivers in comparison to any discharge from the Development Site.

8.5.2.1.5 Effects on Local Groundwater Levels

Quarrying activities below the groundwater table had the potential to impact local groundwater levels in the vicinity of the Development Site. Once the quarrying operations extended below the groundwater table, groundwater levels in the surrounding areas could potentially have been lowered as the groundwater flowed towards the newly created void. Any significant drawdown of the local groundwater table could potentially have impacted local groundwater wells.

However, groundwater level monitoring at the site reveals the presence of a shallow groundwater system which lies above the floor level of the existing quarry (300mOD). During site investigations (borehole drilling) all water strikes were minor and described typically as seepages. Furthermore, no significant inflows of groundwater were noted during inspections of the existing quarry faces. No significant groundwater inflows would be expected at elevations of 300mOD. The groundwater present at the Development Site is hosted in bedrock that had a low permeability and groundwater flowpaths are short.

Therefore, based on the hydrogeological and topographic setting of the Development Site there was no potential for significant effects on groundwater levels. Due to the low permeability of the bedrock aquifer any minor effects were localised.

Pathways: Groundwater flow and groundwater levels (infiltration rates i.e. groundwater recharge).

Receptors: Groundwater levels in the underlying Shanragh GWB.

Assessment of Effects in the absence of mitigation measures: Due to the topographical and hydrogeological setting of the Development Site, the effect in the absence of mitigation measures could potentially have been the same as the residual effect described in Section 8.7.1.5 *i.e.* no effect on groundwater levels.

8.5.2.1.6 Contamination of Groundwater by Leakages and Spills

The removal of vegetation, stripping of soil/subsoil, and the extraction and processing of the rock was completed using machinery. Such machinery were powered by diesel engines and operate using hydraulics. Unless carefully managed such plant and machinery had the potential to leak hydraulic oils or cause fuel leaks. The accidental release of these compounds into the environment had the potential to negatively impact the groundwater quality in the underlying bedrock aquifer. Discharges from wastewater systems at the welfare facilities could also potentially have resulted in the contamination of groundwater.

It is understood that there were no significant contamination events at the Development Site during the Extraction Phase.

Pathway: Infiltration and short groundwater flowpaths.

Receptor: Local groundwater quality.

Assessment of effects in the absence of mitigation measures: In the absence of mitigation measures the effect could potentially have been greater than the residual effect described in Section 8.7.1.6. However, there is no knowledge of significant contamination events at the Development Site, and given the nature of the local hydrogeological regime with limited rates of groundwater recharge and short groundwater flowpaths, no significant effects would have occurred. The effect in the absence of mitigation measures would have been a negative, indirect, slight, long-term and unlikely effect on groundwater quality.

8.5.2.1.7 Contamination of Surface Waters by Leakages and Spills

Accidental spillage of petroleum hydrocarbons during refuelling of machinery and plant (static and mobile) construction plant with petroleum hydrocarbons is a significant pollution risk to surface waters and associated ecosystems and to terrestrial ecology. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in the death of aquatic organisms. Discharges from wastewater systems at the welfare facilities could also potentially have resulted in the contamination of surface waters.

Surface water was the main sensitive receptor. The surface water discharge from the Development Site provided a direct hydrological connection between the quarry and downstream watercourses including the Mortarstown Stream, the Fushoge River and the River Barrow. However, due to the large flow volumes in the Fushoge and Barrow rivers there was limited potential for effects on these watercourses (even in the absence of mitigation measures). Note that the Development does not in any way rely upon the dilution/assimilative capacity of any watercourse. The mitigation measures prescribed in Section 8.6.1.6 ensured the protection of all watercourses in close proximity and further downstream of the Development Site. There would have also been the potential for short-term effects on the Raheendoran Stream prior to the alteration of the drainage regime.

It is understood that there were no significant contamination events at the Development Site during the Extraction Phase.

Pathway: Surface water runoff, short groundwater flowpaths and surface water discharge from the quarry.

Receptor: Downstream surface water quality (Mortarstown Stream, Fushoge River, River Barrow and the Raheendoran Stream).

Assessment of effects in the absence of mitigation measures: In the absence of mitigation measures the effect could potentially have been greater than the residual effect described in Section 8.7.1.7. However, there is no knowledge of significant contamination events at the Development Site, and if there was a spill it would likely have been localised and absorbed by the environment at a local scale. The effect could potentially have been a negative, indirect, significant, long-term, unlikely effect on surface water quality. The greatest effects could potentially have occurred on the Mortarstown Stream with the significant of effects decreasing progressively downstream.

8.5.2.1.8 Effects on Group Water Schemes

The Ballinabranna GWS source supply is located ~2.4km to the east/southeast of the Development Site. The Development Site is not located within the delineated Source Protection Area associated with this GWS. The Source Protection Area is situated ~600m to the south.

