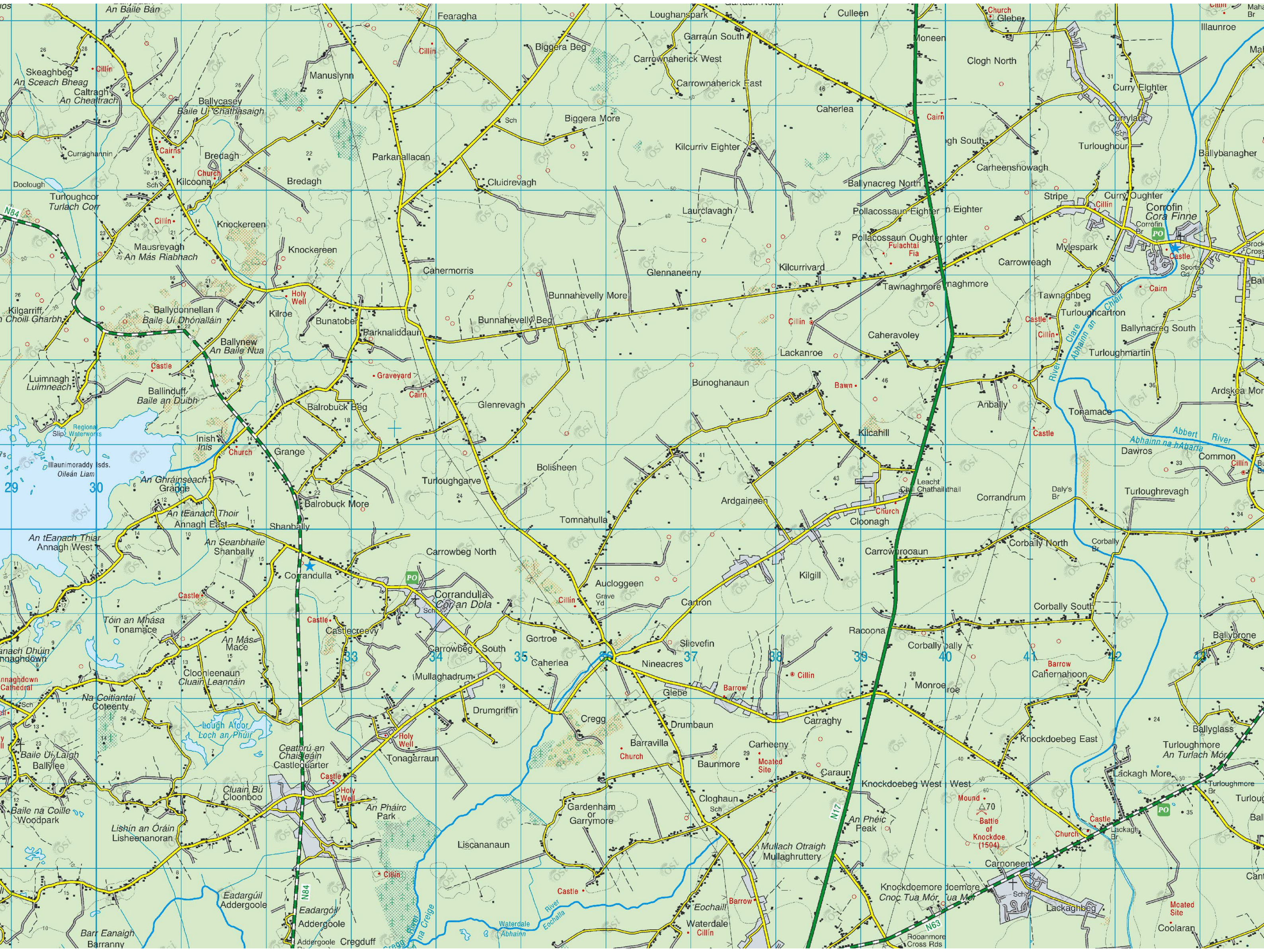
CHAPTER 8

WATER



QUARRY CONSULTING

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Appendices

8.0 WATER

8.1 Introduction

This 'Water' chapter of the Environmental Impact Assessment Report (EIAR) has been prepared for a proposed lateral extension of an existing, permitted, operational, limestone quarry at Ardgaineen townland, Claregalway, Co. Galway. The purpose of this chapter of the EIAR is to present the baseline hydrological and hydrogeological environment and to then complete the Impact Assessment as governed by EIA Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (EIA Directive). Specifically, this chapter uses baseline studies of the site and the receiving environment to apply Environmental Protection Agency (EPA) (2022) Guidelines on the information to be contained in Environmental Impact Assessment reports. An EPA (2022) focussed Impact Assessment assesses potential impacts, assigns mitigation measures and then reassess potential resultant residual impacts. Potential cumulative impacts are also addressed. Site investigations involving methods that are non-intrusive (Geophysics) and intrusive (Drilling) have been completed over a number of years to inform the characterisation of bedrock and how water moves through and from the site. The measurement of flows, water sampling and laboratory analyses complement the Site Investigations.

The existing quarry manages its waters arising at the site in compliance with a Galway County Council issued Section 4 Discharge Licence (W/502/22), which was issued in June 2023. The Conditions of the Licence are therefore current in the context of the obligations of the current Groundwater Regulations and Surface Water Regulations. The fact that the Discharge Licence was issued in 2023 means that the management of water at the quarry has been proven to be compliant with the Objectives of the Regulations enacting the Water Framework Directive (WFD). Management of waters at the site is by a Nature Based Solution that comprises infiltration across a vegetated wetland area and percolation of treated waters to groundwater. A Condition of the Licence is that Quarterly Monitoring Reports are submitted to Galway County Council: Nine Quarterly Monitoring Reports have been submitted and a copy of each report is presented with the Discharge Licence, and its supporting documents, in Appendix 8.1 of this EIAR.

8.1.1 Assessor's Expertise

The evaluation of the hydrological and hydrogeological environment and the assessment of impacts was completed by **Dr. Pamela Bartley (Principal of Hydro-G)** who is considered a karst groundwater specialist with quarry, Section 4 Discharge Licencing and Public Water Supply expertise. Hydro-G holds the required Professional Indemnity Insurance, Employers and Public Liability Insurance. Pamela is a member of Engineers Ireland and the International Association of Hydrogeologists (Irish Group).

Pamela is a water focussed civil engineer with over 25 years practical experience in field-based groundwater investigations, drilling, instrumentation, surface water sampling, flow gauging and impact assessments, public water supply from groundwater boreholes, quarry assessments, Section 4 Discharge Licensing and wastewater treatment using Nature Based Systems. Pamela completed her primary training in the RTC system in 1990. She completed a Certificate in Civil Engineering in Letterkenny RTC and a Diploma in Water and Wastewater Engineering at Sligo RTC. She spent a total of 15 years studying water, the underground environment and the law of the environment in formal academic institutions: RTCs, Queens University of Belfast and Trinity College Dublin. Her Bachelor of Engineering degree was completed in the school of Civil Engineering at Queen's University, Belfast, and her postgraduate education at the School of Civil Engineering at Trinity College, Dublin (TCD). She completed an MSc. in Environmental Engineering at the School of Civil Engineering at TCD, which had geotechnical, hydrology, hydrogeology and legislation specialities and later a hydrogeologically focussed Ph.D at TCD in which Teagasc, the EPA, the GSI and the Departments of Environment and Agriculture were joint Steering Group members. In the past 15 years, Pamela has become a specialist in quarry and discharge evaluations in the context of enacted Irish Regulation and EU Directives, including compliance with the Water Framework Directive. She has evaluated the limestone environment at 21 regionally important quarries in counties spanning from Donegal, through Sligo, Mayo, Galway, Limerick, Kerry, Tipperary, Cork, Kilkenny, Meath, Westmeath and Laois. She has directed and observed the drilling of bedrock boreholes into limestone at 200 locations, at least, in Ireland and evaluated potential for groundwater movement. Pamela's quarry assessments, successful EIARs gaining planning and associated Section 4 Discharge Licences include sites, as follows:

(i) Bennettsbridge Limestone, Co. Kilkenny consent to continue at an existing site following previous refusals at Board level and successful review update of the Section 4 Discharge Licence (ENV/W/78, 2017) permitting a range of 22,000m3/d as the annual average with maximums up to 70,000m3/d throughout the rainfall season. The discharge is to a drain that discharges to the River Nore. The large range is because it is a diffuse karst aquifer and during high rainfall there is a large volume of water on the floor carried through the epikarst of the walls.

(ii) Mc Grath Limestone Works Ltd, Cong, Co. Galway (W391/05_R1, 2019) permitting a discharge of 10,000m3/d to the Cong Canal upstream of Lough Corrib (SAC, SPA, proposed NHA & Public Water Supply for Galway City and environs).

(iii) Churchill Stone Ltd. (Cassidys), Keeloges, Churchill, Letterkenny, Co. Donegal. Section 4 Discharge (Lwat65) permitting discharge to a headwater and upstream of the commencement of mapping for a Pearl Mussel River.

(iv) Harrington Concrete and Quarries, Ardgaineen, Co. Galway (W_502_22) permitting a discharge of 1,483m3/d to a grassed vegetation area, following an oil interceptor, and subsequent discharge to groundwater *via* a Nature Based System in a conduit karst aquifer in a Hydrometric Area of Lough Corrib SAC and SPA.

(v) MC Group Castleisland, Co. Kerry (W214, 2023) permitting a discharge of 540m3/d to surface water.

All but one of the quarries listed above operates in connection to SAC catchments, or close to a NHA Bog (MC Group), and they have successfully managed their discharge, under licence, for many years.

Pamela's Public Water Supply sites of note include borehole drilling and site supervision at Motorway Service Stations, numerous Hotels, Group Water Schemes and Public Water Supply Boreholes. She is an Expert Service Provider (ESP) to Competent Planning Authorities and Uisce Eireann.

8.1.2 EIAR Roadmap

The Road Map for the EIAR was presented in Chapter 2.0 of this EIAR. Chapter 1.0 provided information on the Site location and Context, Chapter 3.0 provided the Description of the Proposed Development and Chapter 16.0 addresses the Interactions and Cumulative Impacts. This Water

Chapter and the Lands, Soils & Geology Chapter were created by the same professional civil engineering hydrogeologist, who has soils, geology, hydrological and groundwater competency.

8.1.3 Project Description

The proposed development being applied for under this current planning application is shown on Figure 2-1 and will consist of:

- Extraction of rock from an area consisting of 4.35 hectares which was previously subject to rock extraction and all associated facilities/works to a final floor level of 4 mOD.
- Lateral extension of the existing permitted quarry area over a greenfield area of c.6.1 ha. area to a final floor level of 4 mOD.
- Restoration of the application area to natural habitat after uses following completion of extraction.
- All related ancillary development and associated site works including processing (crushing, screening and washing) and stockpiling of materials; provision of landscaped screening berms and all other related activities.

The proposed development is within an overall application area of c. 12 hectares and is for a total period of 25 years.

Aggregate extracted from the application area will be processed using mobile crushing and screening plant within the quarry void – refer to Figure 3.1. Processed rock will be stored in the existing permitted quarry area pending use in the ancillary manufacturing plants (asphalt, block, concrete) on site or sale off site.

The majority of the application area is greenfield and lies immediately to the northeast of the existing operating quarry – refer to the introductory Chapters of this EIAR for Site Layout. Part of the application area is within the working zone of the active quarry. Refer to Quarry Consulting's Site Layout presented at the beginning of the EIAR.

Adjacent to the application area proposed for development in this evaluation is a worked limestone quarry, in the ownership of the applicant, in which the limestone has been extracted from natural ground level.

The proposed development area concerns lateral extension into greenfield agricultural lands that form the eastern boundary of the current working floor of the quarry. That proposed greenfield extension area will be deepened to the same elevation as the floor of the operational quarry. It is therefore possible to examine the wall of rock exposed along the greenfield application's boundary with the working floor of the operational quarry.

Natural ground elevation in the greenfield application area, to the east of the working floor, is 40m OD, approximately. The natural elevation of land immediately west of the working quarry is 30m OD, approximately. It is proposed to deepen the greenfield application area to a floor elevation of 4m OD, thereby providing two benches of bedrock for extraction.

The proposed development will involve the stripping and removal of topsoil and overburden. These soils would be placed in storage berms around the perimeter of the proposed quarry extension or used for site restoration purposes in the existing quarry area.

The processing of the extracted rock, into aggregate products, will consist of crushing and screening using fixed and mobile processing plant within the quarry void / application area. Industry standard slope angles, bench heights, and bench widths will be used for extraction operations at the site.

There are approximately 5.5 million tonnes of aggregate stone available for extraction in the proposed lateral quarry extension area.

Surface water will be managed in accordance with the Section 4 discharge licence granted by Galway County Council under reference (W/502/22).

Wastewater will continue to be managed in accordance with the wastewater treatment system previously approved by Galway County Council.

A mobile double skinned fuel bowser will continue to be used to refuel the plant on the quarry floor. During any refuelling of plant on the quarry floor a drip tray is used and a Spill Kit on hand also in case of any accidental spillages. A hydrocarbon interceptor is provided as per the Conditions of the Section 4 discharge licence (W/502/22).

The operational life of the quarry will cease when the material supply has been exhausted. Following this, it is proposed to allow water rebound to its natural level, c. 28m OD, and restore the site to natural habitat uses – refer to EIAR Chapter 3.

8.1.4 Existing Discharge Licence

The application site has a current Section 4 Discharge Licence W/502/22 (granted in 2023) that permits the discharge of 1,483 m3/day from the existing operational quarry floor adjacent to the application area.

The complete reference for the Licence is Comhairle Contae na Gaillimhe (2023) Licence to Discharge Trade or Sewage Effluent to Waters. Reference No. in Register W/502/22. To applicant name Harrington Concrete and Quarries, Cloughvalley, Kilkelly, Co. Mayo. For Harrington Concrete and Quarries premises at Ardgaineen, Claregalway, Co. Galway. Under the Local Government (Water Pollution) Act 1977 & 1990. Signed 7th June 2023. Readers are advised that it is not sewage or effluent but stormwaters and groundwater arisings at a quarry that are licensed in the 'Trade or Sewage Effluent' licence.

The site holds a current Section 4 Discharge Licence (Ref. W/502/22, 7 June 2023) permitting discharge up to 1,483 m^3/day. The licence covers quarry stormwater and groundwater arisings; there is no foul effluent in the licensed flow. Licence ELVs reflect compliance with the Surface Water and Groundwater Regulations and WFD objectives. Nine quarterly compliance reports (2023–2025 to date) are included in Appendix 8.1.

The licenced discharge relates to all waters accumulating in the large attenuation area on the floor, from which water is pumped to a drainage channel that discharges to a wetland area to the west of the site's offices. The discharge is metered and continuously monitored for flow, EC, Turbidity and pH, as per Condition 3 of W/502/22. Refer to Appendix 8.1 for monitoring data.

Ultimately, the discharge is to Groundwater and this is permitted under the Groundwater Regulations (2010, as amended): Regulation 8 of the Groundwater Regulations 2010 allows for direct discharge in Clause 8(a)(ii) “for reinjection of pumped groundwater from mines and quarries or associated with the construction or maintenance of civil engineering works”…. “Subject to a requirement for prior authorisation provided such discharges, and the conditions imposed, do not compromise the achievement of the environmental objectives established for the body of groundwater into which the discharge is made”.

Since the flow meter commenced digital recording, the site discharges an average of 94 m3/day of its maximum permitted 1,483 m3/day Emission Limit Value (ELV) for volume (discharge) specified in the Section 4 Discharge licence W/502/22. The reason the current average is so low is to save on energy (pumping) costs and to provide adequate water on site for necessary uses. The range of discharges recorded is zero to 382 m3/d.

The maximum permitted volumetric ELV of 1,483 m3/d ELV was sanctioned in 2023 by Galway County Council because it was proven to be Groundwater, Surface Water and Birds and Habitats Regulations compliant.

Storm maximum observed values and Climate Change factors are incorporated into the volume ELV of W/502/22.

The current discharge licence’s Conditions have capacity to cater for all future discharge volumes, *i.e.* the proposed lateral extension will not result in an increase in volumes that would require a licence review because those proposed lateral extension lands already send rainfall runoff and interflow to the operational quarry. The floor lagoon is large and has capacity for all storms’ return periods.

The Water Management Systems for the overall landholding are already built, operational, fully functioning and are regulated by the current Section 4 Discharge Licence W/502/22.

The hydrochemical data for the ELVs of the licence relating to quality characteristic demonstrate the functionality of the Water Management Systems.

8.1.5 Consultations

Harrington Concrete and Quarries retained Quarry Consulting, to prepare a planning application for proposed expansion development at their existing quarry at Ardgaineen, Co. Galway. Quarry Consulting managed all pre-planning discussions and scoping as per the provisions of Section 247 of the Planning and Development Acts 2000, as amended. Quarry Consulting issued a project description and preliminary findings to a number of statutory consultees, including the Geological Survey of Ireland (GSI), NPWS and Uisce Eireann.

The Geological Survey of Ireland always request that the national mapping databases are consulted and it is hereby confirmed by Hydro-G that all GSI data bases have been used in this assessment.

Lough Corrib as a Conservation Objective Site and a source of PWS is obviously the most critical receptor. Therefore, the Uisce Éireann response to consultation is a critical component of the assessment. The points raised by Uisce Éireann are reproduced, as follows:

"At present, Uisce Éireann does not have the capacity to advise on the scoping of individual projects. However, in general the following aspects of Water Services should be considered in the scope of an EIA where relevant:

a) Where the development proposal has the potential to impact an Uisce Éireann Drinking Water Source(s), the applicant shall provide details of measures to be taken to ensure that there will be no negative impact to Uisce Éireann's Drinking Water Source(s) during the construction and operational phases of the development. Hydrological / hydrogeological pathways between the applicant's site and receiving waters should be identified as part of the report.

b) Where the development proposes the backfilling of materials, the applicant is required to include a waste sampling strategy to ensure the material is inert.

c) Mitigations should be proposed for any potential negative impacts on any water source(s) which may be in proximity and included in the environmental management plan and incident response.

d) Any and all potential impacts on the nearby reservoir as public water supply water source(s) are assessed, including any impact on hydrogeology and any groundwater/ surface water interactions.

e) Impacts of the development on the capacity of water services (i.e. do existing water services have the capacity to cater for the new development). This is confirmed by Uisce Éireann in the form of a Confirmation of Feasibility (COF). If a development requires a connection to either a public water supply or sewage collection system, the developer is advised to submit a Pre-Connection Enquiry (PCE) enquiry to Uisce Éireann to determine the feasibility of connection to the Uisce Éireann network. All pre-connection enquiry forms are available from https://www.water.ie/connections/connection-steps/

f) The applicant shall identify any upgrading of water services infrastructure that would be required to accommodate the proposed development.

g) In relation to a development that would discharge trade effluent – any upstream treatment or attenuation of discharges required prior to discharging to an Uisce Éireann collection network.

h) In relation to the management of surface water; the potential impact of surface water discharges to combined sewer networks and potential measures to minimise and or / stop surface waters from combined sewers.

i) Any physical impact on Uisce Éireann assets – reservoir, drinking water source, treatment works, pipes, pumping stations, discharges outfalls etc. including any relocation of assets.

j) When considering a development proposal, the applicant is advised to determine the location of public water services assets, possible connection points from the applicant's site / lands to the public network and any drinking water abstraction catchments to ensure these are included and fully assessed in any pre-planning proposals. Details, where known, can be obtained by emailing an Ordnance Survey map identifying the proposed location of the applicant's intended development to datarequests@water.ie *k) Other indicators or methodologies for identifying infrastructure located within the applicant's lands are the presence of registered wayleave agreements, visible manholes, vent stacks, valve chambers, marker posts etc. within the proposed site.*

l) Any potential impacts on the assimilative capacity of receiving waters in relation to Uisce Éireann discharge outfalls including changes in dispersion / circulation characterises. Hydrological / hydrogeological pathways between the applicant's site and receiving waters should be identified within the report.

m) Any potential impact on the contributing catchment of water sources either in terms of water abstraction for the development (and resultant potential impact on the capacity of the source) or the potential of the development to influence / present a risk to the quality of the water abstracted by Uisce Éireann for public supply should be identified within the report.

n) Where a development proposes to connect to an Uisce Éireann network and that network either abstracts water from or discharges wastewater to a "protected"/ sensitive area, consideration as to whether the integrity of the site / conservation objectives of the site would be compromised should be identified within the report.

o) Mitigation measures in relation to any of the above ensuring a zero risk to any Uisce Éireann drinking water sources (Surface and Ground water).

This is not an exhaustive list. Please note: Where connection(s) to the public network is required as part of the development proposal, applicants are advised to complete the Pre-Connection Enquiry process and have received a Confirmation of Feasibility letter from Uisce Éireann ahead of any planning application. Uisce Éireann will not accept new surface water discharges to combined sewer networks.

Hydro-G addresses each of Uisce Eireann's General Scoping Response items specifically in a dedicated Appendix 8.2. In overall summary, the 'Source > Pathway > Model' and EIA Process has been applied, and in combination with the Section 4 Discharge Licence W/502/22 held by the site and received in 2023, a conclusion of no residual risk to Lough Corrib as a source of public water supply is defensible. As previously stated, readers are referred to Appendix 8.1 for a copy of the W/502/22 licence, the Hydro-G (2022) report that supported it and each of the nine Cquarterly Compliance reports submitted to demonstrate no emissions from the site that contravene the Licence Conditions. Again, it is reiterated that the content of Appendix 8.2 presents the detailed response by Hydro-G to each item presented by Uisce Eireann as requiring addressing.

8.1.6 Relevant Information

There have been previous assessments and previous planning applications associated with the site. Hydro-G has taken into consideration historical queries raised by Competent Authorities, local residents and agents. Information of particular note can be summarised, as follows:

- The fact that the site holds a relatively recently issued Section 4 Discharge Licence (W/502/22), issued in June 2023, means that the management of water at the quarry has been proven to be compliant with the Objectives of the Regulations enacting the Water Framework Directive (WFD): As previously stated, Appendix 8.1 of this EIAR contains the Licence and the report that accompanied and supported the application process (Hydro-G, 2022). The groundwater potential impact assimilation report (Hydro-G, 2022) demonstrated compliance with the Groundwater Regulations and the Surface Water Regulations, meaning that the downstream Lough Corrib was assessed by virtue of the fact that when one demonstrates that a proposed discharge will enable Groundwater Threshold Values to be safeguarded, then the ultimate Surface Water systems are also safeguarded. This is how the legislations are founded. A Condition of the Licence is that Quarterly Monitoring Reports are submitted to Galway County Council: Nine Quarterly Monitoring Reports have been submitted and the quarterly demonstration of compliance with the Emission Limit Values specified in the Section 4 Discharge Licence (W/502/22) is the proof that the site does not have potential to damage groundwater or surface water quality.

- With respect to quarrying and potential impact on water quality, consultations with the Environment Section of Galway County Council, previously requested that the use of explosives was assessed in relation to groundwater quality in order to examine potential for impact. This 'Explosive's Residues' assessment is routinely completed by Hydro-G for each quarry and is documented in a data Table presenting a mathematical assessment for hydrochemical impact, with explanatory text after, towards the end of the Impact Section. It is also part of the WFD compliance assessment for chemical status of the groundwater.

- With respect to quantitative status, a numerical 'Groundwater Balance' is also routinely presented for each quarry that Hydro-G assesses. This is documented in a data Table presenting a mathematical assessment for the potential for the volume of water Licensed for management, and discharge at the site, to affect the volume of water available to other users or ecological receptors.
- Previous direction from Galway County Council had requested that Best Practice Hydrogeologically focussed Impact Assessment should be completed. This is routine in all Hydro-G Assessments and is presented as the UK Environment Agency's Impact Assessment methodology presented towards the end of the chapter.

- With respect to Water and Public Water Supply, information relating to scoping responses by Uisce Éireann was presented above. Hydro-G has previously consulted in detail with the Water Section of Galway County Council and the National Federation of Group Water Schemes. Initial project mapping suggested many GWSs within 5km radius of the site. Consultations with Galway County Council's Water Services with respect to the GWS boreholes that have been taken in charge by Galway County Council suggests that there are no GWS abstractions within radius of influence of the subject quarry's operations. Information and maps supplied by the National Federation of Groundwater Schemes in 2018 (Ms. Karen Carney and Mr Joe Gallagher of NFGWS) led to a conclusion that there are no GWS groundwater abstractions within radius of influence of the subject quarry's operations.

- With respect to WFD mapped Status, Risk & general water quality, Hydro-G has downloaded the most up to date water quality indicators for the associated Cregg River downstream of the site (Cregg_010) and the underlying Groundwater Body (Clare Corrib GWB). The data are readily available to all and include the hydrochemistry database from catchments.ie and the Biological Monitoring report (EPA, 2025). The latest data available in August 2025 are the April 2025 Monitoring results for hydrochemistry. In addition, Hydro-G has consulted with the Local Authority Waters officer directly to confirm the sources of the currently reported WFD **Poor Status** and 3rd Cycle **At Risk** mapped for the associated Cregg_010 river: Mr. Francis Deery (LAWATERS) confirmed to Hydro-G (*pers. comm. August 2025)* that the reason for the Poor Status (2025) mapped for the Cregg_010 is because of channelisation and morphological alterations in the vicinity of the EPA Station 'SW Liscananaun' at a distance of 6km from the quarry. Deepening channels and changing morphology are changes made by landowners or state agents managing the river under the Arterial Drainage Act. Hydro-G will present later the actual hydrochemical results from the EPA's published hydrochemical and biological data downstream of the application quarry, which shows that closest to the quarry the quality of the water meets High Status Objectives of the Surface Water Regulations (2009, as amended) & Q4 (2024) Good Status [EPA Monitoring Station 'Bridge near Drumgriffin' @ 3.5km to the south west of the quarry]. However, farther downstream at EPA Monitoring Station 'SW Liscananaun' the Q Rating is Q3 (2023) Poor Status because of the EPA (2024) reported morphological challenges on the river, which create dark and stagnant waters with no flowing riffle zones required for good ecological health. <u>The quarry plays no part in this Poor Status or Risk. All hydrochemical markers generally suggest High Status close to the quarry and its discharge.</u>

- Some Observations made by local homeowners, schools and agents make claims as to poor groundwater quality. However, this is not substantiated by the EPA / WFD mapped Clare Corrib GWB Status of Good and 3rd Cycle Not at Risk. Neither is it substantiated by the results for Water Quality Monitoring at the site, which are presented in the Nine Quarterly Monitoring Reports for the Discharge Licence Compliance (Appendix 8.1) or the EPA dataset for downgradient groundwater quality at Corrandulla Groundwater Monitoring Station [GWIE_WE_G_002012000008] at a distance of 2.7km downstream of the site and its discharge to groundwater: 100% compliance with the Threshold Values of the Groundwater Regulations (2010, as amended) is observed in the last ten years at the EPA's Corrandulla Groundwater Monitoring Station.

- Historical queries of the Planning Authorities for all applications at this site can be summarised, as follows:

    - The fact that the applicant is operating in a mapped **Regionally Important Karstified Aquifer** in a groundwater vulnerability rating of Extreme (Bedrock at Surface) in the Corrib Catchment. It must be noted that most regionally important sources of building and road materials, abstracting limestone for societal use, are operating in Regionally Important Karst Aquifers because Karst Aquifers are almost always Regional Scale and Limestone Quarries are almost always in some type of mapped karst, whether it be Diffuse or Conduit Karst. In addition, the very nature of quarrying is to extract rock for use in roads and housing and commercial building. The extraction of rock is facilitated by removing the overlying soil layer and it is that soil layer that dictates GSI mapped 'Vulnerability'. Just because something is mapped as 'Vulnerable' does not mean that there is a problem. It is 'Pressures', such as proliferation of single domestic residences and poorly maintained domestic wastewater treatment systems or agricultural sources such as slurry spreading, in combination with Vulnerability mapping that creates environmental responses. Hydro-G has always completed these assessments accepting that the work must fully examine whether extending the quarry laterally has potential to impact the groundwater regime by altering flow or introducing pollutants and whether there is potential to, therefore, affect groundwater feeding towards Lough Corrib as a Public Water Supply Source and European Site with its associated habitats and protected flora and fauna.

    - The proposal's interaction with the 'water table' and the potential to adversely affect regional groundwater's quality and quantity and the issue of local water supplies.

Hydro-G takes note that assessment information must evaluate the potential on local wells and groundwater fed habitats. Consultations, by telephone and email, with Galway County Council and the National Federation of Group Water Schemes determined that the area is served by mains supply. Maps supplied by Uisce Eireann (Data Requests) demonstrate the Mains and Foul Sewer networks of the surrounding lands. It is demonstrated that the area is serviced by Uisce Eireann and this is how the quarry supplies itself in water.

- In the assessment of the cumulative effects of plans and projects within the catchment of the proposal, existing (constructed) and extant (non -constructed) permissions must be considered. The assessment shall also include any infrastructural projects within the study area. Hydro-G takes note that existing (constructed) and extant (non-constructed) permissions must be considered and this proposed development must be assessed in light of potential cumulative effects.

8.2 Assessment Methodology

8.2.1 Assessment Objectives

Under the European Union's Environmental Impact Assessment (EIA) Directive (2011/92/EU as amended by 2014/52/EU), major building or development projects in the EU must first be assessed for their impact on the environment. In Ireland, the EPA (2022) Guidance for Information to be Contained in Environmental Assessment are used to guide assessments and the preparation of an Environmental Impact Assessment Report (EIAR). EPA (2022) has been used in this assessment.

The objectives of this assessment are, as per the EIA Directive (2014/52/EU) and EPA Guidance (2022), to:

- Provide baseline hydrogeological and hydrological conditions for the site & update previous assessments based on additional drilling, monitoring information and assessments. This quarry benefits from many years of investigation of the subsurface: geophysical surveys of the proposed lateral extension lands and drilling into the subsurface of these lands. Geology does not change in decades. Geological timescales for changes in limestone are 100,000's of years. No new geophysical surveys are needed. Up to date Groundwater Monitoring (2025) and Quarterly Reports for the Discharge characteristic are representative of current water quality or changes over time.

- Assess the potential impact of the proposed development on the underlying groundwater body, associated surface water bodies and ecosystems. Whilst the requisite EPA (2022) Impact Assessment procedure is populated in this chapter, readers are again referred to Hydro-G (2022) in Appendix 8.1 for assimilation capacity simulation results for impact, which are more quantitative than the qualitative method of EIA procedure[1].

- Upon identification of potential impacts, provide appropriate mitigation measures for any identified potential impacts, as deemed necessary. The proposal, impacts and proposed mitigations will then be reassessed, and residual impacts defined.

[1] *Hydro-G (2022) demonstrated that the site's management and discharge of waters arising could be licenced and enable compliance with the Groundwater Regulations,*

Surface Water Regulations and Water Framework Directive. Galway County Council then issued the Section 4 Licence W/502/22 in 2023. There is no legal requirement to repeat assimilation capacity simulations year after year. The Quarterly Compliance reports (Appendix 8.1) and the EPA Corrandulla Groundwater Monitoring Station's continued compliance with the Threshold Values of the Groundwater Regulations is the evidence that no impact is occurring as a result of the quarry's continued supply of materials to society.

8.2.2 Overall Assessment Methodology

The methodology adopted for this assessment is as follows:

- Review of appropriate guidance and legislation.
- Characterisation of the Receiving Environment (hydrology and hydrogeology).
- Review of the 'Subject' development.
- Site Investigations to explore the potential of the 'Subject' development to result in Environmental Impact.
- Assessment of Potential Effects.
- Identification of Mitigation Measures.
- Assessment of Residual Impacts.

8.2.3 Guidance Documents & Legislative Instruments

Overall, the assessment was prepared with consideration of enacted Irish Regulations, EU Directives and Guidance Documents listed as follows:

- EIA Directive (2014/52/EU) DIRECTIVE 2014/52/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment.
- Groundwater Regulations: European Communities Environmental Objectives (Groundwater) Regulations, S.I. No. 9 of 2010, as amended 2019 as S.I. No. 366 of 2019.
- European Communities (Birds and Natural Habitats) Regulations, 2011. S.I. No. 477 of 2011, as amended 2021 as S.I. No. 293 of 2021.
- European Communities Environmental Objectives (Surface Waters) Regulations 2009 Statutory Instruments S.I. No. 272 of 2009, as amended 2012 (S.I. No. 327 of 2012), 2015 (S.I. No. 386 of 2015) and 2019 (S.I. No. 77 of 2019).

- European Communities (Conservation Of Wild Birds (Lough Corrib Special Protection Area 004042)) Regulations 2012. S.I. No. 455 Of 2012.

- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. Official Journal L 327, 22.12.2000, p. 1–73.

- European Union Habitats (Lough Corrib Special Area of Conservation 000297) Regulations 2022. S.I. No. 384/2022.

- European Union (Drinking Water) Regulations 2023 (S.I. No. 99 of 2023).

- Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, 2022).

- Geology in Environmental Impact Statements: A Guide (IGI, 2002).

- Guidelines for the Preparation of Soils, Geology & Hydrogeology Chapters of Environmental Impact Statements, Institute of Geologists of Ireland (IGI, 2013).

- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment. Department of Housing, Planning and Local Government (2018).

- The Planning System and Flood Risk Management: Guidelines for Planning Authorities. Office of Public Works and Department of Environment, Heritage and Local Government (2009).

- Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, NRA @ https://www.tii.ie/technical-services/environment/planning/Guidelines-on-Procedures-for-Assessment-and-Treatment-of-Geology-Hydrology-and-Hydrogeology-for-National-Road-Schemes.pdf.

- Environmental Management Guidelines for the Extractive Industry (Non-Scheduled Minerals) (EPA 2006).

- Quarries and Ancillary Activities – Guidelines for Planning Authorities, Dept. of Environment, Heritage and Local Government (2004).

- Guidance Document no. GW5: Guidance on the Assessment of the Impact of Groundwater Abstractions. WFD Working Group (2004).

- Using Science to Create a Better Place: Hydrogeological Impact Appraisal for Dewatering Abstractions. Environment Agency, Science Report – SC40020/SR1. Bristol, UK. Boak, et al. (2007).

- Reclamation Planning in Hard Rock Quarries. Department of Civil & Structural Engineering, University of Sheffield, Edge Consultants & Mineral Industry Research Organisation (2004); and

- A Quarry Design Handbook. 2014 Edition. GWP Consultants and David Jarvis Associates Limited, UK (2014).

The author of this chapter hereby confirms that this EIAR chapter and Impact Assessment has utilised all relevant and publicly available datasets available from the GSI, EPA, OSI, Galway County Council, NPWS and the Irish Government (gov.ie). In addition, site specific karst and cave descriptions for features in County Galway been considered, as published in 2022 by the University of Bristol Speleological Society (Boycott *et al.*, 2019).

8.2.4 EPA (2022) Impact Assessment Methodology

More detail for EPA (2022)'s methods are provided in Chapter 2 of this EIAR. The seven generalised degrees of impact significance that are commonly used in EIA, which are provided in EPA (2022, Table 3.4), have been used in this assessment and they are listed, as follows:

1) **Imperceptible:** An effect capable of measurement but without noticeable consequences.
2) **Not Significant:** An effect which causes noticeable changes in the character of the environment but without significant consequences.
3) **Slight:** An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
4) **Moderate:** An effect that alters the character of the environment in a manner consistent with existing and emerging trends.
5) **Significant:** An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
6) **Very Significant:** An effect which, by its character, magnitude, duration or intensity, significantly alters most of a sensitive aspect of the environment.
7) **Profound:** An effect which obliterates sensitive characteristics.

The EPA (2022)'s Criteria and Terminology to be Used in Description of Effects have been applied in this assessment, under the EPA's own categories, as follows:

- Quality, Significance, Extent and Context of Effects.
- Probability & Duration of Effects.
- Types of Effects

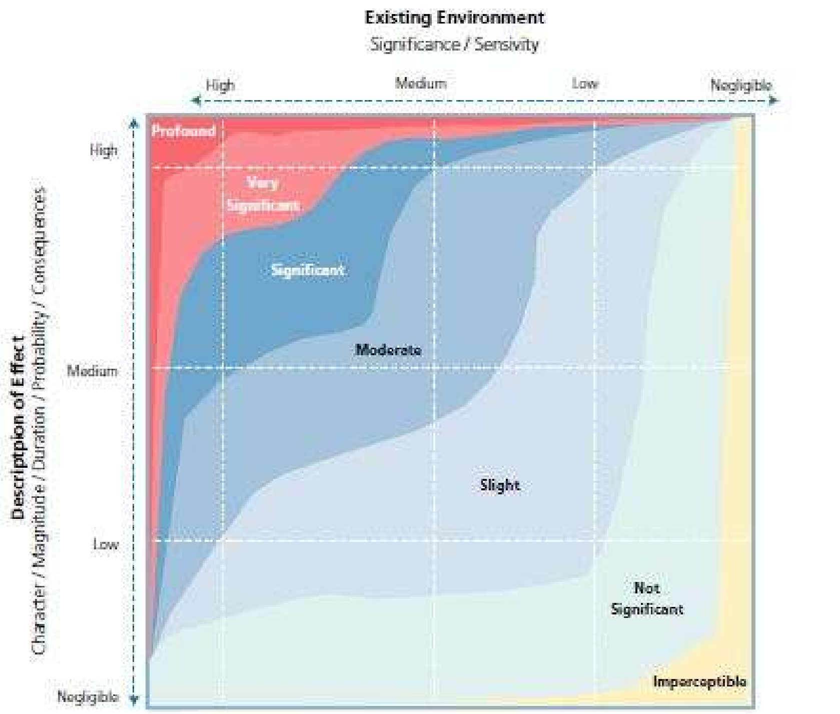
The assessments completed in this Water Section of the EIAR considered phases, as follows:

1) Construction Phase
2) Operational Phase
3) Landscaping, Restoration, Decommissioning & Aftercare

All phases are assessed in this EIAR.

Using the definitions for the degree of impact significance outlined above, the methodology for combining project information was presented in EPA (2022), after SNH (2018), as their Figure 3.5 and is reproduced here as Plate 8.1.

Plate 8.1 EPA (2022), after SNH (2018), Degrees of Effects Significance.



There are seven generalised degrees of effect significance that are commonly used in EIA. Imperceptible, Not Significant, Slight, Moderate, Significant, Very Significant and Profound. Generalised definitions of each of these are provided in Table 3.4. When more specific definitions exist within a specialised factor or topic, e.g. biodiversity, these should be used in preference to these generalised definitions. (ref. Advice Notes[ES].)

The assessment of effects within this chapter is carried out with respect to the hydrogeological and hydrological environment. Within this chapter, potential impacts are considered to be effects of the proposed development's resultant changes to the environment. Criteria for assessing importance of site attributes and their magnitude of importance were evaluated using NRA Guidelines (NRA, 2008), as prescribed in 'Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements' (IGI, 2013). NRA rating criteria uses the same significance terminology as the EPA. However, the NRA & IGI Guidance suggest intermediate steps to justify using that terminology, as follows:

- **Step 1:** Quantify the Importance of a feature for geology and hydrogeology (Tables C2 & C3).
- **Step 2:** Estimate the Magnitude of the impact on the feature from the proposed development (Table C4: Geology, Table C5: Hydrogeology).
- **Step 3:** Determine the Significance of the impact on the feature from the matrix (Table C6) based on the Importance of the feature and the Magnitude of the effect.

IGI (2013) and NRA (2008) Tables of significance to this study are presented here as Tables 8.1, 8.2, 8.3 and 8.4: These frameworks for assessment have been applied in this work.

Table 8.1 Criteria for Rating Site Importance of **Hydrological** Features (NRA, 2008)

Importance of Attribute	Criteria	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
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 > 2,500 homes Quality Class A (Biotic Index Q4, Q5) Floodplain protecting more than 50 residential or commercial properties from flooding Nationally important amenity site for 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-Q4) Floodplain protecting between 5 and 50 residential or commercial properties from flooding Locally important amenity site for wide range of leisure activities
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) Floodplain 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) Floodplain protecting 1 residential or commercial property from flooding Amenity site used by small numbers of local people

Table 8.2 Criteria for Rating Site Importance: **Hydrogeological** Features (IGI, 2013, Table C3)

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 – e.g. 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.
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.

Table 8.3 Criteria for Estimating Magnitude of Impact: **Hydrogeology** Attribute (IGI, 2013, Table C5)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	Removal of large proportion of aquifer. Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off[1]. Calculated risk of serious pollution incident >2% annually[2].
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Removal of moderate proportion of aquifer. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off[1]. Calculated risk of serious pollution incident >1% annually[2].
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Removal of small proportion of aquifer. Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off[1]. Calculated risk of serious pollution incident >0.5% annually[2].
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Calculated risk of serious pollution incident <0.5% annually[2].

Table 8.4 Criteria for Rating of Significant Environmental Impacts (IGI, 2013, Table C6)

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

The application of criteria, as outlined in Tables 8.1 to 8.4 above, to the specifics of the study area provides a general screening of the likely impact to the hydrological and hydrogeological environment. The methodology involves the identification all of the potential receptors within the site boundary and surrounding environment. This information was gathered during the desk study, site walkover, site investigation and monitoring phases of the study.

8.2.5 Dewatering Impact Appraisal

In addition to the application of Irish Guidelines as outlined in EPA (2022) and NRA (2008), and in the absence of Irish Guidance specifically focussed on quarries and hydrogeology, the work presented in this EIAR Section has also applied UK practical guidance as published by the **UK Environment Agency** (the public body equivalent of the Irish EPA). The UK Guidance provides a **'Hydrogeological impact appraisal for dewatering abstractions'** (Boak, R. et. al. (2007) and the approach is succinctly outlined by the EA as follows:

> *"The methodology for hydrogeological impact appraisal (HIA) is designed to fit into the Environment Agency's abstraction licensing process. It is also designed to operate within the Environment Agency's approach to environmental risk assessment, so that the effort involved in undertaking HIA in a given situation can be matched to the risk of environmental impact associated with the dewatering. The HIA methodology can be summarised in terms of the following 14 steps:*

- ***Step 1:*** Establish the regional water resource status.
- ***Step 2:*** Develop a conceptual model for the abstraction and the surrounding area.
- ***Step 3:*** Identify all potential water features that are susceptible to flow impacts.
- ***Step 4:*** Apportion the likely flow impacts to the water features.
- ***Step 5:*** Allow for the mitigating effects of any discharges, to arrive at net flow impacts.

- ***Step 6:*** Assess the significance of the net flow impacts.
- ***Step 7:*** Define the search area for drawdown impacts.
- ***Step 8:*** Identify all features in the search area that could be impacted by drawdown.
- ***Step 9:*** For all these features, predict the likely drawdown impacts.
- ***Step 10:*** Allow for the effects of measures taken to mitigate the drawdown impacts.
- ***Step 11:*** Assess the significance of the net drawdown impacts.
- ***Step 12:*** Assess the water quality impacts.
- ***Step 13:*** If necessary, redesign the mitigation measures to minimise the impacts.
- ***Step 14:*** Develop a monitoring strategy.

"The steps are not intended to be prescriptive, and the level of effort expended on each step can be matched to the situation. Some steps will be a formality for many applications, but it is important that the same thought-process occurs every time, to ensure consistency. The methodology depends heavily on the development of a good conceptual model of the dewatering operation and the surrounding aquifer. The steps of the methodology are followed iteratively, within a structure with three tiers, and the procedure continues until the required level of confidence is achieved. Advice is also given on how to undertake HIA in karstic aquifers and fractured crystalline rocks." Boak, R. *et al.,* (2007).

Hydro-G has applied the **UK Environment Agency**'s step wise process in order to apply a quarry development process to the EPA (2022) and NRA (2008) Guidance and present a reasoned assessment of the potential for impact that might arise in response to the proposed development and its interaction with the activities at the site and in the region.

8.2.6 Specific Study Components

Overall, the study components comprised as follows:

A. Desktop study review of all published national data from the DHLG&H, OPW, EPA, GSI and NPWS. Mapped information and databases for the site and wider region.

B. Review of historical planning documentation and assessments for the site and wider area to include, but not limited to, the following:

   i. Planning file details for historic applications and local sites.
   ii. Drilling records.
   iii. Analysis of monitored discharge rates and pump meter records for the existing quarry sump and other monitoring points within the site.
   iv. Review of details relating to, and visual assessment of, all on-site water management infrastructure.
   v. Historic groundwater level data.

vi. Discharge water quality and historic groundwater quality.

C. Hydro-G has been completing site walkovers at the site since 2016. Water ingress zones, if existing, are noted and understood, drainage patterns and land condition are noted.

D. With respect to site-specific characterisations and assessments having a hydrological and hydrogeological focus, field gathered information is presented in detail in Section 8.5 'Site Investigations'. Intrusive site investigations were undertaken between 2004 and 2021. The study period forms part of a longer and continuing record of investigation and monitoring at the site. The investigation involved the following key components:

i. Surveying in, relative to Malin Head datum, wellhead elevations of all boreholes. This was done in conjunction with a groundwater level survey.

ii. Monitoring of water levels in monitoring wells surrounding the application area.

iii. Sequential water quality sampling of the Site's Discharge was historically related to the quality of water in groundwater boreholes and it was established that the site's discharge monitoring was representative of all waters in the surrounding lands and therefore the discharge record is enough to characterise groundwater. Refer to Hydro-G (2022) for baseline condition and assimilative capacity of receiving waters.

iv. Application in 2022 and successful grant of a Section 4 Discharge Licence for the site: W/502/22 (June, 2023).

v. Completion and supervision by Dr. Pamela Bartley of site investigation probe holes in the application area and the working floor of the operational quarry.

vi. Hydraulic response slug testing was performed on the Monitoring Wells (MWs) to estimate bedrock permeability. The results of these permeability tests were consistent with previous site investigation and shows bedrock in this part of the site to have low permeability and to be reasonably homogenous.

vii. Geophysical survey of the greenfield application area was completed in 2005 and in the discharge zone in 2021. The Apex reports are presented in Appendix 7.4 'Site Investigation Reports'. Results of the geophysical surveys and the interpretative reports will be discussed in more detail later in this chapter. In summary, the greenfield application area is suitable for abstraction of limestone and the discharge area was determined to provide a suitable discharge mechanism as per Regulation 8 of the Groundwater Regulations (2010, as amended).

viii. Irish Drilling completed Trial Pitting, Particle Size Distributions and Permeability Testing in 2021. Refer to the Irish Drilling report (2021) at the end of Appendix 7.4 'Site Investigation Reports'.

ix. Review of groundwater quality in the proposed greenfield application area (Hydro-G Historic & Coyle Environmental, 2025).

x. Review of the site's Quarterly Compliance reports for the characteristics of the discharge, which is the integrator of all waters coming from the sky and from the lands to the east, which are the lateral extension area proposed (as stated, each Quarterly Monitoring Report submitted to Galway County Council is appended here again in Appendix 8.1).

E. Integration of investigation and monitoring findings informed the update to the site's established CSM (Conceptual Site Model) for the hydrogeological system at the site and the local surrounding area's hydrology and hydrogeology.

F. All works were employed in the population of a Hydrogeological Risk Assessment Framework (UK EA).

G. The EIA procedure was followed through the assessment, identification of impacts, mitigation proposals and evaluation of residuals' process.

8.3 Review of the Subject Development

As stated, the site proposed for development, and considered here, is greenfield lands adjacent to an established limestone quarry.

Previous Permissions associated with the site are listed in the introductory chapters of this EIAR and separate Planning Report.

The proposed development is to quarry two benches in depth. The historic workings were enabled by the services of the overall site, such as access roads, water supply, wastewater services, water management systems and discharge licensing. The services for the entire site remain sufficient to service the proposed development. Therefore, new entrance from roads are not necessary. The application site can be accessed by an already working site.

8.3.1 Application Site Location

As described in more detail in Chapter 3 of this EIAR, the site is located to the north of Claregalway and Galway city. The site is afforded with access routes west to Connemara and east to the M17 Motorway connecting Limerick and Tuam, which is north of the site. Harrington Concrete and Quarries is the owner and operator of the site. Access to and from the quarry is *via* a single site entrance. Land use in the vicinity of the site is low intensity grazing agriculture and ribbon housing development along the local roads.

Hydrologically and hydrologically the site is mapped as sitting within the Corrib Catchment [Ha 30], the subcatchment of the river system named the Clare [Galway]_SC_060, Code 30_13 subcatchment and overlying the Clare Corrib Groundwater Body (GWB). The EPA and Water Framework Directive (WFD) teams have reported assessments for the area in EPA (2018, 2021a and 2024). All published data have been employed for the characterisation of the Baseline and the Assessment of Impacts, Required Mitigations and Residual Impacts. With respect to designations, the site's location in the catchment of the Corrib prescribes a significance to Lough Corrib's designation as a European Site (Lough Corrib SAC, Site Code 000297; Lough Corrib SPA Site Code 004042) and the two Statutory Instruments associated: the European Communities Conservation of Wild Birds (Lough Corrib Special Protection Area 004042) Regulations 2012 and Lough Corrib Special Area of Conservation 000297 Regulations 2022. Refer to Figure 8.1.

The CLARE (GALWAY)_070 river runs from north to south at a distance of c.3.5km to the east of the quarry. Lough Corrib SAC and SPA are c. 8km due west of the site. However, in the direction of groundwater flow paths, which is in a northeast to south westerly direction through the site and on to Lough Corrib, the flow path length is c. 11km. The closest downgradient surface water feature is named as the CREGG_010 stream, which is c.1.5km to the south west of the site. More details for regional river systems, WFD catchments, subcatchments and sub basins are provided later in this chapter.

The site is not located within any areas of potential flooding (floodinfo.ie) and the closest mapped OPW Plan is upgradient at Corrofin, at a distance of c.5km to the north east. There is no hydrological connection between the site and Corrofin.

Reference to GSI mapping (www.GSI.ie) for the study area indicates that the underlying bedrock unit is mapped as Dinantian Pure Bedded Limestones and is classified as a 'Regionally Important Karst- diffuse (Rkd)' aquifer.

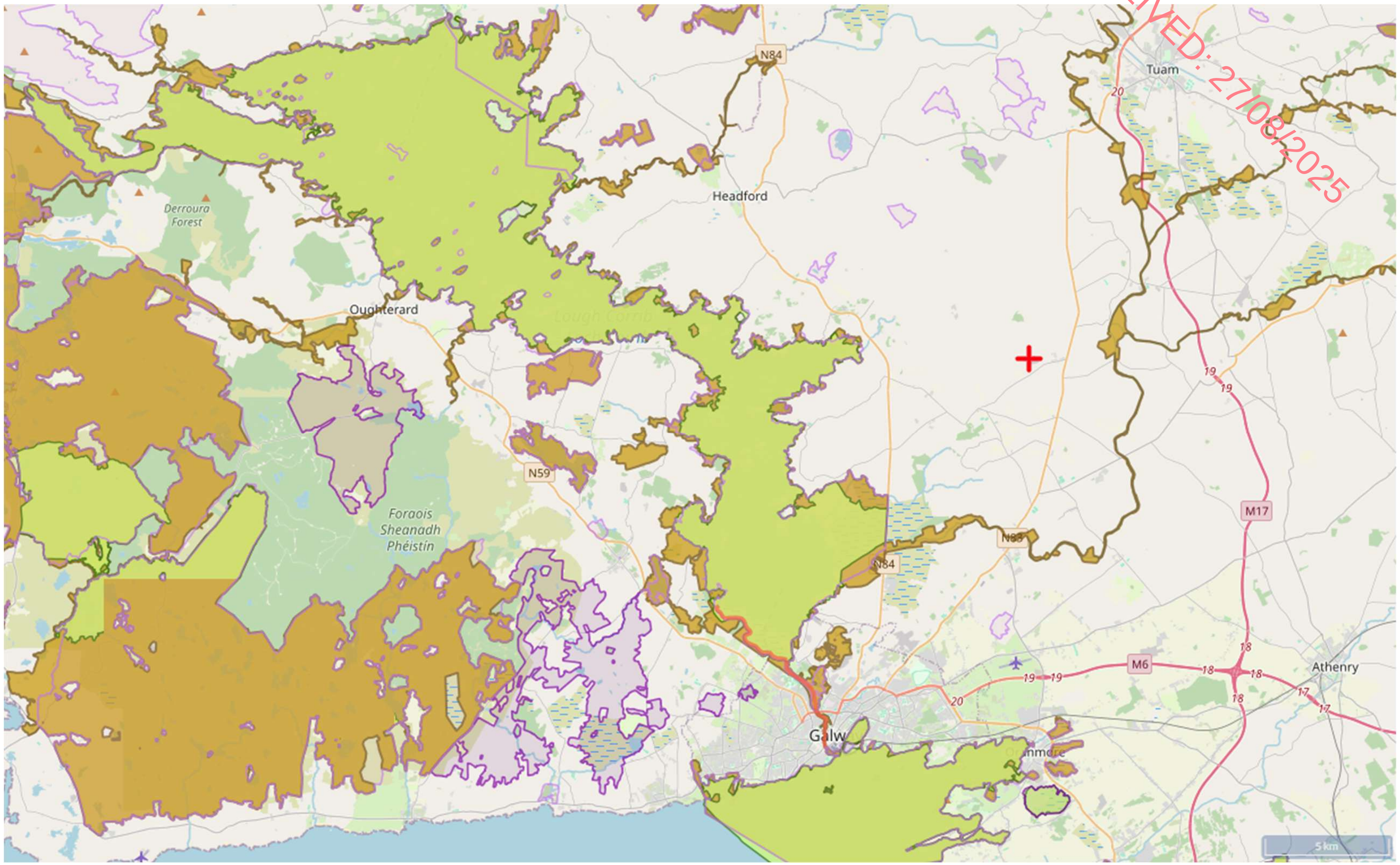


Figure 8.1 Application Site Location (red cross) and EPA mapped designated sites: SACs, SPAs, NHAs.

8.3.2 Overall Site Layout

Some area of the proposed development is within the existing quarry and some of the application area is located along the eastern boundary lands. Some of the application area has already been stripped of overburden and bedrock has been quarried down below existing ground level and some of the application area is greenfield.

The application area is 12ha of extension to an existing limestone quarry whose quarry working area is 14.9 ha. The Red Line boundary of the application area is shown in Figure 8.2, which shows that much of the application area proposes extension into a greenfield agricultural pasture traditionally used for sheep grazing. The part of the application area that is in the existing quarry is included for extraction to 4 mOD, to enable working and stockpiling the new rock.

The main quarry void is located within the centre of the whole ownership site area. There are roads leading out from the base of the void to the quarry surface. There are a number of stockpiles, plant and stone bays in the southwest of the red line boundary application site. There are a number of plant and sheds located in the northwest of the site, including a concrete plant, bitumen plant and a number of sheds.

The proposed application area to the east of the site is hydrologically and hydrogeologically connected to the main site by virtue of the fact that rainfall runoff can naturally flow off the greenfield lands and into the quarry void either by direct rainfall runoff or by epikarst contributions in the exposed rockface of the quarry.

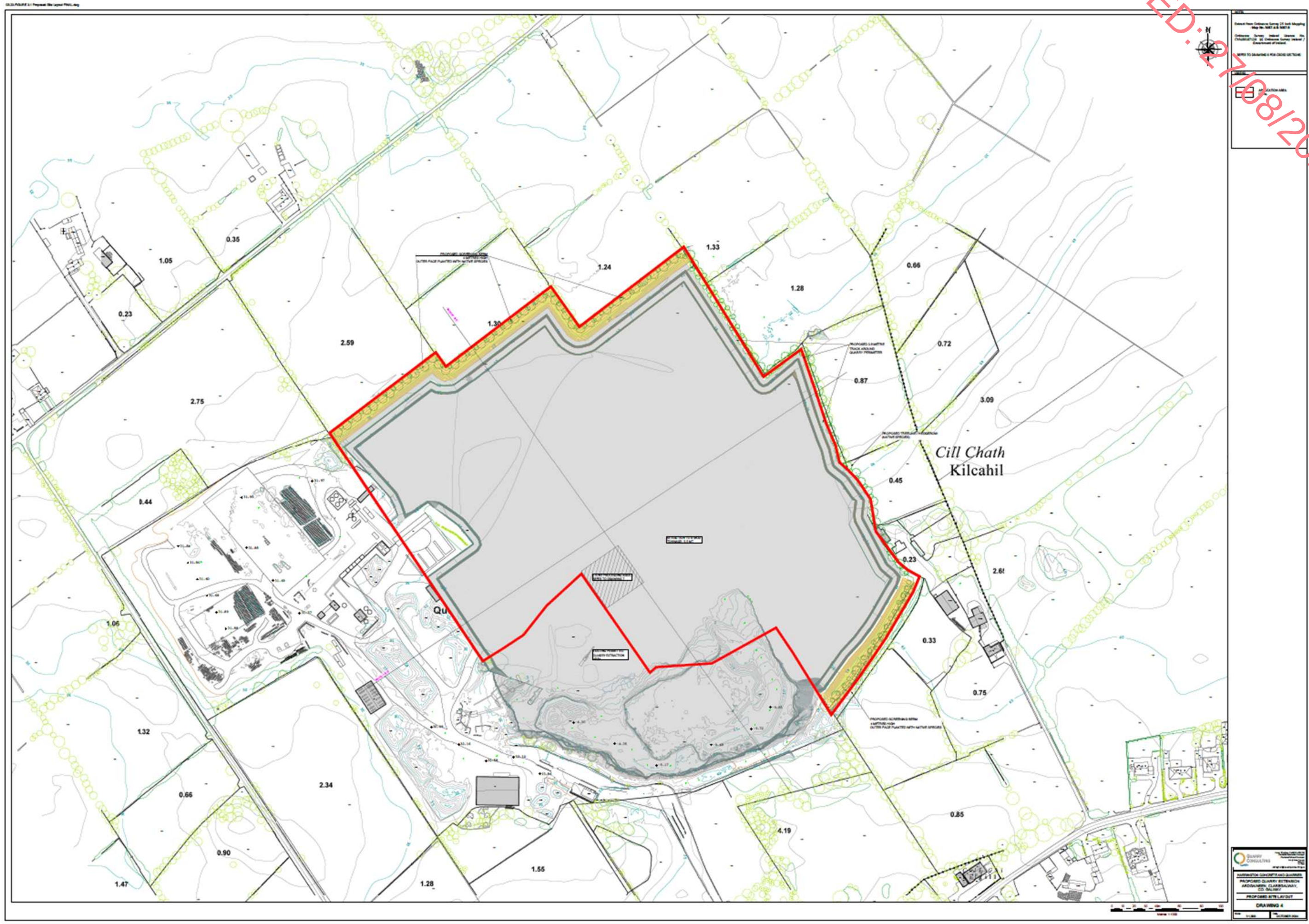


Figure 8.2 Application Area Layout and the Existing Limestone Bedrock Quarry (Refer to Quarry Consulting's Figure 4).

8.3.3 Consent to Discharge

The Conditions of the Section 4 Discharge Licence W/502/22 (2023), which was presented in Appendix 8.1, permits a maximum Emission Limit Volume of 1,483 m3/d. The Emission Limit Values (ELV) for hydrochemical and physiochemical quality permitted are as follows:

- 6 – 9 pH
- <10 mg/l BOD
- <10 mg/l SS
- <15 mg/l COD
- <0.03 mg/l as Total Ammonia
- <18 mg/l as Nitrate NO3
- <0.05 mg/l as Nitrite NO2
- < 0.0001 mg/l Benzo(a) Pyrene (i.e. < LOD of Laboratory suffices)
- < 0.0001 mg/l Total PAH
- < 0.01 mg/l Total Hydrocarbons
- No variability in Electrical Conductivity
- No variability in Colour
- No variability in Turbidity

The discharge's ELVs for volume and hydrochemistry were specified as presented in the Assimilation Capacity Report presented by Hydro-G (2022), which demonstrated that those ELVs would ensure compliance with Environmental Quality Objectives of the Groundwater Regulations (2010, as amended) and Surface Water Regulations (2009, as amended). As previously stated, the Hydro-G (2022) Assimilation Capacity Report is presented with Appendix 8.1's copy of the resultant Section 4 Discharge Licence.