Given the nature of the local hydrogeological regime, the low permeability of the underlying aquifer and the separation distance between the Development Site and the Ballinabranna GWS there was limited potential for effects. Due to the low permeability of the bedrock aquifer, groundwater flowpaths are short and groundwater at the Development Site discharges to surface waters prior to reaching the delineated Source Protection Area.

Receptor: Ballinabranna GWS.

Pathway: Groundwater flowpaths.

Assessment of effects in the absence of mitigation measures: In the absence of mitigation measures the effect could potentially have been similar to the residual effect described in Section 8.7.1.8 *i.e.* no residual effect. The Development Site is not located within the delineated Source Protection Area and all groundwater discharges to local surface water features. Therefore, there was no pathway between the Development Site and the Ballinabranna GWS.

8.5.2.1.9 Effects on Local Private Groundwater Well Supplies

The GSI map several private groundwater wells supplies in the local area. In addition, to the GSI mapped wells, the assessment presented in this chapter is conservative and assumes that all dwellings in the local area are served by a private groundwater supply.

The closest dwellings to the Development Site are located are along local roads: ~184m to the northeast of the existing quarry void, ~250m to the southeast, ~400m to the southwest and ~320m to the northwest of the quarry area.

However, there was no potential for significant effects on local private groundwater well supplies due to the hydrogeological and topographic settings of the Development Site. The Development Site is underlain by rocks of low permeability which rejects the majority of potential groundwater recharge. Water that does recharge to ground flows for short distances (300m maximum) and discharges to nearby watercourses and as springs in the Barrow valley. Therefore, there was limited potential for qualitative effects on local private groundwater well supplies.

As described in Section 8.5.2.1.5, there was no potential for effects on local groundwater levels due to the topographic and hydrogeological setting of the Development Site. Therefore, there was no potential for the Development to effect the quantitative status of local private groundwater well supplies (i.e. well yield).

It is understood that there have been no issues associated with local wells reported during the Extraction Phase which can be attributed to the quarrying activities.

Receptor: Local groundwater well supplies.

Pathway: Groundwater flowpaths.

Assessment of effects in the absence of mitigation measures: In the absence of mitigation measures, the residual effect could potentially have been greater than the residual effect described in Section 8.7.1.9. However, there is no knowledge of significant contamination events at the Development Site, and given the nature of the local hydrogeological regime, no significant effects would have occurred. The effect in the absence of mitigation measures could potentially have been a negative, indirect, slight, long-term and unlikely effect on local private groundwater well supplies.

8.5.2.1.10 Effects on Downstream Designated Sites

The River Barrow and River Nore SAC is located ~1.8km to the east of the Development Site. The SAC is hydrologically connected to the Development Site via the surface water discharge which connects to the Mortarstown Stream. The lower reaches of this stream form part of the SAC. Other designated sites located downstream and hydrologically connected to the Development Site in the River Barrow Catchment include the Cloghristick Wood pNHA. Any potential deterioration in local surface water quality could have impacted these downstream designated sites. However, any potential for effects would have been very limited given the volume of water within the River Barrow.

All other downstream designated sites in the River Barrow Catchment had been screened out of the residual impact assessment due to their distant location from the Development Site.

Pathway: Surface water flowpaths.

Receptors: River Barrow and River Nore SAC and Cloghristick pNHA.

Assessment of effects in the absence of mitigation measures: Even in the absence of mitigation measures, there would not have been significant effects on downstream designated sites due to the large volumes of water within the River Barrow. The effect in the absence of mitigation measures could potentially have been similar to the residual effect described in Section 8.7.1.10 *i.e.* no effect on the River Barrow and River Nore SAC and Cloghristick pNHA.

8.5.2.1.11 Effects on WFD Status

Potential effects on groundwater and surface water quality and quantity as a result of the Development could potentially have impacted the WFD status of the underlying GWB and downstream SWBs. However, the status of the GWBs and SWBs in the vicinity and downstream of the Development Site are described in Section 8.3.3.5.1 and Section 8.3.4.9 respectively, the Barrow_170 and the Shanragh GWB did not experience any deterioration in WFD status across any of the 3 no. WFD cycles to date.

In terms of GWBs, there was limited potential for effects on the WFD status of this GWB due to the scale of the Development in comparison to the scale of the GWB. The main potential for effects was on the WFD status of the Barrow_170 SWB. This SWB includes the Mortarstown Stream which received the quarry discharges. However, significant volumes of water exist within the River Barrow and limit the potential for effects on the status of this entire SWB.

A full WFD Compliance Assessment is included as **Appendix 8-4**.