8.3.4 Water Management at the Site

The management of waters, within the existing permitted limestone quarry, is in accordance with the Conditions of W/502/22. The proposed development is already part of the catchment to the water management system of the main limestone quarry. The surface water management regime will continue to operate as it does now.

Waters arising and requiring discharge at the quarry are rainfall derived surface water runoff from the floor of the quarry and a groundwater flow component through the epikarst all along the boundary with land areas on the periphery of the perimeter walls of the excavation. Rainfall falls on the floor and it runs off to be collected in the floor sump. This sump is used to provide water for products and dust suppression at the site.

The schematic of waters arising, and mode of discharge, are presented in Plate 8.2, photographs of the sump are presented as Plate 8.3 and Plates 8.4 and 8.5 show the discharge area in photograph and aerial image.

Procedures are in place for dispensing fuels and dealing with accidental spillages to ensure that no contaminants enter the ground or surface water environments. In addition, the Conditioned Hydrocarbon interceptor is in place.

The point for discharge sampling has ITM coordinates Easting: 538257, Northing: 740243.
The centre of the discharge zone has ITM coordinates Easting: 538190, Northing: 740218.

The area receiving the discharge shows visual evidence that a plan area of 2,000m2 is the Nature Based Solution diffuse discharge zone area. The site has an agreement with the discharge area's landowner.

The floor sump has a large areal capacity and acts as the attenuation device for storm events. From the floor sump, water is pumped up the wall and into a pipe under the access road to the offices and weighbridge. The flow is measured and instrumented as per the conditions of the Section 4 W/502/22 Licence and volumes of waters arising are presented in the following Section.

Plate 8.2: Schematic of waters arising and mode of discharge.

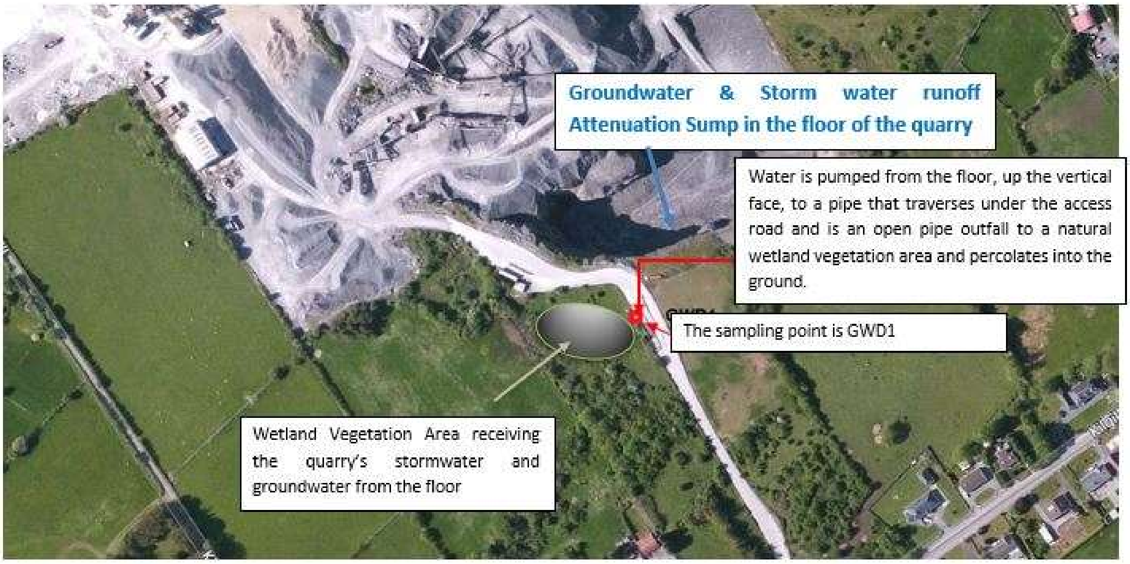


Plate 8.3: Existing sump.

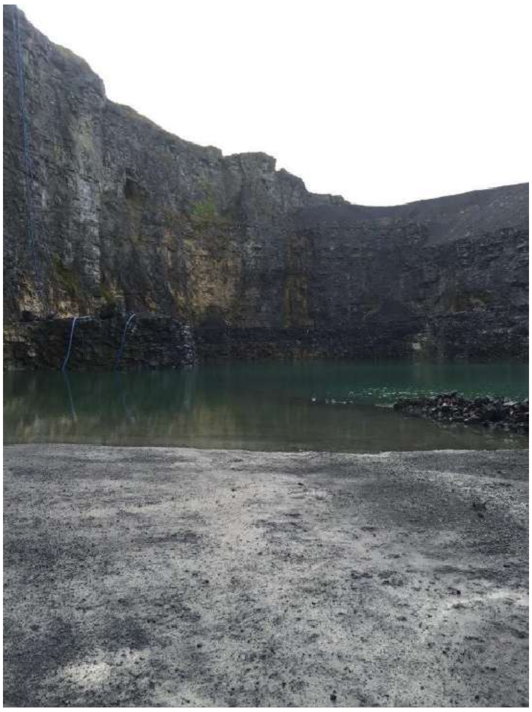
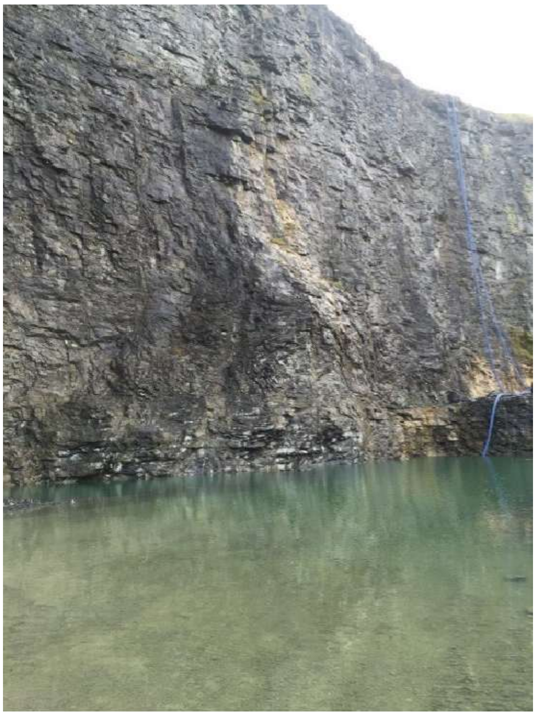
	
Sump in floor of application area looking south.	Sump showing rising main carrying discharge in a 4" rising main, up the southern face to groundlevel.

Plate 8.4 Summertime view of discharge wetland (view from south to north).

Plate 8.5 Google Earth visual showing vegetated indicators of wetted discharge area plan.

8.3.5 Volumes of Water Measured at the Site

As Conditioned by W/502/22, the site's discharge is monitored by Flow Meter and managed on a Telemetric System that enables the Site Manager to check in every day. The daily record for total daily discharge volumes is presented in each of the Quarterly Monitoring Reports of Appendix 8.1.

The range of daily discharge volume totals in 2024 - 2025 has been between zero m3/d and 382 m3/d. As previously stated, the maximum permitted Total Daily Discharge Volume is 1,483 m3/d. The site is in full compliance with its licence and has capacity within its volumetric limit for expansion into the greenfield. In any case, the waters of the greenfield already contribute to the floor of the quarry and are managed within the Licence. This was the conceptual understanding presented in Hydro-G (2022) supporting the application for discharge licence. Refer to Appendix 8.1's Hydro-G (2022) report.

8.3.6 Continuous Physiochemical Monitoring of Discharge Quality at the Site

As Conditioned by W/502/22, the site's discharge is monitored continuously for pH, Temperature, Electrical Conductivity and Turbidity. During the period of highest discharge from the site, which was the first 6 months of 2024 and for discharge volumes averaging 325m3/d, median values recorded for each parameter were as follows:

- 2.98 Turbidity (NTU)
- 9.39 Temperature (oC)
- 8.17 pH (pH)
- 554 Conductivity (us/cm)

The site is in overall compliance with the 'No Change' rules of the Section 4 Licence ELVs for the physiochemical parameters in as much as they can be considering drifts in the instrumentation and degrees of precision of field instrumentation.

8.3.7 Site Services in Water & Wastewater

With respect to water supply, the site has a metered connection with Irish Water, which serves mains supply on all perimeter roads to the quarry.

With respect to toilet facilities and onsite wastewater treatment system serving the site, toilet flushings are discharged to a HydroKlenze Biological WWTP that is designed for the single house. It is a 'BAF' system, which relies on biological action that is maintained by aeration. The product brochure is presented as Appendix 8.3.

In 2015, Hydro-G surveyed the system installed and evaluated invert levels and discharge with the percolation area's installer. The onsite WWTP has a 0.9m3/d treatment capacity and the daily hydraulic loading from the 12 workers at the site at any one time, suggests a site-specific daily load of

0.48 m3/d arising, based on 40l/p/d for open industrial usage as per EPA (1999), which is within the 0.9 m3/d capacity of the WWTP. Therefore, the WWTP provides full treatment.

The percolation area was surveyed by Hydro-G in 2015. The measured dimensions conform to the Guidance requirements of the time of installation, which is EPA (2009), and the recommendations for the equivalent Population Equivalent (PE) at the site. Given a work force of 12, the calculated daily hydraulic loading is 40l/p/d for open industrial usage as per EPA (1999). The conventional 150 litres/p/d is the PE (population equivalent) for one person in the conventional domestic setting/residence. The percolation area measures 10m x 6m and it is a gravity fed system with conventional EPA (2009) recommended 100mm diameter distribution pipes set in gravel trenches at 2.5m centres. There are two trenches, two lengths of pipe – this exceeds the requirements of EPA (2009). Separation distances to boundaries are as per EPA (2009), which was the Guidance requirement at the time of construction.

Therefore, the WWTP and percolation area's systems have been implemented to EPA Guidance of that time, which was EPA (2009) and therefore is concluded that there is no potential for contamination.

In 2015, Hydro-G reported that the existing system poses no risk of significant effect on the environment and no remedial measures are required to mitigate any potential impacts. This conclusion is maintained because the design guidance of EPA (2009) was actually stricter than the current Code of Practice (EPA, 2021b). In the current CoP there are mechanisms for design of development on poorer permeability subsoils and use of more advanced WWTPs for Tertiary Treatment. For the <0.5m3/d loading of the entire site, there is no need for advanced designs.

In 2025 Hydro-G confirmed with the site that the inspected wastewater levels in the WWTP tanks corresponded with invert levels. Levels were at the outlet invert and this is taken to indicate that the tanks have not been compromised. In addition, the visual inspection demonstrated that the wastewater is adequately dealt with prior to discharge. Walkover of the percolation area suggested no ponding and therefore, a fully functioning system is in place still.

Now, the existing environment will be described.

8.4 Existing Environment

The receiving environment is described here. Desktop mapping and published information is presented to describe the land, soils, surface water systems, underlying quaternary and bedrock geology, mapped aquifer and groundwater vulnerability classifications and other information relevant to the Water environment.

8.4.1 Desk Top Resources

Reports, publications, assessments and mapped information and databases for the site and wider region employed in the characterisation of the Baseline included as follows:

- An Coimisiún Pleanála (2025) Map Based Planning Portal. https://www.pleanala.ie/en-ie/Map-Search.

- Apex (2005) Draft Report on The Geophysical Survey at Ardgaineen Quarry, Claregalway, Co. Galway for John Barnett And Associates Ltd. NOVEMBER 2005. O Connor & O Connell.

- Apex (2021) Report on The Geophysical Survey at the Ardgaineen Quarry, Claregalway, Co. Galway for Harrington Concrete. AGP21055. July 2021.

- Boycott, T., Drew, D., Mullan, G., Podesta, J., Simms, M., Wilson, L. (2019) Caves of Mid-West Ireland. Counties Clare, Galway, Mayo and Roscommon. The University of Bristol Speleological Society ISBN 978-0-954850-1-3.

- Daly, D. (1992) A report on the Flooding in the Claregalway area. Groundwater Section Report File 2.2.7. 12pp.

- Daly, D. (1985) Groundwater in County Galway with particular reference to its Protection from Pollution. Geological Survey of Ireland report for Galway County Council. 98pp.

- Drew D.P. and Daly D. (1993) Groundwater and Karstification in Mid-Galway, South Mayo and North Clare. A Joint Report: Department of Geography, Trinity College Dublin and Groundwater Section, Geological Survey of Ireland. Geological Survey of Ireland Report Series 93/3 (Groundwater), 86 pp

- Drew, D.P. (1973a) Hydrogeology of the north Co. Galway – south Co. Mayo lowland karst area, Western Ireland. International Speleology 1973, III, Sub –section Ca.

- Drew, D.P. (1973b). Ballyglunin Cave Co. Galway and the hydrology of the surrounding area. Irish Geography Vol. 6, No. 5. pp 610-617.

- EPA mapping and surface water and groundwater quality data https://gis.epa.ie/EPAMaps/.

- EIA portal https://housinggovie.maps.arcgis.com/

- EPA (2018) 30_13 Clare[Galway]_SC_060 Subcatchment Assessment WFD Cycle 2.

- EPA (2021a) 3rd Cycle Draft Corrib Catchment Report (HA 30). Catchment Science & Management Unit Environmental Protection Agency August 2021 Version no. 1.

- EPA (2024) Cycle 3 HA 30 Corrib Catchment Report, May 2024.
- EPA (2025) Biological Quality Monitoring Report Corrib Catchment. Hydrometric Area 30.
- EPA Register of Abstractions and Information relating to drinking water monitoring results and water supply details reported annually to the EPA by water services authorities. This dataset provides details of all abstractions by Groundwater Body Code. https://eparesearch.epa.ie/safer/.
- Galway County Council Planning Application's Mapping Portal.
- Galway County Council: Water Quality, Group water schemes. http://gccapps.galwaycoco.ie/waterquality/.
- GSI (2003, 2005) Bedrock Geology Sheets 11, 14 & 15, 1:100,000 Map Series. Geological Survey of Ireland.
- GSI On-line Groundwater database. Aquifer Classification, Aquifer Vulnerability, Teagasc Soil Classification, Subsoils, Karst features, groundwater recharge.
- GSI (2004) 1st Draft Clare-Corrib GWB Description June. 2004 Clare-Corrib GWB: Summary of Initial Characterisation.
- Hydro-G (2022) Discharge to Groundwater Licence Application Hydrogeological Report Harrington's Harrington Concrete & Quarries, Ardgaineen, Claregalway, Co. Galway (Hydro-G, January 2022). Lodged with Galway County Council January 2022. Reference No. W/502/22.
- Irish Drilling (2021) Site Investigation Report for Quarry at Ardgaineen, Claregalway, Co. Galway.
- Meehan, *et al.,* (2019) Geoheritage Reports for Knockmaa, Pollnahallia, Knockmaa Quarries, Ballybanagher M17 Road Cut, Ballyglunin Cave and Lough Corrib.
- NPWS (2017) Conservation Objectives: Lough Corrib SAC 000297. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs. Ordnance Survey of Ireland, Sheet No. 6, 1:50,000.
- Ordnance Survey, Ireland Map Series 1:50,000 Sheets 45 & 46 Galway.
- OPW hydrometric flow and level data from EPA/OPW hydrometric stations.
- Previous determinations for the site and historic applications as held by Galway County Council and the Board, including PL20/651 and ABP-307944-20.

- Uisce Eireann (2023) NWRP NW Section 7 Preferred Approach and Uisce Eireann NWRP's Appendices for Terryland and Luimnagh Intake WTP capacities and other information about national assets in potential connectivity with the application site.

In addition to national datasets and desktop available published information, this section also presents an overview of the significant body of historic site investigations at the site to support the development of the baseline environment.

Desk study and site investigation results were then used to complete an Impact Assessment, identification of required mitigation measures and presentation of residual effects, if found.

8.4.2 Historic Land Use

Historic land uses were reviewed using maps and aerial photography and are detailed in Table 7-1 of the Land, Soils and Geology Chapter. There is no information of relevance to the Water Assessment reported here in Chapter 8.

8.4.3 Topography

The application site is situated in a geographical area which is characterised as being a gently undulating low-lying limestone plateau without surface drainage ranging in height from 30-80m above sea level. Refer to Figure 8.3 for regional topography. To the east, immediately bordering the working quarry, the greenfield component of the application lands are 40m OD, approximately. Lands to the west of the overall landholding are 30m OD, approximately. Lough Corrib Lower has a perimeter elevation of 10m OD, approximately, at a distance of c.8 km due west of the site.

Elevations at the site of the active quarry have varied over time. Topography at the working site varies from a natural ground level high point of 35m OD at the weighbridge on the south side of the site to a low zone of -15m OD, approximately, which is the Pre-63 base of the sump in the void of the working quarry. The greenfield application area is proposed for extraction of rock to an elevation of 4m OD and the walls of the quarry bordering the application area allow evaluation of the limestone from the greenfield's ground level to the greenfield's proposed 4m OD floor.

Figure 8.3 The existing quarry at c. 30m OD Ground level and topographical elevations.

8.4.4 Hydrology

The site lies within the Corrib Catchment (HA30), which is the land mass area to the East of Lough Corrib. The EPA (2024) Hydrometric Area Report for HA30 is presented in Appendix 8.4.
Regional and Local Hydrology is shown as Figure 8.4.

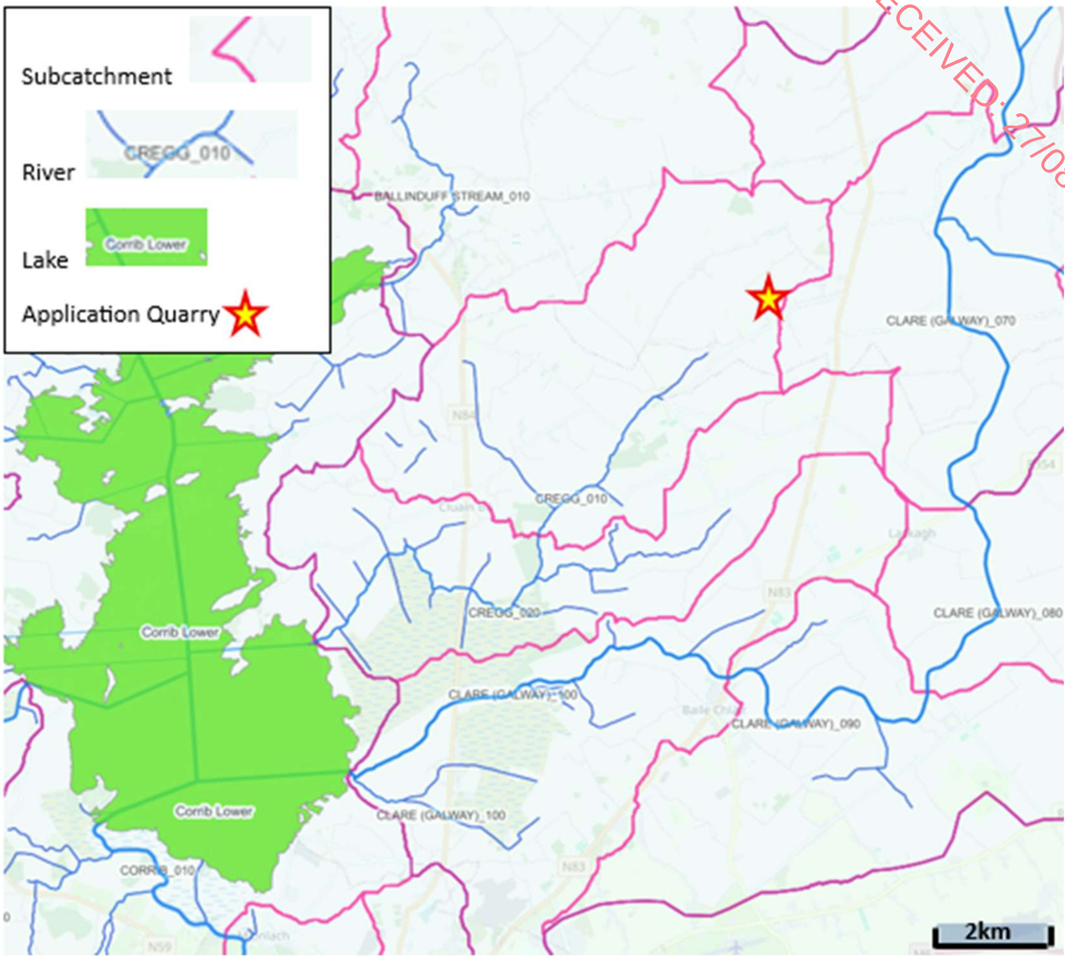


Figure 8.4 Harrington's Ardgaineen Quarry, Local & Regional Hydrology.

The site sits in the EPA mapped subcatchment of the Cregg River, which is c. 1.8km to the south west of the centre of the greenfield application area. The Cregg River discharges to Lough Corrib SAC, SPA & PWS Source. The closest segment of the Cregg River to the quarry is named the Cregg_010 - in which the 01 is taken to signify the 'first order' or commencement of a river.

The Clare [Galway] river is 3.5km to the east of the application site. However, the quarry is mapped by the EPA as part of the sub basin of the Cregg River. Whilst both the quarry and the Cregg River are mapped as sub catchment Clare[Galway]_SC_060, the quarry is not mapped as within a direct sub basin of the Clare [Galway] River. It is noted that the Clare [Galway] River, to the east of the site, is the closest mapped boundary of the Lough Corrib SAC and SPA to the quarry. However, as stated, the quarry is not part of the Clare [Galway] River sub basin. The Clare River discharges into Lough Corrib at a distance of c.12km to the south west of the quarry. The Cregg River discharges into Lough Corrib at a distance c.11km to the south west of the quarry.

The closest shore of Lough Corrib to the quarry is the cove in which the Luimnagh PWS Intake and WTP sits and abstracts from Lough Corrib. Luimnagh PWS intake is c.8,7km west, to north west, of the proposed greenfield application area of the operational quarry. However, groundwater flow direction is conceptualised as being in a south westerly direction from the quarry and in the direction of the rising of the Cregg_010 River.

EPA (2024) reports that the Corrib catchment (HA30) drains a total area of land of 3,113.85 km² into Lough Corrib. The current and proposed lateral extension areas of rock extraction extend across <20ha. The area of rock extraction at Harrington's Ardgaineen Quarry is equivalent to c.0.2km2 and it is therefore 0.006% of the total catchment area of the Corrib's surface water catchment. This has significance in terms of small scale and insignificant potential for impact. Even on a cumulative Impact scale, Mortimer's quarry is to the north of Harringtons and there are other limestone quarries in the catchment. Overall, Mortimers accounts for 0.005%, Harringtons accounts for 0.006% and even if we assumed 50 other limestone quarries, which is gross exaggeration, then the area's dedicated to the provision of roads and building stone and concrete would be <0.5% of the area of the Corrib catchment.

EPA (2024) provides a useful image for the detail of HA30, and its constituent sub components of sub catchments and sub basins, and names of the other Hydrometric Areas (HAs) around the site. Refer to Figure 8.5.

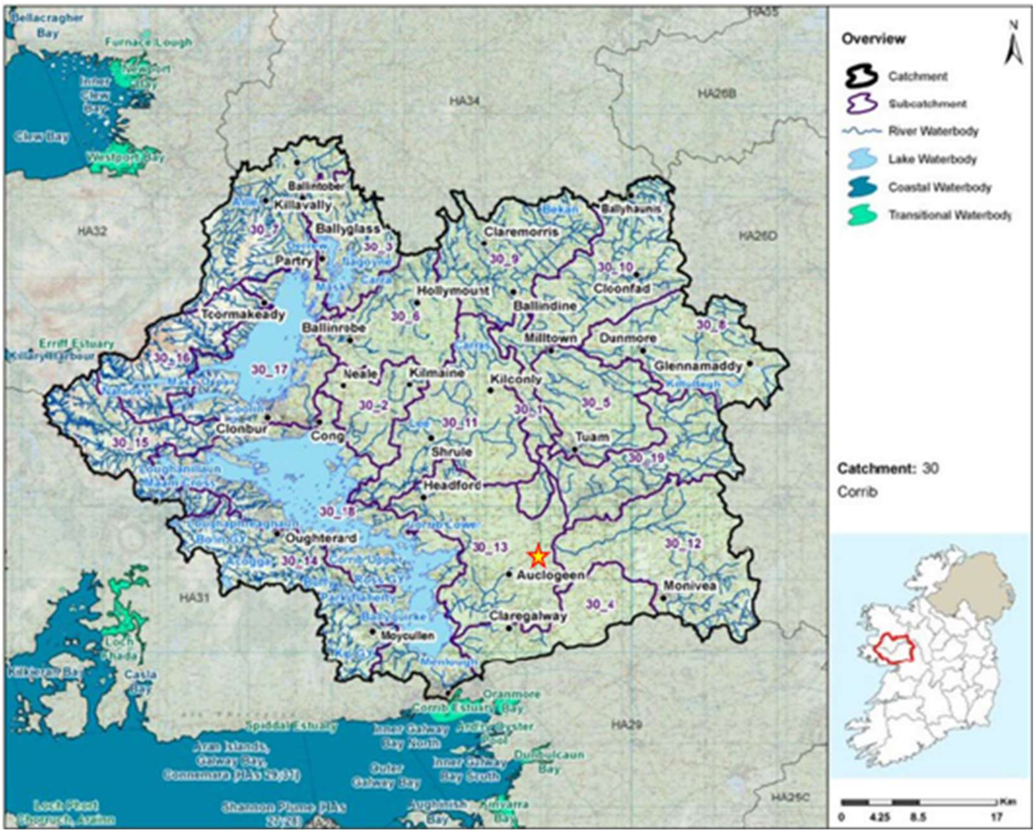


Figure 8.5 EPA (2024) presentation for the Corrib Catchment (HA30).
(Hydro-G Annotation for the approximate location of Harrington's Ardgaineen quarry).

The catchment profile of the Corrib Catchment (HA30) is described by the EPA (https://www.catchments.ie/), as follows:

- "This catchment includes the area drained by the River Corrib and all streams entering tidal water between Renmore Point and Nimmo's Pier, Galway, a total area of 3,113.85 km². The largest urban centre in the catchment is Galway City. The other main urban centres are Tuam, Ballinrobe, Claremorris and Ballyhaunis.
- The total population of the catchment is approximately 116,900 with a population density of 38 people per km².
- This catchment is characterised by a wide, relatively flat, limestone plain occupying the eastern two thirds of the catchment which terminates in the large lakes of Corrib and Mask that abut against the granites of west Galway and the metamorphic uplands of southwest Mayo.
- The entire area of this catchment east of these lakes is karstified limestone with groundwater and surface water highly interconnected in this region.
- The area to the east of Lough Corrib is dominated by karstic type drainage and there are numerous springs, swallow holes and turloughs in this area. The Kilmaine River rises near Kilmaine as a karst spring, flowing southwest and into Lough Corrib near Cross. The Black (Shrule) River drains flows through Shrule before entering Lough Corrib near Inchiquin Island.
- The area around Headford is drained by the Headford Stream, which flows into the southeastern shore of Lough Corrib.
- The eastern side of the catchment is drained by the Clare River and its tributaries. The Dalgan River rises near Ballyhaunis flowing south before meeting the Sinking River at Dalgin Bridge. The Sinking River, loses 80-85% of its flow over a 400-m long reach in summer low flow conditions. At the confluence of the 2 rivers, the system become the Clare River.
- The Clare River continues south and is joined by the Nanny River, Grange River and the Abbert River, which drains the southeastern part of the catchment. The Clare River passes though Claregalway before entering the southern end of Lough Corrib.
- Three large scale drainage schemes were completed in this catchment by the OPW between 1951 and 1986 consist of the Corrib-Clare scheme (1951 to 1959), the Corrib-Headford scheme (1967 to 1973) and the Corrib Mask scheme (1979 to 1986). Flood relief works were completed at Belclare on the Clare River during 1995 and in the Maam Valley during 2001.
- The Corrib River flows out of the southern tip of the Lough, passing through the northern suburbs of Galway City before passing over a large weir near Galway Cathedral, where the river becomes tidal and flowing out to sea at Galway Bay past the Claddagh.
- There are two particularly distinguishing and unusual features of the catchment in the karstic limestone east side of Lough Corrib:
    - The River Clare is not a natural river; it is an aqueduct linking a series of pre-existing lakes, turloughs and reaches of stream. For instance, prior to arterial drainage in the 19th century, the River Abbert sank underground at Ballyglunin and the River Clare sank underground at Turloughmore.
    - A significant proportion of the river flow in the River Clare sinks underground and flows westwards beneath the topographic catchment divide with Lough Corrib, re-emerging as springs, such as Bunatober and Aughcloggeen on the eastern side of Lough Corrib."

EPA (2018) lists that the Corrib catchment comprises 19 subcatchments (Table 1, Figure 1 of EPA 2018) with 97 river water bodies, 31 lakes, one transitional water body, and 21 groundwater bodies. There are no heavily modified or artificial water bodies in the Corrib Catchment. The nearest coastal water body is Oranmore Bay, which is an EPA mapped Transitional Waterbody, c.15.5km due south of the site.

8.4.5 EPA Surface Water Quality Results

There is a downstream EPA surface water monitoring station: Named 'CREGG - Bridge near Aucloggeen' [Station ID RS30C030050] (https://gis.epa.ie/EPAMaps/) and this is c. 1.8 km south west of the centre of the application area and site, approximately. This station has not been surveyed for Biological Quality since 1993. Neither are there hydrochemical data published for that 'CREGG - Bridge near Aucloggeen' @ c. 1.8 km south west of the quarry.

The closest downstream active biological and hydrochemical Monitoring Station on the surface water system is "Bridge near Drumgriffin" [RS30C030100], which is c. 4km to the south west of the application site, and this is reported as Q 4 Good status in the 2024 Survey Period (EPA, 2025 Biological Quality Monitoring Report). Given that this is a spring rising fed river, this water quality is indicative also of good quality groundwater quality downgradient of the quarry. Refer to Appendix 8.4 for EPA Maps and Data Tables (Table A4 for Biological Quality).

Hydrochemical data for the "Bridge near Drumgriffin" [RS30C030100] EPA surface water station is presented as Tables A1 to A3 in Appendix 8.4. In summary, the following can be concluded:

With respect to Table A1(a, b, c) and **2007 to 2015** EPA Data @ 4km downstream in 'surface water' (rising as a spring 2km from quarry):

- Ammonia = High Status compliant
- BOD = High Status compliant
- Ortho-P = Good Status compliant
- pH compliant
- Range of Temperatures = not 1.5oC range
- Other indicators suggest:
    - VERY Hard water = usual for limestone environments.
    - Dissolved Oxygen can be low = hence 'hydromorphological' risk conclusion of EPA.
    - Colour very variable
    - Total Oxidised N = not too bad.
    - Nitrate N Max = VERY HIGH, Mean = normal baseline

With respect to Table A2(a, b, c) and **2016 to 2021 (3rd Cycle)** EPA Data @ 4km downstream in 'surface water' (rising as a spring 2km from quarry):

- Ammonia = One event indicator of gross contamination. Mean value is High Status compliant.
- BOD = Similarly, BOD has one event indicator of gross contamination. Mean value is High Status compliant
- Ortho-P = Range is High Status compliant

- pH compliant
- Range of Temperatures = not 1.5oC range
- Other indicators suggest:
  - VERY Hard water = usual for limestone environments.
  - Dissolved Oxygen can be low = hence 'hydromorphological' risk conclusion of EPA.
  - Colour very variable
  - Total Oxidised N = not too bad.
  - Nitrate N Max = range is normal baseline.

With respect to Table A3(a, b, c) and **2022 to 2025 (Current)** EPA Data @ 4km downstream in 'surface water' (rising as a spring 2km from quarry):

- Ammonia-N = latest EPA Data (2022 - 2025) suggests High Status Ammonia-N in the River in the Max, Min, Average states. Historically, Mean values have been High Status but problematic historical peaks. Apparently resolved.

- BOD = latest data suggests High Status BOD condition. Historically High BOD peaks were correlated to Temperature Peaks, which is why Hydromorphology is the Risk and reason for the Poor Status and At Risk EPA Mapping.

- Generally High Status compliant for ortho-P.

- pH compliant

- high peaks in temperature due to channelisation of the river bed.

- Signifies a VERY Hard Water. Not Specified in the SW Regs. No environmental significance to the WQ Data. Signifies Groundwater signal.

- Not a SW Reg parameter but range in results are normal. Strong Groundwater signal. No environ. significance other than the fact that the quarry discharges to groundwater.

- Very low Dissolved Oxygen signal. This is morphological impact - low flow in the altered state.

- Very low Nitrate N

- Nitrite N = not specified in the SW Regs but it is a parameter of the GW regs: compliant as ug/l TV

- Total Hardness = Signifies a VERY Hard Water. Not Specified in the SW Regs. No environmental significance to the WQ Data. Signifies Groundwater signal.

- TON = No significant Nitrogen content.

- Colour peaks very high in October 2024, again, land related = subsoil, channelisation.

8.4.6 Hydrogeology

The general outline of the underlying Groundwater Body, named the Clare Corrib GWB, is presented as Figure 8.6 with site context and Hydro-G's annotated OVERALL groundwater flow directions in the direction of the main surface water system drain to the groundwater body: Lough Corrib.

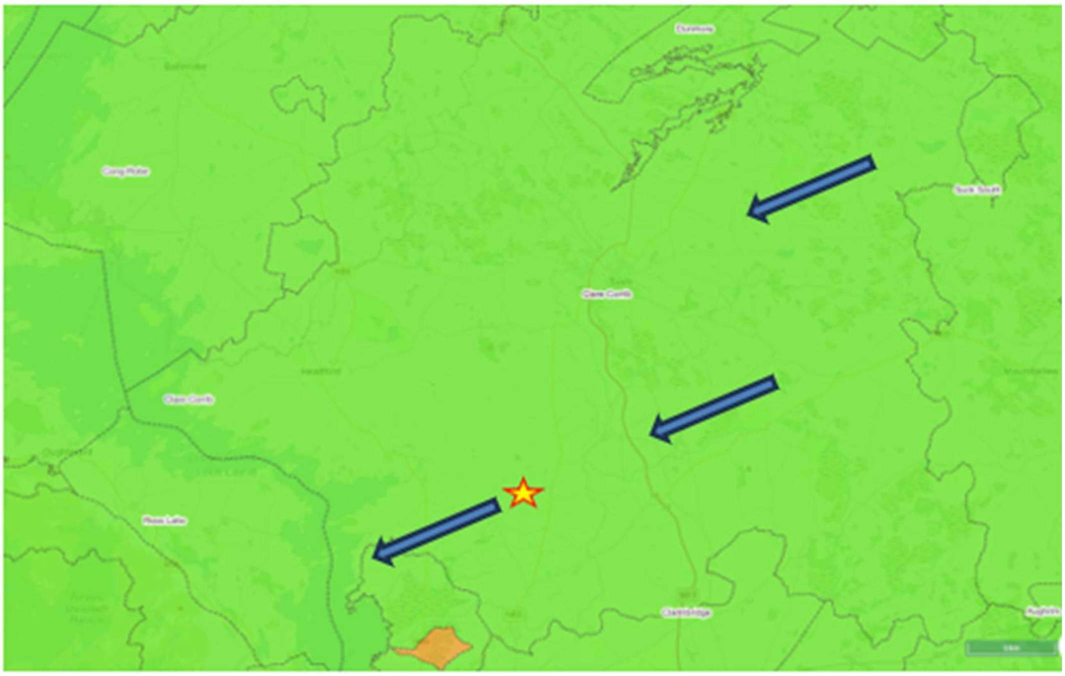


Figure 8.6 EPA (2024) presentation for the Clare Corrib GWB & its Good Status.
(Hydro-G Annotation for the approximate location of Harrington's Ardgaineen quarry).

This groundwater body is reported to have an approximate area of 1,422km2 (GSI, 2004) and its associated surface water features include the Cregg River, River Clare and Lough Corrib. The GSI (2004) has described regional groundwater flow and gradients as follows:

- *"__Overall, flow directions are to the southwest, with all groundwater discharging to L. Corrib.__ Although, there are six surface water catchments within the GWB, a key aspect is that groundwater can flow across the surface water divides and beneath surface water channels, as evidenced by the tracer test data.*

- *These rocks are generally devoid of intergranular permeability. Groundwater flows through fissures, faults, joints and bedding planes. In pure bedded limestones these openings are enlarged by karstification which significantly enhances the permeability of the rock. Karstification can be accentuated along structural features such as fold axes and faults. Groundwater flow through karst areas is extremely complex and difficult to predict. As flow pathways are often determined by discrete conduits, actual flow directions will not necessarily* *be perpendicular to the assumed water table contours, as shown by several tracing studies (Drew and Daly, 1993).*

- *Flow velocities can be rapid and variable, both spatially and temporally. Rapid groundwater flow velocities indicate that a large proportion of groundwater flow occurs in enlarged conduit systems. Groundwater flow in highly permeable karstified limestones is of a regional scale. Flow path lengths can be up to a several kilometres.*

- *Overall, groundwater flow will be towards the River Clare and L. Corrib, but the highly karstified nature of the bedrock means that locally groundwater flow directions can be highly variable."*

8.4.7 Groundwater Flow Direction

Based on GSI published information, above, regional scale groundwater will flow towards Lough Corrib. A Karst Conduit Aquifer classification is of significance to how groundwater might move through conduits, or pipelines or corridors of void space, in the bedrock mass. Limestone is a sedimentary rock that was formed as sediment settled on the beds of prehistoric oceans and was compressed. There is no primary porosity in limestone bedrock, which means that it is not porous like a sponge, there is no contiguous water content in this Karst Conduit limestone bedrock. Groundwater flow in karst conduit bedrock is conceptualised as the plumbing system pipe network of a town's water distribution or storm network or as the pipes connecting radiators in a home and this is well documented by researchers at Trinity College Dublin in their Gort Flood Risk body of work.

The most important hydrogeological concept is where the groundwater will move to after it passes through conduits or corridors under the site. Hydro-G offers that the widely published conceptual understanding of overall groundwater flow direction, as repeatedly cited by the GSI and EPA, is that likely groundwater flow direction from the site will be in the general direction of Lough Corrib. Whilst there may be deflections and meanderings of conduits that influence groundwater flow direction along the way, ultimately all groundwater is trying to escape to the nearest and largest surface water system, which in this case is Lough Corrib. Lough Corrib's shores sit at an elevation of c.5m OD, the proposed greenfield application area is c.40m OD and it is proposed to bring the floor to the approximate same elevation as the shore of Lough Corrib, which is c.10km away in the likely south westerly direction of groundwater flow.

As flow pathways are often determined by discrete conduits, actual flow directions will not necessarily be perpendicular to the assumed water table contours, as shown by several tracing studies in the wider landscape of the Clare Corrib GWB (Drew and Daly, 1993), which showed that:

- Groundwater can flow across surface water catchment divides and beneath surface water channels.
- Flow velocities can be rapid and variable, both spatially and temporally.
- Rapid groundwater flow velocities indicate that a large proportion of groundwater flow occurs in enlarged conduit systems.
- Groundwater flow in highly permeable karstified limestones is of a regional scale. Flow path lengths can be up to a several kilometres, for example 9.6 km from Ballyglunin Cave

to Aucloggeen Spring.

- Overall, groundwater flow will be towards the River Clare and Lough Corrib, but the highly karstified nature of the bedrock means that locally groundwater flow directions can be highly variable.

8.4.8 EPA Groundwater Quality Results

There is an EPA National Groundwater Monitoring Point at location relatively close to the site: Corrandulla (GWIE_WE_G_002012000008) at c.3km downgradient = downstream in the context of groundwater flow and impact potential.

There is an upgradient station at 16km Barnaderg (GWIE_WE_G_002012000003) at c.17km to the north east but this is too far away and upgradient. It is of no relevance to this Impact potential assessment.

All Water Quality is available at https://www.catchments.ie/data.

The National dataset for groundwater quality in the last ten years at the EPA Corrandulla Monitoring Sation is presented in Table A(5) (a & b) of Appendix 8.4 with the Threshold Values of the Groundwater Regulations (2010, as amended) and Hydro-G's explanation of the significance of the results. The National data for 2021 – 2025 confirms the same message as the EPA's mapping for historical Good Status (2016-2021) and 3rd Cycle Not at Risk WFD mapping. With respect to the data in Table A(5) (a & b) of Appendix 8.4, the following can be stated:

- Alkalinity = Results are normal for VERY Hard water = normal for limestone.
- Ammonia = Groundwater Ammonia is Always compliant & a FRACTION of TV.
- Chloride = Always compliant.
- Electrical Conductivity = Always compliant.
- Nitrate N = Groundwater Nitrate N concentration reported, when converted, is still a fraction of the NO3 TV. Low values. Always compliant
- Nitrite N = Low concentrations, always compliant.
- Ortho-P as P = Always compliant.
- pH = Although the GW Regs do not specify a pH range, the results suggest no impact potential for the downstream SW receptors.
- Temperature = Typical GW Range. Normal.
- Total Organic Carbon = Low Organic Carbon content = pure groundwater.
- Total Organic Nitrogen = Low.
- Total Phosphorus = not a specified GW Regs parameter. In any case, it is not excessive.

In previous assessments at the site, upgradient groundwater quality was presented for GWS monitoring data supplied by Galway County Council (e.g. Anabally Cummer, Balroebuckbeg, Carraghy Claregalway) as follows: Groundwater Ammonium levels <0.01 mg/l NH4; Nitrate levels < 10 mg/l NO3; < 0.005mg/l

Nitrite N; Chloride levels 25 mg/l Cl; 7.2pH, on average. Therefore, the historic data is comparably good quality, low nutrient, similar to the current EPA record published.

Overall, it can be concluded that the downgradient groundwater quality is good. The EPA's published data evaluated using the dataset for the last ten years, most recent being April 2025, suggests no measurable impact arising from long term operation of the quarry. On the basis of groundwater quality at the site, WFD Good Status, results for the EPA Corrandulla Groundwater Monitoring Station for the last ten years (2016 – 2025) (Appendix 8.4, Table A5) and monitored discharge quality (Appendix 8.1), the site has not compromised WFD Objectives. The site is deemed to be operating without presenting a threat to WFD Objectives. WFD compliance is concluded.

A separate, stand alone, WFD Compliance Report accompanies this application.

8.4.8.1 Groundwater Vulnerability

Groundwater vulnerability for the application site is mapped by the GSI as ranging from to Rock at Surface (X) to Extreme (E). Due to the nature of quarrying, which requires removal of overburden, the groundwater vulnerability rating at all quarry sites will be Extreme or Rock at Surface. This is normal for all quarries. Groundwater vulnerability mapping is shown as Figure 8.7.

Figure 8.7 GSI groundwater vulnerability mapping.

8.4.8.2 Local Rainfall & Recharge

Using vulnerability classifications and hydrogeological settings, recharge coefficients can represent the ratio of precipitation that theoretically infiltrates vertically to the water table to that which moves as surface overland flow. Based upon a vulnerability classification of Rock at or near Surface or Karst in the main working quarry and most of the greenfield application area, with an Extreme vulnerability mapping for the peripheries of the greenfield application area, the recharge coefficient range applicable to the site is 60-85%. This indicates that under the current hydrogeological setting, approximately 15% of effective rainfall is available for surface runoff. In the region of the site classified as extreme vulnerability, the recharge coefficient range is 70-100%, with an inner range mean of 85%. The GSI presents Rainfall and Recharge information and maps the general area as follows:

- Effective Rainfall (mm/yr): 844
- Recharge Coefficient (%): 85
- Recharge pre-cap (mm/yr): 717

Within the quarry area itself, the nature of the rock matrix will have a low primary porosity and the rock itself is low permeability. Therefore, recharge to groundwater is unlikely to be low through the rock matrix – it occurs in the secondary porosity of these rocks: hence the name karst conduit. Rainfall runoff to the sump lagoon in the quarry floor is the primary mechanism for rainfall to move through and from the site. Within the greenfield lands that are also part of this application, mapped hydrogeological information is more or less the same as for the extracted quarry area. This is because the soil is mapped by the GSI as naturally thin in most of the greenfield area.

8.4.8.3 Aquifer Classification

The quarry and greenfield site are underlain by an aquifer classified as Regionally Important Karst Conduit (RKc). The area of this aquifer is reported by the GSI to be 7062.74 km2. Again, in terms of scale, the site represents 0.003% of the total mapped aquifer area. This has significance in terms of small scale and potentials for impact at the aquifer scale. The GSI mapped Aquifer Map is shown as Figure 8.8.

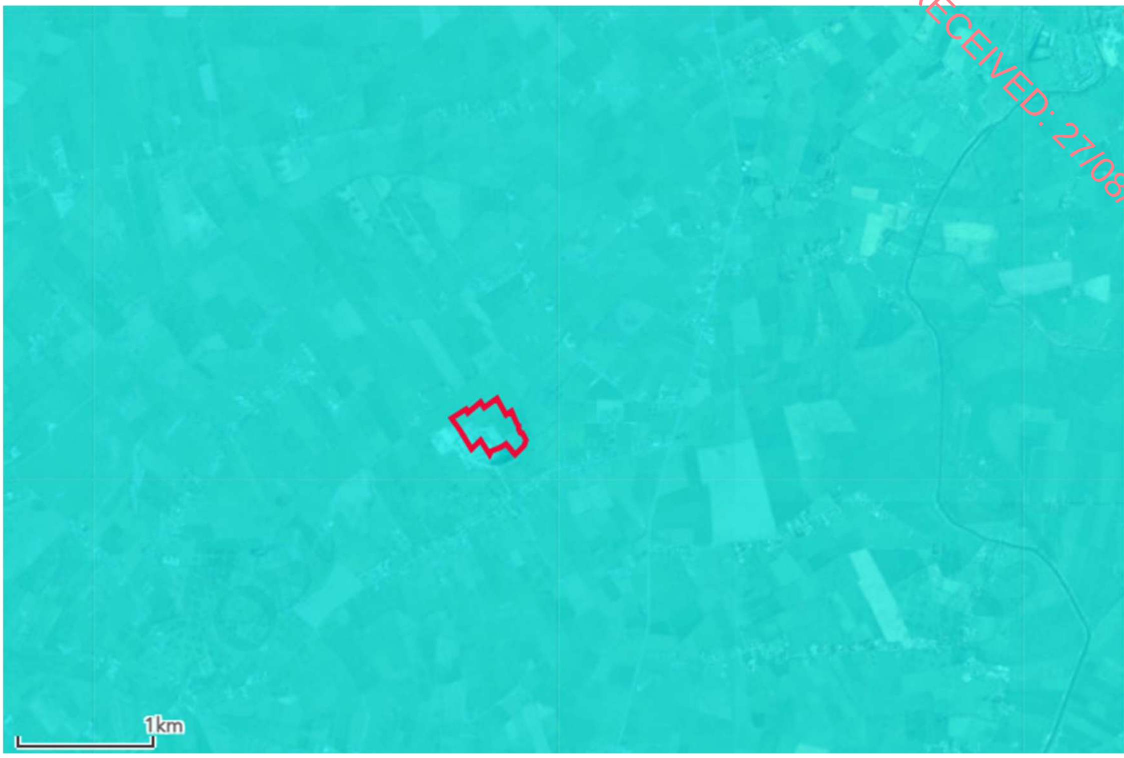


Figure 8.8 Aquifer Mapping.

The GSI (2004) reports that these rocks are generally devoid of intergranular permeability. Groundwater flows through fissures, faults, joints and bedding planes. In pure bedded limestones these openings are enlarged by karstification which significantly enhances the permeability of the rock. Karstification can be accentuated along structural features such as fold axes and faults. Groundwater flow through karst areas is extremely complex and difficult to predict.

8.4.8.4 Mapped Karst

Karstification is the process whereby fissures, faults and joints in the purer units of limestone are enlarged by dissolution. Karstification can considerably enhance the permeability of limestone which has essentially no inter-granular permeability. The area is characterised by numerous karst features such as springs, swallow/sinkholes, sinking streams, turloughs, seasonal lakes and caves and GSI mapping for karst landforms are shown in Figure 8.9, which also shows GSI tracer lines for known underground water systems in the area.

There are no **mapped** karst features at the discharge location or the quarry itself. Hydro-G evaluated the discharge zone and its surrounding area and found no obvious expressions at ground level. There are a couple of water bearing zones in the walls of the quarry and the experience of the quarry manager is that the water coming out from the walls is directly related to pumping water to the discharge area.

Regionally, Turloughs, Springs, Caves and Enclosed Depressions abound in this landscape. There is a mapped cave (1123NEK018) in the townland of KILCURRIVARD at a distance of 2 km north, another cave in the townland of CORBALLY at a distance of 2.3 km to the southeast, AUCLOGGEEN SPRING

(1123SEK012) & cave 3 km downgradient at Cregg, to which Drew & Daly (1993) traced from Ballyglunin Cave (1423NWK016) at a distance of 10 km to the NE and a tracer travel time of 200m/hr. It is therefore known that an input of chemicals can travel 10 km in 50 hours or 2 days, approximately, if it finds an appropriate conduit similar to that evaluated by Drew and Daly (1993).

There are many turloughs in the wider area. There are many karst features not mapped by the GSI.

There are anecdotal reports of caves by locals and there are townlands with the 'Pola...' name that suggests holes in the ground. The historic 6" OSI maps shown many caves in lands remote from the application area but none are mapped in direct vicinity of the application area. There is a 6" mapped cave c. 3km to the north in Kilcurrivard townland and others such as Caheraboley Cave at c. 2km to the northeast of the quarry and on the southern boundary of Caheravoley townland.

However, within radius of influence of the quarry, there are no caves mapped by the GSI or described by the cavers Boycott *et al*. (2019). Walkover by karst hydrogeologist, Pamela Bartley, found no evidence at ground level of subterranean karst in the application area.

Boycott *et al*. (2019) document known caves in North and East Galway and the only cave of note is Ballyglunin cave, which is c.8km to the north west of the application area under consideration and the GSI's mapped tracer data suggests that that there is no connection.

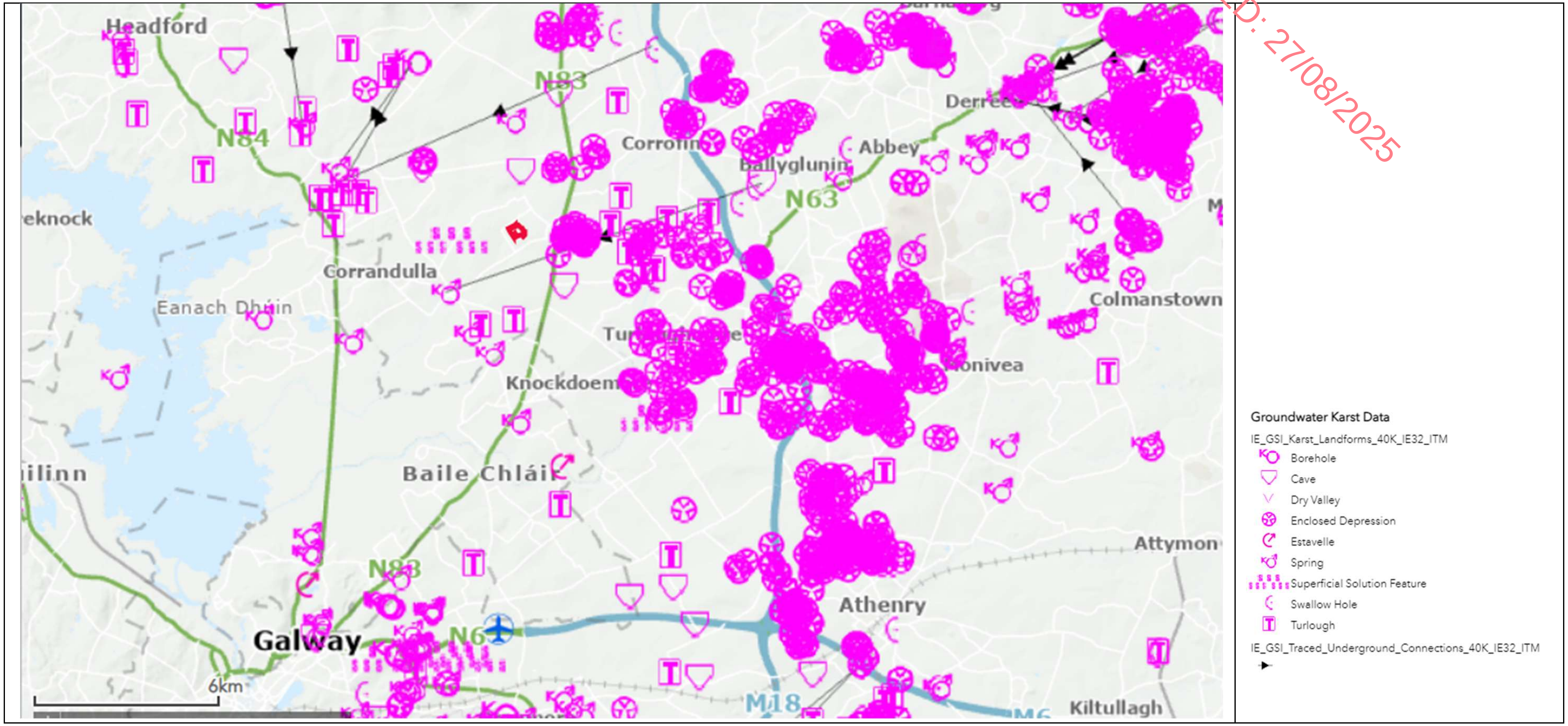


Figure 8.9 Application Site Red Line Boundary (between Corofin and Corrandulla) and GSI Karst Mapping.

8.4.8.5 Large Springs & Known Abstractions

Large springs and large known abstractions are listed in the GSI Groundwater Body Descriptor Sheet for the Clare Corrib GWB (2004) as follows:

Large Springs (GSI, 2004):

Corrandulla GWS (6,764 m3/d)
Kilbannon GWS (5,995 m3/d),
Mullacultra GWS (3,270 m3/d)
Barnaderg Group Scheme (5,000 m3/d),
Ballyhaunis WSS (12,000 m3/d)
Tobernanny,
Gortgarrow Spring (Dunmore Glenamaddy PWS) (2,500 m3/d)
Lettera

Large known borehole abstractions (GSI, 2004):

Gallagh GWS (523 m3/d)
Rusheens Tuam GWS (114 m3/d)
Roadstone Ltd (227 m3/d)
Belclare (114 m3/d).

Hydro-G assesses that the situation of the quarry in the Clare Corrib GWB is at a distance of 1.6km from the Cregg River rising from a spring to the southwest of the site. This is a potential receptor. The EPA monitor this location. However, that spring is also an EPA water quality monitoring station and its historically reviewed results, in previous application documents and assessments completed by Hydro-G, suggest no quarry signature or any indication of linkage. Recent data will be presented later and evaluated in terms of Biological and Hydrochemical quality.

With respect to all other springs and abstraction boreholes, they are not connected to the quarry in terms of likely groundwater flow direction. Refer to associated Section texts in the following sections for expansion of explanation. However, there is no change in the previously reported assessment position of Hydro-G in which it has always been concluded that there is no potential for any interaction between the quarry, groundwater and those springs listed in GSI (2004).

8.4.8.6 GSI Mapped Wells & Groundwater Users

Uisce Eireann supplies mains water in the area. The public supply runs along and serves residences on all perimeter roads bounding the quarry.

There are no mapped wells on the GSI database within 2.5km of the site. The closest mapped wells to the site are presented in Figure 8.10.

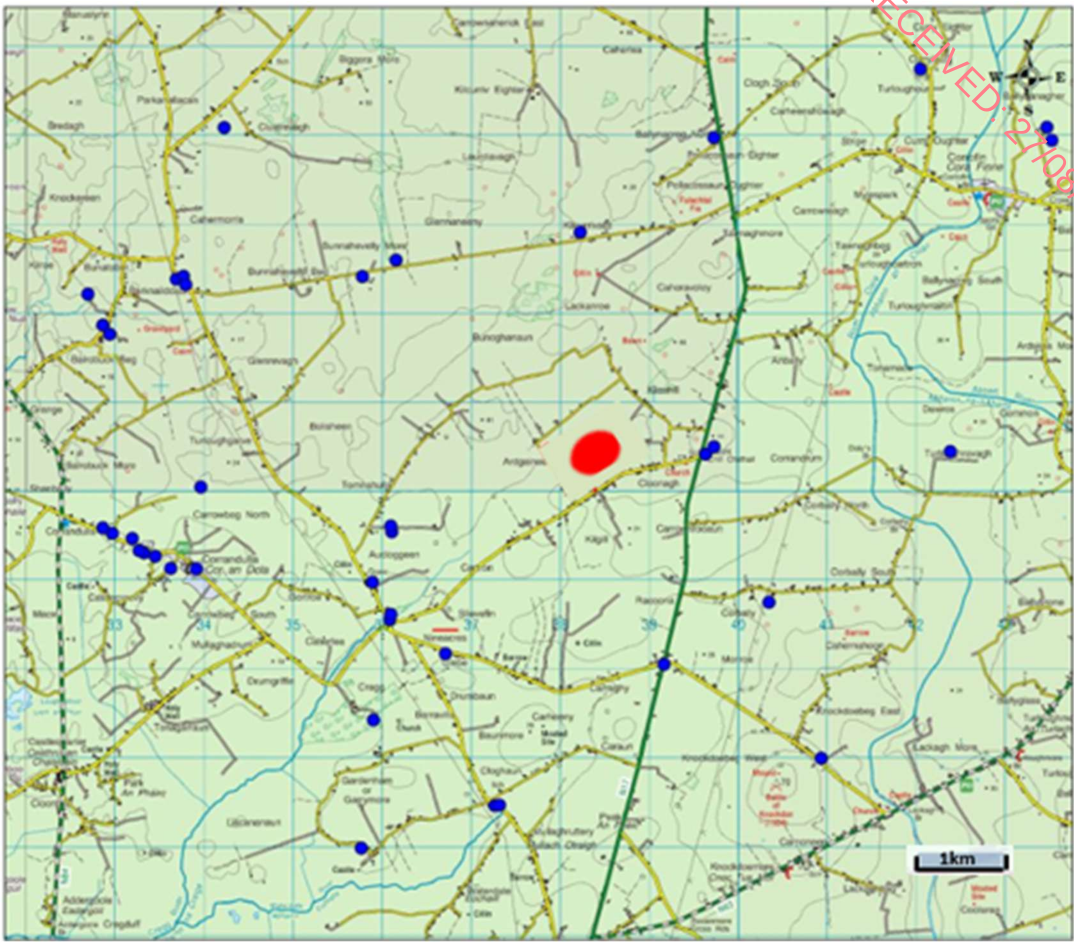


Figure 8.10 Indication of Application Area and Mapped Wells

Regional Group Water Scheme (GWS) wells, as presented by the National Federation of Group Water Schemes (2018), are presented in Figure 8.11.

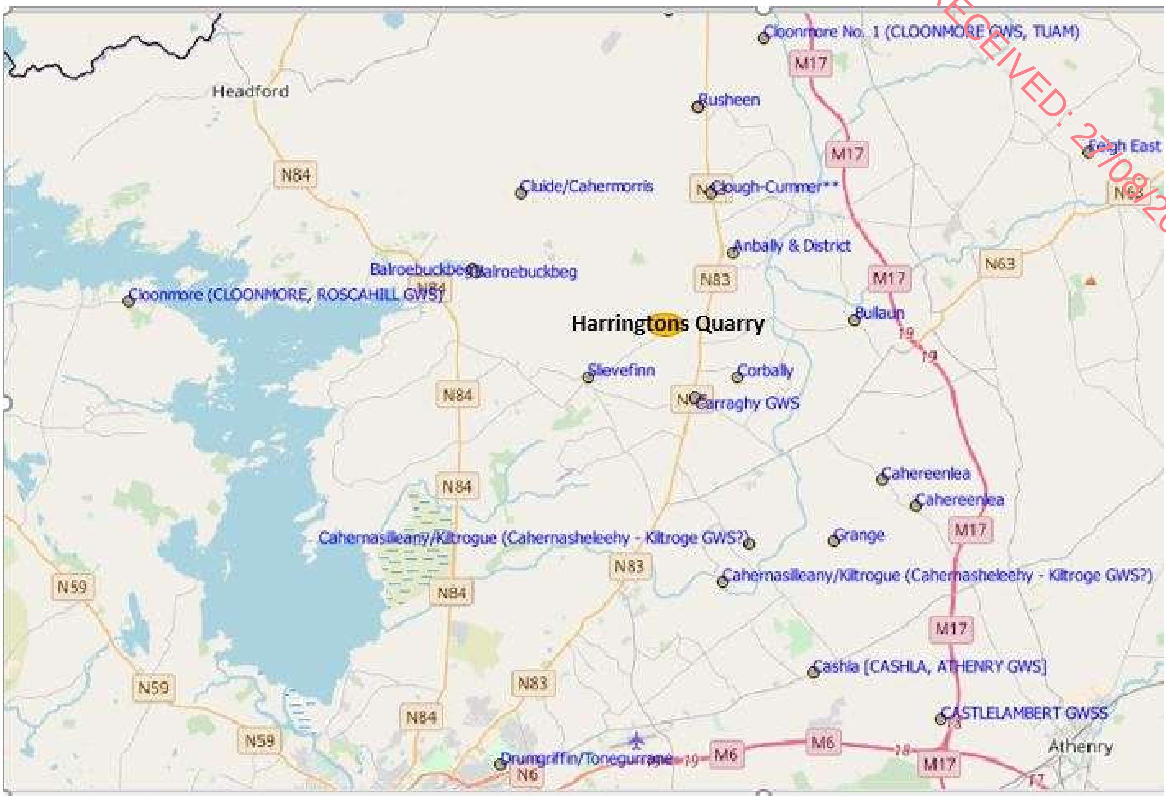


Figure 8.11 regional GWS Locations

There are no public water supplies and no GWS abstractions in such proximity to the site that they could be affected by the development. Field surveys completed in the past returned no obvious wells close to the site that were accessible to a dipmeter for measuring water level.

As part of a previous assessment at the site (2015), consultation with Galway County Council's Water Services (Ms Fiona Holland) with respect to the GWS boreholes that have been taken in charge by Galway County Council, since uploaded on the GSI well database, and all are now supplied by water from Galway County Council. I am satisfied that there are no GWS abstractions within radius of influence of the subject quarry's operations. In 2018 I confirmed this with the NFGWS (Ms Karen Carney). These consultations confirmed that there are no Public Water or GWS abstractions within 5km radius downstream of the site.

Therefore, given the recharge and flow mechanisms, the quarry does not pose a threat to water supply wells. Those Zones of Contribution (ZOCs) mapped by the GSI in the Clare Corrib GWB and directions of groundwater flow are presented as Figure 8.12.

Figure 8.12 Harrington's Quarry, Regional GWS Zones of Contribution and Groundwater Flow.

The potential Zones of Contribution of many GWSs in this GWB have been delineated by the GSI. Zones of Contribution (ZOCs) mapped by the GSI in the Clare Corrib GWB and directions of groundwater flow were presented as Figure 8.12. The mapped ZOCs, distance from the quarry to each well and the potential radius of influence of the quarry's maximum permitted dewatering volume of 1,483 m3/d suggests with confidence that the NFGWS wells are outside the potential sphere of hydrogeological reach of the quarry. This conclusion is supported by calculations as follows:

- The area directly surrounding the quarry which is required to support an annual MAXIMUM abstraction of 1,483 m3/day is c. 1.4km2 based on mapped groundwater recharge amounts mapped by the GSI AND Hydro-G's application of a factor of safety = 2, in order to provide conservative estimations for the Karst system.

- A ZOC area of ~1.4 km2 can be converted to a radius of c. 750 m from the quarry.

The closest mapped GWS's are Slievefinn, Caraghy, Corbally & Anbally & District. The distance of each of these from the quarry are as follows:

- Slievefin GWS = 2.8km distance
- Caraghy GWS = 2.6 km distance
- Corbally GWS = 2.3 km distance
- Anbally & District = 2.8 km distance

It is therefore clear that the radius of influence of the quarry, calculated to be c. 750 m for the maximum Emission Limit Value for discharge (dewatering) with a factor of safety of 2 applied, does not extend to any GWS's. Similarly, for all wells in the area, Figure 8.10 shows GSI mapped wells and there are no wells within the calculated c. 750 m radius of influence from the quarry.

8.4.9 Water Framework Directive Mapping, Status & Risk

EPA Envision mapping provides information on WFD names, codes, status, risk and report links for all cycles of the WFD, for which Ireland is currently in its 3rd Cycle of WFD assessment and reporting.

WFD data are available to all at https://gis.epa.ie/EPAMaps/Water and it is this mapping resource that has been used to populate the Desk Study baseline and WFD assessment, which is reported at the end of this Chapter.

All 3rd Cycle information for the Corrib catchment (HA30), and its associated waterbodies, is reported in a May 2024 3rd Cycle report available at https://www.catchments.ie/data/#/catchment/30.

With respect to surface water (hydrology) the Corrib Catchment (HA30), which has been described earlier in the Section Heading name HYDROLOGY, is the **macro** scale of WFD assessment and reporting. On this large macro scale, the 3rd Cycle Report for the Corrib Catchment (HA30) (EPA, 2024) suggests as follows:

- Sixty-nine percent of surface water bodies were at Good or High Ecological Status in the 2016-2021 monitoring period.
- Ninety-seven percent of groundwater bodies were at Good status.

With respect to groundwater (hydrogeology) underlying the application quarry, the Groundwater Body (GWB) underlying the site is reported by the EPA for WFD Compliance, as follows: Clare Corrib GWB [IE_WE_G_0020]: Good Status (2016-2021) & 3rd Cycle NOT AT RISK. Therefore, the underlying Clare Corrib GWB is one of the 97% achieving its Objectives. The quarry has operated through all WFD Cycles and at no stage has it ever been reported by the EPA report as a Pressure.

With respect to the site's associated surface waters, as previously described in the Section Hydrology:

- Cregg_010 [IE_WE_30C030150], rising 1.8km to the south west, is mapped by the EPA as Poor Status & A Risk. As previously stated, the Poor Status and 3rd Cycle At Risk is reported by the EPA as attributed to Hydromorphological changes caused by others – nothing to do with the quarry. As previously stated, consultation with LAWATERS in August 2025 (Mr. Francis Deery) confirmed that the reason for the Poor Status (2025) mapped for the Cregg_010 is because of channelisation and morphological alterations in the vicinity of the EPA Station 'SW Liscananaun' at a distance of 6km from the quarry. Deepening channels and changing morphology are changes made by landowners or state agents managing the river under the Arterial Drainage Act. Later in this chapter and in Appendix 8.4, with commentary, the actual hydrochemical results from the EPA's published hydrochemical and biological data downstream of the application quarry are presented. It is noted that at the closest hydrochemical monitoring point to the quarry with published data [EPA Monitoring Station 'Bridge near Drumgriffin' @ 3.5km to the south west of the quarry] suggests that the hydrochemical quality of the water meets

High Status Objectives of the Surface Water Regulations (2009, as amended) & the Biological Quality is reported as Q4 (2024) Good Status. However, farther downstream at EPA Monitoring Station 'SW Liscananaun' the Q Rating is Q3 (2023) Poor Status because of the EPA (2024) reported morphological challenges on the river, which create dark and stagnant waters with no flowing riffle zones required for good ecological health. The quarry plays no part in this Poor Status or Risk. All hydrochemical markers generally suggest High Status close to the quarry and its discharge.

- Lough Corrib Lower [IE_WE_30_666a] due west of the quarry is Good Status (2016 – 2021) & 3rd Cycle Risk = NOT AT RISK. Lough Corrib Upper [[IE_WE_30_666b] is Good Status (2016 – 2021) & 3rd Cycle Risk = NOT AT RISK.
- As previously stated, the quarry is not mapped by the EPA as part of the sub basin of the Clare [Galway] River. Therefore, its Status and Risk are not considered here. It is noted that the Clare [Galway] River, to the east of the site, is the closest mapped boundary of the Lough Corrib SAC and SPA to the quarry. However, as stated, the quarry is not part of the Clare [Galway] River sub basin.

The quarry's discharge has been ongoing throughout the EPA monitoring and reporting phases and the quarry has neither affected status nor the achievement of the environmental objectives established for the body of groundwater into which the discharge is made.

8.4.10 Designated Sites

The quarry, the adjacent greenfield lands and the quarry's discharge zone sit within the Corrib catchment and Lough Corrib has designation as a European Site (Lough Corrib SAC, Site Code 000297; Lough Corrib SPA Site Code 004042). Lough Corrib has two Statutory Instruments attached to it, as follows:

- The European Communities Conservation of Wild Birds (Lough Corrib Special Protection Area 004042) Regulations 2012, and
- The European Communities Lough Corrib Special Area of Conservation 000297 Regulations 2022.

The quarry and the relative locations of the NPWS mapped designated sites were shown on Figure 8.1 at the regional scale. A more focussed Figure 8.13 presents the designated sites with their named labels for ease of reference.

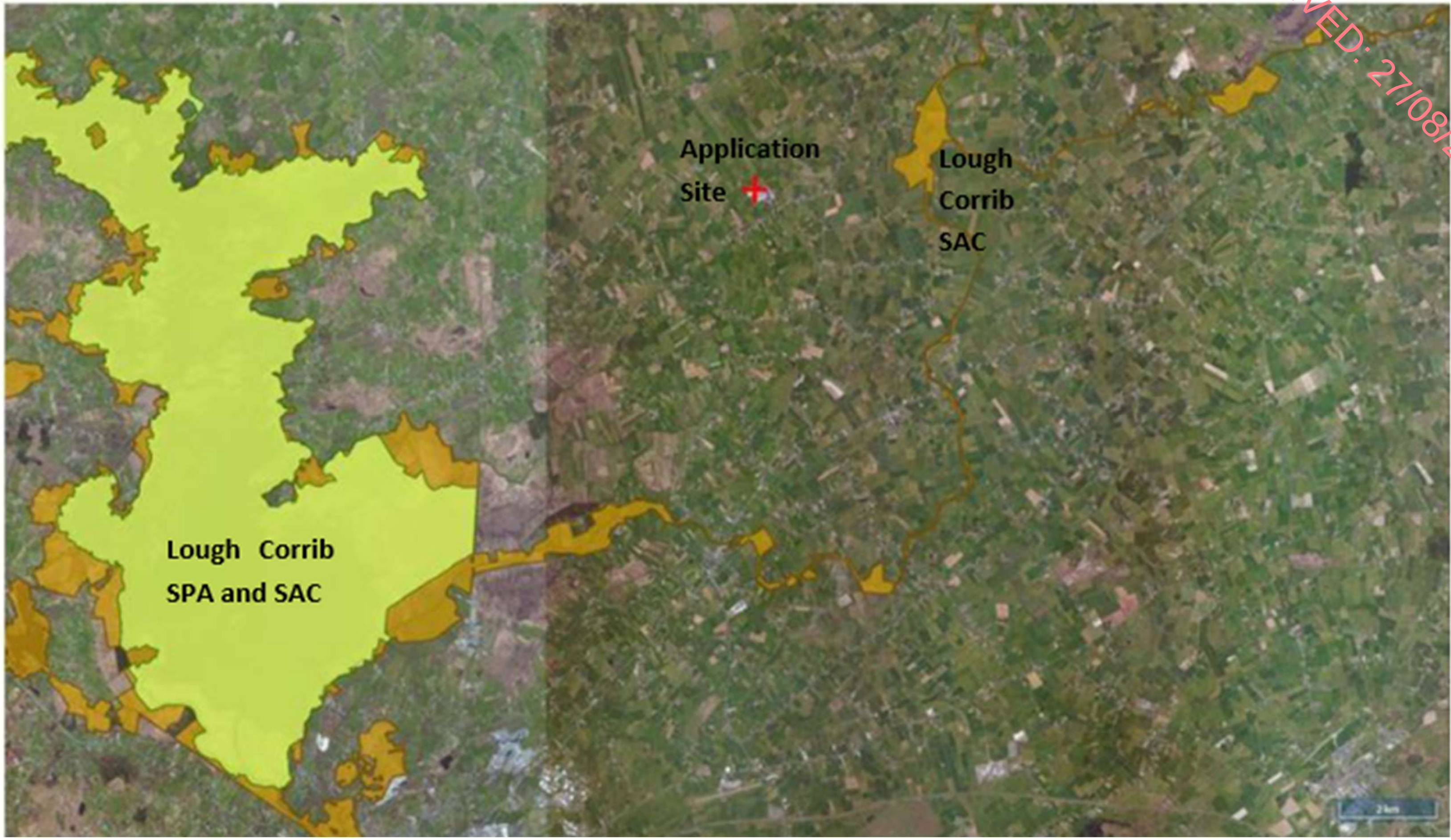


Figure 8.13 Application site location relative to labelled Designated sites.

Lough Corrib SAC and SPA are c.8km due west of the proposed greenfield application area and c.10km in a south westerly direction, which is the direction of groundwater flow. Lough Corrib is situated to the north of Galway city and is the second largest lake in Ireland, with an area of approximately 18,240 ha (the entire site is 20,556 ha). The lake can be divided into two parts: a relatively shallow basin, underlain by Carboniferous limestone, in the south, and a larger, deeper basin, underlain by more acidic granite, schists, shales and sandstones to the north. The surrounding lands to the south and east are mostly pastoral farmland, while bog and heath predominate to the west and north. A number of rivers are included within the SAC as they are important for Atlantic Salmon. These rivers include the Clare, Grange, Abbert, Sinking, Dalgan and Black to the east, as well as the Cong, Bealanabrack, Failmore, Cornamona, Drimneen and Owenriff to the west. In addition to the rivers and lake basin, adjoining areas of conservation interest, including raised bog, woodland, grassland and limestone pavement, have been incorporated into the site.

The NPWS Site Synopsis for Lough Corrib states as follows:

> *"The main threats to the quality of this site are from water polluting activities resulting from intensification of agricultural activities on the eastern side of the lake, uncontrolled discharge of sewage which is causing localised eutrophication of the lake, and housing and boating development, which is causing the loss of native lakeshore vegetation. The raised bog habitats are susceptible to further degradation and drying out due to drainage and peat cutting and, on occasions, burning. Peat cutting threatens Addergoole Bog and already a substantial area of it has been cut away. Fishing and shooting occur in and around the lake. Introduction of exotic crayfish species or the crayfish fungal plague (Aphanomyces astaci) could have a serious impact on the native crayfish population. The bat roost is susceptible to disturbance or development.*
>
> *Despite these ongoing issues, however, Lough Corrib is one the best examples of a large lacustrine catchment system in Ireland, with a range of habitats and species still well represented. These include 15 habitats which are listed on Annex I of the E.U. Habitats Directive, six of which are priority habitats, and nine species which are listed on Annex II. The lake is also internationally important for birds and is designated as a Special Protection Area."*

Lough Corrib SAC (Site Code 000297)'s qualifying interests and conservation objectives are set out in the site synopsis report and conservation objective report [both are available at www.npws.ie]. As stated, Lough Corrib SAC has its own Statutory Instrument issued in 2022 as the European Union Habitats (Lough Corrib Special Area of Conservation 000297) Regulations 2022. S.I. No. 384/2022.

The Lough Corrib SAC site is designated for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive

- [3110] Oligotrophic Waters containing very few minerals
- [3140] Hard Water Lakes
- [3260] Floating River Vegetation
- [6210] Orchid-rich Calcareous Grassland*
- [6410] Molinia Meadows

- [7110] Raised Bog (Active)*
- [7120] Degraded Raised Bog
- [7150] Rhynchosporion Vegetation
- [7210] Cladium Fens*
- [7220] Petrifying Springs*
- [7230] Alkaline Fens
- [8240] Limestone Pavement*
- [91A0] Old Oak Woodlands
- [91D0] Bog Woodland*
- [1029] Freshwater Pearl Mussel (*Margaritifera margaritifera*)
- [1092] White-clawed Crayfish (*Austropotamobius pallipes*)
- [1095] Sea Lamprey (*Petromyzon marinus*)
- [1096] Brook Lamprey (*Lampetra planeri*)
- Version date: 19.08.2013 2 of 5 000297_Rev13.Doc
- [1106] Atlantic Salmon (*Salmo salar*)
- [1303] Lesser Horseshoe Bat (*Rhinolophus hipposideros*)
- [1355] Otter (*Lutra lutra*)
- [1393] Slender Green Feather-moss (*Drepanocladus vernicosus*)
- [1833] Slender Naiad (*Najas flexilis*)

(* = priority; numbers in brackets are Natura 2000 codes)

Many of these habitats are groundwater (GWDTE) and surface water dependent therefore any potential impact on hydrology or groundwater levels has the potential to impact of these habitats. Hydro-G assesses that the habitats of special note, with respect to a quarry development having potential to impact Lough Corrib SAC are:

[3110] Oligotrophic Waters containing very few minerals

[3130] Oligotrophic to Mesotrophic Standing Waters

[3140] Hard Water Lakes

[7210] Cladium Fens*

[7220] Petrifying Springs*

[7230] Alkaline Fens

(* = priority; numbers in brackets are Natura 2000 codes)

It is worth noting, with respect to Groundwater Dependent Terrestrial Ecosystems (GWDTE), that the GSI has mapped an area for a Groundwater Body specifically for the GWDTE's on the eastern border of Lough Corrib: named GWDTE-Lough Corrib Fens 3 & 4 (SAC000297). Groundwater Body Delineations were presented in Figure 8.6. With respect to regional groundwater flow direction, the quarry is c.7km, approximately, upgradient of the closest boundaries of the GWDTEs on the south eastern shore of Lough Corrib.

The Lough Corrib SPA [Site code: 000297] is designated for both nationally and internationally important and significant birdlife. The full bird species list, Conservation Objectives and the Statutory Instrument of note (European Communities (Conservation of Wild Birds (Lough Corrib Special Protection Area 004042)) Regulations 2012. S.I. No. 455 Of 2012) is available at https://www.npws.ie/protected-sites/spa/004042.

There is a cluster of pNHA sites beyond 7km to the northeast of the site, including turloughs. These are upgradient of the quarry, in terms of groundwater flow and therefore are not deemed at risk of interference by activity at the quarry. Karst features (including Turloughs) were presented in Figure 8.9.

The Inspector's report for the 37L application (QD0014, 2013) refers to a submission from the Development Applications Unit specifically relating to nature conservation issues. It stated that "*the quarry is not near any nature conservation sites and its closest is approximately 2.3 kilometres from a European site the Lough Corrib cSAC to the east and 6.5 kilometres to the same SAC to the west*". The DAU submission also states that the main designated SAC protected area that could be affected by groundwater flow and surface water runoff/discharge from the site is ultimately Lough Corrib SAC. This is the only designated SAC protected area that is downstream of the site in terms of groundwater flow direction. The other protected areas are prior to the site in terms of groundwater flow direction and therefore groundwater migrating from the site is unlikely to be hydraulically connected to those upgradient areas, from a potential impact ability.

8.4.11 Geoheritage Sites

There are NO geological heritage sites located within a 5 km radius of the proposed development.

In the wider landscape, Geoheritage sites mapped by the GSI as follows:

(i) Knockmaa (GY082)
(ii) Pollnahallia (GY116)
(iii) Knockmaa Quarries (GY083)
(iv) Ballybanagher M17 Road Cut (GY010)
(v) Ballyglunin Cave (GY013)
(vi) Lough Corrib is also mapped as a Geoheritage site (GY093) under IGI Theme 14, 2 and 7. It is described as "A large lake situated between County Galway's western acidic uplands and the limestone lowlands and is of international conservation importance, for its lakeshore karst assemblages". Co-ordinates (ITM) 517968.525, 744210.183 or 523565E 741910N (Knockferry Pier).

Each of the GSI's Geoheritage site details were discussed in detail in Chapter 7 Lands, Soils & Geology and each Report was presented in Appendix 7-2. This assessment considered the proposed development's potential to interact with the geological heritage sites and determined that there is no Water and Geoheritage connection between the proposed application site and any

Geoheritage site except Lough Corrib and for that reason Lough Corrib is discussed in detail at the end of the chapter in a Section entitled Lough Corrib SAC Protection Measures.

8.5 Site Investigation Information for the Site

8.5.1 Intrusive Site Investigations at the Site

Environmental Impact Assessments have been carried out in connection with various planning applications at or near the site over the past 20 years. Substantive historical site investigation works have been carried out to support these assessments. As previously presented in Chapter 7, and purely to recap, intrusive site investigations completed at the site include, as follows:

- Geophysical Surveys of the Greenfield lands (2005) and the site's discharge zone (2021).
- Trial Pitting and Soils Laboratory Testing of Subsoil Samples.
- Bedrock drilling at 41 locations over the entire site.
- Hydraulic response tests in the floor of the quarry, the bedrock of the greenfield lands and the soils and subsoils of the discharge zone.
- Sampling and laboratory analysis of groundwater, quarry floor sump and discharge water samples.

In this Water Chapter, results of Site Investigations relating to the water environment are presented, as follows:

- Geophysical Survey Areas (Apex 2005 & 2021).
- Groundwater Strike information for Greenfield Application Area's boreholes.
- Hydraulic Conductivity for the bedrock across the site.
- Groundwater Quality in the Greenfield Application Area (2020. 2021, 2024, 2025).
- Discharge Data, which is the same as the floor's sump water

Prior to the presentation of data for Site Investigation (SI) locations, a map of the site and SI Locations is presented as **Figure 8.14.**

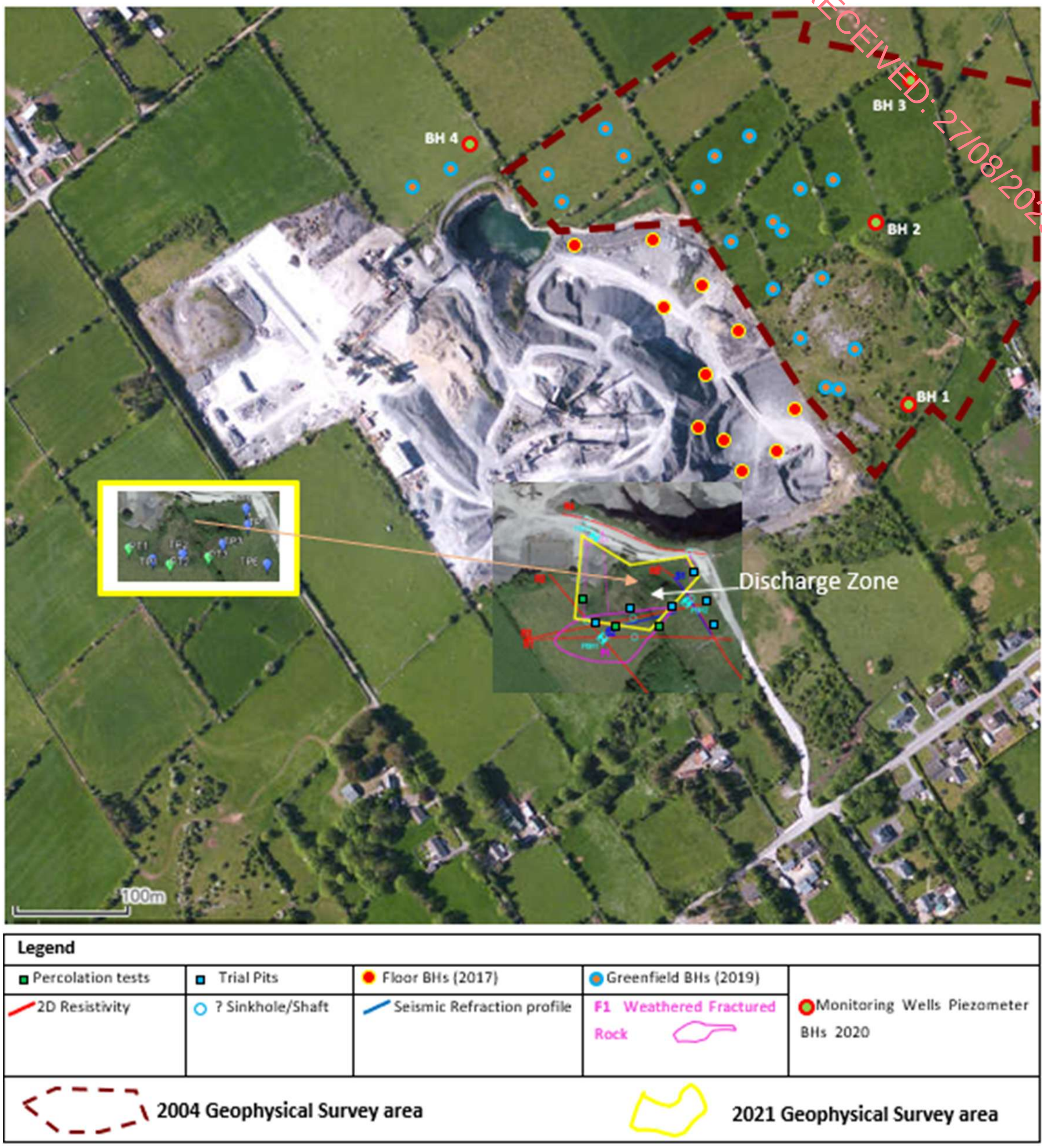


Figure 8.14 Entire site historic site Investigation Locations.

The results were presented in detail in Chapter 7 for all matters relating to Lands, Soils and Geology (e.g., Apex 2005, Apex 2021, Irish Drilling, 2021). In this chapter, only the headlines are presented, as follows:

- The subsoil is thin, as is expected in karst limestone environments.
- When drilled, the bedrock on the current operational floor is grey and black, solid, limestone, very hard, no conduits, no water strikes in the zone of the 10m OD floor elevation to base of hole depth drilled elevation of -8.6m OD. This is typical of the Burren Formation.

- In the greenfield application area, a detailed Apex Geophysical survey was ground truthed by 26 probing SI holes and then 4 Long Term Monitoring Well installations were installed.

- The overall conclusion of the Monitoring Well drilling (2020) is that groundwater strikes are between 38m and 44m bgl and given the slight differences in ground level at each of the drilling sites the water strike elevations range from approximately sea level: i.e. groundwater strike elevation @ -0.62m OD @ MW 03 location and significantly below sea level @ -6.89m OD @ MW04. The proposal is to bring the greenfield to 4m OD. Therefore, the proposal to extract rock will be above the groundwater flow system. This is also evidenced by the eastern wall of the quarry void in which no conduits are observed.

- With respect to hydraulic conductivity results, the saturated hydraulic conductivity results average at 10^{-8} m/s Ksat and this means that the limestone has the ability to conduct of water similar to a heavy clay. This is classic limestone matrix porosity with no ability to transmit water in the limestone itself. Hence, the karst CONDUIT Aquifer classification.

- In overall summary, with respect to hydraulic conductivities completed for various parts of the site, the following is noted:

    - Discharge Area top of rock @ 31m OD, approximately = epikarst Ksat = 10^{-5} m/s (Irish Drilling, 2021).

    - Greenfield area Ksat = 10^{-6} m/s.

    - Quarry Floor deep limestone bedrock @ 10m OD to -20m OD Ksat = 10^{-8} m/s.

- Saturated hydraulic conductivity results at different depths suggest that there is an order of magnitude reduction in hydraulic conductivity between the epikarst limestone, the bedrock at 25m bgl and again another 'order of magnitude' reduction in hydraulic conductivity in the bedrock at 50m bgl. However, these results are somewhat academic. These are the results for bedrock across the entire quarry site. The geophysicist's interpretation of the 2021 geophysical survey in the discharge area suggests potential conduits and by-pass mechanisms, which negates the use of bedrock hydraulic conductivity in any modelling for the site.

- In the Hydro-G (2022) presentation of information for Galway County Council's evaluation of the Section 4 Discharge licence for the site, the discharge of the quarry's waters was presented as a direct discharge, which is permissible under the Groundwater Regulations (2010) for quarrying activities. Considering that the discharge is waters collected on the floor that would have been intended for nature in any case, the activity merely maintains the natural continuum of the groundwater regime. Refer to Hydro-G's Discharge Licence Application report (Hydro-G, January 2022, which is presented in Appendix 8.1 with the resultant Section 4 Discharge Licence for the site: Reference No. Wat502/22).

Now results related to water are presented.

8.5.2 Water Quality

There are three water quality elements for the site:

1. Surface and Groundwater Quality, as presented by the EPA and available at the publically accessible Envision mapping and catchments.ie. Previously presented data in earlier sections and Appendix 8.4. Evaluation suggests good quality groundwater downstream of the site (Corrandulla EPA Station) and although the Cregg_010 has mostly High Status complaint chemical quality and Good Status Biological Quality immediately downstream of the site, its biological quality deteriorates farther downstream due to channelisation created risks that resulted in the EPA assigning Poor Status mapping for the Cregg_010, which has nothing to do with the site.

2. Groundwater Quality in the greenfield application area.

3. Discharge Quality, which is the integrator of the site and the environment in two ways: firstly, the quality of the discharge sample is representative of how site management affects the quality of rainwater runoff as it travels over the excavated rock surfaces at the site and of groundwater arising in the floor sump. Secondly, the quality of the discharge reflects impact potential for the downstream receiving environment. As stated in Section 8.3.2, the site's Section 4 Discharge Licence W/502/22 has Emission Limit Values (ELVs) that control the discharge's hydrochemical quality and Quarterly Monitoring Reports demonstrate compliance with those ELVs (Appendix 8.1, nine reports spanning 2023 – 2025).

8.5.2.1 Greenfield Application Area Groundwater Quality

Results for groundwater quality in the greenfield application area are available for winter (December 2020), Spring (March 2021), Summer (2021, 2024 and 2025). All Laboratory Analyses Certificates for the groundwater system under the greenfield application area are presented in Appendix 8.5, with tables for Historic Data (2020 and 2021). Results for parameters of note with respect to the Groundwater Regulations (2010, as amended) are presented in Table 8.5 for 2024 and 2025.

Table 8.5 Greenfield Summary Groundwater Quality 2024 & 2025 (Groundwater Regulation Parameters)

Harringtons Argaineen Groundwater Greenfield Groundwater Quality			May-24			May-25			
Parameter	**Units**	**GROUNDWATER Regulation's THRESHOLD VALUES 2010, as amended (Column's 3 & 4 TVs = General Quality & Human Consumption)**	**BH4**	**BH3**	**BH2**	**BH4**	**BH3**	**BH2**	**Hydro-G Comment**
PH	pH Unit	6 < pH < 9	8.1	7.5	7.65	7.3	7.1	7.1	COMPLIANT
Electrical Conductivity	uS/cm	1875 uS/cm	625	718	658	693	611	689	COMPLIANT
Chloride	mg/l	187.5	7.1	18.8	9.6	46.34	15.93	15.16	COMPLIANT
Sulphate	mg/l	187.5 mg/l	6.2	14.2	4.4	5.94	6.12	<2.5	COMPLIANT
Nitrate as N03	mg/l	37.5 mg/l as NO3	1.6	24	2.1	8.18	5.06	13.11	COMPLIANT
Nitrite as N02	mg/l	375 ug/l as NO2	0.03	<0.02	<0.02	<0.03	<0.03	0.03	COMPLIANT
TotaL Ammonium as N	mg/l	175 ug/l NH4-N	0.04	<0.03	<0.03	0.05	0.03	0.01	COMPLIANT
Orthophosphate as P04-P	mg/l	35 ug/l = 0.035 mg/l	<0.06	0.14	<0.06	0.01	0.01	0.04	COMPLIANT (with one exception 2024, OK in 2025)
Aluminium	ug/l	150 µg/l	20	20	20	<10	30	479	COMPLIANT
Cadmium	ug/l	150 ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.05	COMPLIANT
Zinc	ug/l	75 ug/l	11	<1	<1	<10	<10	<10	COMPLIANT
Mercury	µg/l	0.75	<1	<1	<1	<0.01	<0.01	<0.01	COMPLIANT
Total Petroleum Hydrocarbons	µg/l	7.5	<10	<10	<10	19	<10	<10	Compliant 5/6: anomalous result in 2025 BH4
Petrol Range Organics	µg/l	not specified	not measured			<10	<10	<10	No Petrol in the 19 ug/l BH4. Anomaly.
Benzo(a)pyrene	ug/l	0.0075	<0.005	<0.005	<0.005	<0.010	<0.010	<0.010	Compliant
Total PAH	ug/l	0.075	<0.173	<0.173	<0.173	<0.010	0.013	0.014	Compliant

Results for the greenfield application area's boreholes suggest, in the context of Column's 3 & 4 Threshold Values (TVs) for General Quality & Human Consumption, as follows:

- pH is neutral and Groundwater Regulation compliant.
- Electrical Conductivity ranges from 611 to 693 uS/cm, which is a limestone signal and Groundwater Regulation compliant.
- Chloride concentrations range from c. 7 to 46 mg/l Cl, complying with the TV of 187.5 mg/l.
- Nitrate concentrations range from 1.6 to 24 mg/l as NO3 and are compliant with the Groundwater Regulation Threshold Value of 37 mg/l.
- The Ammonium-N Threshold Value is 175 ug/l NH4-N (micrograms) and the values reported by the laboratory are in the range 0.01 and 0.05 mg/l (milligrams). On the basis of conversion from mg/l laboratory values, the results for the greenfield application area demonstrate compliance with the Groundwater Regulation Threshold Value.
- Similarly, nitrite concentrations are compliant with the requirements of the Groundwater Regulations, 2010, as amended.
- The greenfield's groundwater concentrations for metals Aluminium, Cadmium, Zinc and Mercury are compliant with the requirements of the Groundwater Regulations, 2010, as amended. In all cases, the results are < LOD (limit of Detection).
- Groundwater beneath the greenfield application area has < LOD for Total Petroleum Hydrocarbons, Benzo(a)pyrene and Total Polyaromatic Hydrocarbons (PAHs) with one exception in BH4 in 2025. However, that exceedance was not associated with an exceedance in Petrol Range Hydrocarbons. For 8/9 parameter results over the course of 2 years, there is compliance with the requirements of the Groundwater Regulations, 2010, as amended.

With respect to groundwater at the operational quarry, as stated in each of the nine Quarterly Compliance Monitoring Reports (Appendix 8.1), Condition 4 of the Licence states that "Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory". However, there are no wells on the operational quarry to which the Discharge Licence relates. Hydro-G has previously reported 11 Site Investigation boreholes on the floor of the quarry and none of those boreholes encountered groundwater strike. The aquifer is mapped as a Regionally Important Karst Conduit Aquifer. No groundwater transmissive conduits were discovered in the drilling completed on the floor of the operational quarry. Therefore, there is nothing to report with respect to Groundwater abstracted from boreholes in the operational quarry because no groundwater was found in boreholes at the operational quarry. Instead, the results for the site's discharge is the indicator of quarry water's quality.

8.5.2.2 Quarry's Discharge Quality Results

For an in depth detail on the long term historical record for discharge, readers are referred to the detail of Appendix 8.1, which presents the Hydro-G (2022) Assimilation Capacity Report and each of the nine Quarterly Compliance Reports (2023 – 2025) for the Section 4 Licence.

The Quarterly Compliance Reports (2023 – 2025) for the Section 4 Licence present a Table for the Quarterly hydrochemistry in the main body of the report and a Summary overarching Table for 'All Results' as the Appendix in each report. The collated results for discharge quality are presented in Table 8.6.

Table 8.6 Discharge Quality Results Harringtons.

2023 Results	Units	W/502/22 Emission Limit Value		Q2 2023	Q3 2023	Q4 2023
Hydrogen Ion (pH)	pH units	6 to 9		8.0	8.1	7.8
Biological Oxygen Demand (BOD)	mg/L	10.0		< 1.0	< 1.0	1.2
Suspended Solids	mg/L	10		< 4	< 4	< 4
Ammonium	mg/L N	0.03		0.03	< 0.02	0.03
Nitrate	mg/L N	18.00		1.47	1.22	1.73
Nitrite	mg/L N	0.05		0.012	< 0.005	< 0.005
Chemical Oxygen Demand (COD)	mg/L	15		< 10	< 10	< 10
Benzo(a)pyrene	µg/L	0.1		not analysed	not analysed	not analysed
Total Hydrocarbons	µg/L	10		not analysed	not analysed	not analysed
Total PAHs	µg/L	0.1		not analysed	not analysed	not analysed
Southern Scientific Laboratory Reference				93347 (23-29240)	96104 (23-30235)	113177 (23-36432)
2024 Results	**Units**	**W/502/22 Emission Limit Value**	**Q1 2024**	**Q2 2024**	**Q3 2024**	**Q4 2024**
Hydrogen Ion (pH)	pH units	6 to 9	8.0	8.1	7.7	7.8
Biological Oxygen Demand (BOD)	mg/L	10.0	< 1.0	<0.1	<0.1	<0.1
Suspended Solids	mg/L	10	<4	< 4	16	12
Ammonium	mg/L N	0.03	0.04	0.02	6.3	0.03
Nitrate	mg/L N	18.00	not reported	10.24	1.56	11.38
Nitrite	mg/L N	0.05	not reported	0.020	0.03	0.05
Chemical Oxygen Demand (COD)	mg/L	15	<10	< 10	11.00	< 10
Benzo(a)pyrene	µg/L	0.1	not reported	< 0.003	< 0.005	< 0.005
Total Hydrocarbons	µg/L	10	not reported	not reported	< 10.0	< 10.0
Total PAHs	µg/L	0.1	not reported	not reported	< 0.005	< 0.005
Southern Scientific Laboratory Reference			118896 (24-38390)	129163 (24-41909)	143769 (24-47350)	153060 (24-50550)
2025 Results	**Units**	**W/502/22 Emission Limit Value**	**Q1 2025**	**Q2 2025**		
Hydrogen Ion (pH)	pH units	6 to 9	7.8	7.7		
Biological Oxygen Demand (BOD)	mg/L	10.0	1.1	< 1.0		
Suspended Solids	mg/L	10	< 4	< 4		
Ammonium	mg/L N	0.03	< 0.02	< 0.02		
Nitrate	mg/L N	18.00	9.77	2.13		
Nitrite	mg/L N	0.05	0.02	< 0.005		
Chemical Oxygen Demand (COD)	mg/L	15	< 10	< 10		
Benzo(a)pyrene	µg/L	0.1	< 0.005	< 0.005		
Total Hydrocarbons	µg/L	10	< 10.0	< 10.0		
Total PAHs	µg/L	0.1	< 0.005	< 0.005		
Southern Scientific Laboratory Reference			160311 (25-00882)	174672 (25-06005)		
Green Highligt in Cells = Compliant: Harringtons Quarry Ardgaineen Co. Galway						

Results for the site's Discharge quality since the issue of the Section 4 Licence in June 2023 are presented in Table 8.7 with the compliance status highlighted in green, relative to the Section 4

Discharge Licence W/502/22's Emission Limit Values. Monitoring results suggest that the discharge quality is in compliance with the Conditions of the Licence for all parameters analysed for most parameters over nine quarters with the exception of a couple of Suspended Solids exceedances in winter 2024 and a completely anomalous Ammonium exceedance that was unexplainable by the laboratory in the context of zero other associated hydrochemical markers. At the commencement of the licence there were some sample list requisition misunderstandings but this issue is now clarified and now resolved.

8.5.2.1 Quarry's Discharge Volume Monitoring

Each of the nine Quarterly Compliance Reports (2023 – 2025) for the Section 4 Licence present a Table with Discharge Volume compliance results per month, graphs for continuous monitoring results for pH, Temperature, Electrical Conductivity and Turbidity, and Hydro-G commentary on compliance. Overall, it is concluded that the site complies with the Discharge ELV and the criteria for continuous monitoring.

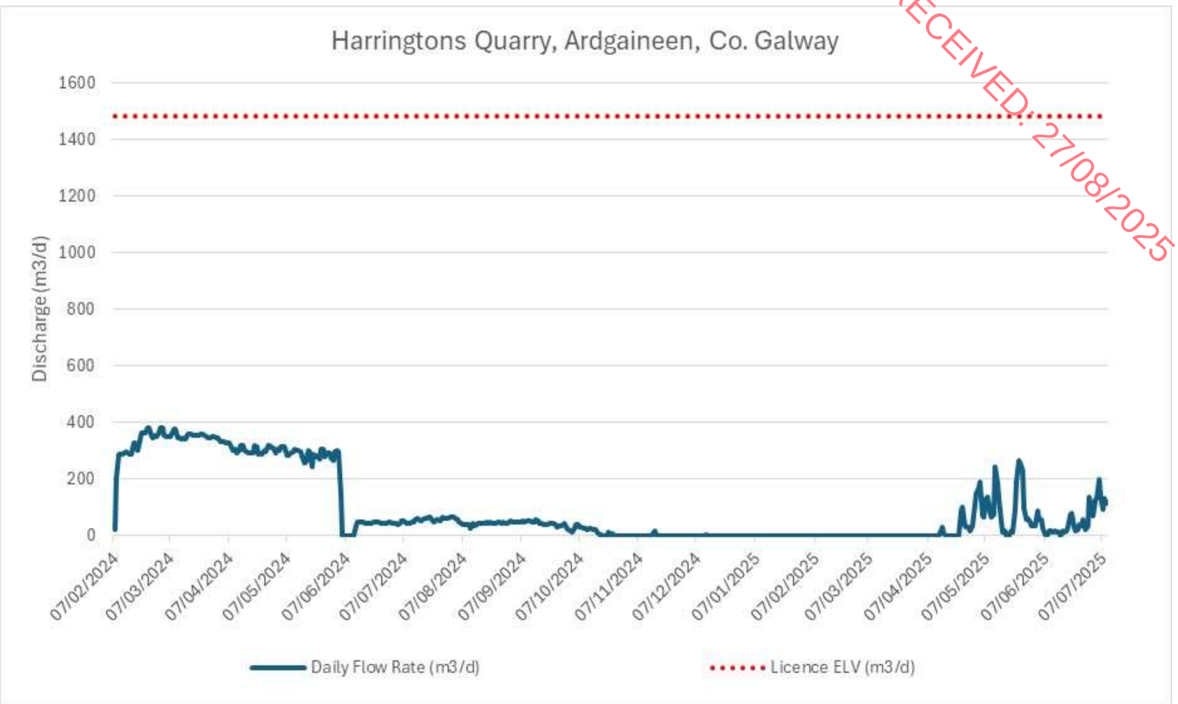
With respect to "1. Scope" detail of the Opening of W/502/22 Discharge Licence states that

> *"This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required."*

The information presented in this report enables Galway County Council to review the licence "*If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge*". In summary, there is adequate capacity in the Discharge Licence's ELV for Volume given that the 1,483m3/d is never remotely approached.

The Discharge Volumes for each day of each year monitored are presented as Graph 8.1.

Since the flow meter commenced digital recording, the site discharges an average of 94 m3/day of its maximum permitted 1,483 m3/day Emission Limit Value (ELV) for volume (discharge) specified in the Section 4 Discharge licence W/502/22. The reason the current average is so low is to save on energy (pumping) costs and to provide adequate water on site for necessary uses. The range of discharges recorded is zero to 382 m3/d.



Graph 8.1 Discharge Volumes for each day of each year monitored.

8.6 Conceptual Hydrogeological Understanding

Baseline and Site Investigation information is now used to present the conceptual understanding for the potential for interaction with, or effect on, groundwater flow in and around the site and with reference to downstream receptors.

From the quarry, although some deviations are expected in karst, overall groundwater flow direction will be towards Lough Corrib and most likely in the south westerly direction. Groundwater quality at the application site is good and discharge quality is good.

The hydrogeological environment is limestone bedrock that is classified by the GSI as Karst conduit. Drilling encountered no water bearing karst conduits under the working quarry's floor or beneath the greenfield area. Eleven boreholes were drilled on the quarry floor in December 2017 and no water strikes, no indication of conduits in the 10 mOD to – 8.6 mOD investigation range. No karst features were encountered. Hydraulic conductivity testing of the rock matrix in the floor boreholes reveals a solid limestone with little primary (matrix) porosity and no secondary permeability in the eleven borehole locations. This suggests that the spacing of the conduits is wider than the site area proposed for rock excavation. However, the 2021 geophysical survey suggested that there may be vertical shafts in the discharge zone, which is a zone that will never be developed in terms of rock excavation.

The discharge meter readings demonstrate that the average volume of discharge ranged from the zero to 385 m3/d and the discharge is deemed compliant with the Emission Limit Value of 1,483 m3/d of the Section 4 Licence. There is adequate headroom in the Licence to accommodate the proposed lateral extension.

On a regional scale, water balance suggests that the combined area of the existing quarry and the area proposed for development in this application will represent 0.1% of the volume of groundwater discharging to the Lough Corrib SAC system.

On a regional scale, groundwater flow in conduits has been traced by the GSI. This is evidenced in the one distinct conduit in the southern face of operational quarry that contributes groundwater to the floor of the quarry. The western, northern and eastern faces of the void are dry and devoid of any evidence of karst. Refer to Plate 8.6 in which the exposed quarry wall with the greenfield application area enables view of the competency of the subsurface limestone at the application site.

Plate 8.6: Exposure of Limestone Bedrock beneath the Greenfield Application Area.

With respect to the EPA Corrandulla Groundwater Monitoring station at c.3km downstream of the site, the data for the past ten years suggests there has been no impact on the receiving environment.

With respect to the closest EPA Surface Water Monitoring Station [Bridge near Drumgriffin]: the latest Biological Monitoring result is Q4 (2024) = Good Status and the hydrochemical dataset for this EPA location suggests compliance with the High Status Environmental Quality Objectives of the Surface Water Regulations (2009, as amended). The reason for the Poor Status (2025) mapped for the Cregg_010 is because of channelisation and morphological alterations in the vicinity of the EPA Station 'SW Liscananaun' at a distance of 6km from the quarry. Deepening channels and changing morphology are changes made by landowners or state agents managing the river under the Arterial Drainage Act. Hydro-G has presented, in Appendix 8.4 with commentary, the actual hydrochemical results from the EPA's published hydrochemical and biological data downstream of the application quarry, which shows that closest to the quarry the quality of the water meets High Status Objectives of the Surface Water Regulations (2009, as amended) & Q4 (2024) Good Status [EPA Monitoring Station 'Bridge near Drumgriffin' @ 3.5km to the south west of the quarry]. However, farther downstream at EPA Monitoring Station 'SW Liscananaun' the Q Rating is Q3 (2023) Poor Status because of the EPA (2024) reported morphological challenges on the river, which create dark and stagnant waters with no flowing riffle zones required for good ecological health. The quarry plays no part in this Poor Status or Risk. All hydrochemical markers generally suggest High Status close to the quarry and its discharge.

No water supply wells were identified within range of potential impact by the quarry. Irish Water supplies water to local households. There are no GWS abstractions within range of impact of the quarry.

With reference to Ordnance Datum,

- The eastern boundary of the current excavation and quarry floor bounds the greenfield application lands and has a land surface elevation of 40m OD, approximately. The western boundary of the quarry landholding bounds lands having an elevation of 30m OD, approximately, which is where the site's discharge zone is.
- The greenfield monitoring wells were drilled to target depths of 45m below ground level and the resultant base of the bored holes are -4 to -12m OD, approximately.
- The proposed floor level elevation of the greenfield application area component of the application under consideration here is 4m OD.
- The locations of the drilled boreholes on the quarry floor have elevations ranging from 10 to 13m OD. Each borehole was drilled to depths in the 20 to 22m range. Therefore, the base depth elevation of the eleven drilled holes on the floor range from -8.6m OD to -11.5m OD.

- Therefore, intrusive site investigations have been completed to depths significantly deeper than proposed for future rock excavation at the site.

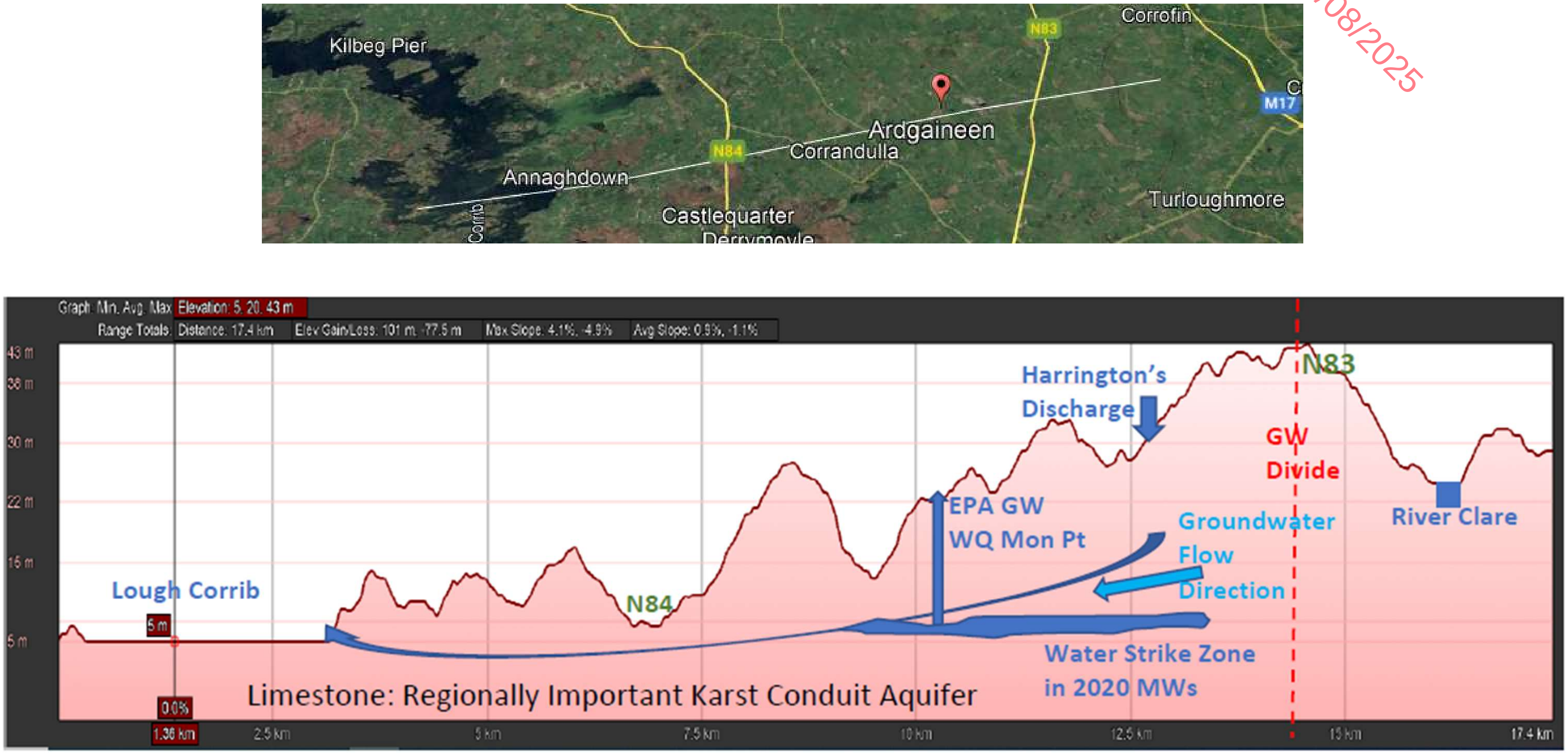
- It is hypothesised that discharge flow will be from the discharge area in unsaturated epikarst towards Lough Corrib in a NE-SW direction. There is thin soil cover in the discharge area (Irish Drilling, 2021). Measured field hydraulic conductivity is 10^{-5} m/s, which equates to 7 m/d, which demonstrates conductance ability. Interpretation of the geophysical survey across the discharge area and in the direction of the walls of the excavation suggests that there may be some preferential pathways (Apex, 2021). That suggestion by the geophysicist's interpretations of survey data is backed up by observations in the wall of the quarry to the NE of the discharge.

- Groundwater quality in the greenfield lands of the application area is not as good as the quality of water discharged at the site from the quarry floor's sump because the sump has a rainfall component that is runoff from bare limestone rather than that in the greenfield area being affected by runoff and percolation through agricultural lands or through on-site wastewater treatment systems upgradient in the catchment. However, all water quality conforms to the requirements of the Groundwater Regulations and monitoring of the discharge suggests good hydrochemical quality

- Given the results for Site Investigations at the site and what is known about the karst systems regionally, the potential impact of the discharge was conceptualised as a 'Direct Discharge' as provided for in the Groundwater Regulations. Regulation 8 of the Groundwater Regulations 2010 allows for direct discharge in Clause 8(a)(ii) "for reinjection of pumped groundwater from mines and quarries or associated with the construction or maintenance of civil engineering works"…. "Subject to a requirement for prior authorisation provided such discharges, and the conditions imposed, do not compromise the achievement of the environmental objectives established for the body of groundwater into which the discharge is made".

- Site investigations suggest that the discharge disperses over the top of rock and there may be direct shafts beneath the discharge zone (Apex, 2021). That information forms part of the conceptual model for the site. A regional scale cross section from Lough Corrib, through the site and through to the River Clare is presented as Figure 8.12, which shows Lough Corrib, the quarry's discharge, likely flow direction, the water strike zone in the Monitoring Wells drilled upgradient of the discharge in 2020, the N83 and N84 roads and the River Clare to the east of the site.

Figure 8.12 Plan view and Cross Section from Lough Corrib through the site and on to the River Clare (source: Google Earth Pro)



In general, there are some small transition zone ingresses at times of heavy rainfall but, primarily, actual groundwater enters through the one conduit in the southern face. The only, singular, evidence of groundwater across the operational quarry and in the walls under the greenfield application area is one conduit in the face of one wall in the southern face, which is not in the current application area: it already has ongoing consent.

All groundwater settles in the sump at the lowest level of the quarry and is pumped to a natural vegetated area to which it again contributes to the same groundwater body from which it originally came. The same volume of rainfall runoff will fall on a similar area with the same runoff co-efficient and volumes derived. The floor of the existing quarry, its sump and the licensed discharge will continue to service the greenfield application area because that greenfield application area has always sent its rainfall runoff and interflow component to the quarry's floor.

8.7 Effects, Impact Assessment Methodology & Structure

8.7.1 Methodology for Determination of Impacts

This EIA and EIAR were completed in accordance with enacted EU and Irish legislation pertaining to Environmental Impact Assessment (Directive 2014/52/EU, meaning the EIA Directive and Irish EIA Regulations (2018, as amended 2020). As previously stated, the complete list of Guidance and Legislation employed in the completion of this work was presented earlier.

The Impact Assessment was completed with reference to Guidance relating to EIA and the preparation of EIA Reports, which includes the EU (2017), Department of Housing, Planning and Local Government (2018) and EPA (2022) on Guidelines on the information to be contained in Environmental Impact Assessment Reports.

Criteria for assessing importance of site attributes and their magnitude of importance were taken from the NRA Guidelines (NRA, 2008) and 'Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements' (IGI, 2013).

The tools and structure of the assessment of Effects and Potential Impacts were detailed earlier, in which Industry Standard Tables for rating of the Importance of Environmental Criteria, Significance of Effects, Impacts, Mitigation Measures, Residual Impacts and more are presented.

In addition to the application of Irish Guidelines as outlined in EPA (2022) and NRA (2008), and in the absence of Irish Guidance specifically focussed on quarries and hydrogeology, the work presented in this EIAR Section has also applied UK practical guidance as published by the UK Environment Agency (the public body equivalent of the Irish EPA). The UK Guidance provides a 'Hydrogeological impact appraisal for dewatering abstractions' (Boak, R. et. al. (2007) and the approach was outlined earlier

8.7.2 Development Phases Considered

The evaluation of Potential Effects and Impact Assessment completed usually considers phases as follows:

(i) Construction phase,

(ii) Operational phase and

(iii) Landscaping, Restoration, Decommissioning & Aftercare

A Summary Table for Potential Impacts associated with each phase is presented as Table 8.8.

The procedure for determination of potential impacts on the receiving hydrogeological environment was to identify potential receptors within the site boundary and surrounding environment and use the information gathered during the field work and desk study to assess the degree to which these receptors will be impacted upon.

The application site lies within and adjacent to the existing quarry void, and when considered as a cumulative site, will be of moderate to large size. The site is therefore considered to be an attribute of high importance. In line with best practice, the individual impacts will be considered with respect to the application site, plus the cumulative impacts with respect to the existing and application site.

Generally, at all quarry sites the primary activity with **potential** to impact the local and regional hydrological and hydrogeological environment is the removal of rainfall-runoff and groundwater from the local hydromorphological regime. Stripping soils from the land to create access to rock can have impacts. However, at this site the soil is thin and the risk is deemed lower. In addition, the discharge of waters arising at the proposed development is controlled and regulated under Section 4 Discharge Licence W214.

There are no surface water receptors within the immediate vicinity of the site. However, there are downstream receptors, as follows:

1. The Cregg River rises from a spring at a distance of 1.8km to the southwest of the site. This is a potential receptor. The EPA monitor this river and EPA reported Monitoring details were Tabulated and compared to legislative objectives in Appendix 8.4 and in the text of this chapter.

2. Groundwater is a receptor. EPA reported Monitoring details for the downstream Groundwater Quality Corrandulla Station, 3km from the site, were Tabulated and compared to legislative objectives in Appendix 8.4 and in the text of this chapter.

3. Given that regional groundwater discharges to Lough Corrib SAC and SPA, the lake has also been identified as a potential receptor.

Unmitigated direct impacts that could occur during the enabling (construction) stage are deemed to be significant to moderate and temporary in nature.

Unmitigated direct impacts that could occur during the operational stage are deemed to be slight to moderate and long-term in nature. Given that the use of explosives is considered a significant activity associated with the operational phase, this is evaluated in mathematical detail in later sections.

The restoration stage of the project describes the aftercare phase that follows the cessation of activities. The direct impacts identified as likely to occur during the restoration stage are deemed to be slight to moderate and permanent in duration.

Indirect impacts (or secondary impacts) are those which are not a direct result of the proposed activity, often produced away from the project site or because of a complex pathway such as raw materials extracted and processed on site bring benefits in the production of construction aggregates and products.

Consideration has also been given to environmental impacts associated with unplanned events such as intense rainfall events, spillage, accidents and fire etc.

Impacts that could occur due to unplanned events are also presented. These are deemed to be slight to significant and brief in duration.

Note: In relation to the information presented, * Importance of Attribute was determined on basis of criteria from NRA (2008) and IGI (2013), and informed determination of Significance/ Magnitude of Effects in Column 7, which is principally based on criteria of EPA (2017 & 2022).