Pathways: Surface water and groundwater flowpaths.

Receptors: The WFD status of the Shanragh GWB and downstream SWBs (via lateral groundwater flow and discharge to surface waters).

Assessment of effects in the absence of mitigation measures: Even in the absence of mitigation measures there would have been very limited potential for the Development to alter the WFD status of the Barrow_170 SWB given the large volumes of water within associated with this SWB. Note that the Development does not in any way rely upon the dilution or assimilative capacity provided by any downstream watercourse. The mitigation measures detailed in Section 8.6 ensured the protection of all downstream watercourses. Similarly, there would have been no potential for effects on the WFD status of the underlying Shanragh GWB due to the scale of the Development with respect to the overall size of the underlying Shanragh GWB (148km^2). The effect in the absence of mitigation measures could potentially have been the same as the residual effect described in Section 8.7.1.11 *i.e.* no residual effect.

8.5.2.2 Current Phase (2023 to Present)

8.5.2.2.1 Effects on Downstream Surface Water Flow Volumes

There has been no change to the hydrological regime since the Applicant took ownership of the Development Site in 2023.

As described above for the Extraction Phase, the Development Site discharges to the Mortarstown Stream. Discharge volumes during this phase will have been comparable to those during the Extraction Phase. Any effects on downstream surface watercourses were limited given the relatively small discharge volumes and the significant attenuation provided on the floor of the quarry and in the settlement ponds.

Pathways: Site drainage and surface water discharge.

Receptors: Surface water flow volumes in downstream watercourses (Mortarstown Stream, Fushoge River, the River Barrow).

Assessment of effects in the absence of mitigation measures: In the absence of mitigation measures, and attenuation of water on the floor of the quarry and in the settlement pond, the effect could potentially have been a negative, moderate, direct, long-term effect on surface water flow volumes in the Mortarstown Stream. There would have been no potential for effects on the Fushoge River or the River Barrow due to the large volumes of water within these river waterbodies in comparison to any potential discharge from the Development Site.

8.5.2.2.2 Contamination of Groundwater by Leakages and Spills

During the Current Phase, there was very limited activity at the Development Site apart from routine environmental monitoring and site inspections. The risks are the same as those described in Section 8.5.2.1.6 but of a much lesser extent due to the lower number of vehicles and workers attending the site.

Pathway: Infiltration and short groundwater flowpaths.

Receptor: Local groundwater quality.

Assessment of effects in the absence of mitigation measures: Even in the absence of mitigation measures there would have been no potential for significant effects on local groundwater quality due to the nature of the Current Phase and the hydrogeological characteristics of the Development Site (Poor Bedrock Aquifer of low permeability and short groundwater flowpaths). The residual effect could potentially have been the same as that described in Section 8.7.2.1.2 i.e. a negative, imperceptible, long-term, indirect, unlikely effect on groundwater quality.

8.5.2.2.3 Contamination of Surface Water by Leakages and Spills

During the Current Phase, there was very limited activity at the Development Site associated with environmental monitoring and site inspections. The risks are the same as those described in Section 8.5.2.1.7 but of a much lesser extent due to the lower number of vehicles and workers attending the site. During the Current Phase there was no potential for effects on the Raheendoran Stream.

Pathway: Surface water runoff, short groundwater flowpaths and surface water discharge from the quarry.

Receptor: Downstream surface water quality (Mortarstown Stream, Fushoge River and River Barrow).

Assessment of effects in the absence of mitigation measures: In the absence of mitigation measures there would have been no potential for significant effects due to the nature of the Current Phase and the lack of works being completed at the site. The residual effect could potentially have been the same as that described in Section 8.7.2.1.3 *i.e.* a negative, imperceptible, long-term, indirect, unlikely effect on downstream surface water quality.

8.5.2.2.4 Effects on Local Private Groundwater Well Supplies

No effects on local private groundwater well supplies will have occurred during this phase. Drainage remained unchanged from the Extraction Phase and there was no deepening of the quarry void, therefore there was no potential for quantitative effects on local well supplies. Furthermore, given the very limited nature of works being completed at the site, there was no risk of qualitative effects on local groundwater well supplies.

Receptor: Local groundwater well supplies.

Pathway: Groundwater flowpaths.

Assessment of effects in the absence of mitigation measures: Even in the scenario where no control measures were being implemented there would not have been a significant effect on local private groundwater well supplies due to the nature of the Current Phase and the local hydrogeological regime. The effect could potentially have been similar to the residual effect described in Section 8.7.2.1.4 *i.e.* no residual effect.