Table 8.8 Summary of Potential Impacts

Scenarios where impacts may arise	Activity	Attribute	Importance of attribute	Nature and description of the effect	Quality of effect	Significance/magnitude of effect *	Extent & Context of effect	Probability of effects (pre-mitigation)	Duration and frequency	Type of effect
Construction Phase	Earthworks – stripping and movement of overburden, movement of aggregate stockpiles	Groundwater	High	Mobilisation and migration of suspended solids Sediment deposition in low elevations	Negative	Significant	Clare Corrib Groundwater Body & Downstream Creg_010 River	Likely	Temporary Occasionally	Direct & Indirect
	Use of earthworks machinery and equipment – spillages during refuelling, use and storage of lubricants	Groundwater initially & potentially downstream surface water receptors	High	Contamination of groundwaters with hydrocarbons, which could potentially travel to downstream surface waters	Negative	Moderate	Clare Corrib Groundwater Body, Downstream Creg_010 River & Lough Corrib SAC SPA	Unlikely	Momentary Occasionally	Direct & Indirect
	Upgrading/Installing site infrastructure.	Groundwater initially & potentially downstream surface water receptors	High	Mobilisation and migration of suspended solids Sediment deposition in low elevations	Negative	Moderate	Clare Corrib Groundwater Body & Downstream Creg_010 River	Unlikely	Temporary Once	Direct & Indirect
Operational Phase	Movement of overburden, movement of aggregate stockpiles	Groundwater initially & potentially downstream surface water receptors	High	Mobilisation and migration of suspended solids Sediment deposition in channels disrupting sensitive riverine habitats	Negative	Significant	Clare Corrib Groundwater Body, Downstream Creg_010 River & Lough Corrib SAC SPA	Likely	Occasionally Temporary	Direct & Indirect
	Extraction of bedrock	Bedrock Aquifer	High	Change in unsaturated thickness resulting in change in groundwater vulnerability classification. Deterioration in groundwater quality	Negative	Slight	Bedrock aquifer	Likely	Permanent	Direct
	Blasting of bedrock	Groundwater & possibly downgradient surface waters	High	Deterioration in groundwater and surface water quality	Negative	Moderate	Clare Corrib Groundwater Body, Downstream	Likely	monthly Long-term	Direct

Scenarios where impacts may arise	Activity	Attribute	Importance of attribute	Nature and description of the effect	Quality of effect	Significance/magnitude of effect *	Extent & Context of effect	Probability of effects (pre-mitigation)	Duration and frequency	Type of effect
							Creg_010 River & Lough Corrib SAC SPA			
	Use of quarrying machinery and equipment – spillages during refuelling, use and storage of lubricants	Groundwater & possibly downgradient surface waters	High	Contamination of surface waters and groundwaters with hydrocarbons	Negative	Moderate	Clare Corrib Groundwater Body, Downstream Creg_010 River & Lough Corrib SAC SPA	Likely	Rarely Temporary	Direct
	Quarry dewatering	Bedrock aquifer: *i.e.* Groundwater & possibly downgradient surface waters	High	Reduction in third party well yields Reduction in spring flows Reduction in baseflow to surface waters	Negative	Moderate	Groundwater resource, Creg-010 Rising, Third-party wells	Unlikely	Rarely Temporary	Direct
	Use of Natural Vegetated Wetland Discharge Zone	Groundwater & possibly downgradient surface waters	High	Removal and entrapment of particulate matter entrained in waters leaving site	Positive	Significant	Clare Corrib Groundwater Body, Downstream Creg_010 River & Lough Corrib SAC SPA	Likely	Long-term Constant	Direct
	Use of wheelwash	Groundwater & possibly downgradient surface waters	High	Removal and entrapment of particulate matter attached to haulage vehicles	Positive	Slight	Clare Corrib GWB	Unlikely	Long-term Constant	Direct
	Wheelwash maintenance	Groundwater & possibly downgradient surface waters	High	Improve wheelwash and reduces Mobilisation and migration of suspended solids	Neutral	Not Significant	Clare Corrib GWB	Unlikely	Long-term Annual	Direct
	Use of hydrocarbon interceptors	Groundwater & possibly downgradient surface waters	High	Entrapment of hydrocarbons lost during refuelling/discharge	Positive	Slight	Clare Corrib Groundwater Body, Downstream Creg_010 River & Lough Corrib SAC SPA	Likely	Long-term Constant	Direct

Scenarios where impacts may arise	Activity	Attribute	Importance of attribute	Nature and description of the effect	Quality of effect	Significance/magnitude of effect *	Extent & Context of effect	Probability of effects (pre-mitigation)	Duration and frequency	Type of effect
	Pumped discharge of quarry waters	Groundwater & possibly downgradient surface waters	High	Potential introduction of contaminants	Negative	Imperceptible	Clare Corrib Groundwater Body, Downstream Creg_010 River & Lough Corrib SAC SPA	Unlikely	Long term Constant	Direct
	Monitoring	Groundwater	High	Monitoring of discharge rates, suspended solids, discharge water quality, receiving surface water quality, groundwater quality	Positive	Not Significant to Imperceptible	On site	Unlikely	Continuous, hourly, quarterly, annually	n/a
Restoration Phase	Removal of semi-mobile and mobile plant (pumps, generators, etc.)	Groundwater & possibly downgradient surface waters	High	Elimination of hydrocarbon sources	Positive	Slight	Within site boundary	Likely	Permanent	Direct
	Dismantling and removal of fixed plant & machinery (plant, wheelwash, etc.)	Groundwater & possibly downgradient surface waters	High	Elimination of hydrocarbon sources	Positive	Slight	Within site boundary	Likely	Permanent	Direct
	Landscaping and movement of infrastructure and overburden stockpiles necessary to facilitate site restoration	Groundwater & possibly downgradient surface waters	High	Mobilisation and migration of suspended solids Sediment deposition in channels disrupting sensitive riverine habitats	Negative	Moderate	Clare Corrib Groundwater Body	Likely	Once-off Temporary	Direct & Indirect
	Cessation of pumping & discharge	Groundwater & possibly downgradient surface waters	High	Recovery of groundwater level Reduction in risk of contamination to surface waters	Positive	Significant	Clare Corrib Groundwater Body, Downstream Creg_010 River & Lough Corrib SAC SPA	Likely	Permanent	Direct
Unplanned Events	Major Spillage	Groundwater & possibly	High	Hydrocarbon contamination	Negative	Significant	Clare Corrib Groundwater Body, Downstream	Unlikely	Temporary Rarely	Direct

Scenarios where impacts may arise	Activity	Attribute	Importance of attribute	Nature and description of the effect	Quality of effect	Significance/magnitude of effect *	Extent & Context of effect	Probability of effects (pre-mitigation)	Duration and frequency	Type of effect
		downgradient surface waters					Creg_010 River & Lough Corrib SAC SPA			
	Fire		High	Contamination of spent firefighting waters	Negative	Significant	Within site boundary	Unlikely	Brief	Direct
	Intense Rainfall Events		High	On-site flooding	Negative	Slight	Within site boundary	Unlikely	Brief	Indirect

8.7.3 WFD Chemical Status Change Potential: Blasting Impacts

Mass balance calculations are presented to demonstrate potential for effects of blasting to present nitrogen residues in the discharge waters, which has potential to impact groundwater quality. The risk to groundwater and surface water is assessed by quantifying the resultant concentrations for the potential residual nitrogen compounds Nitrate (NO3), Ammonia (NH4) and Nitrite (NO2).

Peak activity rates of the extraction activities, blasting frequency and the type of explosives used were supplied to Hydro-G by the quarry manager. The explosives used in quarry are Kemex 70. Kemex 70 is a site mixed bulk emulsion explosives produced from emulsion matrix. Emulsion matrix is essentially an aqueous solution of ammonium nitrate emulsified in oil. Kemex products may also contain ammonium nitrate prills, fuel oil, aluminium and/or gassing agents. The Technical Data Sheets (TDS's) and MATERIAL SAFETY DATA SHEET (MSDS's) for explosives, primers and detonators used at the site are held at the site and in the offices of the hydrogeologists.

Literature suggests that small percentages of nitrogen compounds can remain as residual coating on bedrock following blasting. This has the potential to be dissolved when it comes into contact with water, albeit potential concentrations are low. The study that is most referenced was completed by Environment Canada in 1988 (Ferguson & Leask, 1988). This study outlines a procedure for determining the residual N compounds for various mine site types. The stepwise procedure used in the 1988 study for predicting aqueous concentrations of N species, is as follows:

a) Calculate the annual leached nitrogen loading (kg/year) for the entire site based upon annual explosive mass usage and residual N fraction associated with explosive type.
b) Separate the leached nitrogen loading among quarry components (e.g. entering surface water, remaining on extracted rock etc.)
c) Separate into loadings of N compounds (Nitrate, Nitrite and Ammonia), and
d) Calculate the flow concentration.

The concentrations of N species in discharge water from the proposed lateral extension at the application site quarry are calculated using this procedure. This is presented in Table 8.9, below. The MAXIMUM area of land in which **blasting** could occur is taken as 4.35 ha plus 6.6 ha = c. 11 ha.

In the calculations for potential impact, the highest residual upper limit of the range has been adopted in all simulations. In this way, the highest concentrations of N species concentrations have been calculated. These are very conservative assumptions. The calculation also assumes that 100% of residual N is dissolved in drainage waters and is subsequently pumped from the quarry by dewatering.

The results of calculations presented in Table 8.9 clearly show that the residual N compounds would have concentrations each of less than 0.004 mg/l N. Specifically, resultant increases in concentrations in waters within the quarry, if impacted by explosives within the entire quarry site area, would be: **0.006mg/l NO3, 0.002mg/l NH4 and 0.0004 mg/l NO2.**

Table 8.9 Max. N compound concentrations from explosives in dewatering discharge

EXPLOSIVE MASS BALANCE		
6.1	Proposed New Lateral Extension Extraction Area	ha
4.35	Proposed Deepening of Extraction Area of Exisiting Site	ha
10.45	Total Blast Rock Area	ha
104,500	Total Area exposed to Explosives	m2
36	Maximum Greenfield Area Depth of Rock to be Blasted (40mOD - 4mOD)	m
0.2	Explosive Mass Required	kg/m3
544,000	Explosives Mass Required	kg
25	Planned Duration of extraction	years
21,760	Explosives Mass Required per year	kg/yr
Explosives Chemical Components		
94%	% Explosive mass as Ammonium Nitrate	%
35%	% Ammonium Nitrate as N	%
Explosives Chemical MASS		
7,159	Mass of N	kg/yr
6	Residual percentage	%
430	Residual N left behind	kg/yr
Total N Species Generated by explosive's residues (areal annual loading rate)*	***41.10***	***Kg/ha/yr***
*facilitates comparison with agricultural inputs [total quarry area used]. Compare to 170 kg N/ha/yr Total Nitrogen loadings permitted in the Good Agricultural Practice Regulations (SI 605 of 2017)		
Residual N COMPOUNDS**		
425	Residual NO_3 *(75-99% of Residual N value)*	**kg/yr**
103	Residual NH_4 *(0.5 - 24% of Residual N value)*	**kg/yr**
26	Residual NO_2 *(0-6% of Residual N value)*	**kg/yr**
****Highest possible % Residuals Adopted from the available ranges, as conservative measure.**		
WATER BALANCE		
1,483	Section 4 Licence W502/22 Maximum Permitted Discharge Volume	m^3/day
541,295,000	Quarry Discharge	litres/yr
INCREASE IN NITROGEN COMPOUND CONCENTRATIONS***		
Additional Residual NO_3	***0.002***	***mg/l/d***
Additional Residual NH_4	***0.001***	***mg/l/d***
Additional Residual NO2	***0.0001***	***mg/l/d***

With respect to the calculated resultant concentrations determined for the site following blasting, as presented in Table 8.9, context is offered as follows:

- The limit for nitrate in waters affected by agriculture is 50 mg/l NO3 (Nitrate & Good Agricultural Practice Regulations) and it is also 50 mg/l NO3 for the Freshwater Fish Directive (2006/44/EC). Therefore, the simulated resultant increase in concentration in the discharge waters of 0.002 mg/l NO3 poses no threat to breach of Environmental Quality Objectives or the Threshold Value of 37.5mg/l NO3 as specified in the Groundwater Regulations.

- The limit for Ammonia in High Status Waters EQS (Surface Water Regulations 2009) is 0.04 mg/l NH4 and the resultant increase in concentration calculated for the discharge waters is 0.001 mg/l NH4. Environmental impact is not envisaged because the resultant concentrations calculated adhere to the High Status EQSs of the Surface Water Regulations.

- Overall, the residual concentrations of nitrate, nitrite and ammonia are so low that the site will continue to comply with the requirements of the Threshold Values of the Groundwater Regulations (2010) & the targets set out in both the Freshwater Fish Directive and Salmonid Waters Regulations.

In summary, having used conservative values in this approach the resulting N species concentrations are small, and below all relevant Regulatory Environmental Quality Standards (EQSs). The risk of impact to local water quality arising from the use of explosives at the site is therefore negligible. These calculations are based on maximum possible residuals of explosives.

8.7.4 WFD GWB Quantitative Compliance

A Groundwater Balance for the Groundwater Body is presented as Table 8.10.

With reference to the information presented in Table 8.10, the Groundwater Balance and Discharge Volumes assessment enables response to many aspects of potential for impact, as follows:

A. Quantitative Status Compliance & Cumulative Impact Assessment in terms of all registered abstractions from the Clare Corrib GWB and the Lough Corrib catchment: The published EPA Register of Abstractions (December, 2024) suggests that a total of 49,942m3/d is abstracted from the area of interest.

B. To present clarity for queries previously posed in historic RFIs issued by GCC, such as “To Ensure That Proposed Quarrying Activities Do Not Adversely Impact on The Local or Regional Natural Groundwater Levels and Consequently Water Supplies.”

C. In the context of context of Lough Corrib SAC, SPA and PWS Source.

Given that the Clare-Corrib GWB is reported to have an approximate area of 1,422km2 (GSI, 2004) and that the GSI assigns a groundwater recharge value of c. 500 mm/yr, calculations presented in Table 8.10 suggest, as follows:

(a) On a GWB scale average, the volume of groundwater associated with this Groundwater Body is c. 700 million m3/yr, approximately, or ~1.9 million m3/d.

(b) The Proportion of the Quarry's Maximum Permitted Section 4 Discharge Licence (W/502/22) maximum daily discharge Emission Limit Value of 1,483 m3/d represents 0.08% of the **Clare Corrib GWB's** annual rechange amount to groundwater from rain falling on its catchment.

(c) On a cumulative basis, all registered abstractions for the Clare Corrib GWB and Lough Corrib's catchment represents 0.5% of the **Clare Corrib GWB's** annual rechange amount to groundwater from rain falling on its catchment.

Table 8.10 Regional hydrogeology & Harrington's Quarry's groundwater management.

Regional Hydrogeology & Harrington's Quarry's Groundwater Management	
GSI assigned area for 'Clare Corrib Groundwater Body' (km2)	1,422
Clare Corrib Groundwater Body (m2)	1,422,000,000
AVERAGE Across Region GSI Effective Rainfall (mm/yr)	704
AVERAGE Across Region GSI Groundwater Recharge (mm/yr)	500
GSI Groundwater Recharge (m/yr)	0.5
Groundwater Recharge to Clare Corrib GWB = [0.5m rainfall recharge x 1,422,000,000 m2 area] (m3/yr)	711,000,000
AVERAGE Groundwater Recharge to Clare Corrib GWB = [0.5m rainfall recharge x 1,422,000,000 m2 area]/365 days] (m3/d)	1,947,945
Section 4 Discharge Licence (W/502/22) maximum daily discharge volume from the quarry (m3/d)	1,483
Annual Discharge based on MAX daily discharge from the quarry (m3/yr)	541,295
Hydro-G Calculations	
1. WFD Scale - Quarry Only	
Proportion of Quarry's discharge volume as a % of Clare Corrib GWB's annual rechange amount to groundwater from rain falling on its catchment (%)	**0.08**
2. WFD Scale - Cummulative - All Abstractions	
ALL Registered abstractions from the Clare Corrib GWB and Lough Corrib including Harringtons (m3/d)	**48,942**
Proportion of ALL GROUNDWATER Users as a % of Clare Corrib GWB's annual rechange amount to groundwater from rain falling on its catchment (%)	**0.5**
Given that the % Usage by All Groundwater Users is < 1% (actually 0.5%), and that Harrigntons is 0.08% of the volume of Groundwater Available (IF they discharge the maximum permitted 1,483 m3/d). The % Change is insignificant because it is infitisimal. The Conclusion is No Potential for Impact using EPA (2025 & GW5 (2004) Impact Criteria.	

Overall, Hydro-G offers that the % of waters intercepted at the quarry is below the 5% threshold value of the Water Framework Directive Working Group (GW5) and is therefore deemed 'Low Potential Impact' and 'Not at Significant Risk' by WFD characterisation methods (GW5, 2005). This water balance data provides the confidence to assert that there will be no adverse impact on the local or regional groundwater regime.

Hydro-G offers that for the calculated 0.5% quarry's impact, there could be neither direct nor indirect impact on Lough Corrib SAC, SPA or source of Public Water Supply. These calculations can be considered as SCREENING tools.

In combination with the Emission Limit Value controls applied in the Section 4 Discharge Licence (W/502/22), the site is deemed to present neither qualitative nor quantitative Impact Potential to the receiving ecological, hydrological and hydrogeological environments.

8.7.5 Mitigation Measures

The significant potential impacts identified in Table 8.8 are resolved under the mitigation measures set out under Table 8.11. The key principles of avoidance, prevention, reduction and remedy/off-set have been adhered to in this regard.

8.7.6 Residual Impacts

Residual impacts refer to the degree of environmental change that will occur after the proposed mitigation measures have taken effect.

Assuming implementation of the mitigation measures, the majority of residual impacts on the hydrological and hydrogeological environment during all phases are assessed to be **unlikely** and **imperceptible**.

Residual Impacts are presented in the Mitigation Measures Table 8.11.

There are no anticipated residual impacts on the hydrological or hydrogeological environment.

A potential residual impact at <u>any</u> quarry site could be reduction of groundwater levels. However, this site is only discharging rainwater. It is obvious that there is no groundwater dewatering in the small scale of the volumes quantified at the discharge point and reported in the Quarterly Compliance Monitoring reports (Appendix 8.1).

A reduction in groundwater head has the **<u>potential</u>** to affect local third-party wells or downstream spring or surface water discharges. However, at this site the waters arising are recharged back to the groundwater system under Section 4 Discharge Licence W/502/22.

Table 8.11 Summary of Mitigation Measures & Residual Impact Assessment

Scenarios where impacts may arise	Potential Impact			Mitigation Measure	Residual Effect (following Mitigation)	
	Activity	Attribute/ Receiving Environment	Character of Potential Impact	Description of Mitigation	Significance or Quality of Effect	Probability
Construction phase	Earthworks – stripping and movement of overburden, movement of aggregate stockpiles	Groundwater	Mobilisation and migration of suspended solids	• Slope control and interception fencing at toe of any overburden stockpiles. • Stockpiles will be vegetated to enhance stability. Establishment of rooting restricts surface erosion. • Stockpiled material shall be re-used in the restoration process.	Imperceptible	Unlikely
	Use of earthworks machinery and equipment – spillages during refuelling, use and storage of lubricants	Groundwater initially & potentially downstream surface water receptors	Contamination of groundwaters and surface waters with hydrocarbons	• Waste and fuel materials will be stored in designated areas that are isolated from surface water drains or open waters (*e.g.* excavations). Hazardous wastes such as waste oil, chemicals and preservatives, will be stored in sealed containers. Fuelling, lubrication and storage areas and site offices will not be located within 30m of drainage ditches or the settlement sumps. • All waste containers will be stored within a secondary containment system (*e.g.* a bund for static tanks or a drip tray for mobile stores and drums). All bunded tanks will be capable of storing 110% of the tank capacity. Where more than one tank is stored, the bund must be capable of holding 110% of the largest tank of 25% of the aggregate capacity (whichever is greater). Drip trays used for drum storage must be capable of holding at least 25% of the drum capacity. Where more than one drum is stored the drip tray must be capable of holding 25% of the aggregate capacity of the drums stored.	Imperceptible	Unlikely

Scenarios where impacts may arise	Potential Impact			Mitigation Measure	Residual Effect (following Mitigation)	
	Activity	**Attribute/ Receiving Environment**	**Character of Potential Impact**	**Description of Mitigation**	**Significance or Quality of Effect**	**Probability**
				• Regular monitoring of water levels within drip trays and bunds due to rainfall will be undertaken to ensure sufficient capacity is maintained at all times. • A wheel wash facility exists near the site offices and the roads have sprinkler systems. • Regular monitoring and maintenance of silt traps will be undertaken in accordance with the manufacturer's specifications • Oil which accumulates within the hydrocarbon interceptor shall be regularly removed by an appropriately licensed contractor. In addition, the hydrocarbon interceptor shall be appropriately maintained in accordance with the manufacturer's specification. • Regular visual monitoring of the attenuation sump and wetland area will be undertaken to ensure no visual oil or fuel contamination is present. • An oil interceptor is fitted and has the capacity to deal with the licence limit of 1,483m^3/d.		
	Upgrading/Installing site infrastructure: interceptors and plant	Groundwater initially & potentially downstream surface water receptors	Mobilisation and migration of suspended solids Sediment deposition in channels disrupting sensitive riverine habitats	Appropriate Construction Management Plans shall be prepared for any works area.	Imperceptible	Unlikely

Scenarios where impacts may arise	Potential Impact			Mitigation Measure	Residual Effect (following Mitigation)	
	Activity	Attribute/ Receiving Environment	Character of Potential Impact	Description of Mitigation	Significance or Quality of Effect	Probability
Operational Phase	Extraction of bedrock	Bedrock aquifer	Change in unsaturated thickness resulting in change in groundwater vulnerability classification. Deterioration in groundwater quality	Vulnerability classification in the area shall be maintained at the current classification: Extreme.	Imperceptible	Unlikely
	Blasting of bedrock	Groundwater initially & potentially downstream surface water receptors	Deterioration in groundwater and surface water quality	Blasting is regulated and controlled by industry standards. Kemex emulsion explosives is used at the site. In the EIAR Hydro-G presented a sequence of calculations to estimate N-residue in discharge waters due to blasting. The results of the calculations show that the simulated increases in nitrogen species' concentrations will be low. Environmental Quality Objectives will be maintained. Calculations suggest that the risk of impact to the water quality is imperceptible.	Imperceptible	Unlikely
	Use of quarrying machinery and equipment – spillages during refuelling, use and storage of lubricants	Groundwater initially & potentially downstream surface water receptors	Contamination of surface waters and groundwaters with hydrocarbons	As per mitigation measures outlined above for Construction Phase	Imperceptible	Unlikely
	Quarry dewatering – lowering of groundwater levels in surrounding area	Bedrock aquifer	Reduction in spring flows Reduction in baseflow to surface waters	Hydraulic response resting of the bedrock aquifer suggests that dewatering at the site would not impact local wells, if there were any: Irish Water supplies mains water supply and there are no Group Water Schemes within radius of influence. As was demonstrated previously in the EIAR, there are no active groundwater receptors that may be at risk of impact from groundwater drawdown within the ~800m calculated radius of influence from the centre of the sump. There will be no significant net loss or gain in the GWB system because volume	Slight	Unlikely

Scenarios where impacts may arise	Potential Impact			Mitigation Measure	Residual Effect (following Mitigation)	
	Activity	Attribute/ Receiving Environment	Character of Potential Impact	Description of Mitigation	Significance or Quality of Effect	Probability
				intercepted and managed at the site represents, by calculated water balance, <0.1% of the regional groundwater volume and the volume intercepted is recycled to the original groundwater system.		
	Use of natural wetland area as Discharge Zone	Groundwater initially & potentially downstream surface water receptors	Removal and entrapment of particulate matter entrained in waters leaving site	Discharge waters will flow naturally to the floor sump, which is oversized and can handle all storm event return periods. The quarry sump has sufficient volumetric capacity to accommodate all waters for the required residence time. Discharge will be of a quality that will not have a detrimental impact on surface water quality in terms of suspended solids.	Imperceptible	Unlikely
	Use of wheelwash	Groundwater initially & potentially downstream surface water receptors	Removal and entrapment of particulate matter attached to haulage vehicles	A wheel wash facility exists near the site offices and the roads will have sprinkler systems for dust suppression.	Imperceptible	Unlikely
	Wheelwash maintenance	Groundwater initially & potentially downstream surface water receptors	Mobilisation and migration of suspended solids	The wheelwash is to be maintained in accordance with manufacturer's specifications.	Imperceptible	Unlikely
	Use & maintenance of hydrocarbon interceptors	Groundwater initially & potentially downstream surface water receptors	Entrapment of hydrocarbons lost during refuelling/discharge	A hydrocarbon interceptor is in place as part of compliance with the Section 4 Discharge Licence. Oil that accumulates within hydrocarbon interceptors shall be regularly removed by an appropriately licensed contractor. The hydrocarbon interceptors shall be appropriately maintained in accordance with the manufacturer's specifications.	Imperceptible	Unlikely
	Pumped discharge of quarry waters	Groundwater initially & potentially	Increase flood risk to downgradient receptors	The quarry sump is adequately sized to accept the ordinary average rainfall event plus the 1 in 100 extreme rainfall event of 2 day duration.	Imperceptible	Unlikely

Scenarios where impacts may arise	Potential Impact			Mitigation Measure	Residual Effect (following Mitigation)	
	Activity	Attribute/ Receiving Environment	Character of Potential Impact	Description of Mitigation	Significance or Quality of Effect	Probability
		downstream surface water receptors		A flowmeter is fitted on the discharge line to measure and log discharge rates.		
	Pumped discharge of quarry waters	Groundwater initially & potentially downstream surface water receptors	Deterioration in surface water quality	The hydrochemical assimilative capacity assessment determined that there is sufficient capacity in the groundwater to accommodate discharge waters from the quarry.	Imperceptible	Unlikely
	Monitoring	Groundwater initially & potentially downstream surface water receptors	Monitoring of discharge rates, suspended solids, discharge water quality, receiving surface water quality, groundwater quality	The sump is inspected visually; the oil interceptor is checked. The wetland area is evaluated regularly.	Imperceptible	Unlikely
Decommissioning phase	Removal of semi-mobile and mobile plant (pumps, generators, etc.)	Groundwater initially & potentially downstream surface water receptors	Elimination of hydrocarbon sources	Positive impact: no mitigation required.	None	None
	Dismantling and removal of fixed plant & machinery (plant, wheelwash, etc.)	Groundwater initially & potentially downstream surface water receptors	Elimination of hydrocarbon sources	Positive impact: no mitigation required. Materials such as concrete can be crushed and recycled for use as an aggregate in the construction industry.	None	None

Scenarios where impacts may arise	Potential Impact			Mitigation Measure	Residual Effect (following Mitigation)	
	Activity	Attribute/ Receiving Environment	Character of Potential Impact	Description of Mitigation	Significance or Quality of Effect	Probability
	Landscaping and movement of overburden stockpiles necessary to facilitate site restoration	Groundwater initially & potentially downstream surface water receptors	Mobilisation and migration of suspended solids Sediment deposition in channels disrupting sensitive riverine habitats	Site restoration will take place on a phased basis as extraction is completed in defined areas of the site and detailed in the Site Restoration Plan (Refer to EIAR Chapter 3) .	Imperceptible	Unlikely
	Cessation of pumping & discharge	Groundwater initially & potentially downstream surface water receptors	Recovery of groundwater levels Reduction in risk of contamination to surface waters	Post-completion groundwater levels will return to current baseline levels, thereby partially filling any voids.	None	None
	Landscaping and movement of soils necessary to facilitate site restoration	Groundwater initially & potentially downstream surface water receptors	Potential for silt run off during restoration	Works to be completed with Construction Management Plan, Mitigation Measures and Controls.	Imperceptible	Likely
Unplanned events	Major Spillage	Groundwater initially & potentially downstream surface water receptors	Hydrocarbon contamination	All runoff generated on potentially at-risk areas will pass through the hydrocarbon interceptor prior to discharge. Potentially harmful chemicals stored on site (e.g. lubricants) to be stored under cover on bund trays.	Imperceptible	Unlikely
	Fire	Groundwater initially & potentially downstream surface water receptors	Contamination of spent firefighting waters	Used firefighting water which may be potentially contaminated but can be contained. Contained firefighting water will be disposed of appropriately by a licensed contractor.	Imperceptible	Unlikely

Scenarios where impacts may arise	Potential Impact			Mitigation Measure	Residual Effect (following Mitigation)	
	Activity	**Attribute/ Receiving Environment**	**Character of Potential Impact**	**Description of Mitigation**	**Significance or Quality of Effect**	**Probability**
	Intense Rainfall Events	Groundwater initially & potentially downstream surface water receptors	On-site & off-site flooding	Runoff draining to the sump can be attenuated to cater for a 1 in 100 year return period.	Imperceptible	Unlikely

8.7.7 Cumulative Impact Assessment

Review of Galway County Council's Online Planning database did not show any permitted development that could be considered to be in such proximity to the site that there could be any cumulative impact on the water environment.

The only quarries in the same groundwater body are the Mortimer Quarry and adjacent McTigue Quarry in Belclare, Tuam, at a distance of 8km to the north, approximately. Neither of those quarries are dealing with groundwater. Neither are discharging. Both quarries are sufficiently remote from the application site in a massive groundwater body. In the scale of the hydrogeological environment, the 8km separation distance alone would preclude any potential for cumulative impact.

Similarly, review of the EIA portal (https://housinggovie.maps.arcgis.com/) did not reveal any developments that could interact with the development proposal in any way as to contribute a cumulative impact with the site. As previously stated, there are no other quarries within potential radius of influence of the groundwater dewatering catchment of the quarry.

There are applications for consent that are still in the planning process and one might have considered that they have potential to interact with the application site. There are many Wind Turbine development proposals for the Clare Corrib Groundwater Body before An Bord Pleanála under the Strategic Infrastructure Development process. However, it can be concluded with confidence that these wind turbine proposals will not gain planning consent because they propose actions contrary to Proper Planning for many reasons. For the wind turbine mast proposal 'Laurclavagh' in closest proximity to the quarry, substantive reasons supporting confidence that it will be refused by the Board include as follows:

1. Galway's County Development Plan 2022 – 2028 has mapped the area as Generally Not Acceptable in Appendix A Renewable Energy Strategy.

2. The reasons for mapping the area as not acceptable for turbines include lack of wind **and the fact** that the turbine masts are propose for the shores of Lough Corrib Special Protection Area for Birds and the turbine masts are in the flight paths of protected species of birds and bats.

3. The applicants failed to acknowledge the fact that their proposal to discharge construction waters to ground would require a Section 4 Discharge Licence in which there is no demonstration of feasibility presented.

4. That the proximity of the development and the proposed infiltration pits was not correctly assessed with respect to the requirements of the Drinking Water Regulations (2023) and the PWS at Luimnagh intake on Lough Corrib.

5. None of the turbine proposer's have completed cumulative impact assessments with respect to the quarries already excavating bedrock in proximity to the mini quarries proposed for turbine foundations.

It is therefore confident that the Board will be unable to justify consent for the proposed turbines.

There are no other industries in proximity with respect to the groundwater body. There is no other industry within the EPA HydroTOOL mapped surface water catchment.

There is a concrete batching plant and an asphalt plant within the overall Harrington Concrete and Quarries landholding but outside the application area currently under consideration. The potential for cumulative impact is none. The reasons supporting a conclusion of no potential for cumulative impact include as follows:

(i) No new concrete batching plant or asphalt plant are proposed, and therefore no duplication of potential pressure,
(j) the existing plants are controlled by Planning Conditions and the Section 4 Discharge Licence controlling the quality of the final discharge,
(k) the proposed extension is intended to supply the same materials to the batching plants as were supplied by the excavations that occurred in the lands now completed in excavation,
(l) the current proposal for extension will not increase or intensify the rate of production through the batching plants only enable continued operation at an existing site set out for these purposes.

In the assessments presented in this work, the effect of the existing quarry and its maximum combined dewatering amount was considered. Water balance and hydrochemical evaluations suggested that the existing quarry and the proposed development, to extend into adjacent greenfield lands, was defensible and justifiable. The combined runoff and groundwater interception amounts was calculated and deemed 'low potential for impact' (WFD GW5) or insignificant within the scale of the Regionally Important Karstified Aquifer's groundwater flow volumes.

An overall conclusion of no potential for cumulative impact is therefore concluded.

8.7.8 Worst Case Impact

Under the worst case of what might happen, a major conduit could be intercepted and the quarry void would fill with groundwater. A lake would be created; the quarry would cease to operate. Water Level in the lake would be 28m OD, approximately. This is the water rebound level for the restoration. The elevation of 28m OD is approximately equal to the level of the open conduit in the wall in which water ingresses during wet weather and in proximity to the epikarst layer / transition zone.

This 'worst case' scenario is highly unlikely to occur because Site Investigations included drilling 41 bedrock boreholes, to depths well below the proposed excavation elevation, and there was no evidence of any conduits. There was evidence of 'karst' but the karst is dry gravelly clay infills and not water bearing conduits. There is evidence of a large conduit in the southern wall of the void and even with that conduit the water level in the void is managed with a relatively small range of pumping, which has been measured to range from zero m3/d to a maximum daily average of 1,483 m3/d (recorded 2017 to 2025).

8.7.9 Do Nothing' Scenario

If the development did not proceed, the ground of the proposed development would remain similar to the current site status and would be affected. Thus, it would be expected that the application site footprint would not undergo any changes in a 'do-nothing' scenario. Hydro-G has assessed that the groundwater component of the depth proposed for excavation at the site is small, therefore, to extend and excavate is unlikely to change the 'do-nothing' scenario.

8.7.10 Transboundary Impacts

EIA Directive 2014-52-EU invokes the Espoo Convention on Environmental Impact Assessment in a Transboundary Context, 1991, and applies its definition of transboundary impacts. Given the location of the site at 116km, approximately, southwest of the border with Northern Ireland, the nature, size and scale of the proposed development, and the fact that water from the catchment in which the site sits does not flow north, it is expected that the development will not have any significant transboundary effects with respect to water bodies.

8.7.11 Application of EA Hydrogeological Risk Assessment Methodology

In addition to the usual impact assessment, description of likely impacts and mitigation measures presented above, a 'best practice' approach to a hydrogeologically focussed assessment of quarrying and dewatering was also applied (Boak, R. et. al., 2007). This was a specified recommendation of scoping on previous assessments for the site: to apply best practice methodologies in the assessment.

As previously outlined in the Methodology Section of this Water Section, the UK EA's approach suggests a stepwise thought-process. Following on from the completed desk and field studies, Hydro-G answers to each of the steps can be summarised as follows:

- ***Step 1:*** Establish the regional water resource status:

  Answer = The application site and surrounding lands overlie an aquifer that is mapped as a Regionally Important Karst Conduit Aquifer, named the Clare-Corrib groundwater body, assigned Good Status (EPA 2016 - 2021, https://gis.epa.ie/EPAMaps/).

- ***Step 2:*** Develop a conceptual model for the abstraction and the surrounding area:

Answer = The site's discharge (abstraction) is a mixture of rainfall runoff and groundwater inflow. Groundwater inflow is primarily by one distinct conduit. At times of winter rainfall recharge, there are some subsoil/bedrock transition zone ingresses of recent rainfall but most groundwater at the site is from a conduit at 28m OD. No conduits were determined during borehole drilling in the floor of the proposed deepening area. No conduits were determined in any of the bored holes on the greenfield application area. The application site will be extracted down to a final proposed floor level of 4m OD. Land level in the application area ranges from 10m OD to 45m OD, approximately. Proposed excavation current groundwater ingress is therefore known and is <1,500 m3/d. The conceptual model, based on drilling and hydraulic response testing, is that there will be little new groundwater encountered. The porosity of the bedrock is very low. The surrounding area's groundwater flow continues as usual because the groundwater that enters the void is recharged back to groundwater via a subsoil wetland area at original ground level. For a karst system, groundwater ingress is relatively low. The site's water balance accounts for <0.1% of the Clare Corrib groundwater body's water balance.

- ***Step 3:*** Identify all potential water features that are susceptible to flow impacts:
    - *Clare Corrib Groundwater Body*
    - *Cregg spring discharging to Cregg River @ 1.6*km downstream
    - *Lough Corrib SAC & SPA*
    - *River Clare = unlikely, because there is a groundwater divide between the site and the river and the river is in a different mapped catchment.*

- ***Step 4:*** Apportion the likely flow impacts to the water features.

Answer = None Predicted because there is no nett loss of water. Any waters arising at the site are discharged back into the same water system.

Supporting evidence = the Cregg River is monitored by the EPA and no effects have been determined to date. The river is still flowing; the spring is still rising.

Overriding value of significance is that the interception amount at the quarry represents <0.1 % of the Clare Corrib groundwater body's water balance.

- **Step 5:** Allow for the mitigating effects of any discharges, to arrive at net flow impacts:

Answer = Discharge of water, surplus to dust suppression and product generation requirements, is to an on-site discharge zone and this replenishes the same groundwater body. As stated, all waters arising at the site represent <0.1 % of the Clare Corrib groundwater body's water balance and so, even accounting for product use. Therefore, the net flow potential for impact is negligible.

- ***Step 6:*** Assess the significance of the net flow impacts.

Answer = Negligible significance.

- ***Step 7:*** Define the search area for drawdown impacts.

Answer = Area of 2km radius assessed, no targets for impact identified. In any case, the groundwater flow mechanism is Karst Conduit flow with extremely low measured hydraulic conductivity in the bedrock boreholes. The conduit flow mechanism is therefore supported by the fact that field drilling and testing failed to find the conduits. This means that the conduit spacing is wider than the size of the application site. Drawdown, as a primary porosity bedrock media concept is not applicable to the site.

- ***Step 8:*** Identify all features in the search area that could be impacted by drawdown.

Answer = Refer to comment at Step 7, above. An extending drawdown radius concept does not apply to the site because of the karst conduit aquifer classification. However, if that principal were to be applied to the site, the radius of impact would be 700m radius.

- ***Step 9:*** For all these features, predict the likely drawdown impacts.

Answer = None predicted.

- ***Step 10:*** Allow for the effects of measures taken to mitigate the drawdown impacts.

Answer = Not relevant.

- ***Step 11:*** Assess the significance of the net drawdown impacts.

Answer = Not applicable.

- ***Step 12:*** Assess the water quality impacts.

Answer = Groundwater quality and Discharge quality is monitored to be good. Groundwater assimilation capacity simulations have been completed and demonstrate that the licensed discharge can continue and there will be no change in resultant groundwater concentrations. Refer Appendix A. Additional calculations have been completed with respect to explosives residues and no water quality impact is predicted.

- ***Step 13:*** If necessary, redesign the mitigation measures to minimise the impacts.

Answer = this is Not necessary.

- ***Step 14:*** Develop a monitoring strategy.

Answer: A Monitoring Programme is in place for the compliance with Section 4 Licensing. The physical quality of the discharge and the flow is constantly monitored.

In addition, the site samples their discharge waters every month and sends the sample to an accredited laboratory. This is to continue. The waters discharged represent an integrated picture of groundwater and surface waters at the site and therefore discharge monitoring is enough.

8.8 Lough Corrib PWS Protection Measures

As detailed in Appendix 8.2, the development does not have the potential to impact on an Uisce Éireann Drinking Water Source(s). This is confidently asserted because the development has a Section 4 Discharge Licence for 1,483 m3/day permitted Emission Limit Volume (discharge) as specified in the Section 4 Discharge licence W/502/22. The 1,483 m3/d ELV was sanctioned in 2023 by Galway County Council because it was proven to be Groundwater, Surface Water and Birds and Habitats Regulations compliant. Although Lough Corrib is a source for Public Water Supply with Uisce Eireann WTPs and associated intakes at Luimnagh and at Terryland, the application site's water balance component is miniscule compared to the volume of waters entering Lough Corrib from the Corrib catchment.

With respect to the 'Source > Pathway > Receptor' pathway model, the following can be stated:

a. The application site is not connected to the Luimnagh intake because groundwater flow direction from the quarry is to the south west and the Luimnagh intake is north west of the quarry.

b. There is a sufficiently robust control on the 'Source' at the quarry, by virtue of the hydrocarbon interceptor installed as a Condition of the Section 4 Discharge licence W/502/22.

c. The 'Pathway' is monitored by the EPA by the Groundwater Monitoring Station at Corrandulla. The results for that station have been presented in the Appendices and discussed in the text of this Chapter. The EPA Groundwater Monitoring results suggest good quality groundwater and no negative effect of the long term operation of the quarry.

d. The 'Receptor' is a ginormous body of water. The volume of water in Lough Corrib precludes impact arising from any inputs from the relatively small volume of discharge from the quarry, as detailed in the Quarterly Monitoring Reports for the site's discharge (Appendix 8.1).

8.9 Lough Corrib SAC Protection Measures

The main risk associated with the proposed extension to Harringtons Quarry at Ardgaineen, Co. Galway is the initially perceived potential adverse impact it could have on the Lough Corrib SAC. However, the licensed discharge volume is small in the scale of catchment hydrogeological water balance. Therefore, a conclusion of no risk is supported mathematically. The competent solid nature of the rock and Geological Survey of Ireland mapping for groundwater recharge suggests that the site's does not have potential to interfere with Lough Corrib's catchment because the scale of the quarry **is insignificant in the scale of the groundwater balance.**

In general, there are some small transition zone ingresses at times of heavy rainfall but, primarily, actual groundwater enters through the one conduit in the southern face. The only, singular, evidence of groundwater across the operational quarry and in the walls under the greenfield application area is one conduit in the face of one wall in the southern face, which is not in the current application area: it already has ongoing consent.

All groundwater settles in the sump at the lowest level of the quarry and is pumped to a natural vegetated area to which it again contributes to the same groundwater body from which it originally came. The same volume of rainfall runoff will fall on a similar area with the same runoff co-efficient and volumes derived. The floor of the existing quarry, its sump and the licensed discharge will continue to service the greenfield application area because that greenfield application area has always sent its rainfall runoff and interflow component to the quarry's floor.

The Section 4 discharge licence (Galway County Council Reference W/502/22) and its ELVs were demonstrated at the time of issue of the Licence of presenting zero change in resultant groundwater concentrations of the receiving environment. This will ensure maintaining favourable habitat in local surface water receptors of groundwater, whether that is the Cregg spring or Lough Corrib. This justification is supported by the fact that assimilation capacity simulations suggest no change whatsoever in groundwater concentrations. This is because the discharge quality is good and the volume of discharge is relatively small with respect to the volume of groundwater flowing regionally. Review of the site's Discharge Reports and EPA hydrochemical data for the Cregg River supports the conclusion of no impact because the hydrochemical signal in the discharge complies with the Licence Conditions and the EPA data for the Cregg River suggests excellent hydrochemical quality. The reported Poor status of the Cregg River is because of human alteration of the depth and width of the river channel: morphological pressure resulting in poor biological health.

8.10 WFD Assessment

A separate WFD Assessment Report accompanies the application documentation. However, in summary the following details are presented herein:

- The underlying GWB remains mapped as Good Status (2016 – 2021) and 3rd Cycle Not at Risk and the most current EPA published groundwater quality data (April 2025) suggests continued compliance of the Groundwater Body with the Threshold Values of the WFD.

- Whilst the closest downstream associated surface water (Cregg_010) Cregg river is mapped as Poor Status, consultation with LAWATERS (Mr. Francis Deery) suggests that the Poor Status mapping is because of channelisation and morphological alterations by others. The EPA Monitoring Station on the Cregg_010 closest to the quarry is reported as having Good Biological Quality Q4 (2024), which suggests Good Status and, similarly, interrogation of the EPA published hydrochemical dataset for the closest hydrochemical monitoring station on the Cregg_010 River, 3km from the quarry at [Bridge near Drumgriffin], enables Hydro-G evaluation that the High Status concentrations are complied with for most parameters specified as Environmental Quality Objectives of the Surface Water Regulations (2009, as amended).

- Lough Corrib is mapped as Lough Corrib Upper [IE_WE_30_666b], at c.8km due west of the quarry, is Good Status (2016 – 2021) & 3rd Cycle Risk = NOT AT RISK.

- In this chapter, mathematics were presented in Table 8.9 detailing the potential for the use of explosives (blasting) at the site to affect or impact groundwater quality (WFD Chemical Status) and the conclusion is that the residuals of N present no threat and no risk to the underlying GWB.

- In this chapter, mathematics were presented in Table 8.10 detailing the potential for the maximum permitted discharge volume of the Section 4 Licence (Galway County Council Licence Ref. No: W/502/22, issued 7th June 2023) to affect GWB quantitative status and the conclusion is that no risk and no threats are presented by the quarry's maximum permitted 1,843 m3/d in combination with the other registered abstractions (totalling 48,942 m3/d). The cumulative impact of all registered abstractions is 0.5% and this is well within the 5% threshold value of the Water Framework Directive Working Group (GW5) and is therefore deemed 'Low Potential Impact' and 'Not at Significant Risk' by WFD characterisation methods (GW5, 2005). This water balance data provides the confidence to assert that there will be no adverse impact on the local or regional groundwater regime. In addition, by extension of logic, the quarry poses no threat to the quantitative integrity of Lough Corrib SAC, SPA and PWS source.

8.11 Conclusions

EPA (2022) suggests that the impact assessment should be concise and that conclusions regarding the environment are unnecessary. Instead, conclusions on the Impact Assessment are required. It is hereby concluded that with the application of the Specified Mitigation Measures there will be no residual impact on the water environment.

Similarly, it has been determined that there is no potential for Cumulative Impact.

Given that Guidance on Impact Assessment has been applied as per EPA (2022), it is respectfully proposed that the assessment presented also complies with the EIA Directive 2014/52/EU.

8.12 Bibliography & References

Apex (2005) Geophysical Survey Ardgaineen Quarry, Claregalway, Co. Galway. APEX Geoservices Ltd. Geophysical & Geological Consultants. Kilanerin, Gorey, Co. Wexford.

Apex (2021) report on the Geophysical Investigation at the Ardgaineen Quarry Claregalway, Co. Galway for Harrington Concrete. 26th July 2021. Apex Geophysics Limited. Unit 6 Knockmullen Business Park, Gorey, Co Wexford.

Boak, R. et. al. (2007) Using Science to create a better place: Hydrogeological impact appraisal for dewatering abstractions. Environment Agency, Science Report – SC40020/SR1. Bristol, UK, 2007.

Boycott, T., Drew, D., Mullan, G., Podesta, J., Simms, M., Wilson, L. (2019) Caves of Mid-West Ireland. Counties Clare, Galway, Mayo and Roscommon. The University of Bristol Speleological Society ISBN 978-0-954850-1-3.

Comhairle Contae na Gaillimhe (2023). Licence to Discharge Trade or Sewage Effluent to Waters. Reference No. in Register W/502/22. To applicant name Harrington Concrete and Quarries, Cloughvalley, Kilkelly, Co. Mayo. For Harrington Concrete and Quarries premises at Ardgaineen, Claregalway, Co. Galway. Under the Local Government (Water Pollution) Act 1977 & 1990. Signed 7th June 2023.

Daly, D. (1992) A report on the Flooding in the Claregalway area. Groundwater Section Report File 2.2.7. 12pp.

Daly, D. (1985) Groundwater in County Galway with particular reference to its Protection from Pollution. Geological Survey of Ireland report for Galway County Council. 98pp.

Drew D.P. and Daly D. (1993) Groundwater and Karstification in Mid-Galway, South Mayo and North Clare. A Joint Report: Department of Geography, Trinity College Dublin and Groundwater Section, Geological Survey of Ireland. Geological Survey of Ireland Report Series 93/3 (Groundwater), 86 pp

Drew, D.P. (1973a) Hydrogeology of the north Co. Galway – south Co. Mayo lowland karst area, Western Ireland. International Speleology 1973, III, Sub –section Ca.

Drew, D.P. (1973b). Ballyglunin Cave Co. Galway and the hydrology of the surrounding area. Irish Geography Vol. 6, No. 5. pp 610-617.

Dept. of Environment, Heritage and Local Government, April 2004. Quarries and Ancillary Activities – Guidelines for Planning Authorities.

Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (EIA Directive).

EPA (2011) Guidance on the Authorisation of Discharges to Groundwater. Version 1 - December 2011.

EPA Online Water Quality Mapping. (https://gis.epa.ie/EPAMaps/)

EPA (1999) WWT systems for small communities and businesses.

EPA (2022) Guidelines on the information to be contained in Environmental Impact Statements. ISBN 978-1-80009-005-7. May 2022

EPA, 2006 Environmental Management Guidelines for the Extractive Industry (Non-Scheduled Minerals).

EPA (2009) Code of Practice WW treatment for single houses.

EPA (2018) 30_13 Clare[Galway]_SC_060 Subcatchment Assessment WFD Cycle 2.

EPA (2021a) 3rd Cycle Draft Corrib Catchment Report (HA 30). Catchment Science & Management Unit Environmental Protection Agency August 2021 Version no. 1.

EPA (2021b) Code of Practice Domestic Waste Water Treatment Systems (Population Equivalent ≤ 10). Published by the Environmental Protection Agency, Ireland. March 2021.

EPA (2021c) Assessment of the catchments that need reductions in nitrogen concentrations to achieve water quality objectives. WFD River Basin Management Plan – 3rd Cycle. June 2021. EPA Catchments Unit. Version no. 1.6`. https://www.catchments.ie/assessment-of-the-catchments-that-need-reductions-in-nitrogen-concentrations-to-achieve-water-quality-objectives/

EPA (2024) Cycle 3 HA 30 Corrib Catchment Report, May 2024.

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

European Communities (Birds and Natural Habitats) Regulations, 2011. S.I. No. 477 of 2011.

European Communities (Birds and Natural Habitats) (AMENDMENT) Regulations, 2021. S.I. No. S.I. No. 293 of 2021.

European Communities Environmental Objectives (Surface Water) Regulations, 2009. S.I. No. 272 of 2009.

European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations, 2012. S.I. No. 327 of 2012.

European Union Environmental Objectives (Surface Waters) (Amendment) Regulations, 2015. S.I. No. 386 of 2015.

European Union Environmental Objectives (Surface Waters) (Amendment) Regulations, 2019. S.I. No. 77 of 2019.

European Communities Environmental Objectives (Groundwater) Regulations, 2010. S.I. No. 9 of 2010.

European Communities Environmental Objectives (Groundwater) (Amendment) Regulations, 2011, S.I. No. 389 of 2011.

European Communities Environmental Objectives (Groundwater) (Amendment) Regulations, 2012, S.I. No. 149 of 2012.

European Communities Environmental Objectives (Groundwater) (Amendment) Regulations, 2016. S.I. No. 366 of 2016.

European Communities (Conservation Of Wild Birds (Lough Corrib Special Protection Area 004042)) Regulations 2012. S.I. No. 455 Of 2012.

European Union Habitats (Lough Corrib Special Area of Conservation 000297) Regulations 2022. S.I. No. 384/2022.

European Communities Environmental Objectives (Groundwater) Regulations, 2010. Statutory Instruments. S.I. No. 9 Of 2010.

European Union (Drinking Water) Regulations 2023 (S.I. No. 99 of 2023).

Ferguson & Leask (1988) The export of nutrients from surface coal mines. Environment Canada conservation and protection environmental protection pacific and Yukon region west Vancouver, British Columbia.

Galway County Council: Water Quality, Group water schemes. http://gccapps.galwaycoco.ie/waterquality/.

Guidelines for the Preparation of Soils, Geology & Hydrogeology Chapters of Environmental Impact Statements, 2013.

Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, NRA Document.

GSI (2003, 2005) Bedrock Geology Sheets 11, 14 & 15, 1:100,000 Map Series. Geological Survey of Ireland.

GSI On-line Groundwater database. Aquifer Classification, Aquifer Vulnerability, Teagasc Soil Classification, Subsoils, Karst features, groundwater recharge.

GSI (2004) 1st Draft Clare-Corrib GWB Description June. 2004 Clare-Corrib GWB: Summary of Initial Characterisation.

GW5 (2004) WFD Working Group Guidance document Abstraction Impact.

Hydro-G (2022) Discharge to Groundwater Licence Application Hydrogeological Report Harrington's Harrington Concrete & Quarries, Ardgaineen, Claregalway, Co. Galway (Hydro-G, January 2022). Lodged with Galway County Council January 2022. Reference No. Wat502/22.

IGI (2002) Geology in Environmental Impact Statements a Guide.

Irish Drilling (2021) Site Investigation Report for Quarry at Ardgaineen, Claregalway, Co. Galway.

Lyons, M.D. & Kelly, D.L. (2016) Monitoring guidelines for the assessment of petrifying springs in Ireland. Irish Wildlife Manuals, No. 94. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Ireland.

National Parks and Wildlife Service (NPWS). Database of Special Areas of Conservation, National Heritage Areas, National Parks, Special Protection Areas including site synopsis reports.

NPWS (2017) Conservation Objectives: Lough Corrib SAC 000297. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs. Ordnance Survey of Ireland, Sheet No. 6, 1:50,000.

NRA (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide & National Roads Authority (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

Ordnance Survey, Ireland Map Series 1:50,000 Sheets 45 & 46 Galway.

SNH (2018) Scottish National Heritage A handbook on environmental impact assessment: Guidance for Competent Authorities, Consultees and others involved in the Environmental Impact Assessment Process in Scotland, Scottish Natural Heritage, 5th Edition, 2018. Section C8.

WFD Working Group (2004) Guidance document no. GW3: THE CALCAREOUS/ NON-CALCAREOUS (“SILICEOUS”) CLASSIFICATION OF BEDROCK AQUIFERS IN THE REPUBLIC OF IRELAND.

Appendices

Water

Appendix 8.1	Section 4 Discharge Licence W/502/22, Hydro-G (2022) Report supporting & Nine Quarterly Monitoring Reports (2023 – 2025).
Appendix 8.2	Uisce Eireann's Scoping Response and Hydro-G Responses.
Appendix 8.3	On-Site WWTP Details.
Appendix 8.4	EPA Published Quality Data & Maps, Hydro-G Comments.
Appendix 8.5	Site Groundwater Quality Data & Report (2025).

Appendix 8.1

Section 4 Discharge Licence W/502/22

&

Hydro-G (2022)

&

Nine Quarterly Compliance Reports

COMHAIRLE CONTAE NA GAILLIMHE

LOCAL GOVERNMENT (WATER POLLUTION) ACT, 1977 & 1990

LICENCE TO DISCHARGE TRADE OR SEWAGE EFFLUENT TO WATERS

Harrington Concrete and Quarries,
Cloughvalley,
Kilkelly
Co. Mayo

Reference No. in Register
W/502/22

Galway County Council in exercise of the powers conferred on it by the Local Government (Water Pollution) Act 1977 as amended by the Local Government (Water Pollution) Act 1990, hereby grants a licence, Reference number **W/502/22** to discharge trade effluent (*i.e., surface water runoff and groundwater ingested from the quarry area only*) from an attenuation sump to a wetland vegetation area via a petrol/oil interceptor at **Harrington Concrete and Quarries** premises located at **Ardgaineen, Claregalway, Co. Galway** to groundwater subject to the conditions set out in the Schedule hereto.

Signed this 7th **day of** June **2023**

On behalf of Galway County Council.

Eileen Ruane

Director of Services, Environment & Climate Change, Fire & Major Emergency Services, Human Resources and Information Systems

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IMPORTANT NOTICE

Any person may, **before the expiration of the prescribed period, appeal to An Bord Pleanala** against the grant or refusal of a licence, the conditions attached to a licence or the amendment or deletion of conditions or the attachment of new conditions following review of a licence. (See Section 8 Local Government (Water Pollution) Act, 1977).

The prescribed period as per Article 26 of the Local Government (Water Pollution) Regulations 1978 and 1992 is the period of one month beginning on the date of the grant or refusal of the licence or in the case of a decision of the Local Authority following on a review of a licence the date of that decision. (The relevant date is as shown above).

An appeal must be made in writing, stating the subject matter of the appeal and the grounds of appeal and must be accompanied by a deposit of €126. The address of An Bord Pleanala is 64 Marlborough Street, Dublin 1.

An Bord Pleanala, after consideration of any appeal lodged with it, may direct the Local Authority to grant or revoke a licence or to amend or attach conditions relating to it.

SCHEDULE TO LICENCE NO. W/502/22

1. Scope

This licence refers to the attenuation sump discharge of Harrington Concrete and Quarries located at Ardgaineen, Claregalway, Co. Galway. Surface water run-off and ground water collected in the quarry attenuation sump are pumped to a Wetland Vegetation Area via a petrol/oil interceptor where water percolates to ground. This licence is for the existing extraction area of 4.35Ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry or there is an increase in quarrying discharge a full review of this licence will be required. The maximum permitted discharge is **1483m³** per day.

2. Attenuation Sump Discharge

2.1. Discharge

The Licensee shall not discharge, cause or permit the discharge of any contaminated surface water or process water directly to any surface water or groundwater without prior treatment.

2.2. Treated Discharge

The treated discharge shall be discharged to groundwater without posing a pollution risk.

2.3. Discharge Performance Standards

The treated discharge, **prior to its release** to the Wetland Vegetation Area, shall comply with the following standards:

(a) The **Total Suspended Solids** concentration of the discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/litre.

(b) The **Biochemical Oxygen Demand** concentration of the discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(c) The **Chemical Oxygen Demand** concentration of the discharge from the attenuation sump and oil interceptor shall not exceed 15 mg/l.

(d) The **Nitrate (NO_3^-)** concentration of the discharge from the attenuation sump and oil interceptor shall not exceed 18 mg/l.

(e) The **Nitrite (NO_2^-)** concentration of the discharge from the attenuation sump and oil interceptor shall not exceed 0.05 mg/l.

(f) The **Total Hydrocarbon** concentration of the discharge from the attenuation sump and oil interceptor shall not exceed 0.01 mg/l.

(g) The **Total Ammonia** concentration of the discharge from the attenuation sump and oil interceptor shall not exceed 0.03 mg/l.

(h) The **Benzo (a) Pyrene** concentration of the discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(i) The **Total PAH** concentration of the discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(j) The **pH** of the discharge from the attenuation sump and oil interceptor shall not exceed the range of 6-9 pH units.

(k) The **Flow** of the discharge from the attenuation sump and oil interceptor shall not exceed a volume of $1483m^3$/day

(l) The **Colour** of the discharge from the attenuation sump should not change significantly from day to day nor shall there be any evidence of oil and excess solids on visual inspection

(m) The **Conductivity** of the discharge from the attenuation sump and oil interceptor shall not change significantly from day to day

(n) The **Turbidity** of the discharge from the attenuation sump and oil interceptor shall not change significantly from day to day

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3. Discharge Analysis

Analysis of the treated water prior to its discharge shall be carried out by an approved accredited laboratory where readings are not taken on site. The frequency of analysis and the parameters are outlined below. Results of the same shall be forwarded to the Environment Section of Galway County Council on a quarterly basis:

Parameter	Monitoring frequency	Analysis to be performed by accredited laboratory
Flow	Continuous - Daily	
Colour and visual inspection	Daily	
Conductivity	Continuous - Daily	
Turbidity	Continuous - Daily	
pH	Continuous - Daily	
	Quarterly	√
Total Suspended Solids	Quarterly	√
Nitrates NO_3^-	Quarterly	√
Nitrites NO_2^-	Quarterly	√
Chemical Oxygen Demand	Quarterly	√

Biochemical Oxygen Demand	Quarterly	√
Total Ammonia	Quarterly	√
Total PAH	Quarterly	√
Benzo (a) Pyrene	Quarterly	√
Total Hydrocarbons including Diesel range organics and petroleum range organics	Quarterly	√

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4. Groundwater Analysis

Quarterly analysis of groundwater monitoring wells shall be carried out by an approved accredited laboratory.

The following parameters shall be measured and the analysis of the same forwarded to the Environment Section of Galway County Council:

Parameter	**Units**
(a) Water level	mAOD
(b) pH	pH units
(c) Conductivity	µS
(d) Suspended Solids	mg/l
(e) Nitrates	mg/l NO_3
(f) Total Hydrocarbons	mg/l

Where quarrying activities are found to adversely affect local water supplies the provisions of the EPA Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-Scheduled Minerals)', Section 3.3.1 shall apply, and the quarry shall provide a replacement water supply.

5. Petrol / Oil Interceptor

The petrol / oil interceptor should be inspected each working day to ensure it is operating correctly and daily records kept of this. These records should be made available to Galway County Council if requested.

6. Attenuation sump, petrol/oil interceptor & wetland area

6.1 Treatment process

The attenuation sump and petrol/oil interceptor shall be capable of fulfilling the requirements of this licence as outlined in condition No. 2.3 above. Failing this it will be necessary for the licensee to make the necessary changes to the system. The Environment Section of Galway County Council must be notified of any proposed alternations to the treatment process for approval prior to alterations taking place.

6.2 Metering

An approved flow meter shall be fitted to the discharge pipe to allow for the measuring and recording of the daily volume discharged. These records shall be maintained and be available on request to Galway County Council staff. Daily flow reading shall be submitted to the Environment Section of Galway County Council on a quarterly basis. The maximum volume of water discharged from the attenuation sump via the petrol/oil interceptor is 1483m^3 per day.

6.3 Ready access

Access to the attenuation sump, oil interceptor and wetland area shall be allowed to authorised persons appointed under the provisions of the Local Government (Water Pollution) Acts, 1977 and 1990.

6.4 Sampling

A sampling chamber shall be installed at the end of treatment system before the wetland area to allow for the taking of samples of the treated discharge in a safe manner. Ready access to the sampling chamber must be provided at all times.

6.5 Caretaker

The day-to-day inspection and maintenance of the attenuation sump and petrol/oil interceptor shall be the responsibility of the Licensee. The caretaker shall ensure that all pumps and meters are operating correctly and are part of the maintenance program. Records of all servicing shall be maintained and be available on request to Galway County Council staff. A copy of this licence shall be issued to all relevant personnel whose duties relate to any condition of the licence. The name and address of this appointed person shall be supplied to the Environment Section of Galway County Council within 4 weeks from the issuing of this licence. In the event of any change in personnel this change shall be made known immediately.

6.6 Notification of Non-Compliance

The Environment Section of Galway County Council must be notified as soon as practicable after the occurrence of any of the following:

- Any discharge that does not comply with the requirements of the licence
- Any incident with potential for environmental contamination of surface water or groundwater

The licensee shall include as part of the notification, date and time of the incident, details of the occurrence and the steps taken to minimize the emissions and avoid recurrence.

The licensee shall notify the Environment Section of Galway County Council prior to further processing that may impact the effective working of the treatment system.

7 EPA Guidelines

All works must be carried out in accordance with the EPA guidelines 'Environmental Management in Extractive Industry (Non-Scheduled Minerals)'.

8 Annual Contribution

The Licence holder shall pay to Galway County Council an annual contribution of €550. The contribution will be used towards the cost of such monitoring of the activity, as the Council considers necessary for the performance of its duties under the Water Pollution Act 1977-1990.

This amount to be paid shall be adjusted annually in accordance with the Consumer Price Index value appertaining at the time when the payment becomes due. Galway County Council reserves the right to alter the rate of contribution each year in order to take account of the actual cost of monitoring incurred by it in the previous year and estimated for the next year.

9 Changes in ownership

The Environment Section of Galway County Council must be notified in writing of any change to company ownership and/or trading name.

END.

Hydro-G

Discharge to Groundwater

Licence Application

Hydrogeological Report

Harrington Concrete & Quarries,

Ardgaineen, Claregalway, Co. Galway

Local Government (Water Pollution) Acts 1977 & 1990

Consultant Pamela Bartley

January 2022

Hydro-G

50 Henry St.
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Project No.:	21-P12 Harringtons 2021 Ardgaineen
Report Status:	Review issue
Report Title:	Discharge to Groundwater, Licence Application, Hydrogeological Report.
Date:	26th January 2022

Prepared by:

Pamela Bartley

____
Dr. Pamela Bartley B.Eng, M.SC., Ph.D.

NOTES:
This report is for the use solely of the party to whom it is addressed and no responsibility is accepted to any third party.

Pamela Bartley B.Eng., MSc., Ph.D

Pamela is a water focussed civil engineer. With 25 years of field-based practice in borehole drilling, groundwater monitoring and abstraction point management she is now considered a specialist in groundwater assessments and constructions to use groundwater as a source of public water supply. Upon completion of a Diploma in Water and Wastewater Technology at Sligo RTC, she completed her primary degree in Civil Engineering at Queens University, Belfast and then completed a Master's in environmental engineering followed by a hydrogeologically focussed Ph.D. within the school of Civil Engineering at Trinity College, Dublin. Her key work areas are groundwater development from large scale water supply boreholes, hydrogeological assessment of quarries and the evaluation of discharges to groundwater and surface waters. Pamela Bartley's company is Bartley Hydrogeology ltd., registered to trade as Hydro-G.

Pamela has successfully completed post doctorate 'Professional Development' formal course training in the areas of:

- PSDP & PSCS (IOSH certified, 2016);
- Karst Hydrogeology (GSI, 2013);
- On Site Wastewater & Water Services Amendment Act 2012 (IE, Western Region 6 week programme 2012 & Dublin 2012);
- Zero Discharge Willow Wastewater Systems Design Courses (Denmark 2008 & 2011 & Ireland 2012);
- Expert Witness (IE, 2011);
- Planning & Development Act (IE, 2010);
- Surface Water Regulations 2009 (DoE, 2010 & 2011);
- Sustainable Drainage (Wallingford/CIRIA, 2005 & 2008);
- Source Protection Zone Delineation (IGI/GSI, 2007);
- Groundwater & Contaminant Microbiology (IGI/GSI, 2006);
- Applied Groundwater Modelling (ESI, UK, 2000);
- Site Suitability Assessment (FETAC, 2002).

Pamela's water supply borehole expertise has been gained in the field on DBO2 East Galway drilling in karst limestone for large scale abstractions for Group Water Schemes and assessments of many Public Supply sources for Irish Water. Pamela has a particular skillset in regionally important quarries and the legislatively driven assessments required for these sites, many in SAC environments. Pamela has worked on many Section 4 Discharge Licence impact assessments.

As a result of work in evaluating planning appeals, Pamela has become specialist in planning evaluations in the context of enacted Irish Regulation and EU Directives concerning the water environment such as the Groundwater Regulations (S.I. No. 9 of 2010), Surface Water Regulations (S.I. No. 272 of 2009), Water Framework and Habitats' Directives. Pamela is a qualified and certified 'Site Assessor' and interviewer of examination candidates in respect of eligibility for the Site Suitability FETAC Qualification. In the past, she has lectured in third level institutions (WIT, CIT, 1996 – 1999), delivered practical laboratory instruction in the assessment of subsoils for the FETAC Site Assessor programme and also demonstrated hydraulics laboratory modules at Trinity College Dublin (1996). She has been an invited guest speaker at An Board Pleanàla, The Irish Concrete Federation, The Health Service Executive, Environmental Health Officers National Conference, The Irish Planning Institute's National Conference, The International Association of Hydrogeologists National Conference (Irish Branch) and has delivered hydrogeological lectures to the public during Science Week.

Hydro-G is the registered trading name of Pamela Bartley's company Bartley Hydrogeology Ltd., a company registered in Galway Ireland. The company holds professional indemnity insurance of €2million for each and every claim in each period and the company holds both employers and public liability insurances.

Pamela is qualified and IOSH certified to act as PSDP (Project Supervisor Design Phase) & PSCS (Project Supervisor Construction Stage) as defined by the Construction Regulations. The company is a registered Irish Water Supplier (no. 1855) and Pamela Bartley is HSQE approved within Irish Water.

Contents

Report Plates

Associated Figures Series

Appendices

Executive Summary

- Harrington's Quarry, Ardgaineen, Claregalway Co. Galway is an existing pre-63 quarry and the management of waters at the site requires regularisation by means of application for a Section 4 discharge licence. The licence is required for the existing discharge of quarry waters to the Clare Corrib Groundwater Body (IE_WE_G_0020), *via* the subsoil in a wetland area in the vicinity of the site.

- This report has been prepared for Galway County Council to enable evaluation for the discharge to be licensed in the context of the Groundwater Regulations (SI 9 of 2010 as amended by SI 366 of 2016: hereafter simply referred to as the Groundwater Regulations). The discharge is diffuse and to an established wetland area from which it percolates to ground and groundwater. There is no engineered percolation area and neither is one deemed necessary in the context of Regulation. Regulation 8 of the Groundwater Regulations 2010 allows for direct discharge in Clause 8(a)(ii) *"for reinjection of pumped groundwater from mines and quarries or associated with the construction or maintenance of civil engineering works"…. "Subject to a requirement for prior authorisation provided such discharges, and the conditions imposed, do not compromise the achievement of the environmental objectives established for the body of groundwater into which the discharge is made".*

- The site lies within the Corrib catchment (Hydrometric Area 30) and Lough Corrib has designation as a European Site (Lough Corrib SAC, Site Code 000297; Lough Corrib SPA Site Code 004042) and has a specific Statutory Instrument attached to it in the European Communities (Conservation of Wild Birds (Lough Corrib Special Protection Area 004042)) Regulations 2012.

- The site sits between the river Clare (Galway)_070 and Lough Corrib. The river Cregg_010 rises at a distance of 1.5km to the south-west of the site's discharge. Hydrogeologically, the site is upstream of the rising Cregg River and upstream of Lough Corrib. The river Clare is upstream of the site, hydrologically, and parts of the river Clare are mapped as part of Lough Corrib SAC.

- With respect to WFD Status (EPA 2010 – 2015 and 2013 – 2018) and 2nd and 3rd WFD Cycle mapped Risk:

  a. The receiving groundwater is the Clare Corrib Groundwater Body (IE_WE_G_00200, which is mapped as Groundwater in SAC habitats, and its WFD Status is mapped by the EPA as **Good Status** (2010 – 2015 and again 2013 - 2018) but assigned an **'At Risk'** classification in both the 2nd and 3rd WFD Cycles (https://gis.epa.ie/EPAMaps/Water). The **Good Status** designation of the receiving water is concurrent with long-standing operation of the quarry and its associated dewatering discharge. Therefore, the site's operation and discharge is **NOT** compromising the achievement of the environmental objectives established for the body of groundwater into which the discharge is made. The 'At Risk' classification is reported in EPA (2021) as "*For the At Risk groundwater bodies the significant issue is nutrient pollution and diminution of quality of associated surface waters for chemical reasons, which are impacting all four groundwater bodies*", in the Corrib catchment. EPA (2018) states that **Agriculture** is the identified nutrient pressure in the groundwater body.
  b. The site sits 3km west of between the river Clare (Galway)_070 (IE_WE_30C011000) which is mapped as Good Status and 'Not at Risk'.
  c. The river Cregg_010 rises at a distance of 1.5km to the south-west of the site's discharge. This river is mapped as Moderate Status and At Risk. EPA (2021) states that the Cregg_010 is "At Risk WB proposed by GCC because of its importance for Lough Corrib." The quarry is not mentioned in any WFD Report (2018, 2021).
  d. The site is 8km, approximately, due east of Lough Corrib Lower (IE_WE_30_666a) and the lake is mapped as Good status (2010 – 2015). Whilst previously mapped as At Risk in the WFD 2nd Cycle due to Invasive Species pressure (EPA, 2019), Lough Corrib Lower is now mapped as Not at Risk (EPA, 2021).

- **It is therefore concluded that the ongoing discharge has not compromised the objectives of the WFD.**

- The site is operational and has planning consent. The southern portion of the deepest part of the quarry acts as the sump. The surface area of the sump can change with the weather but it can spread to a surface area of 20,000m2 on the floor and the volumetric capacity is 6,000 m^3, approximately. All waters arising at the site flow by gravity to the sump on the floor and are pumped up the wall of the quarry, some waters are diverted to the concrete block making systems and other water to the sprinklers, wheelwash and other site dust suppression. The 6" line to the discharge area has a flow meter. Discharge is to a natural wetland in a parcel of land to the south of the site's offices.

- The site's discharge is instrumented with a flow meter. The average daily discharge, calculated over a 4-year period is 1,109 m3/d with a maximum recorded average discharge of 1,483 m3/day. It is good practice to apply a +20% factor for future climate change. The likely daily average future discharge volume is therefore calculated to be 1,780 m3/d, approximately.

- There is a long record of water quality at the site and Hydro-G employed the qualitative and quantitative characteristics of the on-going discharge as well as Site Investigation information for the discharge area and wider site area to populate the required Groundwater Assimilation Capacity simulations as Guided by EPA (2011).

- The overall objective of this evaluation is to present reasoned and justified Discharge Licence Conditions to Galway County Council so that a Section 4 Discharge Licence can be issued with Conditions that are appropriate to both the water management regime at the site and facilitate administrative compliance for the receiving waters with Environmental Quality Objectives of the Groundwater Water Regulations. The works completed here also consider the discharge in the context of other relevant Regulations such as the Surface Water Regulation (2009 as amended 2012, 2015 & 2019) & the Birds and Natural Habitats Regulations (2011 as amended 2021).

- On the basis of my calculations, the Environmental Quality Objectives of the EC Environmental Objectives Groundwater Regulations can be adhered to for scientifically justified Conditions as presented in Table 11 of this report.

- Water balance calculations suggest that the site's proposed maximum future discharge volume equates to 0.1% of the water in the Clare Corrib Groundwater Body and this low percentage further supports the conclusion of no potential for impact, as guided by GW5 WFD Working Group (2005).

- With respect to Appropriate Assessment, the following is pertinent:
  a. There will be no impacts on groundwater or surface water.
  b. An Ecological Survey (Applied Ecology Ireland, 2022) has confirmed that the site has had no measurable negative impact on the environment.
  c. Assimilation Capacity Simulations for the proposed future maximum discharge of 2,000m^3/d suggests no change in any Threshold Values parameters specified in the Groundwater Regulations. The receiving groundwater water will remain compliant with the Objectives of the Groundwater Regulations.
  d. The quality of the water discharging from the site is dominated by rainfall runoff and the quarry sump is more than adequate.
  e. Mitigation measures are in place, to prevent impact, by virtue of the fact that the existing sump is large, the discharge is pumped and therefore controllable by an On/Off switch. The quarry floor can be allowed to flood if required.

- A monitoring programme is proposed and consists of monthly discharge sampling for the Emission Limit Values of the Discharge Licence issued and daily recording of discharge volumes. Compliance points have been presented. The site will adhere to any licence specifications of the Local Authority.

1.0 Introduction

Harrington's Quarry at Ardgaineen, Claregalway, Co. Galway is an existing, operational quarry. The quarry will be referred to as "the site" for ease of reference throughout this report. The centre of the site has ITM Grid References: 538,246 E; 740,427N.

The site is located on the outskirts of Claregalway with access routes west to Connemara, south to Galway city and north to Tuam. The site lies within the Corrib Catchment, Clare [Galway]_SC_060 Code 30_13 subcatchment and is underlain by the Clare Corrib Groundwater Body (GWB). Characterisations, Pressures and other significant information presented in EPA (2019 and 2021) have been reviewed and considered in this assessment.

Throughout the history of the site there have been grants of permission for aggregate crushing, aggregate storage, asphalt plant and associated works, concrete batching and block making and the provision of welfare facilities for staff (offices and sanitary services) spanning 1992 to 2013. Part of the quarry 4.35 Ha. was granted Substitute Consent (Ref SU0053) in February 2017.

Because the site is operational, a lot of it is working area that has already been stripped of overburden. The site has a well-established floor and associated operational sump in the deepest and oldest part of the site. All waters flow to that sump, by gravity, and are discharged to the Clare Corrib Groundwater Body via a natural wetland area to the south of the site offices. Throughout the operation of this discharge, the underlying Clare Corrib Groundwater Body has maintained its Good Status (https://gis.epa.ie/EPAMaps/Water). However, the Clare Corrib Groundwater Body is assigned a Risk Classification of 'At Risk' by the WFD teams (https://gis.epa.ie/EPAMaps/Water). EPA (2019) states that Agriculture is the identified pressure in the groundwater body. EPA (2021) cites nutrient pollution as the pressure on each Groundwater Body in the Corrib (HA30) catchment. The source of nutrients can be domestic wastewater systems or agriculture. Quarries do not provide a source of nutrients. While there are chemicals associated with the use of explosives at quarry sites, the management of explosives is well controlled by licensed sub-contractors.

The site sits between the river Clare (Galway)_070 and Lough Corrib. The river Cregg_010 rises at a distance of 1.5km downstream and to the south-west of the site's discharge. Refer to the associated Figures series, Figure 1 for Location and to Figure 2 for Regional Surface Waters. The site lies within the Corrib catchment and Lough Corrib has designation as a European Site (Lough Corrib SAC, Site Code 000297; Lough Corrib SPA Site Code 004042) and has a specific Statutory Instrument attached to it in the European Communities (Conservation of Wild Birds (Lough Corrib Special Protection Area 004042)) Regulations 2012. Refer to Figure 3 for Designated Sites.

This report presents as follows:

a. An introduction to the site, its landscape setting and the provision of services are presented as Section 2.0,

b. Characteristics of the discharge at the site & evaluation of the potential impacts of blasting on the discharge quality, are presented as Section 3.0.

c. Site Investigation Results are presented as Section 4.0,

d. Assessment of the hydraulic and hydrochemical feasibility of the discharge are presented as Section 5.0.

e. A monitoring programme is proposed in Section 6.0,

f. A discussion is presented in Section 7.0 in which it is demonstrated that the proposed, and simulated, Emission Limit Values support a grant of a Section 4 Discharge Licence which complies with the Groundwater and Birds & Habitats Regulations,

g. Overall conclusions are presented in Section 8.0.

2.0 The Site

2.1 Site & Landscape

The site is located within in the townland of Ardgaineen, Claregalway, in Co. Galway. The site is situated 8km, approximately, to the north of the village of Claregalway, 13km, approximately, to the northeast of Galway City, and 12km southwest of Tuam, Co. Galway. The site lies 1.3km, approximately, to the west of the M17 motorway and is also readily accessible from the N83, N84 and N17. The quarry is accessed by the L6182 road that links the N83 to the N84. A 200m driveway separates the working quarry from the local public road L6182.

The existing quarry covers a total area of 14.9 Ha. which includes the extraction areas and a manufacturing area which includes processing infrastructure, concrete plant and asphalt plant, storage sheds, workshops, administrative infrastructure and ancillary facilities. Rock is extracted and processed into various of aggregate which is sold to market or used to manufacture a range of concrete and bituminous products.

The wider area comprises a high density of one-off housing, with the nearest houses located approximately 200m from boundary of the site. Immediately adjacent to the quarry site there are agricultural fields. The application site is situated in an area which is characterised as being a gently undulating low lying limestone plateau without surface drainage. Natural land surface elevations range in height from 30-80m OD (Ordnance Datum). The site's location is shown on Figure 1.

Land use in the wider area is mainly agricultural. There is extensive one-off housing domestic 'ribbon development' on the roads approaching the quarry. The area is serviced by Irish Water in potable water. The area is not serviced for wastewater and so it is assumed that each of the houses along the road have their own wastewater treatment plants and discharge to groundwater via subsoil percolation.

Within the existing quarry there are areas for extraction, crushing, screening and processing of stone, an asphalt plant, concrete batching plants, block yard, settlement ponds, stockpiling areas, weighbridge, wheel wash and associated offices and other buildings. The overall site is securely fenced with screen mounds on the site perimeter. The overall site is securely fenced.

The underlying Soils, Subsoils, Vulnerability, Bedrock Geology, Aquifer and WFD Status & Risk mapping are presented in the associated Figures and discussed in Section 4 describing the hydrogeology of the site and local area.

2.2 Site Services

With respect to water, the site has a metered connection with Irish Water, which has mains supply along all roads in the vicinity of the site.

With respect wastewater, toilet flushings are discharged to a HydroKlenze Biological WWTP, which is a 'BAF' system, which relies on biological action that is maintained by aeration. The product brochure is presented in Appendix A. Hydro-G surveyed the system installed and evaluated invert levels and discharge with the percolation area's installer. The WWTP is functional and has structural integrity. The WWTP has a 0.9m3/d treatment capacity and the daily hydraulic loading from the 12 workers at the site at any one time, suggests a site-specific daily load of 0.48 m3/d arising, based on 40l/p/d for open industrial usage as per EPA (1999), which is within the 0.9 m3/d capacity of the WWTP. Therefore, the WWTP provides full treatment. The percolation area was surveyed by Hydro-G in 2015. The measured dimensions conform to the EPA Guidance relevant at that time, which was EPA (2009), for the population equivalent at the site. Given a work force of 12, the calculated daily hydraulic loading is 40l/p/d for open industrial usage as per EPA (1999). The conventional 150 litres/p/d is the PE (population equivalent) for one person in the conventional domestic setting/residence and this is maintained in EPA (2021). The percolation area measures 10 m x 6 m and it is a gravity fed system with conventional EPA (2009) recommended 100mm diameter distribution pipes set in gravel trenches at 2.5m Centres. There are two trenches, two lengths of pipe – this exceeds the requirements of EPA CoP (2009). Therefore, the WWTP and percolation area's systems have been implemented to EPA (2009) Code of Practice to ensure that there is no potential for contamination. Separation distances to boundaries are as per EPA (2009) CoP. The existing system poses no risk of significant effect on the environment and no remedial measures are required to mitigate any potential impacts.

2.3 Groundwater Hydrogeology

Groundwater is relied upon to supply ten Group Water Schemes (GWSs) within 10km radius of the discharge. However, each of those GWSs have had their Source Protection Areas (SPA) mapped and each SPA is upgradient of the site, in terms of groundwater flow, with the closest boundary at a distance of 2.6 km from the discharge. There is therefore no potential for interaction with the site.

The GWB underlying the site is the Clare-Corrib GWB (GSI, 2004), which is mapped as Good Status and Not at Risk (https://gis.epa.ie/EPAMaps/Water EPA 2022). This groundwater body is reported to have an approximate area of 1,422km2 (GSI, 2004) and its associated surface water features include the Cregg River, River Clare and Lough Corrib. The GSI (2004) has described the characteristics of the Clare Corrib GWB as follows:

- *The main aquifer category in this GWB is: Rkc: Regionally important karstified aquifer dominated by conduit flow. Karstification is widespread in this GWB. Recorded karst features number 219, but are considered to represent only a fraction of existing features.*

- *The Dinantian Pure Bedded Limestones are generally over 100 m thick. Most groundwater flows in an epikarstic layer a couple of metres thick and in a zone of interconnected solutionally-enlarged fissures and conduits that extends approximately 30 m below this. Deeper inflows can occur in areas associated with faults or dolomitisation.*

- *Overall, flow directions are to the southwest, with all groundwater discharging to L. Corrib. Although, there are six surface water catchments within the GWB, a key aspect is that groundwater can flow across the surface water divides and beneath surface water channels, as evidenced by the tracer test data.*

- *These rocks are generally devoid of intergranular permeability. Groundwater flows through fissures, faults, joints and bedding planes. In pure bedded limestones these openings are enlarged by karstification which significantly enhances the permeability of the rock. Karstification can be accentuated along structural features such as fold axes and faults. Groundwater flow through karst areas is extremely complex and difficult to predict. As flow pathways are often determined by discrete conduits, actual flow directions will not necessarily be perpendicular to the assumed water table contours, as shown by several tracing studies (Drew and Daly, 1993).*

- *Flow velocities can be rapid and variable, both spatially and temporally. Rapid groundwater flow velocities indicate that a large proportion of groundwater flow occurs in enlarged conduit systems. Groundwater flow in highly permeable karstified limestones is of a regional scale. Flow path lengths can be up to a several kilometres.*

- *Overall, groundwater flow will be towards the River Clare and L. Corrib, but the highly karstified nature of the bedrock means that locally groundwater flow directions can be highly variable.*

- *The main groundwater discharges are to the streams, rivers and large springs found within the body. The area is principally drained by the River Clare and its tributaries, however the present-day drainage network has been changed significantly by arterial drainage that took place early in the nineteenth century. Much of the current stream network is a storm runoff system and is inactive during summer months. Prior to artificial drainage, streams sank underground via a few turlough sinks in the GWB.*

- *Within the GWB, surface water catchments are often bypassed by groundwater flowing beneath surface water channels and across surface water catchment divides.*

- *In general, the degree of interconnection in karstic systems is high and they support regional scale flow systems. Flow paths have been measured up to 10 kilometres in length.*

The GSI (www.dcenr.maps.arcgis.com) presents site information, as follows:

a. **Soils:** At the discharge area the soils are mapped as "Till derived chiefly from limestone" and at the quarry itself they are Rock at Surface, which is the case with all quarries, naturally;

b. Subsoils: At the discharge area the subsoils are mapped as "Till derived from limestone" and at the quarry itself they are Kartsified bedrock outcrop or subcrop (KaRck);

c. Vulnerability: At the discharge area the Vulnerability is mapped as E Extreme and at the quarry itself as 'X', rock at surface;

d. Bedrock: Dinantian Pure Bedded Limestones of the Burren Formation, described as pale grey clean skeletal limestone. The formation is typified by pale-grey packstones and wackestones, but also contains intervals of dark cherty limestones, often associated with oolitic grainstones.

e. **Aquifer:** Rkc : Regionally important karstified aquifer dominated by conduit flow.

f. Karst Features: There are no mapped karst features at the discharge location or the quarry itself. Hydro-G evaluated the discharge zone and its surrounding area and found no obvious expressions at ground level. There are a couple of water bearing zones in the walls of the quarry and the experience of the quarry manager is that the water coming out from the walls is directly related to pumping water to the discharge area. Regionally, Turloughs, Springs, Caves and Enclosed Depressions abound. There is a mapped cave (1123NEK018) in the townland of KILCURRIVARD at a distance of 2 km north, another cave in the townland of CORBALLY at a distance of 2.3 km to the southeast, AUCLOGGEEN SPRING (1123SEK012) & cave 3 km downgradient at Cregg, to which Drew & Daly (1993) traced from Ballyglunin Cave (1423NWK016) at a distance of 10 km to the NE and a tracer travel time of 200m/hr. It is therefore known that an input of chemicals can travel 10 km in 50 hours or 2 days, approximately, if it finds an appropriate conduit similar to that evaluated by Dew and Daly. There are many turloughs in the wider area.

g. **Groundwater Recharge**: At the discharge area, GSI mapping presents as follows:

a.	Average Recharge (mm/yr)	422
b.	Recharge Coefficient (%)	60.00
c.	Effective Rainfall mm/yr	703.500
d.	Recharge (pre cap) mm/yr	422
e.	Recharge Cap Apply	N
f.	Depth to Bedrock	<3m

The information on recharge will be used later in the assessment of hydraulic loading etc., as specified in the Guidance on the information required for an Application for Discharge to Groundwater (WTSG, 2011).

The receiving groundwater water is the Clare Corrib Groundwater Body and its WFD Status is mapped by the EPA as **Good Status** (2010 – 2015 and again 2013 - 2018) but assigned an **'At Risk'** classification in both the 2nd and 3rd WFD Cycles (https://gis.epa.ie/EPAMaps/Water). The **Good Status** designation of the receiving water is concurrent with long-standing operation of the quarry and its associated dewatering discharge. Therefore, the site's operation and discharge is **NOT** compromising the achievement of the environmental objectives established for the body of groundwater into which the discharge is made. The 'At Risk' classification is reported in EPA (2021) as "*For the At Risk groundwater bodies the significant issue is nutrient pollution and diminution of quality of associated surface waters for chemical reasons, which are impacting all four groundwater bodies*", in the Corrib catchment. EPA (2018) states that **Agriculture** is the identified pressure in the groundwater body.

2.4 Surface Water Hydrology & Status

On a regional scale the application site is located within the Corrib surface water catchment within Hydrometric Area 30, which is mapped as covering a total area of 3,113 km^2. The site is 8km, approximately, due east of Lough Corrib Lower (IE_WE_30_666a) and the lake is mapped as Good status (2010 – 2015). Whilst previously mapped as At Risk in the WFD 2nd Cycle due to Invasive Species pressure (EPA, 2019), Lough Corrib Lower is now mapped as Not at Risk (EPA, 2021).

The river Clare (Galway)_070 (IE_WE_30C011000) is 3km east, approximately, and is mapped as Good Status and 'Not at Risk'. There is an OPW hydrometric station on the river Calare at Corbally (Stn 30011), at a distance of 4km., approximately, from the discharge but it is not operational. The regional conceptual understanding (GSI, 2004) is that groundwater generally flows to the southwest and towards Lough Corrib. Therefore, it is unlikely that the site's discharge flows towards the river Clare. In any event, the catchment for the Clare River is large, the closest hydrometric station on the river Clare is at Claregalway, 7km south to southwest, and the mapped catchment is 1,073 km^2.

The river Cregg_010 rises at a distance of 1.5km to the south-west of the site's discharge. This river is mapped as Moderate Status and At Risk. EPA (2021) states that the Cregg_010 is "At Risk WB proposed by GCC because of its importance for Lough Corrib." The quarry is not listed as a pressure or connected to the At Risk classification for the Creg_010 in any of the catchments/ie/WFD/ EPA reports for the catchment or sub catchments (EPA, 2018, 2021). EPA HydroTOOL has a Model Node on the Cregg_010 at a distance of 5.6 km, approximately, downstream of the discharge and the contributing catchment for that Model Node 30_1967 includes the site and its discharge. Refer to Plate 1.

Plate 1 Site, Surface Water Hydrology, HydroTOOL Model Nodes & catchment for downstream Model Node 30_1967

With reference to Plate 1, the site sits in the upper reaches of the catchment for the HydroTOOL Model Node 30_1967 on the Creg_010 and the mapped catchment area to the Model Node is 12.9 km^2, approximately.

Given that the mapped catchment for the HydroTOOL Model Node 30_1967 on the Creg_010 includes the quarry, this is taken to signify that the EPA does not map the site as being part of the river Clare (Galway)'s catchment.

3.0 Discharge Volumes & Hydrochemistry

3.1 Water Management

All precipitation at the application site will follow a number of routes. Precipitation falling on the site will pool in shallow depressions and evaporate off the surface or percolate through the underlying bedrock layers over time. Some will flow by gradient to the quarry attenuation sump located in the authorised extraction area of the quarry. Water is stored at this location for a period of time before being pumped to the quarry surface in order to maintain the groundwater level in the quarry at a safe working level.

Water pumped to the surface follows one of two routes. It is used to supply the manufacturing plant and for dust suppression. Storage tanks located at the manufacturing plant and at locations around the quarry are topped up on an as required basis. Surplus water is pumped to an area located close to the wheel wash and flows, by gravity via a concrete pipe under the site's internal access route, to a wetland area where water is retained and percolates to ground over time. Plate 2 illustrates the mechanism of dewatering the sump and Plates 3 and 4 provide detail photographs including a photo of the wetland area.

Plate 2 Schematic of Discharge Mechanism

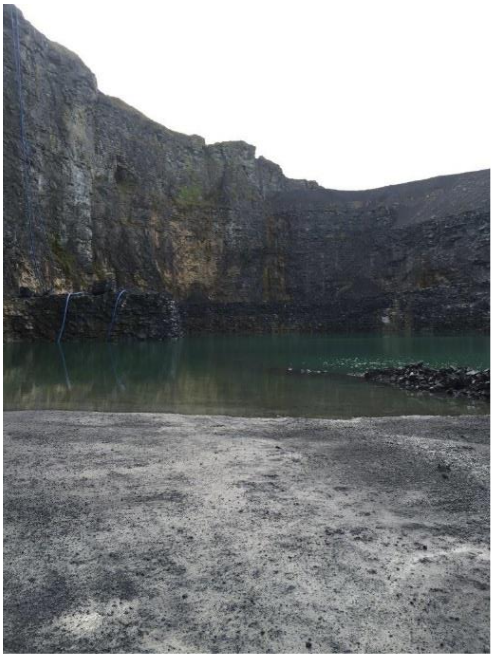
Procedures are in place for dispensing fuels and dealing with accidental spillages to ensure that no contaminants enter the ground or surface water environments.

The point for discharge sampling has ITM coordinates Easting: 538257, Northing: 740243.

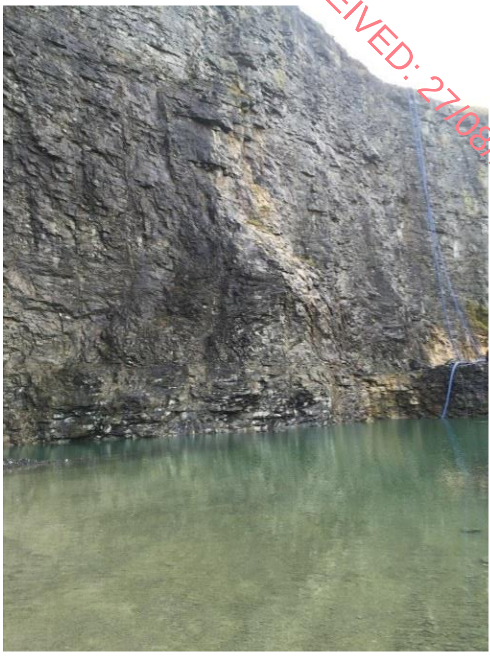
The centre of the discharge zone has ITM coordinates Easting: 538190, Northing: 740218.

The area receiving the discharge shows visual evidence that a plan area of 2,000m^2 is the diffuse discharge zone area (Refer to Plate 5).

Plate 3 Existing discharge mechanism at the site: from floor sump to land surface.



Sump in floor of application area looking west.



Sump showing rising main carrying discharge in a 4" rising main, up the southern face to groundlevel.

4" Blue discharge pipe preceding wetland at groundlevel.

Wintertime view of the vegetated wetland type area receiving the discharge (view from NE to SW).

Plate 4 Summertime view of discharge wetland (view from south to north).

Plate 5 Google Earth visual showing vegetated indicators of wetted discharge area plan ~2000m^2.

3.2 Discharge Volumes arising

A flow meter on the line to the discharge wetland enables recording of discharge volumes. The information presented in Table 1.

Table 1 Discharge Meter Flow readings and Calculated Daily Discharges.

	Meter Reading (m3)	Interval Days	Average Daily Discharge (m3/d)	Notes	Current Area (4.35ha)	Current Max Discharge Average + 20%
20/12/2017	399018	0				
22/12/2017	401575	2	**1279**	Peak Groundwater & small amount of product usage		
08/01/2018	424954	17	**1375**	Peak Groundwater time, x-mas holidays = no product and no on site usage		
10/01/2018	427694	2	**1370**			
17/01/2018	438072	7	**1483**			
13/06/2018	599619	151	**1070**	January - June Average		
26/06/2018	602494	13	**221**	Summer, very dry, hot	Long Term 4 Year Average = ~1,109 m3/d	~1,780 m3/d
08/02/2019	753144	225	**670**	VERY AVERAGE considering drought		
14/02/2019	760903	6	**1293**	wet wintery weather		
01/02/2020	104800	350	**983**	the dial has turned over, data includes summertime		
17/06/2021	783197	502	**1351**	long term average (~18 mths)		
06/01/2022	48412	203	**1306**	dial has turned over		

The information presented in Table 1 demonstrates that the average volume of discharge ranged from the minimum average daily volume recorded in the drought summer of 2018 of 221 m3/d to a maximum daily average of 1,483 m3/d recorded over a wet week in in January 2018. This is as expected because the discharge volume is dominated by rainfall runoff over a large limestone rock working area.

The data presented in Table 1 represent a 4-year observation period and it is concluded that the long term daily average discharge to the wetland area is 1,109 m3/d, approximately.

As a means of cross checking the discharge volumes, conventional Water Balance calculations suggest that surface water runoff calculations for the entire working area of the quarry's excavated area (11.6ha) can be evaluated as follows:

- SAAR = ~1,076 (mm/yr) [Source: EPA HydroTOOL Model Node 30_1967]
- Effective Rainfall = 703.5 mm/yr [Source: GSI Groundwater Data Viewer]

Calculations thereby suggest as follows:

- Effective Rainfall = 703.5 (mm/yr)
- Effective Rainfall = 0.7035 (m/yr)
- Site Total Area = 14.9 (ha)
- Site Total Area = 149,000 (m^2)
- Whole Site Total Current rainfall runoff generation = 104,822 (m^3/yr)
- Whole Site Total Current rainfall runoff generation AVERAGE = **287 (m^3/d)**

The calculated direct rainfall runoff average daily value of 287 m^3/d is rainfall runoff only from the quarry floor.

There will be an additional input to a quarry from rainfall runoff off surrounding lands through the exposed subsoil and epikarst top of rock. The walls of all quarries provide an easy exit from the subsoils of surrounding lands. Using contours to delineate a likely contributing catchment surrounding the perimeter of the excavated are, suggests a likely area of 30 ha = 300,000 m^2. Completing the same calculations as bullet pointed, above, suggests an additional contributing rainfall runoff from surrounding lands in the order of **578 m^3/d**, on average.

Therefore, the total amount of rainfall runoff collected in the sump is calculated as **578 + 287 = 865 m3/d.**

The GSI's web tool on the Groundwater Mapping page (https://dcenr.maps.arcgis.com/) suggests that groundwater recharge in the vicinity of the quarried rock at the site is **598 mm/yr and 422 mm/yr** in the greenfield perimeter lands surrounding the rock excavation. Based on these values, the following can be deduced:

- 14.9 Ha. void @ 0.598m/yr groundwater recharge = 89,102 m/yr = **244 m3/d**
- 30 ha contributing area perimeter of the void @ 0.422m/yr groundwater recharge = 126,600 m3/yr = **347 m3/d**

Adding rainfall and the groundwater recharge amounts suggests a potential daily volume requiring management at the site as follows:

865m3/d + 244 m3/d + 347 m3/d = 1,456 m3/d

Considering the water balance calculation total of **1,456 m3/d compares well with the PEAK Discharge Volume observed in January 2018, which was 1,483 m3/d.**

With respect to calculating a realistic value for discharge licence evaluation, it is convention to apply a +20% factor to account for extreme rainfall events that might be associated with climate change. Hydro-G suggests that this +20% should be applied to the January 2018 maximum recorded average discharge value of 1,483 m3/d. Therefore, a climate change factored discharge volume of 1,780 m3/d might be appropriate for the site. Hydro-G suggests that the calculated value of 1,780 m3/d should be rounded up to 2,000 m3/d and should be considered as a maximum licence provision in order to account for hydrogeological and local recharge patterns unknowns.

In conclusion, the discharge volume requiring evaluation for licensing purposes is 2,000 m3/d, including Climate Change and other potential uncertainty factoring.

3.3 Discharge Quality

The site routinely collects water samples for the discharge and the entire historical record is presented in Appendix B with Certificates of Analysis. Discharge quality concurrent with entire site groundwater quality sampling completed by Hydro-G is presented in Table 2. While there are many years data available for the site and these are presented in the Appendices, the simulations for assimilation capacity assessment require upgradient groundwater quality and Hydro-G sampled both discharge and upgradient groundwater quality at the same time in December 2020, March 2021 and May 2021. Winter, Spring and Early summer are therefore represented in these data. The results presented in Table 2 concur with the historical values of the summary tables of Appendix B.

Table 2 Monitored Discharge Quality

		Lab	**CLS**		**City Analysts**
		Lab ID	1116751	1154857	579207
Parameter	**Units**	**GROUNDWATER Regulation's THRESHOLD VALUES 2010, 2011, 2012, 2016**	**Discharge 18/12/20**	**Discharge 11/03/21**	**Discharge 18/5/21**
PH	pH Unit	6 < pH < 9	7.9	8.1	8.05
Electrical Conductivity	uS/cm	1875 uS/l	548	531	521
Chloride	mg/l	187.5	Not analysed	16.9	18.2
Nitrate as N03	mg/l	37.5 mg/l as NO3	7.2	6.98	< 8.90
Nitrite as N02		375 ug/l as NO2	3 ug/l	<0.017 mg/l	< 0.066 mg/l
Ammonia as N		175 ug/l NH4-N	8 ug/l	0.009 mg/l	0.013 mg/l
Orthophosphate as P04-P		35 ug/l = 0.035 mg/l	10 ug/l	<0.01 mg/l	< 0.025 mg/l
Phosphorus, Total as P	mg/l	not specified	<0.05	0.008	< 0.200
BOD5	mg/l O2	not specified	<1	<1	< 2
COD	mg/l	not specified	<10	<10	Not analysed
Hardness as CaCO3	mg/l	not specified	225	200	259
Calcium	mg/l	not specified	Not analysed	97	91.9
Aluminium, Total	ug/l	150 µg/l	32	10	8.3
Alkalinity CaCO3	mg/l	not specified	244	272	211
Total Organic Carbon	mg/l	not specified	2.75	2.20	3.05
Total Suspended Solids	mg/l	not specified	4	<2	< 5
Sulphate	mg/l	187.5 mg/l	Not analysed	22.4	25.7
Magnesium	mg/l	not specified in GW or SW Regs but results are DW Reg Compliant	Not analysed	7	7.07
Iron	ug/l		Not analysed	<10	40.4
Manganese	ug/l		Not analysed	<5	0.9
Cadmium	ug/l	150 ug/l	Not analysed	<0.5	< 0.2
Zinc	ug/l	75 ug/l	<5	<5	< 2.8
Cobalt - Total	µg/l	not specified	Not analysed	Not analysed	< 1
Mercury - Total	µg/l	0.75	Not analysed	<0.01	< 0.05
TPH >C6 - C40	µg/l	7.5	<10	35 **Unknown Pattern	< 10
Benzo(a)pyrene	ug/l	0.0075	not reported		< 0.01
Total PAH		0.075 ug/l	Not analysed	68 ng/l = 0.068 ug/l	< 0.01 ug/l
Clostridium perfringens	cfu/100ml	not specified	Not analysed	0	1
Coliforms	MPN/100 ml		Not analysed	0	77
E.coli	MPN/100 ml		Not analysed	0	29.5
Enterococci	cfu/100ml		Not analysed	4 ?	22

The Quality of the discharge is Groundwater Regulation Compliant. With respect to individual parametric values the following can be stated,

- The discharge's pH is 8 PH units, approximately, which is slightly higher than neutral but within the accepted range of 6 to 9 pH units.
- Electrical Conductivity is compliant and as expected for the limestone bedrock that the water travels through and over.
- Nitrates average 8 mg/l NO_3, which is a fraction of the Groundwater Regulations Threshold Value of 37.5 mg/l.
- Ammonia N ranges from 8 to 13 ug/l NH4-N, which is a small fraction of the TV of 175 ug/l NH4-N.
- BOD and COD are < LOD of the different laboratories, at <2 mg/l BOD and < 10 mg/l COD. These parameters are not specified int eh Groundwater Regulations, but the discharge was analysed for the parameters so as to

evaluate potential contamination. Results suggest a high-quality water that has no potential to affect Biochemical or Chemical demands in the water.

- Suspended Solids are below the LOD in each Laboratory and are reported as ranging from < 2 to < 4 mg/l SS.
- Metals are extremely low.
- Hydrocarbons are <LOD.
- The issue of microbiology is strange. These microbiological constituents are not specified in the Groundwater Regulations. However, for Direct Discharges they are sometimes requested. In March there were none detected (the 4 Enterococci has to be a mistake because total Coli were zero and so we can't have a constituent of the total that is greater than the total). In May there were coliforms. However, the discharge is from a large open water sump and contamination from birds on open water is common. The same will be the case for the downgradient Lough Corrib SPA.
- Overall, it is concluded that the discharge quality is good and conforms to both the Surface Water Regulation and Groundwater Regulation parameters specified.

The results for the discharge will be employed later in the assessment of potential for Discharge Licensing in the context of Groundwater Assimilation Capacity simulation, which are guided by EPA (2011 and 2014) and DoEHG (2011).

3.4 Blast History & Water Quality

During consultations with the Environment Section of Galway County Council in advance of Site Investigations for this application, Ms. Tina Ryan (*pers.comm.*) requested that the record for blasts at the site was compared to groundwater quality in order to examine any evidence of impact. Blast dates over the last number of years at the site were provided as follows:

- 16/08/2019
- 03/09/2019
- 24/09/2019
- 25/09/2019
- 21/10/2019
- 05/11/2019
- NO BLASTS for 11 months
- 06/10/2020
- 10/11/2020
- 22/11/2020
- NO BLASTS for 9 months
- 10/08/2021
- 23/10/2021
- 11/11/2021

Hydro-G reviewed the long-term EPA water quality dataset available for the closest downgradient groundwater monitoring station, which is <3km downgradient of the discharge in the context of groundwater flow. The data suggests no evidence of impact from blasting at the site. Hydro-g presents data of relevance and the location of the EPA downstream groundwater quality location as Appendix C. Results are also discussed in Section 4.5.4.

4.0 Site Investigations

In the summer of 2021 the area receiving the discharge was investigated using geophysics (Apex Geophysics, 2021) and intrusively by Trial Pitting, Infiltration Tests and subsequent analysis of the soils in the laboratory (Irish Drilling, 2021). The Site Investigations conducted in the discharge area are shown in Plate 6.

4.1 Subsoil

With Hydro-G direction and attendance on site, Irish Drilling conducted the subsoil investigation, in accordance with BS5930 (2015): Code of Practice for Site Investigations, as shown in Plate 6 (a). The fieldwork consisted of the following:

- Six trial pits (TP-1 to TP-6) were excavated and were logged and photographed by a geotechnical engineer and samples were taken for testing in the laboratory.
- Three Infiltration tests (PT-1, PT-2, PT-3), carried out to BRE 365
- Laboratory testing was carried out on representative samples. Tests carried out were natural moisture content, Atterberg limits and Particle Size Distribution tests.
- All test locations were surveyed, to National co-ordinates, using a Trimble CU Bluetooth Total Station.

The Irish Drilling Site Investigation Report is presented in full in Appendix D. Groundwater was not encountered. The results of the Irish Drilling Trial Pits can be summarised as follows:

Beneath a thin layer of topsoil the trial pits encountered gravelly sandy silt, with cobbles and boulders, overlying bedrock.

Rock was encountered at the following depths:

Location	Depth	Remarks
TP-1	1.40m *(30.59m O.D.)*	Refusal on limestone
TP-2	0.60m *(31.13m O.D.)*	Refusal on limestone
TP-3	0.90m *(31.15m O.D.)*	Refusal on limestone
TP-4	0.70m *(33.20m O.D.)*	Refusal on limestone
TP-5	0.60m *(34.11m O.D.)*	Refusal on limestone
TP-6	0.70m *(34.98m O.D.)*	Refusal on limestone
PT-1	1.00m *(30.76m O.D.)*	Refusal on limestone
PT-2	0.70m *(31.27m O.D.)*	Refusal on limestone
PT-3	0.20m *(31.93m O.D.)*	Refusal on limestone

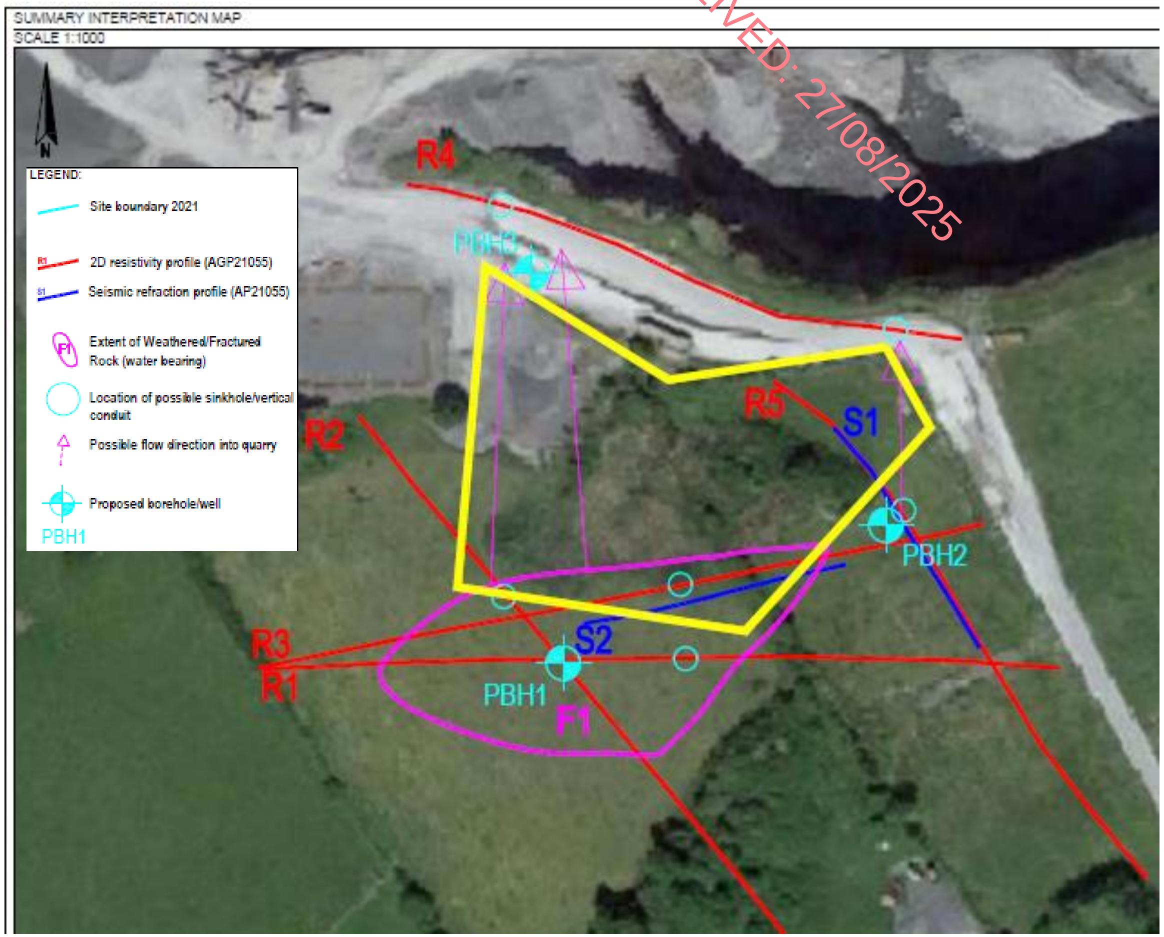
The results of Irish Drilling's infiltration tests suggest that the fully saturated Hydraulic Conductivity for the top of rock is 8.07×10^{-5} m/s, on average. Refer to Appendix D for full detail.

4.2 Geophysics

The results of the 2021 Apex geophysical survey indicated thin overburden over clean limestone with areas of weathering and clay infill in the discharge area. The reported interpretation of Apex's geophysical surveying suggested 6 possible vertical conduits or sinkholes in which there might be groundwater recirculation into the quarry void. Refer to Plate 6 (b). Additional geophysical information is available for greenfield lands adjacent to the quarry in the northeast, which were surveyed by Apex Geoservices Ltd. in 2004 and consisted of EM conductivity, ERT profiles and seismic profiles. Results of both the 2004 and 2021 surveys are reported and presented in Appendix D. Entire site investigation results available, from drilling and previous geophysical surveys, are presented as Plate 7 and an overlay of geophysics and upgradient Monitoring Well drilling is presented as Plate 8.

Plate 6 Site Investigations conducted in the land area receiving the discharge.

(a) Locations of Trial Pits, Percolation Tests and Soil Samples analysed by Irish Drilling (2021, Appendix D).



(b) Geophysics completed (Apex, 2021): refer to Appendix D and DWG AGP21055_02.

4.3 Drilling

Considering the Apex 2021 identified vertical shafts and possible swallow holes, Hydro-G concluded that additional borehole drilling was not necessary because groundwater was accessible in the floor sump adjacent and the full bedrock profile is available for visual evaluation in the walls of the quarry to the north and immediately adjacent to the discharge area. In addition, Hydro-G has previously supervised the drilling of 11 boreholes on the floor of the quarry, 26 Site Investigation holes in the greenfields to the north and east of the quarry floor and supervised the installation of 4 long term piezometers at the site. There are, therefore, 41 drilling locations already in the vicinity of the discharge. Drilling locations area presented in Plate 7 and Borehole Logs and Hydraulic Response Test details are contained within the Site Investigation Appendix D. Drilling results are discussed in the following section of this report.

Plate 7 Entire Site Indicative Site Investigation Locations

Legend				
Percolation tests	Trial Pits	Floor BHs (2017)	Greenfield BHs (2019)	Piezometer BHs (2020)
2D Resistivity	? Sinkhole/Shaft	Seismic Refraction profile	F1 Weathered Fractured Rock	Flow into Quarry ??
2004 Geophysical Survey area			2021 Geophysical Survey area	

(Refer to Appendix D: Irish Drilling SI report & Apex Reports 2021 & 2004 DWGs for more clarity on the Geophysics)

Borehole drilling at numerous locations at the site has demonstrated as follows (refer to Plate 7):

A. ● **Floor BHs (2017)**: In December 2017, eleven boreholes were drilled on site. The boreholes were drilled in the quarry floor for a proposal to deepen the current floor level within that area, which averages 10m OD in its lower zones, to a target depth of -5m OD.

Each borehole was 4" diameter, drilled with the blast rig. Hydro-G was on site for each borehole's drilling and logging. Each borehole returned the exact same lithology. There were no changes and no features of note. Therefore, a generalised table of details is presented rather than eleven BH logs with nothing to show. BH details are presented in Table 3.

With respect to drilling results, each hole was drilled at 4" diameter with the blast rig. Returns presented a grey and black, solid, limestone, very hard, no conduits, no water strikes in the zone of 10m OD to lowest depth drilled elevation of -8.6m OD. The limestone was pale grey in northern part of proposed vertical extension area and dark cherty limestones in the southern zone. This is not uncommon in the Burren Formation. Subsequent to drilling, the bedrock was tested for its hydraulic conductivity using falling head response tests in each of the boreholes, except BH6 & BH7, which had gotten covered by a spoil heap. With respect to hydraulic conductivity results, the saturated hydraulic conductivity results average at 10^{-8} m/s Ksat and this means that the limestone has the ability to conduct of water similar to a heavy clay. This is classic limestone matrix porosity with no ability to transmit water in the limestone itself. Hence, the karst CONDUIT Aquifer classification. Hydraulic response test results are also presented in Table 3.

Table 3 2017 Floor BHs Summary Results

		Borehole Drilling Information						Falling Head Response Tests: Hydraulic Conductivity Result			
	NGR	Ground Level Elevation (m OD)	Depth Drilled (m)	Base of Borehole Elevation (m OD)	Drilling Notes/ Limestone encountered/Karst Conduits?	BH Water Level (m bgl) February 2018	BH Water Level (m OD) February 2018	Ksat (m/s)	Ksat (m/d)	Ksat (m/d)	Hydraulic Conductivity Comment/ Primary or Secondary Porosity?
BH 1	38327, 40418	11	21.6	-10.6	4" diameter holes, drilled with blast rig, returned gray and black, solid, limestone, very hard, no conduits, no water strikes in the zone of 10m OD to lowest depth drilled elevation of minus 8.6m OD. Pale grey in northern part of proposed vertical extension area and dark cherty limestones in the southern zone.	2.1	8.9	4E-07	0.03	3.E-02	Hence, the karst CONDUIT Aquifer classification.These Ksat (m/d) results present a limestone matrix that has a slower conductance of water than a heavy clay. This is classic limestone matrix porosity of no ability to transmit water.
BH 2	38315, 40400	10.5	22	-11.5		14.8	-4.3	8E-10	0.00007	7.E-05	
BH 3	38319, 40366	11	22	-11		2	9	4E-08	0.004	4.E-03	
BH 4	38266, 40377	11	21.5	-10.5		10.55	0.45	5E-09	0.0004	4.E-04	
BH 5	38257, 40370	10	21.5	-11.5		3.55	6.45	2E-09	0.0002	2.E-04	
BH 6	38265, 40349	11	21	-10		lost in spoil heaps					
BH 7	38266, 40349	10	21.6	-11.6							
BH 8	38328, 40464	12	22	-10		0.5	11.5	3E-08	0.0025	3.E-03	
BH 9	38320, 40489	13	22	-9		4	9	8E-10	0.0001	1.E-04	
BH 10	38304, 40505	13	21.6	-8.6		1.2	11.8	1E-08	0.0008	8.E-04	
BH 11	38240, 40515	13	21.6	-8.6		0.95	12.05	2E-07	0.02	2.E-02	
								7E-08	6E-03	6E-03	**Average**
								8E-10	7E-05	7E-05	**Min**
								4E-07	3E-02	3E-02	**Max**

Those 2017 BHs are upgradient of the discharge zone in terms of regional groundwater elevation flow towards Lough Corrib. The 2017 BHs target from 10 to 11m OD at the top of BHs to BH base depths of -10m OD, on average. Given that the discharge zone's ground elevation is 32m OD, approximately (refer to Trial Pit Logs, Irish Drilling SI Report 2021, Appendix D), the 2017 BHs represent deep limestone at a depth of 22m to 42m below ground elevation of the discharge zone. Results of the 2017 drilling therefore suggest a competent tight limestone bedrock matrix at a significant depth below the discharge elevation and very low hydraulic conductivities.

B. Greenfield BHs (2019): In February 2019, twenty-six investigation holes were drilled to ground truth the 2004 Apex geophysical surveys. These holes were drilled with the blast hole to test clay infills identified in the Apex 2004 work. Refer to Appendix D for the 2004 Geophysical report at the back of the 2021 report. The 2019 BHs revealed limestone rock at surface in most BHS and dry limestone drilling to 30m bgl. Those Clay Infills identified in the Apex work of 2004 did ground truth correctly in 2 BHs only when drilling did reveal dry gravelly Clay infills from ground level to 14m bgl, when the rig could not progress further. This blast holes were not retained because the drilling was used to test the Apex 2004 geophysical results and inform the locations of four permanent monitoring BHs to house 50mm piezometers for long term groundwater monitoring and water quality sampling and analysis.

C. Piezometer BHs (2020): In October 2020, four Monitoring Wells, 45m deep each, were installed with 50mm piezometers, which were sealed with bentonite grout seals above screens set to target the groundwater strike zones. The four Monitoring Wells were completed at Ground Level with above ground steel casing and protective fences. Two of the four Monitoring Well locations were chosen to target solid limestone and two locations were selected to target the weathered zones indicated in the Apex 2004 geophysical survey. For each Monitoring Well, both the drillers notes and Borehole Logs are presented in the Site Investigation Appendix D. An overlay of Monitoring Well locations and Apex 2004 geophysical mapping is presented as Plate 8. The conditions encountered at each MW were related to ground level elevations and drilling details of note are summarised in Table 4. The drilling experiences are described in the text below.

Table 4 MW details of note

	MW 01	MW 02	MW 03	MW 04
MW Co-ordinates	538442E, 740406N	538468E, 740555N	538445E, 740668N	538077E, 740609N
Total Drilled Depth (m)	**45**	**45**	**45**	**45**
Drilling Details				
Ground Level (m OD)	41.37	40.86	37.38	33.11
Depth of Overburden (m)	0.4	3.7	7	0.3
Top epikarst (m OD)	40.97	37.16	30.38	32.81
Top solid rock (m OD)	39.87	36.36	29.88	31.91
Karst features encountered & depths	NONE	11.9 to 13.8m bgl = dry weathered zone & 28m to 38.4m bgl dry weathered zone.	Deep overburden but no features in bedrock, no voids, dry drilling.	NONE
Water Strike (m bgl)	**>43m bgl**	**42.5m bgl**	**38m bgl**	**40m bgl**
Water Strike (m OD)	**-1.63**	**-1.64**	**-0.62**	**-6.89**
END of MW Drilled Depth (m OD)	-3.63	-4.14	-7.62	-11.89
Calculated Unsaturated depth (m) [i.e. relative to Discharge Zone's Ground Elevation 32m OD]	34	34	33	39

The details presented in Table 4 were determined from the drilling experiences, as follows:

- **MW 01 = Targeting Solid Limestone:**
  - Ground Level Elevation = 41.37m OD
  - Topsoil to 0.4m bgl, broken rock @ 0.4m bgl and solid limestone @ 1.5m bgl.
  - This suggests a 1.1m deep Epikarst at the top of the rock from 0.4m bgl to 1.5m bgl.
  - Well drilled to a total depth of 45m (*i.e.* base elevation = -3.63m OD).