8.5.2.2.5 Effects on Downstream Designated Sites

During the Current Phase the site remains hydrologically connected to the River Barrow and River Nore SAC. This risks to the receiving waters (in terms of water quantity and water quality) are the same as those detailed in Section 8.5.2.1.10 but of a much lesser extent due to the significantly lower intensity of works. Less activity on-site has decreased the likelihood of pollution incidents. The risk is much reduced in comparison to the Extraction Phase.

Pathway: Surface water flowpaths.

Receptors: River Barrow and River Nore SAC and Cloghristick pNHA.

Assessment of effects in the absence of mitigation measures: Even in the absence of mitigation measures, there would not have been significant effects on downstream designated sites due to the large volumes of water within the River Barrow and due to the limited activity on-site. The effect in the absence of mitigation measures could potentially have been similar to the residual effect described in Section 8.7.2.1.5 *i.e.* no effect on the River Barrow and River Nore SAC and Cloghristick pNHA.

8.5.2.2.6 Effects on WFD Status

With the cessation of quarrying activities there was significantly less potential for the entrainment of suspended solids in surface water runoff. Similarly, machinery and plant have been removed, reducing the potential for accidental spills and leaks of hydrocarbons.

Therefore, there was little potential for the Current Phase to effect the WFD status of the receiving waterbodies.

Pathways: Surface water and groundwater flowpaths.

Receptors: The WFD status of the Shanragh GWB and downstream SWBs (via lateral groundwater flow and discharge to surface waters).

Assessment of effects in the absence of mitigation measures: Due to the reduced activity at the site, combined with the large volume of water within the Barrow_170 SWB and the large scale of the underlying Shanragh GWB, the effect in the absence of mitigation measures could potentially have been the same as the residual effect described in Section 8.7.2.1.6 *i.e.* no effect.

8.6 Avoidance, Remedial & Mitigation Measures

8.6.1 Extraction Phase (1995 Baseline-2023)

8.6.1.1 Effects on Local Groundwater Vulnerability Rating

The removal of overburden from the extraction area resulted in a slight increase in the groundwater vulnerability rating.

The main mitigation with respect to groundwater quality which was employed during the extraction phase was the employment of best practice mitigation measures with respect to oil usage and refuelling of plant and machinery. These mitigation measures are described in full in Section 8.6.1.6 below.

All operations on-site were completed in accordance with a comprehensive Environmental Management Plan (EMP) which was updated as a working document and oversaw all activities at the site.

8.6.1.2 Effects Due to Alteration of Drainage Patterns

The unintended rerouting of the upper reaches of the Raheendoran Stream as a result of the previous extraction activities and the redirection of this water towards the Mortarstown Stream had a profound negative effect. The hydromorphology of the Raheendoran Stream within the extraction area has been erased and the drainage patterns within the extraction area were altered as a result of the Development. No specific mitigation measures were implemented with respect to preserving the Raheendoran Stream within the site. Note that the proposed restoration plan includes measures to redirect water back into the Raheendoran Stream (refer to Section 8.7.3).

8.6.1.3 Potential Effects on Downstream Surface Water Flow Volumes

The Development included the provision of a water management system. There was no discharge of untreated or unattenuated waters from the extraction area.

The water management system at the site comprises of the following:

- Water entering the quarry void largely comprises largely of rainfall or runoff from the lands immediately upgradient of the quarry. There is no significant inflow of groundwater which reduces the volume of water to be attenuated and subsequently discharged;
- Due to the low permeability of the underlying bedrock aquifer, this water gathers on the floor of the quarry;
- There are 2 main flooded areas (one in the north and one in the south) on the quarry floor which provide significant attenuation of water; and,
- A suitably sized settlement pond was also constructed downgradient of the quarry and provides additional attenuation of water from the southern section of the quarry.

The constructed settlement pond and the large, flooded areas on the quarry floor served to attenuate and restrict runoff rates from the site. Based on the flow monitoring described in Section 8.3.3.2, discharge volumes form the quarry are likely to have been small and comparable to greenfield runoff rates.

8.6.1.4 Effects from the Entrainment of Suspended Solids in Surface Waters

The discharge licence granted by Carlow County Council in November 2011 (DL/S4/2011/2) with the purpose of licensing discharges to waters. Previously the quarry had 18 no. conditions imposed in 2007 by Carlow Co. Co. which sought assurance in relation to prohibiting surface water runoff to discharge to the public road, prohibiting wastewater discharge, restricting the construction of ancillary buildings, requiring unsoiled surface water run-off collection and disposal. The operation of the quarry in accordance with these conditions would have been effective in addressing any potential negative effects on downstream water quality from the entrainment of suspended solids. Whilst no annual environmental reports are available, EPA Q-ratings on the watercourses downstream of the Development Site do not indicate any deterioration in water quality over this time period in the Fushoge River, indicating that the Development Site was largely compliance with the conditions and that all water was being attenuated and treated prior to discharge.