- Solid limestone rock from 1.5m to 45m bgl, with no voids, no clay bands and no heavily weathered zones. Mostly a black soft rock, with strong sulphur odour. Some layers of slightly harder grey to dark grey rock.
- No real water strike, small amount of water seeping in from 43m bgl and below (Elevation = > -1.63m OD).
- Completed with a 45m long 50mm piezometer with a geotextile sock over a factory slotted screen from 39m to 45m bgl.
- Clean washed pea gravel from 45m to 38m and bentonite seal from 38m to Ground Level.
- **CONCLUSION MW 01:** Apex 2004 Geophysics is correct & Solid Limestone is found here.

- **MW 02 = Targeting Geophysical Anomaly zone (Apex, 2004, Appendix D):**
  - Ground Level Elevation = 40.86m OD.
  - Topsoil to 0.3m bgl, Gravelly Cobbly Clayey Sands and some rock from 0.3m until 3.7m bgl = Glacial fill above rock with epikarst broken limestone at 3.7m to 4.5m bgl.
  - Solid dark grey limestone bedrock @ 4.5m bgl.
  - Black to grey/dark grey solid limestone. Easy solid drilling from 4.5m to 11.9m bgl.
  - Very weathered rock with clay bands and loose material from 11.9 to 12.2m bgl and then a 0.3m DRY void with CLAY and loose rock again from 12.5m to 13.8m bgl = DRY Karst Feature.
  - Solid from 13.8m bgl to 28.4m bgl but dry weathered zone again from 28.4m to 33m bgl.
  - Solid Limestone again from 33m to end of bored hole to 45m (*i.e.* base elevation = -4.14m OD).
  - Water strike @ 42.5m bgl (Water Strike Elevation = -1.64m OD).
  - Completed with a 45m long 50mm piezometer with a geotextile sock over a factory slotted screen from 39m to 45m bgl.
  - Clean washed pea gravel from 45m to 38m and bentonite seal from 38m to Ground Level.
  - **CONCLUSION MW 02:** Apex 2004 Geophysics is correct & there are weathered zones and dry voids here.

- **MW 03 = Targeting Geophysical Anomaly zone (Apex, 2004):**
  - Ground Level Elevation = 37.38m OD
  - Topsoil to 0.4m bgl.
  - Clayey sandy Gravel or very weathered rock from 0.4m until 7m bgl = Glacial fill above solid bedrock.
  - 7m to 7.5 m is broken rock = epikarst.
  - 7.5m = Solid Limestone rock with no voids, no clay bands. Mostly black, soft, easy to drill rock with strong sulfur smell and some slightly harder, grey to dark grey Limestone to drilled depth of 45m (*i.e.* base elevation = -7.62m OD).
  - Water strike @ 38m bgl (Water Strike Elevation = -0.62m OD).
  - Completed with a 45m long 50mm piezometer with a geotextile sock over a factory slotted screen from 36m to 45m bgl.
  - Clean washed pea gravel from 45m to 35m and bentonite seal from 35m to Ground Level.
  - **CONCLUSION MW 03:** Apex 2004 Geophysics is correct in that there is epikarst glacial fill but is deeper than they think at 7.5m but no anomalies in the limestone bedrock to 45m here.

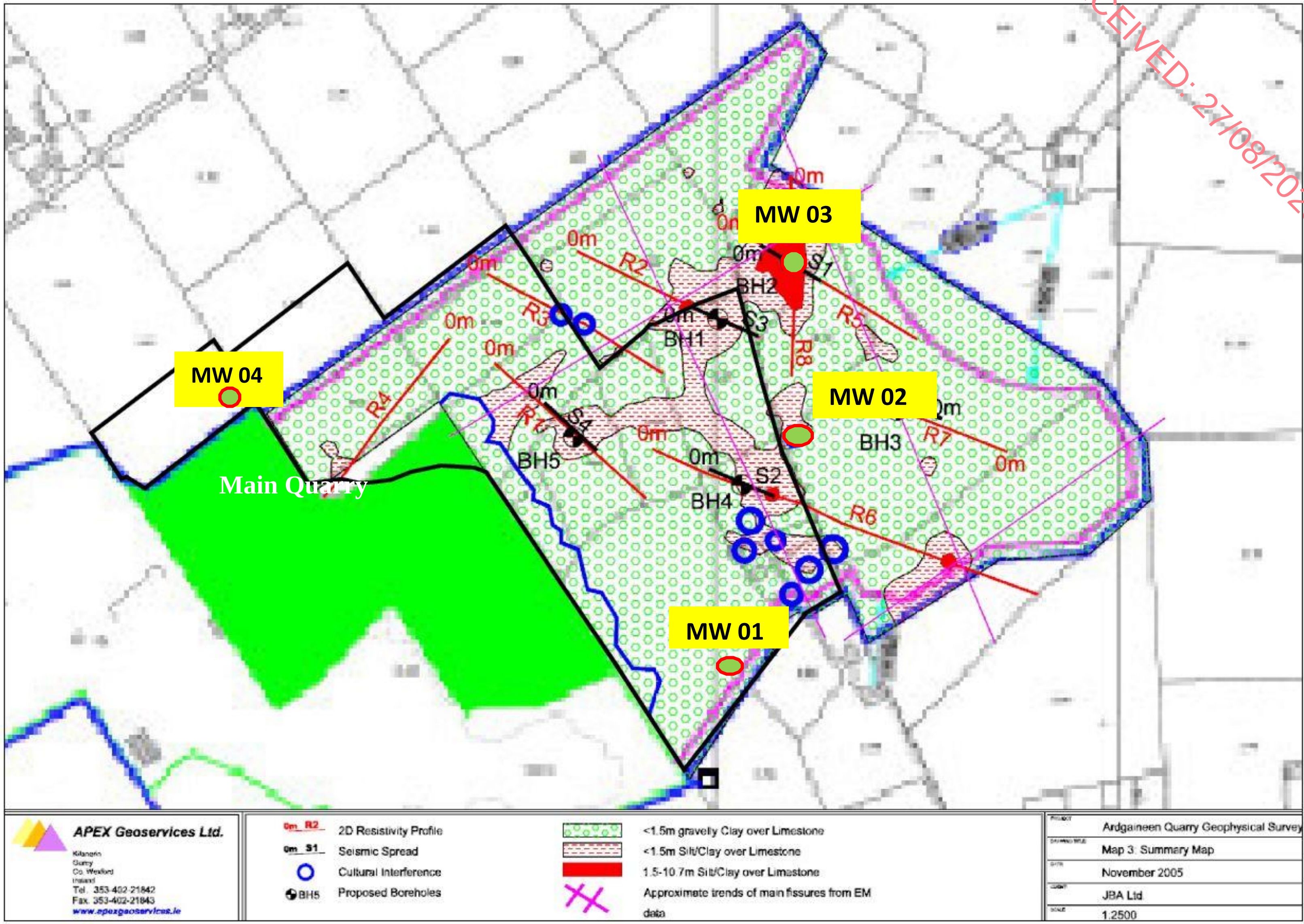
- **MW 04 = Evaluating outside the Apex 2004 survey area**
  - Ground Level Elevation = 33.11m OD
  - Topsoil to 0.3m bgl followed by gravelly subsoil to 1.2m bgl.
  - Broken rock from 1.2m bgl to 1.5m bgl.
  - Well drilled to a total depth of 45m (*i.e.* base elevation = -11.89m OD).

- Solid limestone rock from 1.5m to 45m bgl, with no voids, no clay bands and no heavily weathered zones. Mostly a black soft rock, with strong sulphur odour. Some layers of slightly harder grey to dark grey rock.
- Water @ 40m bgl (Elevation = -6.89m OD).
- Completed with a 45m long 50mm piezometer with a geotextile sock over a factory slotted screen from 36m to 45m bgl.
- Clean washed pea gravel from 45m to 35m bgl and bentonite seal from 35m to Ground Level.
- **CONCLUSION MW 04:** Solid Limestone was found here.

The overall conclusion of the Monitoring Well drilling (2020) is that groundwater strikes are between 38m and 44m bgl and given the slight differences in ground level at each of the drilling sites the water strike elevations range from groundwater at approximately sea level (*i.e.* -0.62m OD @ MW 03 location) or below sea level at -0.62m OD @ MW 02 to -6.89m OD @ MW04. Considering that the ground elevation at the discharge zone is 32m OD, approximately, there is at least 33m of unsaturated bedrock between the discharge and the groundwater table. However, the Irish Drilling (2021) subsoil investigation revealed very thin soil cover and the Apex 2021 geophysical survey revealed that there are POTENTIALLY vertical shafts in the discharge area, with infill mechanisms for movement towards the walls and so it would be better to conceptualise and model the discharge as a 'direct discharge', which is permitted in the Groundwater Regulations (2010) and is referred to in Appendix D of the WTSG (2011) Guidance Manual for the Authorisation of Discharges to Groundwater.

The floor of the lowest floor in the quarry is 10m OD, approximately. The sump has a large surface area and collects rainfall runoff from the working quarry. The elevation of the sump is above the groundwater strike elevation in the four Monitoring Wells to the east and northeast of the floor. This suggests that the capacity of the floor sump, set above groundwater strike levels, has the ability to provide and retain stormwater for the required attenuation period.

Plate 8 Monitoring Well Locations (2020) overlaid on Apex 2004 Geophysical Mapping Interpretations



4.4 Bedrock Hydraulic Conductivity

As is the convention, for the purposes of calculating bedrock hydraulic conductivity, fully saturated rising head response tests were completed on the four MWs installed in October 2020. The calculation methodology is presented in Appendix D. Results and consequent calculations suggest as follows:

- MW 01 = 3.65 * 10^{-7} m/s
- MW 02 = 2.84 * 10^{-6} m/s
- MW 03 = 2.22 * 10^{-6} m/s
- MW 04 = 2.99 * 10^{-7} m/s

It must be noted that the results confer the values for the bedrock in the elevation range of the piezometer's screened intervals, which were in solid limestone bedrock in each of the four monitoring wells MW 01 – MW 04. The average hydraulic conductivity of the solid bedrock in the screened interval depth range of 5 to -5m OD is calculated to be 1.43* 10^{-6} m/s.

In overall summary, with respect to hydraulic conductivities completed for various parts of the site, the following is noted:

A. Discharge Area top of rock @ 31m OD, approximately = epikarst Ksat = 10^{-5} m/s (, 2021), Appendix D & Section 4.1 of this report.

B. Greenfield area upgradient of quarry floor and discharge area @ piezometer screened interval 5m OD to -5m OD Ksat = 10^{-6} m/s (Appendix D).

C. Quarry Floor deep limestone bedrock @ 10m OD to -20m OD Ksat = 10^{-8} m/s (Hydro-G, 2017) & Table 3.

Results at different depths suggest that there is an order of magnitude reduction in hydraulic conductivity between the epikarst limestone, the bedrock at 25m bgl and again another 'order of magnitude' reduction in hydraulic conductivity in the bedrock at 50m bgl. However, these results are somewhat academic. These are the results for bedrock across the entire quarry site. The geophysicist's interpretation of the 2021 geophysical survey in the discharge area suggests potential conduits and by-pass mechanisms, which negates the use of bedrock hydraulic conductivity in any modelling for the site. Instead, the discharge of the quarries waters needs to be considered as a direct discharge, which is permissible under the Groundwater Regulations (2010) for quarrying activities. Considering that the discharge is waters collected on the floor that would have been intended for nature in any case, the activity merely maintains the natural continuum of the groundwater regime. Quality is the only issue. The site has demonstrated that the discharge can hydraulically get away from the discharge area. The discharge does not have the potential to cause flooding of houses or roads. Hydrochemical impact is the issue requiring consideration.

4.5 Water Quality

4.5.1 Upgradient Groundwater Quality

Upgradient groundwater quality was determined by sampling from Monitoring Wells MW 01, 02, 03 & 04 (refer to Plate 7). Groundwater samples were collected in winter (December), Spring (March) and early Summer (May) 2021.

Initially, a preliminary sample was collected from upgradient groundwater monitoring location MW 04 in December 2021 and the groundwater was found to be compliant with all Groundwater Regulation parameters analysed except for Aluminium (this is a sediment and laboratory issue, the ICP machine at the original laboratory was repeatedly down and could not return results that were deemed reasonable by many water focussed colleagues across many sites. A change to City Analysts laboratory resolved the issue, as is evidenced by the results for May 2021. Aside from metals, the same issue was experienced with hydrocarbons at the original laboratory and, again, a change to City Analysts suggests below limit of detection results for PAH and TBH).

All groundwater piezometers were sampled in March 2021 and given that they all returned compliant results, more or less in the same ranges, the May 2021 sampling round again focussed on one upgradient monitoring well.

Laboratory Certificates of Analysis are presented in Appendix B and summary parameters of note with respect to the Groundwater Regulations (2010, as amended 2016) are presented in Table 5. The average and maximum parameter concentrations are presented in Table 6 and it is the maximum value for each parameter that will be employed in simulation effects later in this work. Results are discussed after Tables 5 and 6.

Table 5 Upgradient Monitoring Wells Summary Groundwater Quality for Groundwater Regulation Parameters

Upgradient Groundwater Quality Harringtons Quarry Ardgaineen			CLS Laboratory					City Analysts
		LAB ID	1116747	1154852	1154853	1154854	1154855	579211
Parameter	Units	GROUNDWATER Regulation's THRESHOLD VALUES 2010, 2011, 2012, 2016 (Column's 3 & 4 TVs = General Quality & Human Consumption)	MW 04 = BH4 18/12/20	MW 01 = BH1 Har Ard GW 11/03/21	MW 02 = BH2 Har Ard GW 11/03/21	MW 03 = BH3 Har Ard GW 11/03/21	MW 04 = BH4 Har Ard GW 11/03/21	MW 04 = BH4 Har Ard 18/5/21
PH	pH Unit	6 < pH < 9	7.2	7.1	7.2	7.2	7.2	7.0
Electrical Conductivity	uS/cm	1875 uS/l	578	784	677	593	565	596
Chloride	mg/l	187.5	NA	15.1	21.6	12.1	7.16	< 10.0
Sulphate	mg/l	187.5 mg/l	NA	<5	5.34	<5	<5	< 20.0
Nitrate as N03	mg/l	37.5 mg/l as NO3	3.2	11.3	31.8	5.66	2.18	< 8.90
Nitrite as N02	mg/l	375 ug/l as NO2	<0.002	0.044	<0.017	<0.017	0.039	< 0.066
Ammonia as N	mg/l	175 ug/l NH4-N	0.013	0.02	0.013	0.01	0.026	< 0.010
Ammonia as NH4	mg/l							< 0.013
Orthophosphate as P04-P	mg/l	35 ug/l = 0.035 mg/l	0.018	<0.01	<0.01	<0.01	<0.01	< 0.025
Phosphorus, Total as P	mg/l	not specified	0.18	0.006	0.022	0.016	0.006	< 0.200
Aluminium, Total	ug/l	150 µg/l	1658	1923	3759	505	277	56.4
Cadmium	ug/l	150 ug/l	NA	<0.6	<0.6	<0.6	<0.6	0.2
Zinc	ug/l	75 ug/l	25	<6	24	<6	<6	3.6
Mercury - Total	µg/l	0.75	NA	<0.01	<0.01	<0.01	<0.01	< 0.05
TPH >C6 - C10	µg/l	7.5	individual TPH sinatures not reported until change of lab to City Analysts in May 2021					< 0.10
TPH >C10 - C21	µg/l							< 0.10
TPH >C21 - C40	µg/l							< 0.10
TPH >C6 - C40	µg/l		<10	44 **Unknown Pattern	89 **Unknown Pattern	74 **Unknown Pattern	<20	< 10
Benzo(a)pyrene	ug/l	0.0075	NA	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Total PAH	ug/l	0.075	NA	0.048	0.082	0.057	0.065	< 0.01

Result cells in Table 5 that are highlighted in pale green indicate compliance with the Groundwater Regulation TVs.

Table 6 Upgradient Monitoring Wells Groundwater Quality Average and Maximum Concentrations for GW Regs

Upgradient Groundwater Quality Harringtons Quarry Ardgaineen						
Parameter	**Units**	**GROUNDWATER Regulation's THRESHOLD VALUES 2010, 2011, 2012, 2016** (Column's 3 & 4 TVs = General Quality & Human Consumption)	**Minium Value Reported**	**Maximum Value Reported**	**AVERAGE Concentrations Upgradient WQ**	**units**
PH	pH Unit	6 < pH < 9	7.00	7.20	7.15	pH Unit
Electrical Conductivity	uS/cm	1875 uS/l	565	784	632	uS/cm
Chloride	mg/l	187.5	7.16	21.6	12	mg/l
Sulphate	mg/l	187.5 mg/l	<5	<20	<5	mg/l
Nitrate as N03	mg/l	37.5 mg/l as NO3	2.18	31.8	10	mg/l
Nitrite as N02	mg/l	375 ug/l as NO2	<0.002	< 0.066	0.010	mg/l
Ammonia as N	mg/l	175 ug/l NH4-N	0.01	0.026	0.01	mg/l
Orthophosphate as P04-P	mg/l	35 ug/l = 0.035 mg/l	<0.01	0.018	0.01	mg/l
Aluminium, Total	ug/l	150 µg/l	56	lab issue	56	ug/l
Cadmium	ug/l	150 ug/l	0.2	<0.6	0.60	ug/l
Zinc	ug/l	75 ug/l	4	24	10	ug/l
Mercury - Total	µg/l	0.75	<0.01	<0.01	<0.01	µg/l
TPH >C6 - C10	µg/l	7.5		< 0.10		µg/l
TPH >C10 - C21	µg/l			< 0.10		µg/l
TPH >C21 - C40	µg/l			< 0.10		µg/l
TPH >C6 - C40	µg/l			< 10		µg/l
Benzo(a)pyrene	ug/l	0.0075		< 0.01		ug/l
Total PAH	ug/l	0.075		< 0.01		ug/l

- Results presented in Tables 5 and 6, for parameters specified in the Groundwater Regulations that are of relevance to the activity at the site, indicate as follows:
- The groundwater is neutral with a range of pH values from 7pH to 7.2 and an average of 7.15pH
- Electrical Conductivity ranges from 565 to 784 uS/cm and this is an expected range for limestone bedrock. The range suggests different pathways as is expected in karst. The average value is 632 uS/cm. Results comply with the Groundwater Regulations Threshold Value of 1875 uS/cm for Columns 3 & 4 tests for general quality and potential impact on human uses.
- Chloride concentrations are acceptable and the range of 7.16 to 21.6 mg/l CL is normal and complies with the Groundwater Regulations Threshold Value of 187.5 uS/cm for Column 4 tests for general quality and potential impact on future use. Chloride is not specified in Colum 3 of the Groundwater Regulations test for general impact because it is not deemed a parameter important in that assessment.
- Sulphate concentrations are low, comply with Threshold Values of the Groundwater Regulations and are below the Limit of Detection (LOD) of each laboratory used.
- With respect to nitrate concentrations in the groundwater, all sample results demonstrate compliance with the 37.5 mg/l NO_3 Trigger Value specified in the Groundwater Regulation's Columns 3 & 4 tests for general quality and potential impact on human uses. However, there is one result of six that is elevated at 31.8 mg/l NO_3 for MW 02 in March 2021. All other results are relatively low ranging from 2 to 11 mg/l NO_3. When all 6 results are considered, the average value is 10mg/l NO_3. No other nutrient is elevated at MW 02, neither ammonia, ortho-P or nitrite but Chloride is elevated in association with the elevated Nitrate. This suggests bagged fertiliser. If ammonia and ortho P were elevated with the nitrate then it could be either septic tanks or grazing animal

excretions but chloride is a constituent of bagged fertiliser. While Chloride can also come from septic tanks, one would expect an ortho-P signal with it also. Therefore, I conclude use of bagged fertilisers KCL or Cl with N is common enough in bagged fertilisers. However, the single elevation is an anomaly and the other 5 results are low. Each of the 6 are compliant with the Groundwater Trigger Values. The average value of 10mg/l NO_3 is relatively low.

- The Groundwater Regulations Trigger Value for Nitrite is specified as 375 ug/l (note ug units) and Irish laboratories still report this value in mg/l. Converting the reported range of <0.002 to <0.066 suggests that the groundwater at the site is Groundwater Regulation compliant with values reported as < the LOD of each lab and therefore between <2 ug/l and <66 ug/l. These values suggest concentrations of nitrite in upgradient groundwater that are at least one order of magnitude lower than the Trigger Value (TV) for nitrates and more often than not they are two orders or magnitude lower than the TV.

- Again, the Groundwater Regulation TV for Ammonia-N is specified in ug/l units and the required Trigger Vlaue demanding further investigation is specified in the Irish Statute as 175 ug/l NH4-N. Again, Irish laboratories issue the results in mg/l units. Conversion of the concentrations reported for the site suggest Ammonia-N concentrations ranging from 0.01 to 0.026 mg/l, which converts to a range of 10 to 26 ug/l, which are an order of magnitude lower than the Regulatory values. For the purposes of perspective, the High Status Environmental Quality Objective for Ammonia in the Surface Water Regulations is 0.04 mg/l Ammonia-N for the mean scenario and 0.09 mg/l for the 95%tile. IF one were to conceptualise this groundwaters contribution to the downstream receptor Lough Corrib, the observed mean value in the upgradient groundwater at this site is a small fraction of the Environmental Quality Objective required to maintain Objectives of High Status for the SAC Lough Corrib water body. This means that the ammonia concentration in groundwater quality upgradient of the site suggests high water quality.

- The concentrations of ortho-P in the groundwater are reported as <0.01 mg/l MRP-P LOD of the laboratory in 4 of five occasions and <LOD of the other lab on one occasion. Results in December 2021 suggest a value of 0.018 mg/l, which is equivalent to 18 ug/l MRP-P when the Groundwater Regulation TV is 35 ug/l. The range observed at the site is 10 to 18 ug/l, with an average of 10 ug/l MRP-P. The groundwater is therefore off exceptionally high quality and also conforms with the High-Status limits of the Surface Water Regulations.

- With respect to metals, Hydro-G advises that there were issues at the original laboratory's ICP analyser and numerous letters were issued by the laboratory to clients regarding problems, calibration, breakdowns. When results did emerge, they made no sense to many water professionals IF the sample contained suspended solids, which piezometer samples can. An alternative laboratory was sought. Results for metals conform with the Groundwater Regulation Threshold Values for Aluminium, Cadmium, Zinc and Mercury. Concentrations of metals in the upgradient groundwater are low.

- With respect to hydrocarbons, Hydro-G became dissatisfied with the lack of specific results from the first laboratory. Analysis was moved to a laboratory that could provide specific hydrocarbon results rather than "unknown patterns" as was being reported from the initial laboratory. All results reported for May 2021 convey below LOD limits of the laboratory for TPH and PAH hydrocarbons in the groundwater upgradient of the site. With respect to TPH, the EPA acknowledge that no Irish laboratory can achieve the 7.5 ug/l TV specified in the regulations. However, it is generally accepted that if the sample is reported as less than the accredited concentration of 10 ug/l TPH then it is more than likely that there are undetectable concentrations in the water (Dr. Matt Craig, EPA, *pers.comm.)*.

- In overall conclusion, the groundwater upgradient of the site is of very high quality overall with low nutrients, low metals, below LOD limits of the laboratory for TPH and PAH hydrocarbons.

4.5.2 Sump Water Quality

Summary results for the quality of water in the floor sump is presented in Table 7 and laboratory Certificates of Analysis are presented in Appendix B.

Table 7 Summary results for the quality of water in the floor sump

		Lab	CLS		City Analysts	
		Lab ID	1116748	1154856	579208	
Parameter	Units	GROUNDWATER Regulation's THRESHOLD VALUES 2010, 2011, 2012, 2016 (Column's 3 & 4 TVs = General Quality & Human Consumption)	Floor Sump December 2020 18/12/20	Floor Sump March 2021 11/03/21	Floor Sump May 2021 18/5/21	Hydro G Note
PH	pH Unit	6 < pH < 9	7.9	8.1	7.94	The Quality of Water Collected in the Sump on the Floor is Groundwater Regulation Compliant. Nitrates average 7 mg/l NO3, Ammonia N is very low, BOD and COD are < LOD, Suspended Solids range from 6 to 8 mg/l SS but it most be remembered that the sample is taken a the edge and more settlement of solids is likley prior to discharge. Metals are extremely low and hydrocarbons are <LOD.
Electrical Conductivity	uS/cm	1875 uS/cm	535	477	492	
Chloride	mg/l	187.5	Not analysed	16.5	18.8	
Nitrate as N03	mg/l	37.5 mg/l as NO3	7.2	6.59	< 8.90	
Nitrite as N02	mg/l	375 ug/l as NO2	3	<0.017	< 0.066	
Ammonia as N		175 ug/l NH4-N	9 ug/l	0.008 mg/l	< 0.010 mg/l	
Orthophosphate as P04-P	mg/l	35 ug/l = 0.035 mg/l	<0.01	<0.01	< 0.025	
Phosphorus, Total as P	mg/l	not specified	<0.05	0.006	< 0.200	
BOD5	mg/l O2	not specified	<1	<1	< 2	
COD	mg/l	not specified	<10	Not analysed	Not analysed	
Aluminium, Total	ug/l	150 µg/l	30	31	7.8	
Total Suspended Solids	mg/l	not specified	12	6	8	
Sulphate	mg/l	187.5 mg/l	Not analysed	18.3	25.6	
Cadmium	ug/l	150 ug/l	Not analysed	<0.5	< 0.2	
Zinc	ug/l	75 ug/l	<5	<5	< 2.8	
Mercury - Total	µg/l	0.75	Not analysed	<0.01	< 0.05	
TPH >C6 - C40	µg/l	7.5	< 10	25 **Unknown Pattern	< 10	
Benzo(a)pyrene	ug/l	0.0075	Not reported	<0.01	< 0.01	
Total PAH	ug/l	0.075	Not analysed	0.043	< 0.01	

With respect to the quality of water collected in the sump on the floor of the quarry, results presented in Table 7 suggest that for Groundwater Regulation parameters and other parameters of note such as BOD, COD and suspended solids, the following can be concluded,

- The quality of water collected in the Sump on the floor is Groundwater Regulation Compliant.
- Nitrates average 7 mg/l NO3, which is a fraction of the Groundwater Regulation's Threshold Value of 37.5 mg/l.
- Ammonia N is very low with all values <10 ug/l, which suggests no ammonia really and is in compliance with the Groundwater Regulation TV of 175 ug/l.
- BOD and COD are very low at < 2 and <10 respectively, which is below the limit of detection of the analyser.
- Suspended Solids range from 6 to 8 mg/l SS but it must be remembered that the sample is taken at the edge of the sump and more settlement of solids is likely prior to discharge. Samples are also collected at the point of discharge and the results there demonstrate full settlement of suspended solids prior to discharge.
- Metals are extremely low in the floor sump's waters and Hydrocarbons are <LOD in the floor sump's waters.
- Overall, it is concluded that the waters collected on the floor are of good quality, which reflects good management at the site.

4.5.3 Discharge Water Quality

Discharge quality data were presented as Table 1 of this report. However, it is worth recapping here because these results are now used to complete the evaluation for potential impact on the receiving groundwater. With respect to the quality of water discharged, the results presented in Table 1 and presented in Table 8 as Minimum, Maximum and Average values. The results were discussed in Section 3.3 and it was concluded that the discharge quality is very good with low concentrations of nutrients, low BD, Low COD, low SS and no hydrocarbons. For the purpose of presenting the most conservative evaluation, the MAXIMUM observed concentration is simulated for worst case impact in the receiving groundwater.

Table 8 Discharge Quality Concentration Ranges Measured

		Lab				
		Lab ID				
Parameter	Units	GROUNDWATER Regulation's THRESHOLD VALUES 2010, 2011, 2012, 2016	Minium Value Reported	Maximum Value Reported	AVERAGE Discharge Concentrations	units
PH	pH Unit	6 < pH < 9	7.9	8.1	7.98	pH Unit
Electrical Conductivity	uS/cm	1875 uS/cm	521	548	534.50	uS/cm
Chloride	mg/l	187.5	16.9	18.2	17.6	mg/l
Nitrate as N03	mg/l	37.5 mg/l as NO3	7.2	< 8.90	8.00	mg/l
Nitrite as N02		375 ug/l as NO2	3 ug/l	<66	<40	ug/l
Ammonia as N		175 ug/l NH4-N	8 ug/l	13 ug/l	9 ug/l	ug/l
Ammonia as NH4	mg/l				0.02	mg/l
Orthophosphate as P04-P		35 ug/l = 0.035 mg/l	10	13	10.00	ug/l
Phosphorus, Total as P	mg/l	not specified	0.008	0.008	<0.05	mg/l
BOD5	mg/l O2	not specified	<1	< 2	<1	mg/l O2
COD	mg/l	not specified	<10	<10	<10	mg/l
Hardness as CaCO3	mg/l	not specified	200	225	242.00	mg/l
Calcium	mg/l	not specified	91.9	97	94.45	mg/l
Aluminium Dissolved	ug/l	not specified			11.50	ug/l
Aluminium, Total	ug/l	150 µg/l	8.3	32	16.77	ug/l
Alkalinity CaCO3	mg/l	not specified	211	272	227.50	mg/l
Total Organic Carbon	mg/l	not specified	2.20	3.05	2.90	mg/l
Total Suspended Solids	mg/l	not specified	<2	4	<4	mg/l
Sulphate	mg/l	187.5 mg/l	22.4	25.7	25.70	mg/l
Potassium	mg/l	not specified			4.63	mg/l
Sodium	mg/l	not specified			11.00	mg/l
Magnesium	mg/l	not specified in GW or SW Regs but results are DW Reg Compliant	7	7.07	7.04	mg/l
Iron	ug/l		<10	40.4	23.00	ug/l
Iron, Soluble	ug/l				13.40	ug/l
Manganese	ug/l		0.9	<5	2.00	ug/l
Cadmium	ug/l	150 ug/l	< 0.2	<0.5	<0.5	ug/l
Zinc	ug/l	75 ug/l	< 2.8	<5	<5	ug/l
Cobalt - Total	µg/l	not specified	< 1	< 1	< 1	µg/l
Mercury - Total	µg/l	0.75	<0.01	< 0.05	< 0.05	µg/l
TPH >C6 - C40	µg/l	7.5	< 10	<10	< 10	µg/l
Benzo(a)pyrene	ug/l	0.0075	< 0.01	< 0.01	< 0.01	ug/l
Total PAH		0.075 ug/l	< 0.01 ug/l	0.068	0.035	ug/l
Clostridium perfringens	cfu/100ml	not specified	0	1	<1	cfu/100ml
Coliforms	MPN/100 ml		0	77	38.55	MPN/100 ml
E.coli	MPN/100 ml		0	29.5	14.75	MPN/100 ml
Enterococci	cfu/100ml		4 ?	22	13.00	cfu/100ml

As stated, Laboratory Certificates of Analysis were presented in Appendix B. NOTE: When a value is reported as <LOD of the laboratory's analyser, it is accepted that the value can be zero or half the LOD. Half the LOD will be adopted in the assimilation capacity simulations.

4.5.4 EPA Downgradient Water Quality

There is an EPA Groundwater Monitoring Quality Station 2.8km downstream of the discharge. This is a relatively short distance in karst groundwater considering that Drew has traced groundwater velocities at 200m/hr in a conduit to the south of the quarry (source: https://dcenr.maps.arcgis.com/apps/MapSeries).

Appendix C contains EPA data of relevance and the link on how to source and download the data from the EPA website. Consideration and evaluation of the EPA data shows that Ammonia-N concentrations are generally less than the Limit of detection of the analyser, nitrates are generally <10 mg/l NO3, nitrites are <LOD and other indicator parameters suggest that there is no evidence of impact from the quarry. The site's monitoring data and the EPA data are in agreement.

5.0 Conceptual Site Model

Ground level elevation in the discharge zone is 33m OD, approximately. Water level at the ultimate receptor, which is Lough Corrib SAC and SPA, is 5m OD, approximately. The water strike zones in the monitoring wells upgradient of the discharge were all below sea level. It is hypothesised that discharge flow will be from the discharge area in unsaturated epikarst towards Lough Corrib in a NE-SW direction.

There is thin soil cover in the discharge area (Irish Drilling, 2021). Measured field hydraulic conductivity is 10^{-5} m/s, which equates to 7 m/d, and at that conductance ability, the calculated potential future maximum loading rate) will be able to get away. Rainfall plus discharge of 2,000m3/d over an area of 2,000m2 (i.e. 1.003 m3/m2/d = 1 m/d = <Ksat 7 m/d). Therefore, hydraulically it can get away from the top of rock as measured in the Irish Drilling (2021) Trial Pits and associated BRE365 infiltration tests.

Interpretation of the geophysical survey across the discharge area and over towards the walls of the excavation suggests that there may be some preferential pathways to groundwater (Apex, 2021). That suggestion by the geophysicist's interpretations of survey data is backed up by observations in the wall of the quarry to the NE of the discharge.

Upgradient groundwater quality is not as good as the quality of water discharged at the site from the quarry floor's sump because the sump has a rainfall component that is runoff from bare limestone rather than runoff agricultural lands or through on-site wastewater treatment systems upgradient in the catchment. Monitoring of the discharge quality suggests good hydrochemical quality.

Upgradient groundwater strike in four Monitoring Wells installed under Hydro-G's supervision in 2020 suggest that the natural groundwater strike zone is at least 30m below the discharge zone.

Given the results for Site Investigations at the site and what is known about the karst systems regionally, the potential impact of the discharge should be conceptualised as a 'Direct Discharge' as provided for in the Groundwater Regulations. Regulation 8 of the Groundwater Regulations 2010 allows for direct discharge in Clause 8(a)(ii) "for reinjection of pumped groundwater from mines and quarries or associated with the construction or maintenance of civil engineering works"…. "Subject to a requirement for prior authorisation provided such discharges, and the conditions imposed, do not compromise the achievement of the environmental objectives established for the body of groundwater into which the discharge is made". Review of EPA reports and web mapping suggests that the Status of the underlying groundwater body and all downstream receptors is good. The quarry's discharge has been ongoing throughout the EPA monitoring and reporting phases and the quarry has neither affected status nor the achievement of the environmental objectives established for the body of groundwater into which the discharge is made. The requirements of the Groundwater Regulations is therefore adhered to with respect to the discharge. While some downstream water receptors might be mapped as At Risk by the EPA and reported for WFD assessments, the Risk is presented by agriculture and on-site domestic wastewater treatment plants discharging to thin soil cover.

Site investigations suggest that the discharge disperses over the top of rock and there may be direct shafts beneath the discharge zone (Apex, 2021). That is the conceptual model.

A regional scale cross section from Lough Corrib, through the site and through to the River Clare is presented in Plate 9.

The regional cross section presents the Lough Corrib, the quarry's discharge, likely flow direction, the water strike zone in the Monitoring Wells drilled upgradient of the discharge in 2020, the N83 and N84 roads and the River Clare to the east of the site.

The assessment for assimilation capacity, hydraulic acceptance and compliance with the hydrochemical Threshold Values of the Groundwater Regulations are presented in the next Section.

Plate 9 Cross Section from Lough Corrib to the discharge (source: Google Earth Pro)

Plate 9(a) Plan view of cross section line

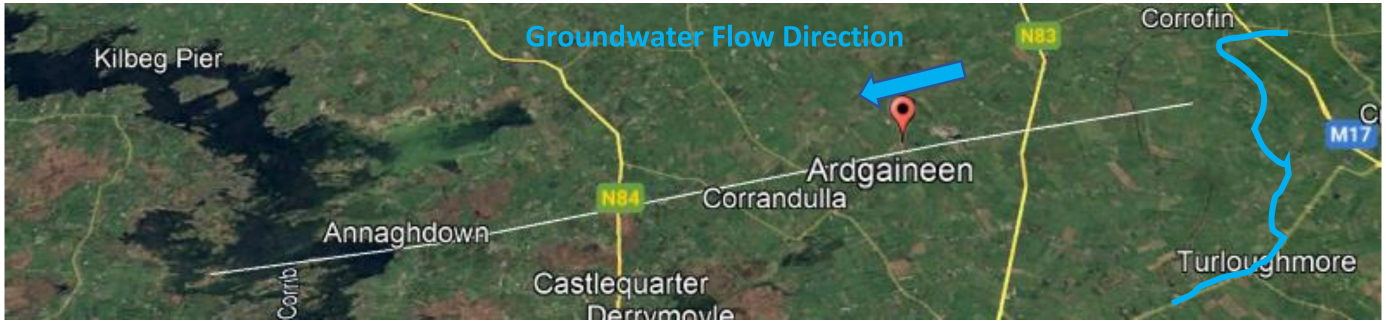
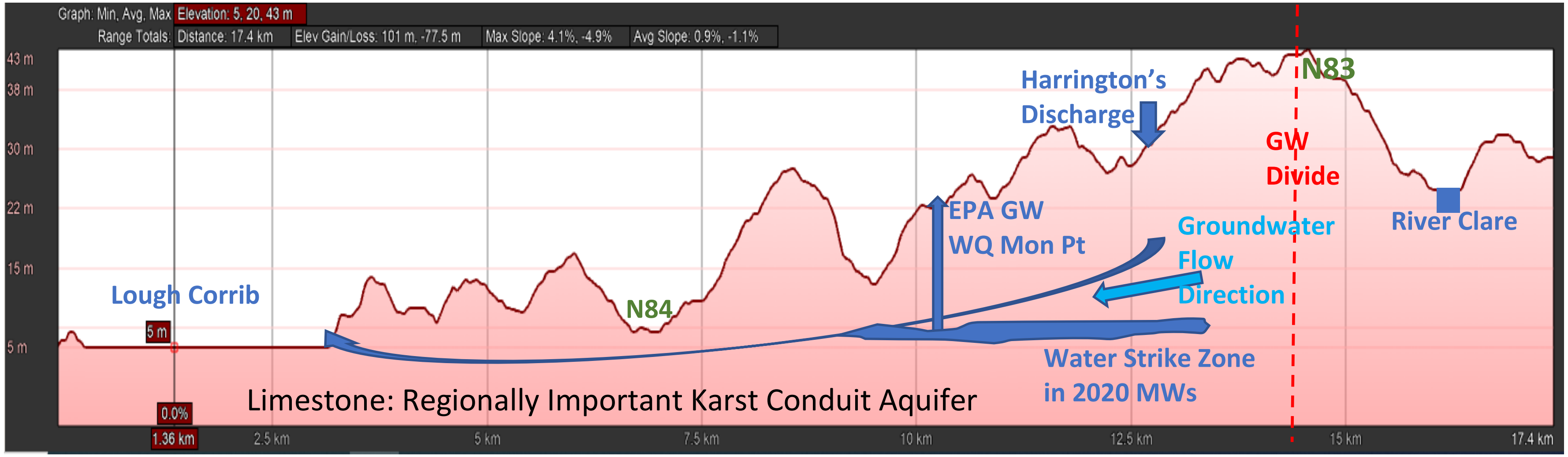


Plate 9(b) Cross Section, annotated by Hydro-G for indication of relative locations.



6.0 Assessment

This section presents the evaluation of the potential effect of the discharge in the context of regulatory obligations. Overall, assessment of this discharge consent requires consideration as to whether the discharge is feasible and defensible in the context of the European Communities Environmental Objectives (Groundwater) Regulations (S.I. No. 272 of 2009 as amended).

Section 5.0 is structured as follows:

- Section 5.1 presents the presents the assessment of feasibility from the perspective of hydraulic feasibility and Assimilation Capacity Mass Balance as outlined in the Guidance manuals.
- Section 5.2 presents an evaluation of the output from the Assimilation Capacity simulations for compliance with the requirements of the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010, as amended 2011, 2012, 2016).
- Section 5.3 presents information on other Section 4 discharges in the area for the purposes of Cumulative Impact assessment.
- Section 5.4 presents an evaluation of the potential for impact on downstream GWDTEs and designated sites.

6.1 Discharge Feasibility

6.1.1 Hydraulic Feasibility

Hydraulic feasibility calculations are presented in Table 9, following EPA 2011 Guidance calculation methods using the wetland discharge area of 2,600m2, approximately. The ability of the subsoil and bedrock to accept the discharge, from a hydraulic perspective is proven by operational experience at the site.

Table 9 Hydraulic Feasibility calculations

Harringtons Quarry Argaineen, Co. Galway: DISCHARGE ZONE Hydraulic Feasibility Validation	Units	Value	Source
Climate Change +Factored Maximum Future Discharge	m3/d	2000	Max Future Loading rate
Discharge Zone Area	m2	2000	Discharge Zone Available Area
Quarry Floor's Sump Water's Areal loading rate to Discharge Area	m3/m2/d	1.0	calculated
Effective Rainfall AT the Discharge Area	m/yr	0.7035	GSI
Effective Rainfall through 2,000m2 Percolation area	m3/yr	1407	calculated
Effective Rainfall through 2,000m2 Percolation area	m3/d	3.85	calculated
Total Hydraulic Loading	**m3/d**	**2003.85**	**calculated**
Hydraulic Loading Rate to discharge area area	m3/m2/d	1.002	calculated (m3/d loading rate / m2 discharge area)
Hydraulic Loading Rate to discharge area area	m/d	1.002	calculated (i.e. m3/m2/d is same as m/d)
Hydraulic Conductivity of underlying Top of Bedrock	m/s	8.70E-05	Irish Drilling 2021
	m/d	7.52	m/s units converted to m/d unit to compare with actual loading rate
Hydro-G's Evaluation			
Hydraulic Conductivity CAPACITY of the top of bedrock underlying the discharge area is 7.52 m/d and this acceptance capacity is greater 7.5 times greater than the actual discharge loading rate value of 1.002 m/d.			
A top of bedrock acceptance rate of 7.52 m/d is greater than the 1m/d loading rate = the discharge is hydraulically feasible.			

The information presented in Table 9 demonstrates that the discharge is hydraulically feasible, and licensing is justified on the physical basis i.e. hydraulic acceptance of the top of rock. Hydrochemical feasibility must now be assessed using Assimilation Capacity.

6.1.2 Assimilation Capacity Mass Balance

With respect to justifying the discharge on a hydrochemical basis, EPA (2011) then requires that the calculated resultant groundwater concentrations are examined with respect to compliance with the Environmental Objectives of the Groundwater Regulations (2010, as amended). The Assimilation Capacity equation, as presented by EPA (2011) and DoEHLG (2011) is as follows:

Cgw = [(Cin x Qin) + (Cgwu x Qgw)] / (Qin + Qgw)

where

Cgw = resulting concentration in groundwater

Cin = concentration in the infiltrating water

Qin = volumetric rate of infiltrating water

Cgwu = concentration in the aquifer from upgradient areas

Qgw = flow through the aquifer*

***Note:** with respect to the simulation input for Qgw = flow through the aquifer, Hydro-G has adopted the most conservative volume for flow as 1% of the groundwater flow in the upgradient groundwater catchment. It is not appropriate to use Darcy's law to karst groundwater systems. Therefore, the conventional reliance on hydraulic conductivity and gradients has not been applied here. Adopting a 1% of potential flow is deemed to present a justified assessment for potential resultant concentrations.

With reference to the information presented earlier in this report, a collation of all relevant simulation data is presented in Table 10, which will be the data employed in Assimilation Capacity simulations.

Table 10 Collation of all relevant simulation data for Groundwater Regulation Parameters

Dishcharge Volume to be Simulated 2,000m3/d			UPGRADIENT Groundwater Maximum Value Reported	Discharge Maximum Value Reported*
Parameter	**Units**	**GROUNDWATER Regulation's THRESHOLD VALUES 2010, 2011, 2012, 2016**		
PH	pH Unit	6 < pH < 9	7.2	8.1
Electrical Conductivity	uS/cm	1875 uS/l	784	548
Sulphate	mg/l	187.5 mg/l	<20	25.7
Chloride	mg/l	187.5	21.6	18.2
Nitrate as N03	mg/l	37.5 mg/l as NO3	31.8	<8.9
Nitrite as N02	ug/l	375 ug/l as NO2	33	33
Ammonia as N	ug/l	175 ug/l NH4-N	26	13
Orthophosphate as P04-P	ug/l	35 ug/l = 0.035 mg/l	18	12
Phosphorus, Total as P	mg/l	not specified	0.022	0.008
BOD5	mg/l O2	not specified	<2	<2
Aluminium, Total	ug/l	150 µg/l	56	32
Cadmium	ug/l	150 ug/l	0.3	0.25
Zinc	ug/l	75 ug/l	<6	<5
Mercury - Total	µg/l	0.75	<0.01	<0.05
TPH >C6 - C40	µg/l	7.5	<10	<10
Benzo(a)pyrene	ug/l	0.0075	<0.01	<0.01
Total PAH		0.075 ug/l	<0.01	<0.01

* For Petroleums and metals, the values chosen are from the second laboratory due to issues previously explained. In addition, when a < LOD is reported, it is convention to adopt half the LOD as the simualtion concentration.

Resultant groundwater concentration simulations are presented in full detail as Appendix E and summary results presented in Table 11.

Table 11 Resultant Groundwater Concentrations for the simulated proposed maximum daily discharge of 2000m^3/d.

Parameter Simulation Number	Parameter	units	GW Regulations 2016 Threshold Value (TV)	Discharge Characteristic Monitoring Record MAXIMUM Concentrations recorded	PROPOSED ELVs i.e. simulation values	Upgradient Groundwater Concentration	SIMULATED Resultant Cgw BELOW Discharge Area	Change in Groundwater Cocntrations in response to ovelying discharge	GW Regulations 2016 TV Compliance
1	**BOD**	mg/l	Not Specified	<2	<10	**<2**	<2	no change	Not Specified
2	**COD**	mg/l		<10	<15	**<10**	<10	no change	
3	**SS**	mg/l		4	<10	**3**	3	no change	
4	**Temp**	oC		10	10	**11**	11	no change	
5	**pH**	pH units	**6.5 to 9**	8.1	6 to 9 pH	**7.2**	7.2	no change	Yes
6	**Electrical Conductivity**	uS/cm	**1875**	548	<900	**748**	784	no change of scientific significance	Yes
7	**Sulphate**	mg/l	**187.5**	25.7	<50	**10**	10.0	no change	Yes
8	**Chloride**	mg/l	**187.5**	18.2	<50	**21.6**	21.6	no change	Yes
9	**Nitrate**	mg/l NO3	**37.50**	<8.9	<18	**31.8**	30.6	reduction	Yes
10	**Nitrite**	ug/l NO2	**375**	33	<50	**33.0**	34.0	1 ug/l = not significant	Yes
11	**Total Ammonia**	ug/l as N	**175**	13	<30	**26**	26	no change	Yes
12	**Ortho-P as P**	ug/l as P	**37.5**	12	<20	**18**	18	no change	Yes
13	**Aluminium**	ug/l	**150**	12	<50	**56**	55	small, insignificant decrease	Yes
14	**Cadmium**	ug/l	**150**	0.25	<5	**0.3**	0.3	no change	Yes
15	**Zinc**	ug/l	**75**	<5	<15	**3**	3.0	no change	Yes
16	**Mercury**	ug/l	**0.75**	<0.05	<1	**0.005**	0.006	no change of scientific significance	Yes
17	**TPH**	ug/l	**7.5**	<10	<10	**<10**	<10	no change	Yes
18	**Benzo(a)pyrene**	ug/l	**0.0075**	<0.01	<0.01	**<0.01**	<0.01	no change	Yes
19	**Total PAH**	ug/l	**0.0750**	<0.01	<0.01	**<0.01**	<0.01	no change	Yes

6.2 Groundwater Regulation Compliance

The Emission Limit Values simulated demonstrate full compliance with the Threshold Values of the Groundwater Regulation (2010, as amended). Results presented in Table 11 and Appendix E demonstrate that for the nineteen parameters simulated, there was no change in concentrations and for most parameters, relative to upgradient groundwater quality. For the parameters Mercury and Electrical Conductivity there were minute changes in the resultant concentrations but of no scientific significance. The reason that the discharge does not change the concentration in the underlying groundwater is for the following reasons:

1. The monitored discharge quality is good and it is therefore possible to specify relatively low discharge ELVs for simulation. This is a stormwater derived runoff and not treated wastewater. Therefore, impact is not envisaged.
2. The quality of groundwater upgradient of the site is good.
3. The discharge volume is vey small relative to the size of the upgradient catchment and flow in the Regionally Important karst aquifer.

Generally, it is only required to simulate the effect for Groundwater Regulation parameters but SS, Total P, BOD and COD are also presented here because they are important evaluation parameters in this work for potential impact on downstream surface water receptors to which groundwater will discharge. Suspended Solids are important because it is imperative that solids do not impede permeability. Total P, BOD and COD are important for downstream surface water quality in Lough Corrib SAC & SPA. All parameters imulated demonstrate no change in resultant concentrations following the discharge.

6.3 Cumulative Impact

With respect to potential cumulative impact, the quarry's discharge has been simulated to suggest no change in resultant groundwater concentrations. Therefore, there cannot be an 'in combination' cumulative effect because the quarry's discharge is not changing the situation hydrochemically. Neither is the quarry's discharge changing things hydrologically because the water being discharged was always supposed to go to groundwater and the downstream surface water receptor discharge zones.

EPA maps envision system was reviewed for other Section 4 and IPPC licenses (https://gis.epa.ie/EPAMaps/default). There are no other licensed quarry discharges in the area. There are no IEL, IPC or IPPC licenses in the upgradient or downgradient catchment. There are seven Section 4 discharge licenses and six of those are for domestic type wastewaters from either nursing homes, schools or housing developments. One Section 4 discharge license is for a fish hatchery. The seven Section 4 discharge licenses are spread over an area of 140km^2 upgradient of the eastern coastline of Lough Corrib that is within potential range of the quarry's discharge. Adding the proposed new licence for the quarry would suggest 17.5km^2, approximate, areal diffusion per discharge licence. Considering that the GSI assigns an average value of 500mm/yr of groundwater recharge in the region, the amount of groundwater flow available for each discharge would be 24,000m3/day, on average. This is a lot of groundwater for each discharge. Cumulative impact is not envisaged.

6.4 Designated & GWDTEs Sites Potential Impact Assessment

With respect to potential impacts on downstream designated sites or the ecology of waters, the proposed maximum discharge volume of 2000m3/d has been simulated for proposed defensible Emission Limit Values and there will be no change in groundwater quality.

The simulation method and evaluation were completed using the maximum discharge concentrations monitored and the maximum observed groundwater quality.

The outcome of the simulations, which follows EPA (2011) and DoEHLG /WSNTG (2011) guidance, is that there will be no significant change in concentrations for all Groundwater Regulation parameters simulated. Similarly, no change is envisaged for other simulated parameters of note such as BOD, COD, and SS, which although not specified in the Groundwater Regulations, would be considered important for downstream surface water receptors.

The site of the proposed discharge is hydraulically connected to the downstream designated Lough Corrib SAC and SPA and parts of that Lough Corrib SAC are mapped for the river Clare to the east of the quarry.

The site is also upgradient of the Groundwater Dependent Terrestrial Ecosystem (GWDTE) [IE_WE_G_0106], GWDTE-Lough Corrib Fens 3 & 4 (SAC000297).

With respect to potential for affecting the quality of waters in downstream designated sites, *i.e.* hydrochemical, considering that there will be no resultant change in groundwater quality directly underneath the discharge, it is concluded that there can be no hydrochemical impact on downstream receptors. The investigations conducted as part of this work demonstrate that the quality of the discharge water is better than upgradient groundwater. This is rational because the site's discharge has a rainfall runoff component that will act to dilute groundwater enriched from agriculture and on-site wastewater treatment plants associated with extensive ribbon development in the catchment.

With respect to potential for hydrological effects on downstream receptors, water balance suggests no potential for impact if the GW5 WFD Working Group's Guidance document (2005) is applied. On a regional scale, rainfall derived surface water runoff and groundwater interception and management at the site represents 0.1% of the volume of groundwater flowing in the Clare Corrib Groundwater Body and discharging to the Lough Corrib SAC system. This <1% valueof waters intercepted at the quarry is below the 5% threshold value of the Water Framework Directive Working Group (GW5) and is therefore **deemed 'Low Potential Impact' and 'Not at Significant Risk'** by WFD characterisation methods (GW5, 2005). This water balance data provides the confidence to assert that there will be no adverse hydrological impact on the local or regional groundwater regime or downstream designated sites or GWDTEs.

Table 12 Regional hydrogeology & Harrington's Quarry's groundwater management.

Regional hydrogeology & Harrington's Quarry's groundwater management	
GSI assigned area for 'Clare Corrib Groundwater Body' (km2)	1,422
Clare Corrib Groundwater Body (m2)	1,422,000,000
GSI Stated Total Regional Karst Aquifer (Conduit) Area (km2)	7,063
Total Aquifer Area (m2)	7,063,000,000
AVERAGE Across Region GSI Effective Rainfall (mm/yr)	700
AVERAGE Across Region GSI Groundwater Recharge (mm/yr)	500
GSI Groundwater Recharge (m/yr)	0.5
Groundwater Recharge to Clare Corrib GWB = [0.5m rainfall recharge x 1,422,000,000 m2 area] (m3/yr)	711,000,000
AVERAGE Groundwater Recharge to Clare Corrib GWB = [0.5m rainfall recharge x 1,422,000,000 m2 area]/365 days] (m3/d)	1,947,945
Rainfall Recharge to Total Aquifer area = [AVERAGE 0.5m groundwater rainfall recharge x 7,063,000,000 m2 area] (m3/yr)	3,531,500,000
Future Anticipated maximum daily discharge volume from the quarry (m3/d)	2,000
Annual Discharge based on MAX daily discharge from the quarry (m3/yr)	730,000
Hydro-G Calculation	
Proportion of Quarry's discharge volume as a % of Clare Corrib GWB's annual rechange amount to groundwater from rain falling on its catchment (%)	**0.10**
Rainfall Recharge to Total Aquifer area = [0.5m rainfall recharge x 7,063,000,000 m2 area] (m3/yr)	3,531,500,000
Proportion of Quarry's Discharge as a % of the total aquifer area's annual recharge to groundwater from rainfall (%)	**0.02**

7.0 Monitoring Programme Proposed

A monthly monitoring programme is proposed and consists of monthly discharge sampling for the Emission Limit Values of the Discharge Licence issued and daily recording of discharge volumes. The date of the routine monthly monitoring will be planned to be completed in the week following a blast at the site.

Proposed On-site Compliance Monitoring Points are presented as Plate 10. Monitoring of the quality of the discharge itself is the Compliance point for the input. Two downstream Groundwater Piezometers are proposed within the site of the discharge. AN agreement is in place between the operator and landowner (Refer to ESP documentation accompanying this application).

A downstream off-site compliance point can be the EPA Groundwater Monitoring Point Corrandulla at 2.8km downstream of the site. MP Code IE_WE_G_0020_1200_0008. Refer to Appendix C for details and location map.

8.0 Mitigation Proposed

A hydrocarbon interceptor will be positioned in advance of the discharge point. Refer to Earth Science Partnership DWG January 2022.

Plate 10 Monitoring and Compliance Points on Site

NOTE: Refer to Appendix C for off Site Compliance Point

DAVID = ? WHERE IS THE OIL INTERCEPTOR GOING?

9.0 Discussion

The geophysicist's interpretation of the 2021 geophysical survey in the discharge area suggests potential conduits and by-pass mechanisms, which negate the use of bedrock hydraulic conductivity in any modelling for the site. The experience of responses in the wall to pumping to the discharge zone at the site suggests that the geophysicists' 2021 interpretation is correct. While bedrock hydraulic conductivities have been determined, instead, the discharge needs to be considered as a direct discharge, which is permissible under the Groundwater Regulations (2010) for quarrying activities. The discharge is diffuse and to an established wetland area from which it percolates to ground and groundwater. There is no engineered percolation area and neither is one deemed necessary in the context of Regulation. Regulation 8 of the Groundwater Regulations 2010 allows for direct discharge in Clause 8(a)(ii) "for reinjection of pumped groundwater from mines and quarries or associated with the construction or maintenance of civil engineering works"…. "Subject to a requirement for prior authorisation provided such discharges, and the conditions imposed, do not compromise the achievement of the environmental objectives established for the body of groundwater into which the discharge is made". These exemptions are discussed fully in the EPA (2014) Guidance for the Authorisation of Direct Discharges [NOTE: that Guidance is specifically for Direct Discharges of domestic-type wastewater but there has been no issue, as yet, for direct discharges of quarry waters]. The fact that quarry waters are rainfall and groundwater arisings being reinjected to the groundwater system suggests less of a threat than domestic type wastewater and hence less urgency on the agencies to write specific Guidance for quarries. All effort in Ireland is expended on the efforts to reverse the pollution caused by inappropriately positioned domestic wastewater treatment systems and on curbing the increase in contamination caused by agriculture, which is rampant. For example, EPA, 2009, 2021a, 2021b, 2021c.

Considering that the discharge is rainfall runoff and groundwaters collected on the floor of the quarry that would have been intended for nature in any case, the activity merely maintains the natural continuum of the groundwater regime.

With respect to WFD Status (EPA 2010 – 2015 and 2013 – 2018) and 2nd and 3rd WFD Cycle mapped Risk:

a. The receiving groundwater water is the Clare Corrib Groundwater Body and its WFD Status is mapped by the EPA as **Good Status** (2010 – 2015 and again 2013 - 2018) but assigned an **'At Risk'** classification in both the 2nd and 3rd WFD Cycles (https://gis.epa.ie/EPAMaps/Water). The **Good Status** designation of the receiving water is concurrent with long-standing operation of the quarry and its associated dewatering discharge. Therefore, the site's operation and discharge is **NOT** compromising the achievement of the environmental objectives established for the body of groundwater into which the discharge is made. The 'At Risk' classification is reported in EPA (2021) as "*For the At Risk groundwater bodies the significant issue is nutrient pollution and diminution of quality of associated surface waters for chemical reasons, which are impacting all four groundwater bodies*", in the Corrib catchment. EPA (2018) states that **Agriculture** is the identified pressure in the groundwater body.

b. The site sits 3km west of between the river Clare (Galway)_070 (IE_WE_30C011000) which is mapped as Good Status and 'Not at Risk'.

c. The river Cregg_010 rises at a distance of 1.5km to the south-west of the site's discharge. This river is mapped as Moderate Status and At Risk. EPA (2021) states that the Cregg_010 is "At Risk WB proposed by GCC because of its importance for Lough Corrib."

d. The site is 8km, approximately, due east of Lough Corrib Lower (IE_WE_30_666a) and the lake is mapped as Good status (2010 – 2015). Whilst previously mapped as At Risk in the WFD 2nd Cycle due to Invasive Species pressure (EPA, 2019), Lough Corrib Lower is now mapped as Not at Risk (EPA, 2021).

It is therefore concluded that the ongoing discharge **has not compromised** the water quality objectives of the WFD.

The site's average discharge volume recorded over a 4-year period suggests and average of 1,109 m3/d with a peak of 1,483 m3/d. Applying a +20% factor for climate change suggests a future potential maximum of 1,780 m3/d but Hydro G suggests that it makes most sense to simulate and licence a potential future maximum of 2,000 m3/d, which presents a small mathematical rounding for the purposes of potential unforseens and efficient compliance administration for all parties.

Hydraulically, the discharge gets away from the discharge zone. Historical observations show this to be a fact. However, the guidance (EPA, 2011 & DoEHLG/WSNTG, 2011) requires mathematical confirmation and this has been shown with the use of Site Investigation results for the hydraulic conductivity at the top of bedrock (Irish Drilling, 2021). Hydraulically, the 1m3/m2 loading rate each day is 7 times lower, at least, than the hydraulic acceptance capacity of the top of bedrock, which was directly measured in 2021 by Irish Drilling in BRE 365 tests in the actual discharge area. The measured hydraulic conductivity reduces with depth in the bedrock and this is normal. The system is karst and the discharge will diffuse laterally.

Given that the hydraulic issue is fine, quality impact is the main issue requiring assessment. The site has demonstrated that the discharge can get away from the discharge area. Hydrochemical impact assessment suggests no significant change in all 19 parameters simulated. Both Groundwater Regulation and other parameters such as BOD, SS and COD were simulated. No change of scientific significance is envisaged. The simulations were completed using a very conservative 1% of upgradient groundwater flow volumes. Therefore, the finding of no potential for impact is concluded.