The Development utilised a water management system designed to prevent contamination of local surface waters with elevated concentrations of suspended solids. All water within the quarry void was directed to flooded areas on the quarry floor or suitably sized settlement ponds in the floor of the quarry (and downgradient of the quarry) which allowed for the settlement of suspended solids prior to discharge.

Management of Drainage from Spoil Storage Areas: Excavated soil/subsoil material was used for landscaping throughout the Development Site and in the construction of boundary berms. Berms were sealed with a digger bucket and vegetated as soon possible to reduce sediment entrainment in drainage water. Once re-vegetated and stabilised berms were no longer be a potential source of silt laden drainage water.

The topsoil/overburden was removed incrementally as the quarry expanded. This limited the potential for effects as only small volumes of material were disturbed at any one time.

Timing of Site Preparation Works: The removal of soil/subsoil form the other extraction area was carried out during periods of low rainfall. This minimised the risk of entrainment of suspended sediment in drainage water.

No other mitigation measures were required.

8.6.1.5 Effects on Local Groundwater Levels

The extraction only extended to a depth of 304mOD, thereby significantly limiting the potential for effects on groundwater levels.

The Development did not include any active dewatering.

Site investigations and groundwater level monitoring at the site have revealed that the rock underlying the Development Site is of low permeability. No significant groundwater inflows are occurring into the existing quarry void.

The Development had no potential to significantly impact local groundwater levels.

Furthermore, there was no significant alteration of local groundwater recharge or surface water runoff rates as a result of the Development.

No specific mitigation measures were required.

8.6.1.6 Contamination of Groundwater by Leakages and Spills

Whilst there is no record of the mitigation measures implemented at the site with respect to hydrocarbons there is no evidence of pollution or spillages at the site. Furthermore the downstream Q-ratings do not record any deterioration in water quality. Based on the above, the highest standards of site management were likely maintained and utmost care and vigilance followed to prevent accidental contamination or unnecessary disturbance to the site during the operation of the quarry. These measures would have been tried and tested, best practice measures and would have been the same as those which are implemented at quarries across the country. No additional mitigation measures with respect to hydrocarbons would have been required.

The Section 261 Registration Notification from 2007 included a condition which restricted the construction of ancillary buildings. There is no evidence of wastewater disposal from the site and all wastewater was likely removed from the site by a licenced contractor.

8.6.1.7 Contamination of Surface Water by Leakages and Spills

The mitigation measures were the same as those described in Section 8.6.1.6.

8.6.1.8 Effects on Group Water Schemes

There was no effects on the Ballinabranna GWS for the following reasons:

- The separation distance (~2.4km) between the Development Site and the boreholes which supply the Ballinabranna GWS;
- No area of the Development Site is located within the delineated Source Protection Area associated with this GWS. The Source Protection Area is located ~600m to the south;
- The low permeability of the bedrock underlying the Development Site means that the majority of potential groundwater recharge is rejected;
- Groundwater flowpaths are short with groundwater discharging into nearby surface watercourses;
- Therefore, there was no potential for groundwater at the Development Site to reach the Ballinabranna GWS boreholes;
- Furthermore, there was no significant inflow of groundwater into the quarry void and the Development has very limited potential to alter groundwater recharge rates;
- Compliance with the conditions issued by Carlow Co. Co. in 2007 and the discharge Licence conditions would have been effective in addressing any potential negative effects on local water quality; and,
- These mitigation measures were used at similar bedrock quarries across the county and are proven to protect the hydrogeological environment.

8.6.1.9 Effects on Local Private Groundwater Well Supplies

There were no effects on the local private groundwater well supplies for the following reasons:

- The separation distance between the extraction area and local private groundwater well supplies;
- The low permeability of the bedrock underlying the Development Site means that the majority of potential groundwater recharge is rejected;
- No conduits for groundwater flow were present at the Development Site that could act as a pathway for potential contaminants;

- Groundwater flowpaths are short with groundwater discharging into nearby surface watercourses;
- There was no significant inflows of groundwater into the quarry void and the Development had very limited potential to alter groundwater recharge rates;
- Therefore, there was no potential for the Development to impact groundwater levels or groundwater quantity in local well supplies;
- Compliance with the conditions issued by Carlow Co. Co. in 2007 and the discharge licence conditions would have been effective in addressing any potential negative effects on local water quality;
- It is understood that there was no significant contamination events at the Development Site; and,
- These mitigation measures are used at similar bedrock quarries across the county and are proven to protect the hydrogeological environment.

8.6.1.10 Potential Effects on Downstream Designated Sites

There was no potential for effects on the River Barrow and River Nore SAC or Cloghristick Wood pNHA for the following reasons:

- Whilst the Development is hydrologically connected to the River Barrow and these designated sites, the Development is in excess of 2km from the Barrow;
- The length of the hydrological flowpath between the Development Site and the SAC is >2.5km whilst the flowpath to the pNHA is ~6km;
- There was limited potential for effects due to the volume of water within the River Barrow in comparison to the small discharge volumes;
- However, the Development does not rely on the dilution or assimilative capacity of any downstream watercourse;
- The Development utilised a water management system designed to prevent contamination of local surface waters with hydrocarbons or suspended solids;
- Compliance with the conditions issued by Carlow Co. Co. in 2007 and the discharge licence would have been effective in addressing any potential negative effects on local water quality; and,
- By ensuring the protection of watercourses proximal to the site, the status of all downstream designated sites was also protected.

8.6.1.11 Potential Effects on WFD Status

Strict mitigation measures in relation to the protection of surface waters and groundwaters have been described in the preceding sections. The implementation of these mitigation measures ensured the quantitative and qualitative status of the receiving SWBs and the underlying GWB were not altered.

8.6.2 There was no change in the WFD status of the underlying Shanragh GWB or downstream SWBs (Barrow_170 SWB) resulting from the Development. As such, the Development was compliant with the requirements of the Water Framework Directive (2000/60/EC).**Current Phase (2023 to Present)**

8.6.2.1.1 Effects on Downstream Surface Water Flow Volumes

The water management system described in Section 8.6.1.3 continued to operate during the Current Phase. Surface water from the quarry was attenuated on the floor of the quarry and in the suitably sized settlement ponds. There was no discharge of untreated or unattenuated water.

8.6.2.1.2 Contamination of Groundwater by Leakages and Spills

During the Current Phase, there was very limited activity at the Development Site. No refuelling occurred on site and all plant and machinery associated with the quarrying were removed from the site. No specific mitigation measures were required with respect to hydrocarbons.

8.6.2.1.3 Contamination of Surface Water by Leakages and Spills

Due to the limited activity on-site, no specific mitigation measures were required with respect to hydrocarbons.

8.6.2.1.4 Effects on Local Private Groundwater Well Supplies

No specific mitigation measures required due to the limited activity on-site and the local hydrogeological regime which is characterized by a bedrock of low permeability.

8.6.2.1.5 Effects on Downstream Designated Sites

There was no discharge of untreated or unattenuated waters during the Current Phase. All water within the quarry void is attenuated in the flooded areas on the floor of the quarry or in the suitably sized settlement ponds. These features also allow for the settlement of suspended solids from solution, therefore, protecting downstream surface water quality. No additional mitigation measures were required.

8.6.2.1.6 Effects on WFD Status

The mitigation measures in relation to the protection of surface waters and groundwaters have been described in the preceding sections. The implementation of these mitigation measures ensured the quantitative and qualitative status of the receiving SWBs and the underlying GWB were not altered.

There was no change in the WFD status of the underlying Shanragh GWB or downstream SWBs (Barrow_170 SWB) resulting from the Development. As such, the Development was compliant with the requirements of the Water Framework Directive (2000/60/EC).

8.7 Residual Effects

8.7.1 Extraction Phase (1995 Baseline-2023)

8.7.1.1 Effects on Local Groundwater Vulnerability Rating

Residual Effects: The Development did not result in a significant increase in the groundwater vulnerability rating of the local area due to the presence of this soils/subsoils which overlay the extraction area. The residual effect was a negative, irreversible, slight, direct, permanent, likely effect on the local groundwater vulnerability.

Significance of Effects: For the reasons outlined above and with implementation of the mitigation measures, there was no significant effects on the local groundwater vulnerability rating.

8.7.1.2 Effects Due to Alteration of Drainage Patterns

Residual Effects: The Development erased the former channel of the Raheendoran Stream which used to flow across the extraction area prior to any development. The Development has therefore had a negative, direct, profound, permanent, effect on the hydromorphology of the Raheendoran Stream within the site. The Development redirected flow towards the Mortarstown Stream. This increase in flow volumes would have been small due to the attenuation of water within the quarry, therefore the residual effect on the hydromorphology of the Mortarstown Stream (due to increased flows possibly causing erosion) was a negative, indirect, imperceptible, permanent effect.

Significance of Effects: For the reasons outlined above, a local profound effect occurred on the hydromorphology of the Raheendoran Stream within the extraction area. No significant effect occurred on the morphology of the Mortarstown Stream.