The quarry's discharge is pumped from the floor sump and is therefore controllable.

A monitoring programme has been proposed and the Local Authority can add to the proposed programme in a Licence issued.

The quarry's discharge is better hydrochemical quality than the upgradient groundwater because the floor's water has a large rainwater component. Therefore, the discharge is deemed justified and defensible with respect to regulation.

10.0 Overall Conclusions & Proposed ELVs

Mathematical evaluations, as guided by EPA 2011 and DoEHLG / WSNTG 2011, using the site-specific results of Site Investigations at the site support the conclusion of not potential for impact arising from the proposed maximum future discharge of 2,000m3/d at the site.

I have independently assessed and simulated the receiving water's response to assimilating 2,000 m3/d maximum ELV Volume and assess that the proposed discharge is Ground Water Regulation compliant for all parameters simulated and for the Emission Limit Values presented in Table 13. Further, the proposed discharge is Salmonid Regulations compliant for Suspended Solids. Evidence to support that the site can achieve the ELVs proposed is also shown in Table 13 where the maximum observed discharge concentration for each parameter is presented.

Table 13 Proposed Emission Limit Values for Discharge Licence

Parameter	units	Discharge Monitoring Record MAXIMUM Concentrations recorded	PROPOSED ELVs i.e. simulation values
Volume	**m3/d**	1,483	2000 *
BOD	mg/l	<2	<10
COD	mg/l	<10	<15
SS	mg/l	4	<10
Temp	oC	10	10
pH	pH units	8.1	6 to 9 pH
Electrical Conductivity	uS/cm	548	<900
Sulphate	mg/l	25.7	<50
Chloride	mg/l	18.2	<50
Nitrate	mg/l NO3	<8.9	<18
Nitrite	ug/l NO2	33	<50
Total Ammonia	ug/l as N	13	<30
Ortho-P as P	ug/l as P	12	<20
Total P	mg/l P	0.008	<0.1
Aluminium	ug/l	12	<50
Cadmium	ug/l	0.25	<5
Zinc	ug/l	<5	<15
Mercury	ug/l	<0.05	<1
TPH	ug/l	<10	<10
Benzo(a)pyrene	ug/l	<0.01	<0.01
Total PAH	ug/l	<0.01	<0.01

I conclude this assessment in the context of the requirements of the European Communities Environmental Objectives (Groundwater Regulations) Regulations, 2010, as amended, the requirements of the European Communities (Quality of Salmonid Waters) Regulations 2009, as amended, and the requirements of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011). I conclude that on the proposed ELV MAX of 2,000 m3/d individually, or in combination with other plans or projects is <u>not</u> likely to have a significant effect on any European Sites.

A monthly monitoring programme is proposed and consists of monthly discharge sampling for the Emission Limit Values of the Discharge Licence issued and daily recording of discharge volumes. The site will adhere to any additional licence specifications of the Local Authority. The date of the routine monthly monitoring will be planned to be completed in the week following a blast at the site.

Pamela Bartley

Signed: ______________________ Date: ___ 26/1/2022 _

Dr. Pamela Bartley BEng, MSc, PhD

11.0 REFERENCES & Bibliography

EPA Envision Maps https://gis.epa.ie/EPAMaps/ = EPA maps portal for water quality, Section 4 licenses, Appropriate Assessment, Current Water Framework Status Reports, industry etc..

EPA (2009) Code of Practice: Wastewater Treatment Systems for Single Houses. 2010.

EPA (2011) Guidance on the Authorisation of Discharges to Groundwater. EPA, Ireland ISBN 978-1-84095-413-5.

EPA (2014) Guidance on the Authorisation of Direct Discharges to Groundwater. EPA, Ireland. ISBN: 978-1-84095-545-3.

EPA (2018) 30_13 Clare[Galway]_SC_060 Subcatchment Assessment WFD Cycle 2.

EPA (2021)a Code of Practice Domestic Waste Water Treatment Systems (Population Equivalent ≤ 10). Published by the Environmental Protection Agency, Ireland. March 2021.

EPA (2021)b Assessment of the catchments that need reductions in nitrogen concentrations to achieve water quality objectives. WFD River Basin Management Plan – 3rd Cycle. June 2021. EPA Catchments Unit. Version no. 1.6`. https://www.catchments.ie/assessment-of-the-catchments-that-need-reductions-in-nitrogen-concentrations-to-achieve-water-quality-objectives/

EPA (2021)c 3rd Cycle Draft Corrib Catchment Report (HA 30). Catchment Science & Management Unit Environmental Protection Agency August 2021 Version no. 1.

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

European Communities (Birds and Natural Habitats) Regulations, 2011. S.I. No. 477 of 2011.

European Communities (Birds and Natural Habitats) (AMENDMENT) Regulations, 2021. S.I. No. S.I. No. 293 of 2021.

European Communities Environmental Objectives (Surface Water) Regulations, 2009. S.I. No. 272 of 2009.

European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations, 2012. S.I. No. 327 of 2012.

European Union Environmental Objectives (Surface Waters) (Amendment) Regulations, 2015. S.I. No. 386 of 2015.

European Union Environmental Objectives (Surface Waters) (Amendment) Regulations, 2019. S.I. No. 77 of 2019.

European Communities Environmental Objectives (Groundwater) Regulations, 2010. S.I. No. 9 of 2010.

European Communities Environmental Objectives (Groundwater) (Amendment) Regulations, 2011, S.I. No. 389 of 2011.

European Communities Environmental Objectives (Groundwater) (Amendment) Regulations, 2012, S.I. No. 149 of 2012.

European Communities Environmental Objectives (Groundwater) (Amendment) Regulations, 2016. S.I. No. 366 of 2016.

GSI web portal for Soils, Subsoils, Geology, Aquifer, Vulnerability, Recharge, Contours, WFD Groundwater Bodies etc. https://dcenr.maps.arcgis.com/apps/

NPWS (2011) Conservation objectives.

S.I. No. 605 of 2017. EUROPEAN UNION (GOOD AGRICULTURAL PRACTICE FOR PROTECTION OF WATERS) REGULATIONS 2017. S.I. No. 605 of 2017.

WFD Working Group (2005) Guidance document no. GW5: GUIDANCE ON THE ASSESSMENT OF THE IMPACT OF GROUNDWATER ABSTRACTIONS.

WSTG (2011) Discharges to Groundwater Guidance to the Applicant. Local Authority Services National Training Group. August 2011. Revision B.

www.wfdireland.ie. Historic Status Reports.

Data Report 1

Q2 (2023)

Section 4 Discharge Licence W/502/22

(issued 7th June 2023)

at

Harrington Concrete and Quarries Ltd

Ardgaineen, Claregalway, Co. Galway

Prepared by Consultant Dr. Pamela Bartley, Hydro-G

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Project No.: 25-14 Harringtons Ardgaineen

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Report Title: Data Report 1: Q2 (2023) Harringtons Concrete and Products Ltd. Discharge Licence W/502/22.

Pamela Bartley

Prepared by: ___________________________

Dr. Pamela Bartley B.Eng, M.SC., Ph.D.

NOTES:

This report is for the use solely of the party to whom it is addressed and no responsibility is accepted to any third party.

About the Author

Pamela Bartley is a water focussed civil engineer. She has 30 years of field-based practice in borehole drilling, groundwater monitoring and abstraction point management in limestone karst environments. Her Ph.D was a field based karst limestone environment study. She has also completed training with the GSI at their karst specialist course run in the Burren. Her primary qualification is a Diploma in Water and Wastewater Technology at Sligo RTC. She then completed her primary degree in Civil Engineering at Queens University, Belfast, followed by an M.Sc. in Environmental Engineering, followed by a field-based hydrogeologically focussed Ph.D. within the School of Civil Engineering at Trinity College, Dublin. Her key work areas are: groundwater development from large scale water supply boreholes, hydrogeological assessment of quarries and the evaluation of discharges to groundwater and surface waters. Pamela Bartley's company is Bartley Hydrogeology ltd., registered to trade as Hydro-G.

Pamela has successfully completed post doctorate 'Professional Development' formal course training in the areas of:

- PSDP & PSCS (IOSH certified, 2016);
- Karst Hydrogeology (GSI, 2013);
- On Site Wastewater & Water Services Amendment Act 2012 (IE, Western Region 6-week programme 2012 & Dublin 2012);
- Zero Discharge Willow Wastewater Systems Design Courses (Denmark 2008 & 2011 & Ireland 2012);
- Expert Witness (IE, 2011);
- Planning & Development Act (IE, 2010);
- Surface Water Regulations 2009 (DoE, 2010 & 2011);
- Sustainable Drainage (Wallingford/CIRIA, 2005 & 2008);
- Source Protection Zone Delineation (IGI/GSI, 2007);
- Groundwater & Contaminant Microbiology (IGI/GSI, 2006);
- Applied Groundwater Modelling (ESI, UK, 2000);
- Site Suitability Assessment (FETAC, 2002).

As a result of work in evaluating planning appeals, Pamela has become specialist in planning evaluations in the context of enacted Irish Regulation and EU Directives concerning the water environment such as the Groundwater Regulations (S.I. No. 9 of 2010), Surface Water Regulations (S.I. No. 272 of 2009), Water Framework and Habitats' Directives. Pamela is a qualified and certified 'Site Assessor' and interviewer of examination candidates in respect of eligibility for the Site Suitability FETAC Qualification. In the past, she has lectured in third level institutions (WIT, CIT, 1996 – 1999), delivered practical laboratory instruction in the assessment of subsoils for the FETAC Site Assessor programme and demonstrated hydraulics laboratory modules at Trinity College Dublin (1996). She has been an invited guest speaker at An Board Pleanála, The Irish Concrete Federation, The Health Service Executive, Environmental Health Officers National Conference, The Irish Planning Institute's National Conference, The International Association of Hydrogeologists National Conference (Irish Branch) and has delivered hydrogeological lectures to the public during Science Week.

Hydro-G is the registered trading name of Pamela Bartley's company Bartley Hydrogeology Ltd., a company registered in Galway Ireland. The company holds requisite employer's and public liability insurances. In addition, the company holds professional indemnity insurance of €2million.

Pamela is qualified and IOSH certified to act as PSDP (Project Supervisor Design Phase) & PSCS (Project Supervisor Construction Stage) as defined by the Construction Regulations. The company is a registered Irish Water Supplier (no. 1855) and Pamela Bartley is HSQE approved within Irish Water.

Contents

1.0 Introduction

Hydro G was commissioned by Harringtons Concrete and Products Ltd to prepare a Data Report for the **2nd Quarter 2023** Discharge Licence in place for the quarry operation at Ardgaineen, Claregalway, Co. Galway (Galway County Council Licence Ref. No: W/502/22, issued 7th June 2023). This report has been prepared to fulfil this requirement and pertains to the **first** reporting period since the Licence was issued.

It is acknowledged that Licence W/502/22 stipulates return of results on a Quarterly basis and this practice will be put in place going forward.

2.0 Discharge Licence Conditions

Licence conditions relevant to this report include the following:

1. Scope

This Licence refers to the attenuation sump discharge of Harrington Concrete and Quarries located at Ardgaineen, Claregalway, Co. Galway. Surface water run-off and ground water collected in the quarry attenuation sump are pumped to a Wetland Vegetation Area, *via* a petrol/oil interceptor, where water percolates to ground. This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required. **The maximum permitted discharge is 1,483m3 per day.**

2. Attenuation Sump Discharge.

2.1 **Discharge:** The Licencee shall not discharge, cause or permit the discharge, of any contaminated surface water or process water directly to any surface water or groundwater without prior treatment.

2.2 **Treated Discharge:** The discharge shall be discharged to groundwater without posing a pollution risk.

2.3 **Discharge Performance Standards:** The treated discharge, **prior to its release** to the Wetland Vegetation Area, shall comply with the following standards:

(a) The **Total Suspended Solids** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(b) The **Biochemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(c) The **Chemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 15 mg/l.

(d) The **Nitrate (NO_3-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 18 mg/l.

(e) The **Nitrite (NO_2-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.05 mg/l.

(f) The **Total Hydrocarbon** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.01 mg/l.

(g) The **Total Ammonia** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.03mg/l.

(h) The **Benzo (a) pyrene** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(i) The **Total PAH** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(j) The **pH** of the Discharge from the attenuation sump and oil interceptor shall be in the range 6 - 9 pH units.

(k) The **Flow** of the Discharge from the attenuation sump and oil interceptor shall not exceed 1,483 m3/day.

(l) The **Colour** of the Discharge from the attenuation sump should not change significantly from day to day nor shall there be any evidence of oil or excess solids on visual inspection.

(m) The **Conductivity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

(n) The **Turbidity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

3. Discharge Analysis

Analysis of the treated water prior to discharge shall be carried out by an approved accredited laboratory where readings are not taken on site. The frequency of analysis and the parameters are outlined below. Quarterly results shall be forwarded to the environment section.

Parameter	Monitoring Frequency	Analysis to be performed by accredited laboratory
Flow	Continuous - Daily	
Colour and Visual inspection	Daily	
Conductivity	Continuous - Daily	
Turbidity	Continuous - Daily	
pH	Continuous - Daily	
Total Suspended Solids	Quarterly	√
Nitrates NO_3^-	Quarterly	√
Nitrites NO_2^-	Quarterly	√
Chemical Oxygen Demand	Quarterly	√
Biochemical Oxygen Demand	Quarterly	√
Total Ammonia	Quarterly	√
Total PAH	Quarterly	√
Benzo (a) Pyrene	Quarterly	√
Total Hydrocarbons including Diesel Range Organics and Petroleum Range Organics	Quarterly	√

4. Groundwater Analysis

Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory. The following parameters shall be measured and analysis of same forwarded to the Environment Section of Galway County Council:

Parameter	Units
(a) Water Level	mAOD
(b) pH	pH units
(c) Conductivity	uS/cm
(d) Suspended Solids	mg/l
(e) Nitrates	mg/l No_3^-
(f) Total Hydrocarbons	mg/l

Where quarrying activities are found to adversely affect local water supplies the provisions of the EPA Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)', Section 3.3.1 shall apply, and the quarry shall provide a replacement water supply.

5. Petrol / Oil Interceptor

The petrol / oil interceptor should be inspected each working day to ensure it is operating correctly and daily records kept of this. These records should be made available to Galway County Council if requested.

Other matters in the licence include details about the following. Readers are referred to the Licence itself for specific detail.

6. Attenuation sump, petrol/oil interceptor & wetland area

6.1 Treatment Process – must be able to achieve the Treatment Standards of Condition 2.3.
6.2 Metering – Install Flow Meter, record Daily Discharge, report Quarterly. Limit 1,483m3/d.
6.3 Ready Access – must be allowed for Authorised Persons under the Water Pollution Acts.
6.4 Sampling – Sampling Chamber after treatment and before wetland. Plus access required.
6.5 Caretaker – Day to Day Inspection. Notified Person named and details supplied to GCC.
6.6 Notification of Non-Compliance – Make GCC aware, record details of noncompliance.

7. EPA Guidelines

All works must be carried out in accordance with the EPA Guidelines 'Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)'.

8. Annual Contribution

€550 due annually. Shall be adjusted with the Customer Price Index value. GCC can increase.

9. Changes in Ownership

GCC to be notified in writing if change in company ownership or Trading Name.

3.0 Person Responsible for Caretaking at the Site

Mr. John Gibbons, the quarry manager, is responsible for inspections and maintenance of the infrastructure associated with the discharge. Mr. Gibbons' contact details are on file with Galway County Council.

4.0 Site Data - Monitoring Results

4.1 Flow Data

The site's flow data has not been instrumented as yet with a Continuous Flow Meter because the Discharge Licence has only been issued on the 7th of June 2023. A Service provider is being sought.

Manual flow records suggest an average of 890m3/d discharge for the reporting period.

4.2 Discharge Water's Quality Data

As is required by Licence W/502/22, the site monitors water quality of the final discharge from the site on a Quarterly basis. The laboratory Certificate of Analysis is presented in Appendix A. Discharge water's quality results are presented in Table 1 with each parameter's ELV for the monitoring period.

Table 1 Ardgaineen Quarry Final Discharge Quality Q2 2023.

Green Highligt in Cells = Compliant			
			Q2 2023
Parameter:	Units	W/502/22 Emission Limit Value	07 June 2023
Hydrogen Ion (pH)	pH units	6 to 9	8.0
Biological Oxygen Demand (BOD)	mg/L	10.0	< 1.0
Suspended Solids	mg/L	10	< 4
Ammonium	mg/L N	0.03	0.03
Nitrate	mg/L N	18.00	1.47
Nitrite	mg/L N	0.05	0.012
Chemical Oxygen Demand (COD)	mg/L	15	< 10
Benzo(a)pyrene	µg/L	0.1	not analysed
Total Hydrocarbons	µg/L	10	not analysed
Total PAHs	µg/L	0.1	not analysed
Southern Scientific Laboratory Reference			93347 (23-29240)

With reference to the results presented in Table 1, and the associated Certificates of Analysis in Appendix A, commentary is as follows:

- The pH of the Discharge is 8pH and this is within the 6 to 9 pH Emission Limit Value.
- The discharge's results are below the limit of detection of the laboratory analyser for BOD, COD, and Suspended Solids. This suggests excellent Discharge Quality.

- Overall, Nitrate concentrations are very low, at 1.47 mg/l as NO3, and are compliant with the 18 mg/l NO3 ELV. Ammonium, Nitrite and Nitrate concentrations are compliant.

- At this point, the laboratory were not aware that Benzo(a)pyrene, PAHs, Hydrocarbons were required parameters. Therefore, they were not analysed.

4.3 Continuous Data Recording

The site's discharge is not yet instrumented with a continuous flow meter with physiochemical sensors for parameters as specified in the Licence as follows:

- Flow
- pH
- Turbidity
- Conductivity

A Service Provider is being sought for the provision of Continuous Flow and Physicochemical Monitoring.

4.4 Groundwater Data

Condition 4 of the Licence states that "Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory". However, there are no wells on the operational quarry to which the Discharge Licence relates. Hydro-G has previously reported 11 Site Investigation boreholes on the floor of the quarry and none of those boreholes encountered groundwater strike.

There are site investigation greenfield boreholes for the lands to the east of the quarry but they are not within the operational quarry.

The "1. Scope" detail of the Opening of W/502/22 Discharge Licence states that

> "*This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required.*"

Given that there have been no successful groundwater strikes in 11 boreholes attempted within this quarry because the limestone is the competent Burren Formation Limestone. The aquifer is mapped as a Regionally Important Karst Conduit Aquifer. No groundwater transmissive conduits were discovered in the drilling completed on the floor of the operational quarry. Therefore there is nothing to report with respect to this Condition of the Licence.

5.0 Compliance with Licence Conditions

5.1 With respect to the Volumetric ELV Conditions: Data presented suggests that the mean daily discharge is compliant with the specified ELV for mean daily volume of 1,483 m3/d, on an annual average basis. The average discharge rate was 890 m3/d.

5.2 With respect to Water Quality ELVs: Results presented in Table 1 indicates that the prescribed ELVs were complied with for all parameters analysed. No potential for environmental impact is envisaged.

6.0 Difficulties Encountered

6.1 A Service Provider is being sought for the Continuous Flow and Physiochemical Monitoring Condition of the Licence.

6.2 As part of previous evaluations, Hydro-G supervised the drilling of eleven boreholes on the floor of the quarry and no groundwater was encountered. Therefore, there is no groundwater quality to report.

6.3 The laboratory was unaware of the PAH, Benzo(a)pyrene and Hydrocarbon requirement of the analysis of the discharge for the Licence. Therefore, those parameters have not yet been analysed.

7.0 Register of Incidents

There were no 'serious incidents' to report with respect to this discharge during 2024 or 2025, to date.

8.0 Conclusions

The site is in compliance with those Conditions of the Section 4 Discharge Licence W/502/22 that have been quantified at this time.

Pamela Bartley

Dr. Pamela Bartley B.Eng, M.SC., Ph.D. MIEI

Appendix A

Laboratory Certificates of Analysis

Routine Quarterly Monitoring at the Site

southern scientific services ltd.

RECEIVED: 27/08/2025

Certificate of Analysis

Customer:	Harrington Concrete and Quarries	**Project:**	GWD-1
Address:	Kilkelly Co Mayo	**Site**	
		Date Received:	07/06/2023
		Condition of Sample:	Satisfactory
Report to:	Amanda Tarpey	**Date Analysed:**	07/06/2023 - 27/06/2023
Customer PO		**Issue Date:**	29/06/2023
Quote No.		**BATCH NUMBER:**	**23-29240**

Sadhbh O' Brien

Sadhbh O Brien
Chemistry Team Lead

Index to symbols used & Notes

*	Analysis is not INAB/UKAS accredited
**	Adapted from Standard Methods for the Examination of Water and Wastewater.
***	Customer specific limits
(F)	Analysis carried out at our Farranfore Laboratory.
(D)	Analysis carried out at our Dunrine Laboratory.
LOQ	Parameter Limit of Quantification
Note 6	Subcontracted Parameter.

Notes

- **The results relate only to the items tested.**
- **Opinions and interpretations expressed herein are outside the scope of INAB accreditation.**
- **The analysis report shall not be reproduced except in full without written approval of the laboratory.**
- **Sampling is outside the scope of the laboratory activities.**

Notes for Drinking Water samples

Note A	The water should not be aggressive
Note B	Compliance must be ensured with the conditions that [NO3]/50 + [NO2]/3 =1
Note C	Acceptable to customers and no abnormal change
Note D	In the case of surface water treatment, a parametric value not exceeding 1 NTU in the water ex treatment works must be strived for
Note F	Fluoridated supplies 0.8 mg/L; Natural supplies 1.5 mg/L.

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web site www.southernscientificireland.com | e-mail info@southernscientificireland.com

directors: K. Murphy, M. Murphy & C. Murphy
registered in ireland no 323196 | vat reg no IE 6343196 M

southern scientific services ltd.

Customer Sample Ref:	GWD-1	**Customer Sample Code:**	
Project:	GWD-1	**Sampled By:**	A Tarpey
Our Reference:	93347 (23-29240)	**Sample Matrix:**	
Date Sampled:	07/06/2023	**Time Sampled:**	13:00

Method:	Parameter:	Units	LOQ	Result
	Chemical Analysis: (F)			
SCP 052	Hydrogen Ion (pH)	pH units	*4.0*	8.0
SCP 052	Conductivity	µS/cm @ 20 °C	*15*	417
SCP 015	Biological Oxygen Demand (BOD)	mg/L	*1.0*	< 1.0
SCP 010	Suspended Solids	mg/L	*2*	< 4
SCP 027A	Ammonium	mg/L N	*0.02*	0.03
SCP 027G	Nitrate	mg/L N	*0.25*	1.47
SCP 027F	Nitrite	mg/L N	*0.005*	0.012
SCP 027C	Orthophosphate	mg/L P	*0.01*	< 0.01
SCP 027B	Chloride	mg/L	*0.5*	19.1
SCP 053A/053D	Potassium (K)	mg/L	*1.0*	5.8
SCP 016	Chemical Oxygen Demand (COD)	mg/L	*10*	< 10
SCP 053B/053D	Zinc (Zn)	µg/L	*1*	< 10
SCP 053B/053D	Cadmium (Cd)	µg/L	*1.00*	< 2.00
SCP 053B/053D	Iron	µg/L	*10*	< 10
SCP 053B/053D	Lead	µg/L	*1*	< 2
SCP 053B/053D	Manganese	µg/L	*2*	< 2

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registered in ireland no 323196 | vat reg no IE 6343196 M

Appendix B

Entire Record of Results Reported

Green Highligt in Cells = Compliant			
			Q2 2023
Parameter:	Units	W/502/22 Emission Limit Value	07 June 2023
Hydrogen Ion (pH)	pH units	6 to 9	8.0
Biological Oxygen Demand (BOD)	mg/L	10.0	< 1.0
Suspended Solids	mg/L	10	< 4
Ammonium	mg/L N	0.03	0.03
Nitrate	mg/L N	18.00	1.47
Nitrite	mg/L N	0.05	0.012
Chemical Oxygen Demand (COD)	mg/L	15	< 10
Benzo(a)pyrene	µg/L	0.1	not analysed
Total Hydrocarbons	µg/L	10	not analysed
Total PAHs	µg/L	0.1	not analysed
Southern Scientific Laboratory Reference			93347 (23-29240)

Data Report 2

Q3 (2023)

Section 4 Discharge Licence W/502/22

(issued 7th June 2023)

at

Harrington Concrete and Quarries Ltd

Ardgaineen, Claregalway, Co. Galway

Prepared by Consultant Dr. Pamela Bartley, Hydro-G

Hydro-G

50 Henry St.

Galway

H91 FA4X

pamela@hydro-g.com

091 449950

087 8072744

Project No.: 25-14 Harringtons Ardgaineen

Report Status: ISSUE_V1

Report Title: Data Report 2: Q3 (2023) Harringtons Concrete and Products Ltd. Discharge Licence W/502/22.

Pamela Bartley

Prepared by: ___________________________

Dr. Pamela Bartley B.Eng, M.SC., Ph.D.

NOTES:

This report is for the use solely of the party to whom it is addressed and no responsibility is accepted to any third party.

About the Author

Pamela Bartley is a water focussed civil engineer. She has 30 years of field-based practice in borehole drilling, groundwater monitoring and abstraction point management in limestone karst environments. Her Ph.D was a field based karst limestone environment study. She has also completed training with the GSI at their karst specialist course run in the Burren. Her primary qualification is a Diploma in Water and Wastewater Technology at Sligo RTC. She then completed her primary degree in Civil Engineering at Queens University, Belfast, followed by an M.Sc. in Environmental Engineering, followed by a field-based hydrogeologically focussed Ph.D. within the School of Civil Engineering at Trinity College, Dublin. Her key work areas are groundwater development from large scale water supply boreholes, hydrogeological assessment of quarries and the evaluation of discharges to groundwater and surface waters. Pamela Bartley's company is Bartley Hydrogeology ltd., registered to trade as Hydro-G.

Pamela has successfully completed post doctorate 'Professional Development' formal course training in the areas of:

- PSDP & PSCS (IOSH certified, 2016);
- Karst Hydrogeology (GSI, 2013);
- On Site Wastewater & Water Services Amendment Act 2012 (IE, Western Region 6-week programme 2012 & Dublin 2012);
- Zero Discharge Willow Wastewater Systems Design Courses (Denmark 2008 & 2011 & Ireland 2012);
- Expert Witness (IE, 2011);
- Planning & Development Act (IE, 2010);
- Surface Water Regulations 2009 (DoE, 2010 & 2011);
- Sustainable Drainage (Wallingford/CIRIA, 2005 & 2008);
- Source Protection Zone Delineation (IGI/GSI, 2007);
- Groundwater & Contaminant Microbiology (IGI/GSI, 2006);
- Applied Groundwater Modelling (ESI, UK, 2000);
- Site Suitability Assessment (FETAC, 2002).

As a result of work in evaluating planning appeals, Pamela has become specialist in planning evaluations in the context of enacted Irish Regulation and EU Directives concerning the water environment such as the Groundwater Regulations (S.I. No. 9 of 2010), Surface Water Regulations (S.I. No. 272 of 2009), Water Framework and Habitats' Directives. Pamela is a qualified and certified 'Site Assessor' and interviewer of examination candidates in respect of eligibility for the Site Suitability FETAC Qualification. In the past, she has lectured in third level institutions (WIT, CIT, 1996 – 1999), delivered practical laboratory instruction in the assessment of subsoils for the FETAC Site Assessor programme and demonstrated hydraulics laboratory modules at Trinity College Dublin (1996). She has been an invited guest speaker at An Board Pleanála, The Irish Concrete Federation, The Health Service Executive, Environmental Health Officers National Conference, The Irish Planning Institute's National Conference, The International Association of Hydrogeologists National Conference (Irish Branch) and has delivered hydrogeological lectures to the public during Science Week.

Hydro-G is the registered trading name of Pamela Bartley's company Bartley Hydrogeology Ltd., a company registered in Galway Ireland. The company holds requisite employer's and public liability insurances. In addition, the company holds professional indemnity insurance of €2million.

Pamela is qualified and IOSH certified to act as PSDP (Project Supervisor Design Phase) & PSCS (Project Supervisor Construction Stage) as defined by the Construction Regulations. The company is a registered Irish Water Supplier (no. 1855) and Pamela Bartley is HSQE approved within Irish Water.

Contents

1.0 Introduction

Hydro G was commissioned by Harringtons Concrete and Products Ltd to prepare a Data Report for the 3rd **Quarter 2023** Discharge Licence in place for the quarry operation at Ardgaineen, Claregalway, Co. Galway (Galway County Council Licence Ref. No: W/502/22, issued 7th June 2023). This report has been prepared to fulfil this requirement and pertains to the **second** reporting period since the Licence was issued.

It is acknowledged that Licence W/502/22 stipulates return of results on a Quarterly basis and this practice will be put in place going forward.

2.0 Discharge Licence Conditions

Licence conditions relevant to this report include the following:

1. Scope

This Licence refers to the attenuation sump discharge of Harrington Concrete and Quarries located at Ardgaineen, Claregalway, Co. Galway. Surface water run-off and ground water collected in the quarry attenuation sump are pumped to a Wetland Vegetation Area, *via* a petrol/oil interceptor, where water percolates to ground. This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required. **The maximum permitted discharge is 1,483m3 per day.**

2. Attenuation Sump Discharge.

2.1 **Discharge:** The Licencee shall not discharge, cause or permit the discharge, of any contaminated surface water or process water directly to any surface water or groundwater without prior treatment.

2.2 **Treated Discharge:** The discharge shall be discharged to groundwater without posing a pollution risk.

2.3 **Discharge Performance Standards:** The treated discharge, **prior to its release** to the Wetland Vegetation Area, shall comply with the following standards:

(a) The **Total Suspended Solids** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(b) The **Biochemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(c) The **Chemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 15 mg/l.

(d) The **Nitrate (NO_3-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 18 mg/l.

(e) The **Nitrite (NO_2-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.05 mg/l.

(f) The **Total Hydrocarbon** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.01 mg/l.

(g) The **Total Ammonia** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.03mg/l.

(h) The **Benzo (a) pyrene** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(i) The **Total PAH** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(j) The **pH** of the Discharge from the attenuation sump and oil interceptor shall be in the range 6 - 9 pH units.

(k) The **Flow** of the Discharge from the attenuation sump and oil interceptor shall not exceed 1,483 m3/day.

(l) The **Colour** of the Discharge from the attenuation sump should not change significantly from day to day nor shall there be any evidence of oil or excess solids on visual inspection.

(m) The **Conductivity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

(n) The **Turbidity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

3. Discharge Analysis

Analysis of the treated water prior to discharge shall be carried out by an approved accredited laboratory where readings are not taken on site. The frequency of analysis and the parameters are outlined below. Quarterly results shall be forwarded to the environment section.

Parameter	Monitoring Frequency	Analysis to be performed by accredited laboratory
Flow	Continuous - Daily	
Colour and Visual inspection	Daily	
Conductivity	Continuous - Daily	
Turbidity	Continuous - Daily	
pH	Continuous - Daily	
Total Suspended Solids	Quarterly	√
Nitrates NO_3^-	Quarterly	√
Nitrites NO_2^-	Quarterly	√
Chemical Oxygen Demand	Quarterly	√
Biochemical Oxygen Demand	Quarterly	√
Total Ammonia	Quarterly	√
Total PAH	Quarterly	√
Benzo (a) Pyrene	Quarterly	√
Total Hydrocarbons including Diesel Range Organics and Petroleum Range Organics	Quarterly	√

4. Groundwater Analysis

Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory. The following parameters shall be measured and analysis of same forwarded to the Environment Section of Galway County Council:

Parameter	Units
(a) Water Level	mAOD
(b) pH	pH units
(c) Conductivity	uS/cm
(d) Suspended Solids	mg/l
(e) Nitrates	mg/l No_3^-
(f) Total Hydrocarbons	mg/l

Where quarrying activities are found to adversely affect local water supplies the provisions of the EPA Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)', Section 3.3.1 shall apply, and the quarry shall provide a replacement water supply.

5. Petrol / Oil Interceptor

The petrol / oil interceptor should be inspected each working day to ensure it is operating correctly and daily records kept of this. These records should be made available to Galway County Council if requested.

Other matters in the licence include details about the following. Readers are referred to the Licence itself for specific detail.

6. Attenuation sump, petrol/oil interceptor & wetland area

6.1 Treatment Process – must be able to achieve the Treatment Standards of Condition 2.3.
6.2 Metering – Install Flow Meter, record Daily Discharge, report Quarterly. Limit 1,483m3/d.
6.3 Ready Access – must be allowed for Authorised Persons under the Water Pollution Acts.
6.4 Sampling – Sampling Chamber after treatment and before wetland. Plus access required.
6.5 Caretaker – Day to Day Inspection. Notified Person named and details supplied to GCC.
6.6 Notification of Non-Compliance – Make GCC aware, record details of noncompliance.

7. EPA Guidelines

All works must be carried out in accordance with the EPA Guidelines 'Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)'.

8. Annual Contribution

€550 due annually. Shall be adjusted with the Customer Price Index value. GCC can increase.

9. Changes in Ownership

GCC to be notified in writing if change in company ownership or Trading Name.

3.0 Person Responsible for Caretaking at the Site

Mr. John Gibbons, the quarry manager, is responsible for inspections and maintenance of the infrastructure associated with the discharge. Mr. Gibbons' contact details are on file with Galway County Council.

4.0 Site Data - Monitoring Results

4.1 Flow Data

The site's flow data has not been instrumented as yet with a Continuous Flow Meter because the Discharge Licence has only been issued on the 7th of June 2023. A Service provider is being sought.

Manual flow records suggest an average of 700m3/d discharge for the reporting period.

4.2 Discharge Water's Quality Data

As is required by Licence W/502/22, the site monitors water quality of the final discharge from the site on a Quarterly basis. The laboratory Certificate of Analysis is presented in Appendix A. Discharge water's quality results are presented in Table 1 with each parameter's ELV for the monitoring period.

Table 1 Ardgaineen Quarry Final Discharge Quality Q3 2023.

Green Highligt in Cells = Compliant			
			Q3 2023
Parameter:	Units	W/502/22 Emission Limit Value	04 July 2023
Hydrogen Ion (pH)	pH units	6 to 9	8.1
Biological Oxygen Demand (BOD)	mg/L	10.0	< 1.0
Suspended Solids	mg/L	10	< 4
Ammonium	mg/L N	0.03	< 0.02
Nitrate	mg/L N	18.00	1.22
Nitrite	mg/L N	0.05	< 0.005
Chemical Oxygen Demand (COD)	mg/L	15	< 10
Benzo(a)pyrene	µg/L	0.1	not analysed
Total Hydrocarbons	µg/L	10	not analysed
Total PAHs	µg/L	0.1	not analysed
Southern Scientific Laboratory Reference			96104 (23-30235)

With reference to the results presented in Table 1, and the associated Certificates of Analysis in Appendix A, commentary is as follows:

- The pH of the Discharge is 8.1pH and this is within the 6 to 9 pH Emission Limit Value.

- The discharge's results are below the limit of detection of the laboratory analyser for BOD, Suspended Solids, Ammonium, Nitrite and COD. This suggests excellent Discharge Quality.

- Overall, Nitrate concentrations are very low, at 1.22 mg/l as NO3, and are compliant with the 18 mg/l NO3 ELV.

- The laboratory did not complete the requested Benzo(a)pyrene, PAHs, Hydrocarbons parameters. The site continues to try to get the laboratory to analyse all parameters requested.

4.3 Continuous Data Recording

The site's discharge is not yet instrumented with a continuous flow meter with physiochemical sensors for parameters as specified in the Licence as follows:

- Flow
- pH
- Turbidity
- Conductivity

A Service Provider is being sought for the provision of Continuous Flow and Physicochemical Monitoring.

4.4 Groundwater Data

Condition 4 of the Licence states that "Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory". However, there are no wells on the operational quarry to which the Discharge Licence relates. Hydro-G has previously reported 11 Site Investigation boreholes on the floor of the quarry and none of those boreholes encountered groundwater strike.

There are site investigation greenfield boreholes for the lands to the east of the quarry but they are not within the operational quarry.

The "1. Scope" detail of the Opening of W/502/22 Discharge Licence states that

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Given that there have been no successful groundwater strikes in 11 boreholes attempted within this quarry because the limestone is the competent Burren Formation Limestone. The aquifer is mapped as a Regionally Important Karst Conduit Aquifer. No groundwater transmissive conduits were discovered in the drilling completed on the floor of the operational quarry. Therefore there is nothing to report with respect to this Condition of the Licence.

5.0 Compliance with Licence Conditions

5.1 With respect to the Volumetric ELV Conditions: Data presented suggests that the mean daily discharge is compliant with the specified ELV for mean daily volume of 1,483 m3/d, on an annual average basis. Manual flow records suggest an average of 700m3/d discharge for the reporting period.

5.2 With respect to Water Quality ELVs: Results presented in Table 1 indicates that the prescribed ELVs were complied with for all parameters analysed. No potential for environmental impact is envisaged.

6.0 Difficulties Encountered

6.1 A Service Provider is being sought for the Continuous Flow and Physiochemical Monitoring Condition of the Licence.

6.2 As part of previous evaluations, Hydro-G supervised the drilling of eleven boreholes on the floor of the quarry and no groundwater was encountered. Therefore, there is no groundwater quality to report.

6.3 The laboratory was unaware of the PAH, Benzo(a)pyrene and Hydrocarbon requirement of the analysis of the discharge for the Licence. Therefore, those parameters have not yet been analysed.

7.0 Register of Incidents

There were no 'serious incidents' to report with respect to this discharge during this reported period.

8.0 Conclusions

The site is in compliance with those Conditions of the Section 4 Discharge Licence W/502/22 that have been quantified at this time.

Pamela Bartley

Dr. Pamela Bartley B.Eng, M.SC., Ph.D. MIEI

Appendix A

Laboratory Certificates of Analysis

Routine Quarterly Monitoring at the Site

southern scientific services ltd.

RECEIVED: 27/08/2025

Certificate of Analysis

Customer:	Harrington Concrete and Quarries	**Project:**	Surface Water - GWD-1
Address:	Kilkelly Co Mayo	**Site**	
		Date Received:	04/07/2023
		Condition of Sample:	Satisfactory
Report to:	Amanda Tarpey	**Date Analysed:**	04/07/2023 - 12/07/2023
Customer PO		**Issue Date:**	13/07/2023
Quote No.		**BATCH NUMBER:**	**23-30235**

Sadhbh O' Brien

Sadhbh O Brien
Chemistry Team Lead

Index to symbols used & Notes

*	Analysis is not INAB/UKAS accredited
**	Adapted from Standard Methods for the Examination of Water and Wastewater.
***	Customer specific limits
(F)	Analysis carried out at our Farranfore Laboratory.
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LOQ	Parameter Limit of Quantification
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Notes

- **The results relate only to the items tested.**
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- **Sampling is outside the scope of the laboratory activities.**

Notes for Drinking Water samples

Note A	The water should not be aggressive
Note B	Compliance must be ensured with the conditions that [NO3]/50 + [NO2]/3 =1
Note C	Acceptable to customers and no abnormal change
Note D	In the case of surface water treatment, a parametric value not exceeding 1 NTU in the water ex treatment works must be strived for
Note F	Fluoridated supplies 0.8 mg/L; Natural supplies 1.5 mg/L.

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directors: K. Murphy, M. Murphy & C. Murphy
registered in ireland no 323196 | vat reg no IE 6343196 M

RECEIVED: 27/08/2025

Customer Sample Ref:	GWD-1	**Customer Sample Code:**	
Project:	Surface Water - GWD-1	**Sampled By:**	A Tarpey
Our Reference:	96104 (23-30235)	**Sample Matrix:**	
Date Sampled:	04/07/2023	**Time Sampled:**	13:00

Method:	**Parameter:**	**Units**	**LOQ**	**Result**
	Chemical Analysis: (F)			
SCP 052	Hydrogen Ion (pH)	pH units	*4.0*	8.1
SCP 052	Conductivity	µS/cm @ 20 °C	*15*	495
SCP 015	Biological Oxygen Demand (BOD)	mg/L	*1.0*	< 1.0
SCP 010	Suspended Solids	mg/L	*2*	< 4
SCP 027A	Ammonium	mg/L N	*0.02*	< 0.02
SCP 027G	Nitrate	mg/L N	*0.25*	1.22
SCP 027F	Nitrite	mg/L N	*0.005*	< 0.005
SCP 027C	Orthophosphate	mg/L P	*0.01*	< 0.01
SCP 027B	Chloride	mg/L	*0.5*	19.2
SCP 053A/053D	Potassium (K)	mg/L	*1.0*	4.4
SCP 016	Chemical Oxygen Demand (COD)	mg/L	*10*	< 10
SCP 053B/053D	Zinc (Zn)	µg/L	*1*	< 10
SCP 053B/053D	Cadmium (Cd)	µg/L	*1.00*	< 2.00
SCP 053B/053D	Iron	µg/L	*10*	< 10
SCP 053B/053D	Lead	µg/L	*1*	< 2
SCP 053B/053D	Manganese	µg/L	*2*	< 2

Appendix B

Entire Record of Results Reported

Green Highligt in Cells = Compliant				
			Q2 2023	Q3 2023
Parameter:	**Units**	**W/502/22 Emission Limit Value**	**07 June 2023**	**04 July 2023**
Hydrogen Ion (pH)	pH units	6 to 9	8.0	8.1
Biological Oxygen Demand (BOD)	mg/L	10.0	< 1.0	< 1.0
Suspended Solids	mg/L	10	< 4	< 4
Ammonium	mg/L N	0.03	0.03	< 0.02
Nitrate	mg/L N	18.00	1.47	1.22
Nitrite	mg/L N	0.05	0.012	< 0.005
Chemical Oxygen Demand (COD)	mg/L	15	< 10	< 10
Benzo(a)pyrene	µg/L	0.1	not analysed	not analysed
Total Hydrocarbons	µg/L	10	not analysed	not analysed
Total PAHs	µg/L	0.1	not analysed	not analysed
Southern Scientific Laboratory Reference			93347 (23-29240)	96104 (23-30235)

Data Report 3

Q4 (2023)

Section 4 Discharge Licence W/502/22

(issued 7th June 2023)

at

Harrington Concrete and Quarries Ltd

Ardgaineen, Claregalway, Co. Galway

Prepared by Consultant Dr. Pamela Bartley, Hydro-G

Hydro-G

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Project No.: 25-14 Harringtons Ardgaineen

Report Status: ISSUE_V1

Report Title: Data Report 3: Q4 (2023) Harringtons Concrete and Products Ltd. Discharge Licence W/502/22.

Pamela Bartley

Prepared by: ___________________________

Dr. Pamela Bartley B.Eng, M.SC., Ph.D.

NOTES:

This report is for the use solely of the party to whom it is addressed and no responsibility is accepted to any third party.

About the Author

Pamela Bartley is a water focussed civil engineer. She has 30 years of field-based practice in borehole drilling, groundwater monitoring and abstraction point management in limestone karst environments. Her Ph.D was a field based karst limestone environment study. She has also completed training with the GSI at their karst specialist course run in the Burren. Her primary qualification is a Diploma in Water and Wastewater Technology at Sligo RTC. She then completed her primary degree in Civil Engineering at Queens University, Belfast, followed by an M.Sc. in Environmental Engineering, followed by a field-based hydrogeologically focussed Ph.D. within the School of Civil Engineering at Trinity College, Dublin. Her key work areas are: groundwater development from large scale water supply boreholes, hydrogeological assessment of quarries and the evaluation of discharges to groundwater and surface waters. Pamela Bartley's company is Bartley Hydrogeology ltd., registered to trade as Hydro-G.

Pamela has successfully completed post doctorate 'Professional Development' formal course training in the areas of:

- PSDP & PSCS (IOSH certified, 2016);
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- On Site Wastewater & Water Services Amendment Act 2012 (IE, Western Region 6-week programme 2012 & Dublin 2012);
- Zero Discharge Willow Wastewater Systems Design Courses (Denmark 2008 & 2011 & Ireland 2012);
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- Sustainable Drainage (Wallingford/CIRIA, 2005 & 2008);
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- Groundwater & Contaminant Microbiology (IGI/GSI, 2006);
- Applied Groundwater Modelling (ESI, UK, 2000);
- Site Suitability Assessment (FETAC, 2002).

As a result of work in evaluating planning appeals, Pamela has become specialist in planning evaluations in the context of enacted Irish Regulation and EU Directives concerning the water environment such as the Groundwater Regulations (S.I. No. 9 of 2010), Surface Water Regulations (S.I. No. 272 of 2009), Water Framework and Habitats' Directives. Pamela is a qualified and certified 'Site Assessor' and interviewer of examination candidates in respect of eligibility for the Site Suitability FETAC Qualification. In the past, she has lectured in third level institutions (WIT, CIT, 1996 – 1999), delivered practical laboratory instruction in the assessment of subsoils for the FETAC Site Assessor programme and demonstrated hydraulics laboratory modules at Trinity College Dublin (1996). She has been an invited guest speaker at An Board Pleanála, The Irish Concrete Federation, The Health Service Executive, Environmental Health Officers National Conference, The Irish Planning Institute's National Conference, The International Association of Hydrogeologists National Conference (Irish Branch) and has delivered hydrogeological lectures to the public during Science Week.

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Pamela is qualified and IOSH certified to act as PSDP (Project Supervisor Design Phase) & PSCS (Project Supervisor Construction Stage) as defined by the Construction Regulations. The company is a registered Irish Water Supplier (no. 1855) and Pamela Bartley is HSQE approved within Irish Water.

Contents

1.0 Introduction

Hydro G was commissioned by Harringtons Concrete and Products Ltd to prepare a Data Report for the **4th Quarter 2023** Discharge Licence in place for the quarry operation at Ardgaineen, Claregalway, Co. Galway (Galway County Council Licence Ref. No: W/502/22, issued 7th June 2023). This report has been prepared to fulfil this requirement and pertains to the **third** reporting period since the Licence was issued.

It is acknowledged that Licence W/502/22 stipulates return of results on a Quarterly basis and this practice will be put in place going forward.

2.0 Discharge Licence Conditions

Licence conditions relevant to this report include the following:

1. Scope

This Licence refers to the attenuation sump discharge of Harrington Concrete and Quarries located at Ardgaineen, Claregalway, Co. Galway. Surface water run-off and ground water collected in the quarry attenuation sump are pumped to a Wetland Vegetation Area, *via* a petrol/oil interceptor, where water percolates to ground. This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required. **The maximum permitted discharge is 1,483m3 per day.**

2. Attenuation Sump Discharge.

2.1 **Discharge:** The Licencee shall not discharge, cause or permit the discharge, of any contaminated surface water or process water directly to any surface water or groundwater without prior treatment.

2.2 **Treated Discharge:** The discharge shall be discharged to groundwater without posing a pollution risk.

2.3 **Discharge Performance Standards:** The treated discharge, **prior to its release** to the Wetland Vegetation Area, shall comply with the following standards:

(a) The **Total Suspended Solids** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(b) The **Biochemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(c) The **Chemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 15 mg/l.

(d) The **Nitrate (NO_3-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 18 mg/l.

(e) The **Nitrite (NO_2-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.05 mg/l.

(f) The **Total Hydrocarbon** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.01 mg/l.

(g) The **Total Ammonia** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.03mg/l.

(h) The **Benzo (a) pyrene** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(i) The **Total PAH** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(j) The **pH** of the Discharge from the attenuation sump and oil interceptor shall be in the range 6 - 9 pH units.

(k) The **Flow** of the Discharge from the attenuation sump and oil interceptor shall not exceed 1,483 m3/day.

(l) The **Colour** of the Discharge from the attenuation sump should not change significantly from day to day nor shall there be any evidence of oil or excess solids on visual inspection.

(m) The **Conductivity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

(n) The **Turbidity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

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3. Discharge Analysis

Analysis of the treated water prior to discharge shall be carried out by an approved accredited laboratory where readings are not taken on site. The frequency of analysis and the parameters are outlined below. Quarterly results shall be forwarded to the environment section.

Parameter	Monitoring Frequency	Analysis to be performed by accredited laboratory
Flow	Continuous - Daily	
Colour and Visual inspection	Daily	
Conductivity	Continuous - Daily	
Turbidity	Continuous - Daily	
pH	Continuous - Daily	
Total Suspended Solids	Quarterly	√
Nitrates NO_3^-	Quarterly	√
Nitrites NO_2^-	Quarterly	√
Chemical Oxygen Demand	Quarterly	√
Biochemical Oxygen Demand	Quarterly	√
Total Ammonia	Quarterly	√
Total PAH	Quarterly	√
Benzo (a) Pyrene	Quarterly	√
Total Hydrocarbons including Diesel Range Organics and Petroleum Range Organics	Quarterly	√

4. Groundwater Analysis

Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory. The following parameters shall be measured and analysis of same forwarded to the Environment Section of Galway County Council:

Parameter	Units
(a) Water Level	mAOD
(b) pH	pH units
(c) Conductivity	uS/cm
(d) Suspended Solids	mg/l
(e) Nitrates	mg/l No_3^-
(f) Total Hydrocarbons	mg/l

Where quarrying activities are found to adversely affect local water supplies the provisions of the EPA Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)', Section 3.3.1 shall apply, and the quarry shall provide a replacement water supply.

5. Petrol / Oil Interceptor

The petrol / oil interceptor should be inspected each working day to ensure it is operating correctly and daily records kept of this. These records should be made available to Galway County Council if requested.

Other matters in the licence include details about the following. Readers are referred to the Licence itself for specific detail.

6. Attenuation sump, petrol/oil interceptor & wetland area

6.1 Treatment Process – must be able to achieve the Treatment Standards of Condition 2.3.
6.2 Metering – Install Flow Meter, record Daily Discharge, report Quarterly. Limit 1,483m3/d.
6.3 Ready Access – must be allowed for Authorised Persons under the Water Pollution Acts.
6.4 Sampling – Sampling Chamber after treatment and before wetland. Plus access required.
6.5 Caretaker – Day to Day Inspection. Notified Person named and details supplied to GCC.
6.6 Notification of Non-Compliance – Make GCC aware, record details of noncompliance.

7. EPA Guidelines

All works must be carried out in accordance with the EPA Guidelines 'Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)'.

8. Annual Contribution

€550 due annually. Shall be adjusted with the Customer Price Index value. GCC can increase.

9. Changes in Ownership

GCC to be notified in writing if change in company ownership or Trading Name.

3.0 Person Responsible for Caretaking at the Site

Mr. John Gibbons, the quarry manager, is responsible for inspections and maintenance of the infrastructure associated with the discharge. Mr. Gibbons' contact details are on file with Galway County Council.

4.0 Site Data - Monitoring Results

4.1 Flow Data

The site's flow data has not been instrumented as yet with a Continuous Flow Meter because the Discharge Licence has only been issued on the 7th of June 2023. A Service provider is being sought.

Manual flow records suggest an average of 1,000m3/d discharge for the reporting period.

4.2 Discharge Water's Quality Data

As is required by Licence W/502/22, the site monitors water quality of the final discharge from the site on a Quarterly basis. The laboratory Certificate of Analysis is presented in Appendix A.

Discharge water's quality results are presented in Table 1 with each parameter's ELV for the monitoring period.

Table 1 Ardgaineen Quarry Final Discharge Quality Q3 2023.

Green Highligt in Cells = Compliant			
			Q4 2023
Parameter:	**Units**	**W/502/22 Emission Limit Value**	**04 December 2023**
Hydrogen Ion (pH)	pH units	6 to 9	7.8
Biological Oxygen Demand (BOD)	mg/L	10.0	1.2
Suspended Solids	mg/L	10	< 4
Ammonium	mg/L N	0.03	0.03
Nitrate	mg/L N	18.00	1.73
Nitrite	mg/L N	0.05	< 0.005
Chemical Oxygen Demand (COD)	mg/L	15	< 10
Benzo(a)pyrene	µg/L	0.1	not analysed
Total Hydrocarbons	µg/L	10	not analysed
Total PAHs	µg/L	0.1	not analysed
Southern Scientific Laboratory Reference			113177 (23-36432)

With reference to the results presented in Table 1, and the associated Certificates of Analysis in Appendix A, commentary is as follows:

- The pH of the Discharge is 7.8pH and this is within the 6 to 9 pH Emission Limit Value.

- The discharge's results are below the limit of detection of the laboratory analyser for Suspended Solids, Nitrite and COD. This suggests very good Discharge Quality.

- BOD concentration is very low at 1.2 mg/l BOD, which is compliant with the 10 mg/l BOD.

- Ammonium concentration is compliant and the same as the Emission Limit Value.

- Overall, Nitrate concentrations are very low, at 1.73 mg/l as NO3, and are compliant with the 18 mg/l NO3 ELV.

- The laboratory have still not completed the requested Benzo(a)pyrene, PAHs, Hydrocarbons parameters. The site continues to try to get the laboratory to analyse all parameters requested.

4.3 Continuous Data Recording

The site's discharge is not yet instrumented with a continuous flow meter with physiochemical sensors for parameters as specified in the Licence as follows:

- Flow
- pH
- Turbidity
- Conductivity

A Service Provider is being sought for the provision of Continuous Flow and Physicochemical Monitoring.

4.4 Groundwater Data

Condition 4 of the Licence states that "Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory". However, there are no wells on the operational quarry to which the Discharge Licence relates. Hydro-G has previously reported 11 Site Investigation boreholes on the floor of the quarry and none of those boreholes encountered groundwater strike.

There are site investigation greenfield boreholes for the lands to the east of the quarry but they are not within the operational quarry.

The "1. Scope" detail of the Opening of W/502/22 Discharge Licence states that

> "*This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required.*"

Given that there have been no successful groundwater strikes in 11 boreholes attempted within this quarry because the limestone is the competent Burren Formation Limestone. The aquifer is mapped as a Regionally Important Karst Conduit Aquifer. No groundwater transmissive conduits were discovered in the drilling completed on the floor of the operational quarry. Therefore there is nothing to report with respect to this Condition of the Licence.

5.0 Compliance with Licence Conditions

5.1 With respect to the Volumetric ELV Conditions: Data presented suggests that the mean daily discharge is compliant with the specified ELV for mean daily volume of 1,483 m3/d, on an annual average basis. Manual flow records suggest an average of 1,000m3/d discharge for the reporting period.

5.2 With respect to Water Quality ELVs: Results presented in Table 1 indicates that the prescribed ELVs were complied with for all parameters analysed. No potential for environmental impact is envisaged.

6.0 Difficulties Encountered

6.1 A Service Provider is being sought for the Continuous Flow and Physiochemical Monitoring Condition of the Licence.

6.2 As part of previous evaluations, Hydro-G supervised the drilling of eleven boreholes on the floor of the quarry and no groundwater was encountered. Therefore, there is no groundwater quality to report.

6.3 The laboratory has still not accepted the requirement for analysis of PAH, Benzo(a)pyrene and Hydrocarbon requirement of the analysis of the discharge for the Licence. Therefore, those parameters have not yet been analysed.

7.0 Register of Incidents

There were no 'serious incidents' to report with respect to this discharge during this reported period.

8.0 Conclusions

The site is in compliance with those Conditions of the Section 4 Discharge Licence W/502/22 that have been quantified at this time.

Pamela Bartley

Dr. Pamela Bartley B.Eng, M.SC., Ph.D. MIEI

Appendix A

Laboratory Certificates of Analysis

Routine Quarterly Monitoring at the Site

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Certificate of Analysis

Customer:	Harrington Concrete and Quarries	**Project:**	Surface Water - GWD-1
Address:	Kilkelly Co Mayo	**Site**	
		Date Received:	04/12/2023
		Condition of Sample:	Satisfactory
Report to:	Amanda Tarpey	**Date Analysed:**	04/12/2023 - 13/12/2023
Customer PO		**Issue Date:**	16/01/2024
Quote No.		**BATCH NUMBER:**	**23-36432**

Sadhbh O' Brien

Sadhbh O Brien
Chemistry Team Lead

Index to symbols used & Notes

*	Analysis is not INAB/UKAS accredited
**	Adapted from Standard Methods for the Examination of Water and Wastewater.
***	Customer specific limits
(F)	Analysis carried out at our Farranfore Laboratory.
(D)	Analysis carried out at our Dunrine Laboratory.
LOQ	Parameter Limit of Quantification
Note 6	Subcontracted Parameter.

Notes

- **The results relate only to the items tested.**
- **Opinions and interpretations expressed herein are outside the scope of INAB accreditation.**
- **The analysis report shall not be reproduced except in full without written approval of the laboratory.**
- **Sampling is outside the scope of the laboratory activities.**

Notes for Drinking Water samples

Note A	The water should not be aggressive
Note B	Compliance must be ensured with the conditions that [NO3]/50 + [NO2]/3 =1
Note C	Acceptable to customers and no abnormal change
Note D	In the case of surface water treatment, a parametric value not exceeding 1 NTU in the water ex treatment works must be strived for
Note F	Fluoridated supplies 0.8 mg/L; Natural supplies 1.5 mg/L.

southern scientific services ltd.

Customer Sample Ref:	GWD-1	**Customer Sample Code:**	
Project:	Surface Water - GWD-1	**Sampled By:**	Harrington Concrete
Our Reference:	113177 (23-36432)	**Sample Matrix:**	
Date Sampled:	04/12/2023	**Time Sampled:**	:

Method:	Parameter:	Units	LOQ	Result
	Chemical Analysis: (F)			
SCP 052	Hydrogen Ion (pH)	pH units	*4.0*	7.8
SCP 052	Conductivity	µS/cm @ 20 °C	*15*	542
SCP 015	Biological Oxygen Demand (BOD)	mg/L	*1.0*	1.2
SCP 010	Suspended Solids	mg/L	*2*	< 4
SCP 027A	Ammonium	mg/L N	*0.02*	0.03
SCP 027G	Nitrate	mg/L N	*0.25*	1.73
SCP 027F	Nitrite	mg/L N	*0.005*	< 0.005
SCP 027C	Orthophosphate	mg/L P	*0.01*	0.01
SCP 027B	Chloride	mg/L	*0.5*	14.5
SCP 053A/053D	Potassium (K)	mg/L	*1.0*	3.3
SCP 016	Chemical Oxygen Demand (COD)	mg/L	*10*	< 10
SCP 053B/053D	Zinc (Zn)	µg/L	*1*	< 10
SCP 053B/053D	Cadmium (Cd)	µg/L	*1.00*	< 2.00
SCP 053B/053D	Iron	µg/L	*10*	< 10
SCP 053B/053D	Lead	µg/L	*1*	< 2
SCP 053B/053D	Manganese	µg/L	*2*	< 2

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registered in ireland no 323196 | vat reg no IE 6343196 M

Appendix B

Entire Record of Results Reported

Green Highligt in Cells = Compliant					
			Q2 2023	Q3 2023	Q4 2023
Parameter:	Units	W/502/22 Emission Limit Value	07 June 2023	04 July 2023	04 December 2023
Hydrogen Ion (pH)	pH units	6 to 9	8.0	8.1	7.8
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Suspended Solids	mg/L	10	< 4	< 4	< 4
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Benzo(a)pyrene	µg/L	0.1	not analysed	not analysed	not analysed
Total Hydrocarbons	µg/L	10	not analysed	not analysed	not analysed
Total PAHs	µg/L	0.1	not analysed	not analysed	not analysed
Southern Scientific Laboratory Reference			93347 (23-29240)	96104 (23-30235)	113177 (23-36432)

Data Report 4

Q1 (2024)

Section 4 Discharge Licence W/502/22

(issued 7th June 2023)

at

Harrington Concrete and Quarries Ltd

Ardgaineen, Claregalway, Co. Galway

Prepared by Consultant Dr. Pamela Bartley, Hydro-G

Hydro-G

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Project No.: 25-14 Harringtons Ardgaineen

Report Status: ISSUE_V1

Report Title: Data Report 4: Q1 (2024) Harringtons Concrete and Products Ltd. Discharge Licence W/502/22.