8.7.1.3 Effects on Downstream Surface Water Flow Volumes

Residual Effect: All drainage and runoff water were managed and attenuated prior to release. Due to the topographical setting and hydrogeological characteristics of the Development Site the discharge volumes were small. The residual effect was a negative, direct, imperceptible, long-term, likely effect on downstream surface water flow volumes in the Mortarstown Stream. The Development also resulted in lower flow volumes in the Raheendoran Stream (any change is likely to have been relatively small due to the low flow volumes which were present in the headwaters of the Raheendoran Stream). The residual effect was a negative, direct, moderate, long-term, effect on flow volumes in the Raheendoran Stream.

Significance of Effects: For the reasons outlined above and with the implementation of the listed mitigation measures, there were no significant effects on downstream surface water flow volumes.

8.7.1.4 Effects from the Entrainment of Suspended Solids in Surface Waters

Residual Effect: All drainage and runoff water were managed, attenuated and treated prior to discharge to a drain which is hydrologically connected to the Mortarstown Stream. The residual effect was a negative, indirect, imperceptible, long-term, unlikely effect on downstream surface water quality in the Mortarstown Stream. The residual effect on surface water quality within the Raheendoran Stream was a negative, indirect, moderate, short-term, likely effect on downstream surface water quality in the Raheendoran Stream.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation measures, there were no significant effects on downstream surface water quality.

8.7.1.5 Effects on Local Groundwater Levels

Post-Mitigation Residual Effect: No residual effects on local groundwater levels occurred due to the topographical setting (>300mOD) and hydrogeological characteristics (low permeability of the underlying bedrock aquifer, short groundwater flowpaths and no significant ingress of groundwater into the quarry void) of the Development Site.

Significance of Effects: For the reasons outlined above, there were significant effects on local groundwater levels.

8.7.1.6 Contamination of Groundwater by Leakages and Spills

Residual Effects: The use and storage of hydrocarbons and small volumes of chemicals is a standard risk associated with all quarry sites. It is understood that no significant contamination events have occurred at the Development Site likely as a result of the implementation of proven and effective measures to mitigate the risk of spills and leaks during the Extraction Phase. These same measures have proven effective at numerous other quarry sites. The residual effect was a negative, indirect, imperceptible, long-term, likely effect on groundwater quality.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation measures, there were no significant effects on groundwater quality.

8.7.1.7 Contamination of Surface Water by Leakages and Spills

Residual Effects: It is understood that no significant contamination events have occurred at the Development Site, likely as a result of the implementation of proven and effective measures to mitigate the risk of spills and leaks during the Extraction Phase. The residual effects are considered to be a negative, indirect, imperceptible, long term, unlikely effect on downstream surface water quality.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation measures, there were no significant effects on downstream surface water quality.

8.7.1.8 Effects on Group Water Supplies

Residual Effects: Based on the separation distance and the location of the Development Site outside of the delineated Source Protection Area to the Ballinabranna GWS, combined with the measures for the protection of groundwater quality, there was no residual effect on the Ballinabranna GWS.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigations measures, there was no significant effects on the Ballinabranna GWS.

8.7.1.9 Effects on Local Private Groundwater Well Supplies

Residual Effects: Based on the topographical setting of the Development Site, the local hydrogeological regime (bedrock of low permeability with shot groundwater flowpaths) along with the implementation of the listed mitigation measures for the protection of groundwater quality, the residual effect was an indirect, negative, imperceptible, short-term, unlikely effect on local private groundwater well supplies.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigations measures, there were no significant effects on local private groundwater well supplies.

8.7.1.10 Effects on Downstream Designated Sites

Residual Effects: Due to the separation distances and with the implementation of the listed mitigation measures for the protection for downstream surface water quality, there was no residual effect on downstream designated sites.

Significance of Effects: For the reasons outlined above, there were no significant effects on downstream designated sites.

8.7.1.11 Effects on WFD Status

Residual Effects: With the implementation of the listed mitigation measures for the protection of surface and groundwater quality we consider that there was no residual effect on the WFD status of the underlying GWB or downstream SWBs. It is noted that the status of the Shanragh GWB and the Barrow_170 SWB remained unchanged across all 3 no. WFD cycles.

8.7.2 **Significance of the Effect:** For the reasons outlined above, there were no significant effects on the WFD status of the underlying GWB or downstream SWBs.**Current Phase (2023 to Present)**

8.7.2.1.1 Effects on Downstream Surface Water Flow Volumes

Residual Effects: All drainage and runoff water were managed and attenuated prior to release during the Current Phase. The residual effect was a negative, direct, imperceptible, long-term, likely effect on downstream surface water flow volumes in the Mortarstown Stream.

Significance of Effects: For the reasons outlined above and with the implementation of the listed mitigation measures, there were no significant effects on downstream surface water flow volumes.

8.7.2.1.2 Contamination of Groundwater by Leakages and Spills

Residual Effects: During the Current Phase, there was very limited activity at the Development Site associated with routine environmental monitoring. It is understood that no significant contamination events have occurred at the Development Site. The residual effect was a negative, indirect, imperceptible, long-term, likely effect on groundwater quality.

Significance of Effects: For the reasons outlined above, there were no significant effects on groundwater quality.

8.7.2.1.3 Contamination of Surface Water by Leakages and Spills

Residual Effects: During the Current Phase, there was very limited activity at the Development Site associated with routine environmental monitoring. The residual effects are considered to be a negative, indirect, imperceptible, long-term, unlikely effect on downstream surface water quality.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation measures, there were no significant effects on downstream surface water quality.

8.7.2.1.4 Effects on Local Private Groundwater Well Supplies

Residual Effects: Due to the limited activity at the site and the lack of any reported contamination event, there was no residual effect on local private groundwater well supplies.

Significance of Effects: For the reasons outlined above, there were no significant effects on local private groundwater well supplies.

8.7.2.1.5 Effects on Downstream Designated Sites

Residual Effects: Due to the separation distances and the lack of activity at the Site during the Current Phase, there was no residual effect on downstream designated sites.

Significance of Effects: For the reasons outlined above, there were no significant effects on downstream designated sites.

8.7.2.1.6 Effects on WFD Status

Residual Effects: Due to the limited activity at the site and the lack of any reported contamination event, there was no residual effect on the WFD status of local waterbodies.

Significance of the Effect: For the reasons outlined above, there were no significant effects on the WFD status of the underlying GWB or downstream SWBs.

8.7.3 Restoration Phase

The potential impacts associated with the restoration phase are similar to those outlined during the operational phase. The mitigation measures outlined for the operational phase in order to protect against contamination of soils and bedrock will be implemented throughout the restoration phase.

With the implementation of the mitigation measures no negative impacts on the hydrological and hydrogeological environments are expected during the restoration or post restoration phase. The restoration will have a positive effect in terms of returning the site back to scrubland, the inclusion of a wildlife pond and redirecting water back into the Raheendoran Stream. Water will be redirected back into the stream through a diversion channel from the existing settlement pond to the stream, upstream of the proposed wildlife pond. The settlement pond and wildlife pond will provide attenuation of water during this phase.

8.8 Risk of Major Accidents and Disasters

Flooding can result in downstream Major Accidents and Disasters (MADs). However, there has bene no risk of flooding downstream of the Development Site as a result of the Development due to the attenuation provided by the on-site water management system and the small volumes of water being discharges.

8.9 Assessment of Human Health Effects

Potential health effects arise mainly through the potential for surface and groundwater contamination from the accidental spillage of hydrocarbons or wastewater.

In relation to oils and fuels, best practice controls were in place to ensure any potential sources of contamination on the site were managed appropriately and the volumes present were small in the context of the scale of the project. Furthermore, the wastewater treatment systems at the Development Site was used and there was no discharge of wastewater at the site.

With the implementation of the prescribed mitigation measures, the potential residual effects associated with groundwater contamination and subsequent health effects are negligible.

8.10 Potential Cumulative Effects

Other land use activities in the surrounding area comprise mainly of agricultural land and coniferous forestry plantations. Several other quarries are also located in the local area.

Due to the local hydrogeological regime, the greatest potential for cumulative or in-combination effects with other developments or land use practices will be in terms of surface water quantity and surface water quality. However, other quarries in the local area operated under strict conditions set out in their respective Environmental Management Plans and IPC Licences designed for the protection of surface water quality and quantity. Furthermore, water management systems were present at the Development Site which ensured that there was no discharge of untreated or unattenuated waters. Due to the lack of any significant residual impacts from the Development, apart from the alteration of the hydromorphology of the Raheendoran Stream within the footprint of the extraction area, there were no significant cumulative impacts to downstream surface watercourses.

Similarly, in terms of groundwater, the Development had no significant impact on groundwater quantity (groundwater levels) or groundwater quality due to the nature of the local hydrogeological regime with short groundwater flowpaths and bedrock of low permeability.

Therefore, no significant hydrological and/or hydrogeological cumulative effects occurred.

8.11 Monitoring

8.11.1 Extraction Phase (2005-2014)

A discharge licence was granted by Carlow County Council in November 2011 (DL/S4/2011/2). This discharge licence set out several conditions in relation to emissions to water. Monitoring would have been completed in accordance with the conditions of the discharge licence. However, consultation with Carlow County Council has revealed that there are no Annual Environmental Reports on file.

8.12 Interactions

None.

8.13 References

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PPG1 - General Guide to Prevention of Pollution (UK Guidance Note).

PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note).