Pamela Bartley

Prepared by: ___________________________

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- Zero Discharge Willow Wastewater Systems Design Courses (Denmark 2008 & 2011 & Ireland 2012);
- Expert Witness (IE, 2011);
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Contents

1.0 Introduction

Hydro G was commissioned by Harringtons Concrete and Products Ltd to prepare a Data Report for the 1st **Quarter 2024** Discharge Licence in place for the quarry operation at Ardgaineen, Claregalway, Co. Galway (Galway County Council Licence Ref. No: W/502/22, issued 7th June 2023). This report has been prepared to fulfil this requirement and pertains to the **4th** reporting period since the Licence was issued.

It is acknowledged that Licence W/502/22 stipulates return of results on a Quarterly basis and this practice will be put in place going forward.

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Licence conditions relevant to this report include the following:

1. Scope

This Licence refers to the attenuation sump discharge of Harrington Concrete and Quarries located at Ardgaineen, Claregalway, Co. Galway. Surface water run-off and ground water collected in the quarry attenuation sump are pumped to a Wetland Vegetation Area, *via* a petrol/oil interceptor, where water percolates to ground. This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required. **The maximum permitted discharge is 1,483m3 per day.**

2. Attenuation Sump Discharge.

2.1 **Discharge:** The Licencee shall not discharge, cause or permit the discharge, of any contaminated surface water or process water directly to any surface water or groundwater without prior treatment.

2.2 **Treated Discharge:** The discharge shall be discharged to groundwater without posing a pollution risk.

2.3 **Discharge Performance Standards:** The treated discharge, **prior to its release** to the Wetland Vegetation Area, shall comply with the following standards:

(a) The **Total Suspended Solids** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(b) The **Biochemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(c) The **Chemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 15 mg/l.

(d) The **Nitrate (NO_3-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 18 mg/l.

(e) The **Nitrite (NO_2-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.05 mg/l.

(f) The **Total Hydrocarbon** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.01 mg/l.

(g) The **Total Ammonia** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.03mg/l.

(h) The **Benzo (a) pyrene** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(i) The **Total PAH** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(j) The **pH** of the Discharge from the attenuation sump and oil interceptor shall be in the range 6 - 9 pH units.

(k) The **Flow** of the Discharge from the attenuation sump and oil interceptor shall not exceed 1,483 m3/day.

(l) The **Colour** of the Discharge from the attenuation sump should not change significantly from day to day nor shall there be any evidence of oil or excess solids on visual inspection.

(m) The **Conductivity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

(n) The **Turbidity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

RECEIVED: 27/08/2025

3. Discharge Analysis

Analysis of the treated water prior to discharge shall be carried out by an approved accredited laboratory where readings are not taken on site. The frequency of analysis and the parameters are outlined below. Quarterly results shall be forwarded to the environment section.

Parameter	Monitoring Frequency	Analysis to be performed by accredited laboratory
Flow	Continuous - Daily	
Colour and Visual inspection	Daily	
Conductivity	Continuous - Daily	
Turbidity	Continuous - Daily	
pH	Continuous - Daily	
Total Suspended Solids	Quarterly	√
Nitrates NO_3^-	Quarterly	√
Nitrites NO_2^-	Quarterly	√
Chemical Oxygen Demand	Quarterly	√
Biochemical Oxygen Demand	Quarterly	√
Total Ammonia	Quarterly	√
Total PAH	Quarterly	√
Benzo (a) Pyrene	Quarterly	√
Total Hydrocarbons including Diesel Range Organics and Petroleum Range Organics	Quarterly	√

4. Groundwater Analysis

Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory. The following parameters shall be measured and analysis of same forwarded to the Environment Section of Galway County Council:

Parameter	Units
(a) Water Level	mAOD
(b) pH	pH units
(c) Conductivity	uS/cm
(d) Suspended Solids	mg/l
(e) Nitrates	mg/l No_3^-
(f) Total Hydrocarbons	mg/l

Where quarrying activities are found to adversely affect local water supplies the provisions of the EPA Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)', Section 3.3.1 shall apply, and the quarry shall provide a replacement water supply.

5. Petrol / Oil Interceptor

The petrol / oil interceptor should be inspected each working day to ensure it is operating correctly and daily records kept of this. These records should be made available to Galway County Council if requested.

Other matters in the licence include details about the following. Readers are referred to the Licence itself for specific detail.

6. Attenuation sump, petrol/oil interceptor & wetland area

6.1 Treatment Process – must be able to achieve the Treatment Standards of Condition 2.3.
6.2 Metering – Install Flow Meter, record Daily Discharge, report Quarterly. Limit 1,483m3/d.
6.3 Ready Access – must be allowed for Authorised Persons under the Water Pollution Acts.
6.4 Sampling – Sampling Chamber after treatment and before wetland. Plus access required.
6.5 Caretaker – Day to Day Inspection. Notified Person named and details supplied to GCC.
6.6 Notification of Non-Compliance – Make GCC aware, record details of noncompliance.

7. EPA Guidelines

All works must be carried out in accordance with the EPA Guidelines 'Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)'.

8. Annual Contribution

€550 due annually. Shall be adjusted with the Customer Price Index value. GCC can increase.

9. Changes in Ownership

GCC to be notified in writing if change in company ownership or Trading Name.

3.0 Person Responsible for Caretaking at the Site

Mr. John Gibbons, the quarry manager, is responsible for inspections and maintenance of the infrastructure associated with the discharge. Mr. Gibbons' contact details are on file with Galway County Council.

4.0 Site Data - Monitoring Results

4.1 Flow Data

The site's flow was fully automated on the 7th of February 2024. Results are presented in Table 1.

Table 1 Daily discharge volumes (m3/d) Q1 2024 & Statistics: Max, Min, Mean Daily

2024	Q1 (m3/d) Totals			ELV MAX (m3/d)
Day	Jan-24	Feb-24	Mar-24	
1			364.56	1,438
2			380.31	1,438
3			380.01	1,438
4			355.74	1,438
5			351.85	1,438
6			350.39	1,438
7		21.24	351.63	1,438
8		203.22	357.42	1,438
9		287.87	377.74	1,438
10		289.96	375.97	1,438
11		289.77	343.63	1,438
12		291.96	347.18	1,438
13		296.01	339.32	1,438
14		290.89	347.79	1,438
15		289.83	340.46	1,438
16		287.16	357.00	1,438
17		328.01	358.05	1,438
18		328.52	359.58	1,438
19		302.88	354.14	1,438
20		341.22	354.44	1,438
21		362.79	355.21	1,438
22		364.72	355.07	1,438
23		365.56	358.72	1,438
24		381.46	358.27	1,438
25		381.32	353.60	1,438
26		353.21	351.05	1,438
27		345.99	347.74	1,438
28		356.41	346.40	1,438
29		350.04	349.54	1,438
30			348.01	1,438
31			346.26	1,438
MAX m3/d	Site Not Instrumented	381	380	m3/d
MIN m3/d		21	339	
AVERAGE m3/d		309	355	

4.2 Discharge Water's Quality Data

As is required by Licence W/502/22, the site monitors water quality of the final discharge from the site on a Quarterly basis. The laboratory Certificate of Analysis is presented in Appendix A.

Discharge water's quality results are presented in Table 2 with each parameter's ELV for the monitoring period.

Table 2 Ardgaineen Quarry Final Discharge Quality Q1 2024.

Green Highligt in Cells = Compliant			
			Q1 2024 February
Parameter:	Units	W/502/22 Emission Limit Value	06 February 2024
Hydrogen Ion (pH)	pH units	6 to 9	8.0
Biological Oxygen Demand (BOD)	mg/L	10.0	< 1.0
Suspended Solids	mg/L	10	<4
Ammonium	mg/L N	0.03	0.04
Nitrate	mg/L N	18.00	not reported
Nitrite	mg/L N	0.05	not reported
Chemical Oxygen Demand (COD)	mg/L	15	<10
Benzo(a)pyrene	µg/L	0.1	not reported
Total Hydrocarbons	µg/L	10	not reported
Total PAHs	µg/L	0.1	not reported
Southern Scientific Laboratory Reference			118896 (24-38390)

With reference to the results presented in Table 1, and the associated Certificates of Analysis in Appendix A, commentary is as follows:

- The pH of the Discharge is 8pH and this is within the 6 to 9 pH Emission Limit Value.
- The discharge's results are below the limit of detection of the laboratory analyser for BOD, Suspended Solids and COD. This suggests very good Discharge Quality. Therefore, the results are compliant with the Licence ELVs for BOD, SS and COD.
- Ammonium concentration was 0.04 mg/l, which is SLIGHTLY elevated above the Emission Limit Value of 0.03 mg/l. However given that BOD and COD were <LOD of the laboratory, no environmental impact is envisaged.
- The laboratory did not analyse all of the requested parameters: Nitrate, Nitrite, Benzo(a)pyrene, PAHs, Hydrocarbons parameters. The site continues to try to get the laboratory to analyse all parameters requested.

4.3 Continuous Data Recording

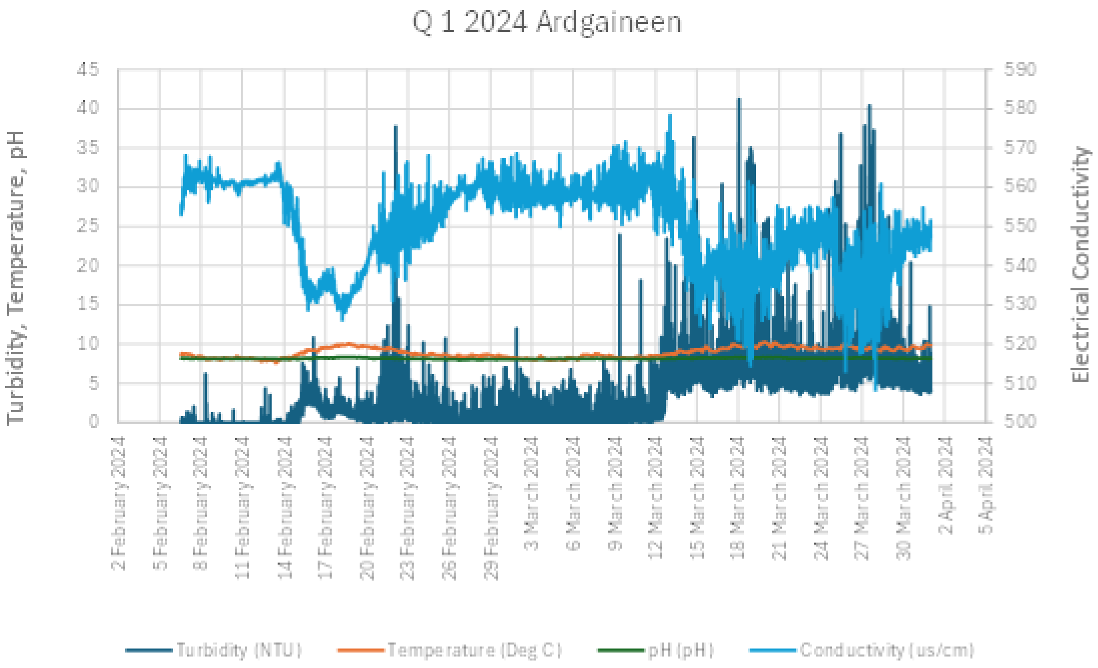
The site's discharge is now instrumented with a continuous flow meter with physiochemical sensors for parameters as specified in the Licence as follows:

- Flow
- pH
- Turbidity
- Conductivity

Data are collected at 5 minute intervals and reported to the service provider's telemetric data service HydroVU. The data service provider is Capital Water Solutions Limited, Co. Roscommon.

The quarry manager is responsible for daily log in to the telemetric system, visual inspections of the discharge and day to day management.

The full data record is held in excel file format in Hydro-G's offices because there are many rows associated with 5 minute intervals for excel rows of data for the reporting period. A graphical presentation of the data is shown in Graph 1, below.



Graph 1 Continuous record for field physiochemical parameters.

The results for continuous monitoring show, as follows:

- Turbidity increases when the pumps start and this is a normal and expected phenomenon associate with the turbid flow condition in pipes. There is no environmental significance to the range of results returned.
- Temperature signal is normal with an average concentration of <10oC.
- pH is relatively constant and within the 6 to 9 pH units ELV of the Licence.
- Electrical Conductivity is within the expected range for a limestone environment.
- The instruments naturally 'drift' but this is expected and will be routinely rectified.

4.4 Groundwater Data

Condition 4 of the Licence states that "Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory". However, there are no wells on the operational quarry to which the Discharge Licence relates. Hydro-G has previously reported 11 Site Investigation boreholes on the floor of the quarry and none of those boreholes encountered groundwater strike.

There are site investigation greenfield boreholes for the lands to the east of the quarry but they are not within the operational quarry.

The "1. Scope" detail of the Opening of W/502/22 Discharge Licence states that

> *"This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required."*

Given that there have been no successful groundwater strikes in 11 boreholes attempted within this quarry because the limestone is the competent Burren Formation Limestone. The aquifer is mapped as a Regionally Important Karst Conduit Aquifer. No groundwater transmissive conduits were discovered in the drilling completed on the floor of the operational quarry. Therefore there is nothing to report with respect to this Condition of the Licence.

5.0 Compliance with Licence Conditions

5.1 With respect to the Volumetric ELV Conditions: The site's flow is now fully recorded. Data presented in Table 1 suggests that the mean daily discharge is compliant with the specified ELV for mean daily volume of 1,483 m3/d, on an annual average basis. Discharge values ranged from 21m3/d to 381m3/d with an average of 325m3/d.

5.2 With respect to Water Quality ELVs: Results presented in Table 2 indicates that the prescribed ELVs were complied with for all parameters analysed except Ammonia, which was slightly elevated above the 0.03 mg/l ELV. However, given that the BOD and COD were less than the Limit of Detection of the Laboratory Analyser. Therefore, no potential for environmental impact is envisaged.

6.0 Difficulties Encountered

6.1 As part of previous evaluations, Hydro-G supervised the drilling of eleven boreholes on the floor of the quarry and no groundwater was encountered. Therefore, there is no groundwater quality to report.

6.3 The laboratory has still not accepted the requirement for analysis of the full list of parameters listed in the discharge Licence. Therefore, some parameters have not yet been analysed. The site continues to attempt to get the list analysed.

7.0 Register of Incidents

Apart from issues with the laboratory and the requested list of parameters, there were no 'serious incidents' to report with respect to this discharge during this reported period.

8.0 Conclusions

The site is in compliance with those Conditions of the Section 4 Discharge Licence W/502/22 that have been quantified at this time, with the exception of a small exceedance for Ammonium. The result reported by the laboratory was 0.04 mg/l when the ELV is 0.03 mg/l. However given that BOD and COD were both <LOD of the analyser, no environmental impact is envisaged. This parameter will be closely monitored going forward.

Pamela Bartley

Dr. Pamela Bartley B.Eng, M.SC., Ph.D. MIEI

Appendix A

Laboratory Certificates of Analysis

Routine Quarterly Monitoring at the Site

southern scientific services ltd.

Certificate of Analysis

Customer:	Harrington Concrete and Quarries	**Project:**	Surface Water - GWD-1
Address:	Kilkelly Co Mayo	**Site**	
		Date Received:	07/02/2024
		Condition of Sample:	Satisfactory
Report to:	Amanda Tarpey	**Date Analysed:**	07/02/2024 - 14/02/2024
Customer PO		**Issue Date:**	22/02/2024
Quote No.		**BATCH NUMBER:**	**24-38390**

Jake Grunfield
Laboratory Analyst

Index to symbols used & Notes

*	Analysis is not INAB accredited
**	Adapted from Standard Methods for the Examination of Water and Wastewater.
***	Customer specific limits
(F)	Analysis carried out at our Farranfore Laboratory.
(D)	Analysis carried out at our Dunrine Laboratory.
LOQ	Parameter Limit of Quantification
Note 6	Subcontracted Parameter.

Notes

- **The results relate only to the items tested.**
- **Opinions and interpretations expressed herein are outside the scope of INAB accreditation.**
- **The analysis report shall not be reproduced except in full without written approval of the laboratory.**
- **Sampling is outside the scope of the laboratory activities.**

Notes for Drinking Water samples

Note A	The water should not be aggressive
Note B	Compliance must be ensured with the conditions that [NO3]/50 + [NO2]/3 =1
Note C	Acceptable to customers and no abnormal change
Note D	In the case of surface water treatment, a parametric value not exceeding 1 NTU in the water ex treatment works must be strived for
Note F	Fluoridated supplies 0.8 mg/L; Natural supplies 1.5 mg/L.

(registered office)
4 park business centre | farranfore | county kerry | ireland | telephone +353 66 976 3588 | fax +353 66 976 3589
dunrine | killarney | county kerry | ireland | telephone +353 64 66 33922 | fax +353 64 66 39022

web site www.southernscientificireland.com | e-mail info@southernscientificireland.com

directors: K. Murphy, M. Murphy & C. Murphy
registered in ireland no 323196 | vat reg no IE 6343196 M

southern scientific services ltd.

RECEIVED: 27/08/2025

Customer Sample Ref:	GWD-1	**Customer Sample Code:**	
Project:	Surface Water - GWD-1	**Sampled By:**	Harrington Concrete
Our Reference:	118896 (24-38390)	**Sample Matrix:**	Surface Water
Date Sampled:	06/02/2024	**Time Sampled:**	15:00

Method:	Parameter:	Units	LOQ	Result
	Chemical Analysis: (F)			
SCP 052	Hydrogen Ion (pH)	pH units	*4.0*	8.0
SCP 015	Biological Oxygen Demand (BOD)	mg/L	*1.0*	< 1.0
SCP 010	Suspended Solids	mg/L	*2*	< 4
SCP 027A	Total Ammonia	mg/L N	*0.02*	0.04
SCP 027B	Chloride	mg/L	*0.5*	14.4
SCP 027D	Sulphate	mg/L	*0.5*	21.1
SCP 053A/053D	Calcium (Ca)	mg/L	*1.0*	105.0
SCP 053A/053D	Magnesium (Mg)	mg/L	*0.2*	7.5
SCP 053A/053D	Potassium (K)	mg/L	*1.0*	3.6
SCP 053A/053D	Sodium	mg/L	*1*	10
SCP 016	Chemical Oxygen Demand (COD)	mg/L	*10*	< 10
SCP 044	Total Phosphorus	mg/L P	*0.04*	< 0.04
SCP 065A	Total Nitrogen	mg/L	*0.5*	1.9
SCP 053B/053D	Iron	µg/L	*10*	< 10
SCP 053B/053D	Manganese	µg/L	*2*	3

Appendix B

Entire Record of Results Reported

Green Highligt in Cells = Compliant						
			Q2 2023	Q3 2023	Q4 2023	Q1 2024 February
Parameter:	**Units**	**W/502/22 Emission Limit Value**	**07 June 2023**	**04 July 2023**	**04 December 2023**	**06 February 2024**
Hydrogen Ion (pH)	pH units	6 to 9	8.0	8.1	7.8	8.0
Biological Oxygen Demand (BOD)	mg/L	10.0	< 1.0	< 1.0	1.2	< 1.0
Suspended Solids	mg/L	10	< 4	< 4	< 4	<4
Ammonium	mg/L N	0.03	0.03	< 0.02	0.03	0.04
Nitrate	mg/L N	18.00	1.47	1.22	1.73	not reported
Nitrite	mg/L N	0.05	0.012	< 0.005	< 0.005	not reported
Chemical Oxygen Demand (COD)	mg/L	15	< 10	< 10	< 10	<10
Benzo(a)pyrene	µg/L	0.1	not analysed	not analysed	not analysed	not reported
Total Hydrocarbons	µg/L	10	not analysed	not analysed	not analysed	not reported
Total PAHs	µg/L	0.1	not analysed	not analysed	not analysed	not reported
Southern Scientific Laboratory Reference			93347 (23-29240)	96104 (23-30235)	113177 (23-36432)	118896 (24-38390)

Data Report 5

Q2 (2024)

Section 4 Discharge Licence W/502/22

(issued 7th June 2023)

at

Harrington Concrete and Quarries Ltd

Ardgaineen, Claregalway, Co. Galway

Prepared by Consultant Dr. Pamela Bartley, Hydro-G

Hydro-G

50 Henry St.

Galway

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Project No.: 25-14 Harringtons Ardgaineen

Report Status: ISSUE_V1

Report Title: Data Report 5: Q2 (2024) Harringtons Concrete and Products Ltd. Discharge Licence W/502/22.

Pamela Bartley

Prepared by: ______________________________

Dr. Pamela Bartley B.Eng, M.SC., Ph.D.

NOTES:

This report is for the use solely of the party to whom it is addressed and no responsibility is accepted to any third party.

About the Author

Pamela Bartley is a water focussed civil engineer. She has 30 years of field-based practice in borehole drilling, groundwater monitoring and abstraction point management in limestone karst environments. Her Ph.D was a field based karst limestone environment study. She has also completed training with the GSI at their karst specialist course run in the Burren. Her primary qualification is a Diploma in Water and Wastewater Technology at Sligo RTC. She then completed her primary degree in Civil Engineering at Queens University, Belfast, followed by an M.Sc. in Environmental Engineering, followed by a field-based hydrogeologically focussed Ph.D. within the School of Civil Engineering at Trinity College, Dublin. Her key work areas are groundwater development from large scale water supply boreholes, hydrogeological assessment of quarries and the evaluation of discharges to groundwater and surface waters. Pamela Bartley's company is Bartley Hydrogeology ltd., registered to trade as Hydro-G.

Pamela has successfully completed post doctorate 'Professional Development' formal course training in the areas of:

- PSDP & PSCS (IOSH certified, 2016);
- Karst Hydrogeology (GSI, 2013);
- On Site Wastewater & Water Services Amendment Act 2012 (IE, Western Region 6-week programme 2012 & Dublin 2012);
- Zero Discharge Willow Wastewater Systems Design Courses (Denmark 2008 & 2011 & Ireland 2012);
- Expert Witness (IE, 2011);
- Planning & Development Act (IE, 2010);
- Surface Water Regulations 2009 (DoE, 2010 & 2011);
- Sustainable Drainage (Wallingford/CIRIA, 2005 & 2008);
- Source Protection Zone Delineation (IGI/GSI, 2007);
- Groundwater & Contaminant Microbiology (IGI/GSI, 2006);
- Applied Groundwater Modelling (ESI, UK, 2000);
- Site Suitability Assessment (FETAC, 2002).

As a result of work in evaluating planning appeals, Pamela has become specialist in planning evaluations in the context of enacted Irish Regulation and EU Directives concerning the water environment such as the Groundwater Regulations (S.I. No. 9 of 2010), Surface Water Regulations (S.I. No. 272 of 2009), Water Framework and Habitats' Directives. Pamela is a qualified and certified 'Site Assessor' and interviewer of examination candidates in respect of eligibility for the Site Suitability FETAC Qualification. In the past, she has lectured in third level institutions (WIT, CIT, 1996 – 1999), delivered practical laboratory instruction in the assessment of subsoils for the FETAC Site Assessor programme and demonstrated hydraulics laboratory modules at Trinity College Dublin (1996). She has been an invited guest speaker at An Board Pleanála, The Irish Concrete Federation, The Health Service Executive, Environmental Health Officers National Conference, The Irish Planning Institute's National Conference, The International Association of Hydrogeologists National Conference (Irish Branch) and has delivered hydrogeological lectures to the public during Science Week.

Hydro-G is the registered trading name of Pamela Bartley's company Bartley Hydrogeology Ltd., a company registered in Galway Ireland. The company holds requisiteemployer's and public liabilityinsurances. In addition, the company holds professional indemnity insurance of €2million.

Pamela is qualified and IOSH certified to act as PSDP (Project Supervisor Design Phase) & PSCS (Project Supervisor Construction Stage) as defined by the Construction Regulations. The company is a registered Irish Water Supplier (no. 1855) and Pamela Bartley is HSQE approved within Irish Water.

Contents

1.0 Introduction

Hydro G was commissioned by Harringtons Concrete and Products Ltd to prepare a Data Report for the 2nd **Quarter 2024** Discharge Licence in place for the quarry operation at Ardgaineen, Claregalway, Co. Galway (Galway County Council Licence Ref. No: W/502/22, issued 7th June 2023). This report has been prepared to fulfil this requirement and pertains to the 5th reporting period since the Licence was issued.

It is acknowledged that Licence W/502/22 stipulates return of results on a Quarterly basis and this practice will be put in place going forward.

2.0 Discharge Licence Conditions

Licence conditions relevant to this report include the following:

1. **Scope**

This Licence refers to the attenuation sump discharge of Harrington Concrete and Quarries located at Ardgaineen, Claregalway, Co. Galway. Surface water run-off and ground water collected in the quarry attenuation sump are pumped to a Wetland Vegetation Area, *via* a petrol/oil interceptor, where water percolates to ground. This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required. **The maximum permitted discharge is 1,483m3 per day.**

2. **Attenuation Sump Discharge.**

2.1 **Discharge:** The Licencee shall not discharge, cause or permit the discharge, of any contaminated surface water or process water directly to any surface water or groundwater without prior treatment.

2.2 **Treated Discharge:** The discharge shall be discharged to groundwater without posing a pollution risk.

2.3 **Discharge Performance Standards:** The treated discharge, **prior to its release** to the Wetland Vegetation Area, shall comply with the following standards:

(a) The **Total Suspended Solids** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(b) The **Biochemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(c) The **Chemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 15 mg/l.

(d) The **Nitrate (NO_3-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 18 mg/l.

(e) The **Nitrite (NO_2-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.05 mg/l.

(f) The **Total Hydrocarbon** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.01 mg/l.

(g) The **Total Ammonia** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.03mg/l.

(h) The **Benzo (a) pyrene** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(i) The **Total PAH** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(j) The **pH** of the Discharge from the attenuation sump and oil interceptor shall be in the range 6 - 9 pH units.

(k) The **Flow** of the Discharge from the attenuation sump and oil interceptor shall not exceed 1,483 m3/day.

(l) The **Colour** of the Discharge from the attenuation sump should not change significantly from day to day nor shall there be any evidence of oil or excess solids on visual inspection.

(m) The **Conductivity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

(n) The **Turbidity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

3. Discharge Analysis

Analysis of the treated water prior to discharge shall be carried out by an approved accredited laboratory where readings are not taken on site. The frequency of analysis and the parameters are outlined below. Quarterly results shall be forwarded to the environment section.

Parameter	Monitoring Frequency	Analysis to be performed by accredited laboratory
Flow	Continuous - Daily	
Colour and Visual inspection	Daily	
Conductivity	Continuous - Daily	
Turbidity	Continuous - Daily	
pH	Continuous - Daily	
Total Suspended Solids	Quarterly	√
Nitrates NO_3^-	Quarterly	√
Nitrites NO_2^-	Quarterly	√
Chemical Oxygen Demand	Quarterly	√
Biochemical Oxygen Demand	Quarterly	√
Total Ammonia	Quarterly	√
Total PAH	Quarterly	√
Benzo (a) Pyrene	Quarterly	√
Total Hydrocarbons including Diesel Range Organics and Petroleum Range Organics	Quarterly	√

4. Groundwater Analysis

Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory. The following parameters shall be measured and analysis of same forwarded to the Environment Section of Galway County Council:

Parameter	Units
(a) Water Level	mAOD
(b) pH	pH units
(c) Conductivity	uS/cm
(d) Suspended Solids	mg/l
(e) Nitrates	mg/l No_3^-
(f) Total Hydrocarbons	mg/l

Where quarrying activities are found to adversely affect local water supplies the provisions of the EPA Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)', Section 3.3.1 shall apply, and the quarry shall provide a replacement water supply.

5. Petrol / Oil Interceptor

The petrol / oil interceptor should be inspected each working day to ensure it is operating correctly and daily records kept of this. These records should be made available to Galway County Council if requested.

Other matters in the licence include details about the following. Readers are referred to the Licence itself for specific detail.

6. Attenuation sump, petrol/oil interceptor & wetland area

6.1 Treatment Process – must be able to achieve the Treatment Standards of Condition 2.3.
6.2 Metering – Install Flow Meter, record Daily Discharge, report Quarterly. Limit 1,483m3/d.
6.3 Ready Access – must be allowed for Authorised Persons under the Water Pollution Acts.
6.4 Sampling – Sampling Chamber after treatment and before wetland. Plus access required.
6.5 Caretaker – Day to Day Inspection. Notified Person named and details supplied to GCC.
6.6 Notification of Non-Compliance – Make GCC aware, record details of noncompliance.

7. EPA Guidelines

All works must be carried out in accordance with the EPA Guidelines 'Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)'.

8. Annual Contribution

€550 due annually. Shall be adjusted with the Customer Price Index value. GCC can increase.

9. Changes in Ownership

GCC to be notified in writing if change in company ownership or Trading Name.

3.0 Person Responsible for Caretaking at the Site

Mr. John Gibbons, the quarry manager, is responsible for inspections and maintenance of the infrastructure associated with the discharge. Mr. Gibbons' contact details are on file with Galway County Council.

4.0 Site Data - Monitoring Results

4.1 Flow Data

The site's flow was fully automated on the 7th of February 2024. Results are presented in Table 1.

Table 1 Daily discharge volumes (m3/d) Q2 2024 & Statistics: Max, Min, Mean Daily

2024	Q2 (m3/d) Totals			ELV MAX
Day	Apr-24	May-24	Jun-24	(m3/d)
1	343.85	293.98	297.55	1,438
2	331.68	307.19	299.34	1,438
3	334.18	300.80	297.80	1,438
4	332.14	315.88	142.44	1,438
5	329.96	314.04	0.00	1,438
6	329.32	312.86	0.00	1,438
7	328.36	282.18	0.00	1,438
8	311.05	285.37	0.00	1,438
9	299.58	290.59	0.00	1,438
10	305.14	294.91	0.00	1,438
11	294.24	304.43	0.00	1,438
12	302.90	301.98	32.44	1,438
13	319.94	299.74	50.00	1,438
14	319.89	296.86	46.16	1,438
15	300.19	277.78	49.36	1,438
16	296.25	254.84	47.60	1,438
17	291.54	259.71	42.43	1,438
18	293.76	299.14	42.42	1,438
19	291.65	298.16	42.01	1,438
20	316.92	243.21	42.53	1,438
21	316.34	286.07	47.95	1,438
22	289.46	277.97	48.99	1,438
23	294.20	283.24	49.69	1,438
24	287.33	270.87	46.37	1,438
25	301.58	306.05	42.19	1,438
26	295.86	304.63	43.82	1,438
27	318.03	278.55	45.27	1,438
28	317.97	291.01	42.71	1,438
29	309.44	292.66	49.02	1,438
30	310.67	273.00	48.68	1,438
31		267.84		1,438
MAX m3/d	344	316	299	
MIN m3/d	287	243	0.00	m3/d
AVERAGE m3/d	310	289	63	

4.2 Discharge **Water's** Quality Data

As is required by Licence W/502/22, the site monitors water quality of the final discharge from the site on a Quarterly basis. The laboratory Certificate of Analysis is presented in Appendix A.

Discharge water's quality results are presented in Table 2 with each parameter's ELV for the monitoring period.

Table 2 Ardgaineen Quarry Final Discharge Quality Q2 2024.

Green Highlight in Cells = Compliant			
			Q2 2024 May
Parameter:	Units	W/502/22 Emission Limit Value	03 May 2024
Hydrogen Ion (pH)	pH units	6 to 9	8.1
Biological Oxygen Demand (BOD)	mg/L	10.0	<0.1
Suspended Solids	mg/L	10	< 4
Ammonium	mg/L N	0.03	0.02
Nitrate	mg/L N	18.00	10.24
Nitrite	mg/L N	0.05	0.020
Chemical Oxygen Demand (COD)	mg/L	15	< 10
Benzo(a)pyrene	µg/L	0.1	< 0.003
Total Hydrocarbons	µg/L	10	not reported
Total PAHs	µg/L	0.1	not reported
Southern Scientific Laboratory Reference			129163 (24-41909)

With reference to the results presented in Table 1, and the associated Certificates of Analysis in Appendix A, commentary is as follows:

- The pH of the Discharge is 8.1pH and this is within the 6 to 9 pH Emission Limit Value.
- The discharge's results are below the limit of detection of the laboratory analyser for BOD, COD and Benzo(a)pyrene. This suggests good Discharge Quality.
- All analysed parameters are within the Licence Limits (ELVs) including pH, BOD, Suspended Solids, Ammonium, Nitrates, Nitrites, COD and Benzo(a)pyrene.
- However, again, issues with the list analysed persist and neither Hydrocarbons nor PAHs were reported. The site continues to attempt to get this rectified.

4.3 Continuous Data Recording

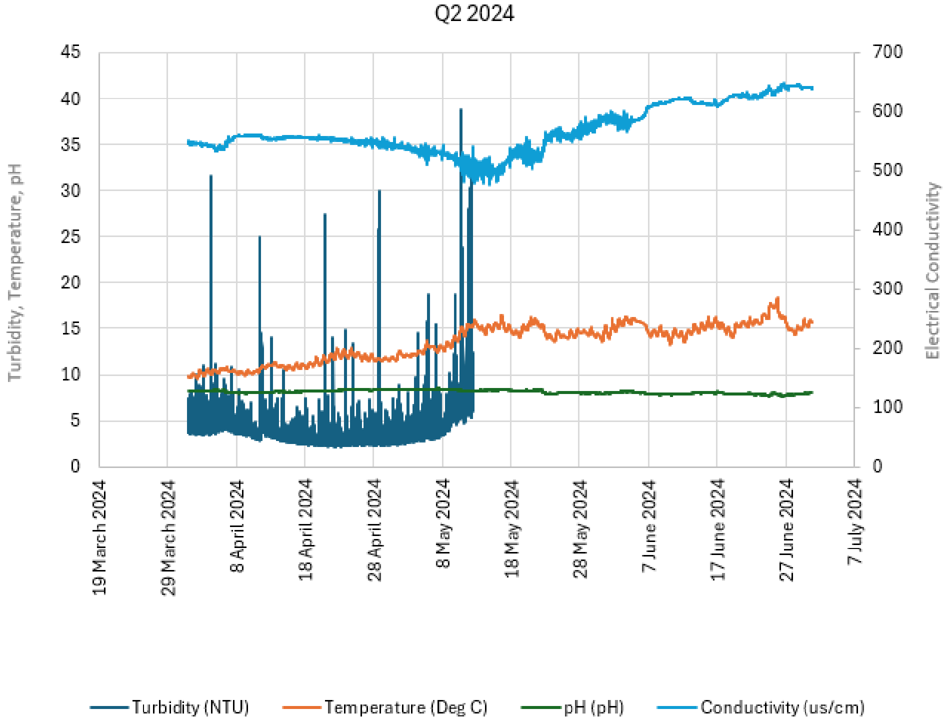
The site's discharge is now instrumented with a continuous flow meter with physiochemical sensors for parameters as specified in the Licence as follows:

- Flow
- pH
- Turbidity
- Conductivity

Data are collected at 5 minute intervals and reported to the service provider's telemetric data service HydroVU. The data service provider is Capital Water Solutions Limited, Co. Roscommon.

The quarry manager is responsible for daily log in to the telemetric system, visual inspections of the discharge and day to day management.

The full data record is held in excel file format in Hydro-G's offices because there are many rows associated with 5 minute intervals for excel rows of data for the reporting period. A graphical presentation of the data is shown in Graph 1, below.



Graph 1 Continuous record for field physiochemical parameters.

The results for continuous monitoring show, as follows:

- The Turbidity probe malfunctioned and was replaced in time.
- The Temperature probe drifted unreasonably and this was also replaced.
- pH is relatively constant and within the 6 to 9 pH units ELV of the Licence.
- Electrical Conductivity is within the expected range for a limestone environment and the instrument's 'drift' was rectified with a service call.
- No environmental impact is envisaged.

4.4 Groundwater Data

Condition 4 of the Licence states that "Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory". However, there are no wells on the operational quarry to which the Discharge Licence relates. Hydro-G has previously reported 11 Site Investigation boreholes on the floor of the quarry and none of those boreholes encountered groundwater strike.

There are site investigation greenfield boreholes for the lands to the east of the quarry but they are not within the operational quarry.

The "1. Scope" detail of the Opening of W/502/22 Discharge Licence states that

> "*This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required.*"

Given that there have been no successful groundwater strikes in 11 boreholes attempted within this quarry because the limestone is the competent Burren Formation Limestone. The aquifer is mapped as a Regionally Important Karst Conduit Aquifer. No groundwater transmissive conduits were discovered in the drilling completed on the floor of the operational quarry. Therefore there is nothing to report with respect to this Condition of the Licence.

5.0 Compliance with Licence Conditions

5.1 With respect to the Volumetric ELV Conditions: The site's flow is now fully recorded. Data presented in Table 1 suggests that the mean daily discharge is compliant with the specified ELV for mean daily volume of 1,483 m3/d, on an annual average basis. Discharge values ranged from 0m3/d to 344m3/d.

5.2 With respect to Water Quality ELVs: Results presented in Table 2 indicates that the prescribed ELVs were complied with for all parameters analysed. However, issues persist with the laboratory and the full list was not analysed.

6.0 Difficulties Encountered

6.1 As part of previous evaluations, Hydro-G supervised the drilling of eleven boreholes on the floor of the quarry and no groundwater was encountered. Therefore, there is no groundwater quality to report.

6.3 The laboratory has still not accepted the requirement for analysis of the full list of parameters listed in the discharge Licence. Therefore, some parameters have not yet been analysed. The site continues to attempt to get the list analysed.

7.0 Register of Incidents

Apart from issues with the laboratory and the requested list of parameters, there were no 'serious incidents' to report with respect to this discharge during this reported period.

8.0 Conclusions

The site is in compliance with those Conditions of the Section 4 Discharge Licence W/502/22 that have been quantified at this time. In the Q1 2024 a slightly elevated Ammonium concentration was reported. However, in the Q2 2024 sampling Ammonium was 0.02 mg/l, which is fully compliant with the 0.03 mg/l Ammonium ELV.

Pamela Bartley

Dr. Pamela Bartley B.Eng, M.SC., Ph.D. MIEI

Appendix A

Laboratory Certificates of Analysis

Routine Quarterly Monitoring at the Site

southern scientific services ltd.

RECEIVED: 27/08/2025

Certificate of Analysis

Customer:	Harrington Concrete and Quarries	**Project:**	Surface Water - GWD-1
Address:	Kilkelly Co Mayo	**Site**	
		Date Received:	03/05/2024
		Condition of Sample:	Satisfactory
Report to:	Amanda Tarpey	**Date Analysed:**	03/05/2024 - 04/06/2024
Customer PO		**Issue Date:**	05/06/2024
Quote No.		**BATCH NUMBER:**	**24-41909**

Sadhbh O' Brien

Sadhbh O Brien
Chemistry Team Lead

Index to symbols used & Notes

*	Analysis is not INAB accredited
**	Adapted from Standard Methods for the Examination of Water and Wastewater.
***	Customer specific limits
(F)	Analysis carried out at our Farranfore Laboratory.
(D)	Analysis carried out at our Dunrine Laboratory.
LOQ	Parameter Limit of Quantification
Note 6	Subcontracted Parameter.

Notes

- **The results relate only to the items tested.**
- **Opinions and interpretations expressed herein are outside the scope of INAB accreditation.**
- **The analysis report shall not be reproduced except in full without written approval of the laboratory.**
- **Sampling is outside the scope of the laboratory activities.**

Notes for Drinking Water samples

Note A	The water should not be aggressive
Note B	Compliance must be ensured with the conditions that [NO3]/50 + [NO2]/3 =1
Note C	Acceptable to customers and no abnormal change
Note D	In the case of surface water treatment, a parametric value not exceeding 1 NTU in the water ex treatment works must be strived for
Note F	Fluoridated supplies 0.8 mg/L; Natural supplies 1.5 mg/L.

(registered office)
4 park business centre | farranfore | county kerry | ireland | telephone +353 66 976 3588 | fax +353 66 976 3589
dunrine | killarney | county kerry | ireland | telephone +353 64 66 33922 | fax +353 64 66 39022
web site www.southernscientificireland.com | e-mail info@southernscientificireland.com
directors: K. Murphy, M. Murphy & C. Murphy
registered in ireland no 323196 | vat reg no IE 6343196 M

RECEIVED: 27/08/2025

Customer Sample Ref:	GWD-1	**Customer Sample Code:**	
Project:	Surface Water - GWD-1	**Sampled By:**	Amanda Tarpey
Our Reference:	129163 (24-41909)	**Sample Matrix:**	Surface Water
Date Sampled:	02/06/2024	**Time Sampled:**	:

Method:	Parameter:	Units	LOQ	Result
	Chemical Analysis: (F)			
SCP 052	Hydrogen Ion (pH)	pH units	*4.0*	8.1
SCP 015	Biological Oxygen Demand (BOD)	mg/L	*1.0*	< 1.0
SCP 010	Suspended Solids	mg/L	*2*	< 4
SCP 027A	Total Ammonia	mg/L N	*0.02*	0.02
SCP 027G	Nitrate	mg/L NO3	*1.11*	10.24
SCP 027F	Nitrite	mg/L NO2	*0.016*	0.020
SCP 016	Chemical Oxygen Demand (COD)	mg/L	*10*	< 10
SCP 060B	Benzo(a)pyrene	µg/L	*0.003*	< 0.003

Appendix B

Entire Record of Results Reported

Green Highligt in Cells = Compliant							
			Q2 2023	Q3 2023	Q4 2023	Q1 2024 February	Q2 2024 May
Parameter:	**Units**	**W/502/22 Emission Limit Value**	**07 June 2023**	**04 July 2023**	**04 December 2023**	**06 February 2024**	**03 May 2024**
Hydrogen Ion (pH)	pH units	**6 to 9**	8.0	8.1	7.8	8.0	8.1
Biological Oxygen Demand (BOD)	mg/L	**10.0**	< 1.0	< 1.0	1.2	< 1.0	<0.1
Suspended Solids	mg/L	**10**	< 4	< 4	< 4	<4	< 4
Ammonium	mg/L N	**0.03**	0.03	< 0.02	0.03	**0.04**	0.02
Nitrate	mg/L N	**18.00**	1.47	1.22	1.73	not reported	10.24
Nitrite	mg/L N	**0.05**	0.012	< 0.005	< 0.005	not reported	0.020
Chemical Oxygen Demand (COD)	mg/L	**15**	< 10	< 10	< 10	<10	< 10
Benzo(a)pyrene	µg/L	**0.1**	not analysed	not analysed	not analysed	not reported	< 0.003
Total Hydrocarbons	µg/L	**10**	not analysed	not analysed	not analysed	not reported	not reported
Total PAHs	µg/L	**0.1**	not analysed	not analysed	not analysed	not reported	not reported
Southern Scientific Laboratory Reference			93347 (23-29240)	96104 (23-30235)	113177 (23-36432)	118896 (24-38390)	129163 (24-41909)

Data Report 6

Q3 (2024)

Section 4 Discharge Licence W/502/22

(issued 7th June 2023)

at

Harrington Concrete and Quarries Ltd

Ardgaineen, Claregalway, Co. Galway

Prepared by Consultant Dr. Pamela Bartley, Hydro-G

Hydro-G

50 Henry St.

Galway

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Project No.: 25-14 Harringtons Ardgaineen

Report Status: ISSUE_V1

Report Title: Data Report 6: Q3 (2024) Harringtons Concrete and Products Ltd. Discharge Licence W/502/22.

Prepared by: ___________________________

Dr. Pamela Bartley B.Eng, M.SC., Ph.D.

NOTES:

This report is for the use solely of the party to whom it is addressed and no responsibility is accepted to any third party.

About the Author

Pamela Bartley is a water focussed civil engineer. She has 30 years of field-based practice in borehole drilling, groundwater monitoring and abstraction point management in limestone karst environments. Her Ph.D was a field based karst limestone environment study. She has also completed training with the GSI at their karst specialist course run in the Burren. Her primary qualification is a Diploma in Water and Wastewater Technology at Sligo RTC. She then completed her primary degree in Civil Engineering at Queens University, Belfast, followed by an M.Sc. in Environmental Engineering, followed by a field-based hydrogeologically focussed Ph.D. within the School of Civil Engineering at Trinity College, Dublin. Her key work areas are: groundwater development from large scale water supply boreholes, hydrogeological assessment of quarries and the evaluation of discharges to groundwater and surface waters. Pamela Bartley's company is Bartley Hydrogeology ltd., registered to trade as Hydro-G.

Pamela has successfully completed post doctorate 'Professional Development' formal course training in the areas of:

- PSDP & PSCS (IOSH certified, 2016);
- Karst Hydrogeology (GSI, 2013);
- On Site Wastewater & Water Services Amendment Act 2012 (IE, Western Region 6-week programme 2012 & Dublin 2012);
- Zero Discharge Willow Wastewater Systems Design Courses (Denmark 2008 & 2011 & Ireland 2012);
- Expert Witness (IE, 2011);
- Planning & Development Act (IE, 2010);
- Surface Water Regulations 2009 (DoE, 2010 & 2011);
- Sustainable Drainage (Wallingford/CIRIA, 2005 & 2008);
- Source Protection Zone Delineation (IGI/GSI, 2007);
- Groundwater & Contaminant Microbiology (IGI/GSI, 2006);
- Applied Groundwater Modelling (ESI, UK, 2000);
- Site Suitability Assessment (FETAC, 2002).

As a result of work in evaluating planning appeals, Pamela has become specialist in planning evaluations in the context of enacted Irish Regulation and EU Directives concerning the water environment such as the Groundwater Regulations (S.I. No. 9 of 2010), Surface Water Regulations (S.I. No. 272 of 2009), Water Framework and Habitats' Directives. Pamela is a qualified and certified 'Site Assessor' and interviewer of examination candidates in respect of eligibility for the Site Suitability FETAC Qualification. In the past, she has lectured in third level institutions (WIT, CIT, 1996 – 1999), delivered practical laboratory instruction in the assessment of subsoils for the FETAC Site Assessor programme and demonstrated hydraulics laboratory modules at Trinity College Dublin (1996). She has been an invited guest speaker at An Board Pleanála, The Irish Concrete Federation, The Health Service Executive, Environmental Health Officers National Conference, The Irish Planning Institute's National Conference, The International Association of Hydrogeologists National Conference (Irish Branch) and has delivered hydrogeological lectures to the public during Science Week.

Hydro-G is the registered trading name of Pamela Bartley's company Bartley Hydrogeology Ltd., a company registered in Galway Ireland. The company holds requisite employer's and public liability insurances. In addition, the company holds professional indemnity insurance of €2million.

Pamela is qualified and IOSH certified to act as PSDP (Project Supervisor Design Phase) & PSCS (Project Supervisor Construction Stage) as defined by the Construction Regulations. The company is a registered Irish Water Supplier (no. 1855) and Pamela Bartley is HSQE approved within Irish Water.

Contents

1.0 Introduction

Hydro G was commissioned by Harringtons Concrete and Products Ltd to prepare a Data Report for the **3rd Quarter 2024** Discharge Licence in place for the quarry operation at Ardgaineen, Claregalway, Co. Galway (Galway County Council Licence Ref. No: W/502/22, issued 7th June 2023). This report has been prepared to fulfil this requirement and pertains to the **6th** reporting period since the Licence was issued.

It is acknowledged that Licence W/502/22 stipulates return of results on a Quarterly basis and this practice will be put in place going forward.

2.0 Discharge Licence Conditions

Licence conditions relevant to this report include the following:

1. Scope

This Licence refers to the attenuation sump discharge of Harrington Concrete and Quarries located at Ardgaineen, Claregalway, Co. Galway. Surface water run-off and ground water collected in the quarry attenuation sump are pumped to a Wetland Vegetation Area, *via* a petrol/oil interceptor, where water percolates to ground. This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required. **The maximum permitted discharge is 1,483m3 per day.**

2. Attenuation Sump Discharge.

2.1 **Discharge:** The Licencee shall not discharge, cause or permit the discharge, of any contaminated surface water or process water directly to any surface water or groundwater without prior treatment.

2.2 **Treated Discharge:** The discharge shall be discharged to groundwater without posing a pollution risk.

2.3 **Discharge Performance Standards:** The treated discharge, **prior to its release** to the Wetland Vegetation Area, shall comply with the following standards:

(a) The **Total Suspended Solids** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(b) The **Biochemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(c) The **Chemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 15 mg/l.

(d) The **Nitrate (NO_3-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 18 mg/l.

(e) The **Nitrite (NO_2-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.05 mg/l.

(f) The **Total Hydrocarbon** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.01 mg/l.

(g) The **Total Ammonia** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.03mg/l.

(h) The **Benzo (a) pyrene** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(i) The **Total PAH** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(j) The **pH** of the Discharge from the attenuation sump and oil interceptor shall be in the range 6 - 9 pH units.

(k) The **Flow** of the Discharge from the attenuation sump and oil interceptor shall not exceed 1,483 m3/day.

(l) The **Colour** of the Discharge from the attenuation sump should not change significantly from day to day nor shall there be any evidence of oil or excess solids on visual inspection.

(m) The **Conductivity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

(n) The **Turbidity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

3. Discharge Analysis

Analysis of the treated water prior to discharge shall be carried out by an approved accredited laboratory where readings are not taken on site. The frequency of analysis and the parameters are outlined below. Quarterly results shall be forwarded to the environment section.

Parameter	Monitoring Frequency	Analysis to be performed by accredited laboratory
Flow	Continuous - Daily	
Colour and Visual inspection	Daily	
Conductivity	Continuous - Daily	
Turbidity	Continuous - Daily	
pH	Continuous - Daily	
Total Suspended Solids	Quarterly	√
Nitrates NO_3^-	Quarterly	√
Nitrites NO_2^-	Quarterly	√
Chemical Oxygen Demand	Quarterly	√
Biochemical Oxygen Demand	Quarterly	√
Total Ammonia	Quarterly	√
Total PAH	Quarterly	√
Benzo (a) Pyrene	Quarterly	√
Total Hydrocarbons including Diesel Range Organics and Petroleum Range Organics	Quarterly	√

4. Groundwater Analysis

Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory. The following parameters shall be measured and analysis of same forwarded to the Environment Section of Galway County Council:

Parameter	Units
(a) Water Level	mAOD
(b) pH	pH units
(c) Conductivity	uS/cm
(d) Suspended Solids	mg/l
(e) Nitrates	mg/l No_3^-
(f) Total Hydrocarbons	mg/l

Where quarrying activities are found to adversely affect local water supplies the provisions of the EPA Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)', Section 3.3.1 shall apply, and the quarry shall provide a replacement water supply.

5. Petrol / Oil Interceptor

The petrol / oil interceptor should be inspected each working day to ensure it is operating correctly and daily records kept of this. These records should be made available to Galway County Council if requested.

Other matters in the licence include details about the following. Readers are referred to the Licence itself for specific detail.

6. Attenuation sump, petrol/oil interceptor & wetland area

6.1 Treatment Process – must be able to achieve the Treatment Standards of Condition 2.3.
6.2 Metering – Install Flow Meter, record Daily Discharge, report Quarterly. Limit 1,483m3/d.
6.3 Ready Access – must be allowed for Authorised Persons under the Water Pollution Acts.
6.4 Sampling – Sampling Chamber after treatment and before wetland. Plus access required.
6.5 Caretaker – Day to Day Inspection. Notified Person named and details supplied to GCC.
6.6 Notification of Non-Compliance – Make GCC aware, record details of noncompliance.

7. EPA Guidelines

All works must be carried out in accordance with the EPA Guidelines 'Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)'.

8. Annual Contribution

€550 due annually. Shall be adjusted with the Customer Price Index value. GCC can increase.

9. Changes in Ownership

GCC to be notified in writing if change in company ownership or Trading Name.

3.0 Person Responsible for Caretaking at the Site

Mr. John Gibbons, the quarry manager, is responsible for inspections and maintenance of the infrastructure associated with the discharge. Mr. Gibbons' contact details are on file with Galway County Council.

4.0 Site Data - Monitoring Results

4.1 Flow Data

The site's flow was fully automated on the 7th of February 2024. Results are presented in Table 1.

Table 1 Daily discharge volumes (m3/d) Q3 2024 & Statistics: Max, Min, Mean Daily

2024	Q3 (m3/d) Totals			ELV MAX (m3/d)
Day	Jul-24	Aug-24	Sept-24	
1	42.28	65.24	52.20	1,438
2	45.26	64.43	47.06	1,438
3	44.55	60.15	49.39	1,438
4	41.13	58.38	49.04	1,438
5	43.01	49.28	46.61	1,438
6	51.27	43.51	47.71	1,438
7	52.73	40.96	51.80	1,438
8	43.34	37.90	49.35	1,438
9	45.14	40.64	51.68	1,438
10	42.70	38.03	53.34	1,438
11	46.20	27.90	50.55	1,438
12	48.17	45.01	47.99	1,438
13	58.57	36.68	45.80	1,438
14	61.41	40.87	56.87	1,438
15	57.40	43.67	53.76	1,438
16	52.67	41.49	44.47	1,438
17	56.57	44.97	42.99	1,438
18	59.11	44.97	41.05	1,438
19	61.97	48.29	38.31	1,438
20	64.86	42.88	37.23	1,438
21	64.54	48.52	41.31	1,438
22	52.13	45.18	44.55	1,438
23	50.14	42.66	42.33	1,438
24	57.54	45.44	38.91	1,438
25	56.08	47.22	29.12	1,438
26	54.28	47.36	35.06	1,438
27	63.63	45.19	32.58	1,438
28	60.19	46.51	40.04	1,438
29	63.16	43.86	43.69	1,438
30	60.72	43.01	25.65	1,438
31	63.63	49.10		1,438
MAX m3/d	65	65	57	m3/d
MIN m3/d	41	28	26	
AVERAGE m3/d	54	46	44	

4.2 Discharge Water's Quality Data

As is required by Licence W/502/22, the site monitors water quality of the final discharge from the site on a Quarterly basis. The laboratory Certificate of Analysis is presented in Appendix A.

Discharge water's quality results are presented in Table 2 with each parameter's ELV for the monitoring period.

Table 2 Ardgaineen Quarry Final Discharge Quality Q3 2024.

Green Highligt in Cells = Compliant			
			Q3 2024
Parameter:	**Units**	**W/502/22 Emission Limit Value**	**05 September 2024**
Hydrogen Ion (pH)	pH units	6 to 9	7.7
Biological Oxygen Demand (BOD)	mg/L	10.0	<0.1
Suspended Solids	mg/L	10	16
Ammonium	mg/L N	0.03	6.30
Nitrate	mg/L N	18.00	1.56
Nitrite	mg/L N	0.05	0.03
Chemical Oxygen Demand (COD)	mg/L	15	11.00
Benzo(a)pyrene	µg/L	0.1	< 0.005
Total Hydrocarbons	µg/L	10	< 10.0
Total PAHs	µg/L	0.1	< 0.005
Southern Scientific Laboratory Reference			143769 (24-47350)

With reference to the results presented in Table 1, and the associated Certificates of Analysis in Appendix A, commentary is as follows:

- The pH of the Discharge is 7.7pH and this is within the 6 to 9 pH Emission Limit Value.

- The discharge's results are below the limit of detection of the laboratory analyser for BOD, Benzo(a)pyrene and Hydrocarbons. This suggests good Discharge Quality.

- All analysed parameters are within the Licence Limits (ELVs) for pH, BOD, Nitrates, Nitrites, COD, Benzo(a)pyrene, Total Hydrocarbons and Total PAHs.

- However, Suspended Solids were reported to be elevated and there is a certain gross laboratory error in the 6.3 mg/l Ammonium value reported by the laboratory. The fact that BOD is reported at <0.1 mg/l suggests that there is ZERO biochemical loading in the water. IF there actually was 6 mg/l of Ammonium, there would be BOD at greater than 0.01 mg/l.

4.3 Continuous Data Recording

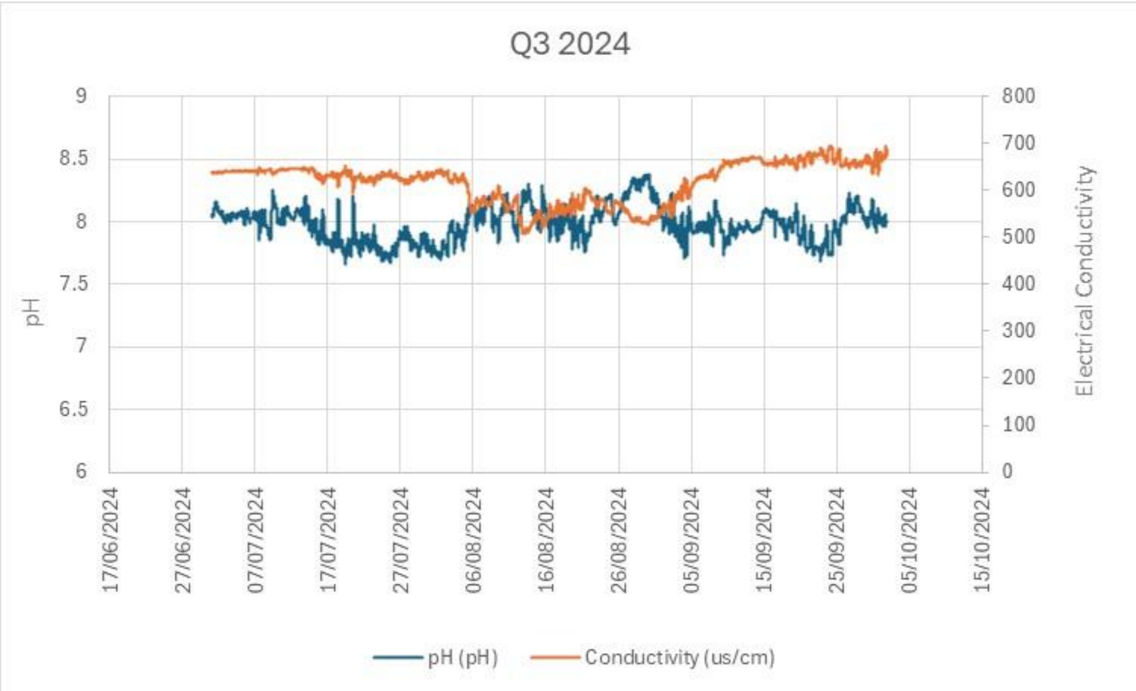
The site's discharge is now instrumented with a continuous flow meter with physiochemical sensors for parameters as specified in the Licence as follows:

- Flow
- pH
- Turbidity
- Conductivity

Data are collected at 5 minute intervals and reported to the service provider's telemetric data service HydroVU. The data service provider is Capital Water Solutions Limited, Co. Roscommon.

The quarry manager is responsible for daily log in to the telemetric system, visual inspections of the discharge and day to day management.

The full data record is held in excel file format in Hydro-G's offices because there are many rows associated with 5 minute intervals for excel rows of data for the reporting period. A graphical presentation of the data is shown in Graph 1, below.



Graph 1 Continuous record for field physiochemical parameters.

The results for continuous monitoring show, as follows:

- The Turbidity probe malfunctioned and although replaced, did not perform.
- The Temperature probe malfunctioned and although replaced, did not perform.
- pH is within the 6 to 9 pH units ELV of the Licence.
- Electrical Conductivity is within the expected range for a limestone environment.

4.4 Groundwater Data

Condition 4 of the Licence states that "Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory". However, there are no wells on the operational quarry to which the Discharge Licence relates. Hydro-G has previously reported 11 Site Investigation boreholes on the floor of the quarry and none of those boreholes encountered groundwater strike.

There are site investigation greenfield boreholes for the lands to the east of the quarry but they are not within the operational quarry.

The "1. Scope" detail of the Opening of W/502/22 Discharge Licence states that

> "*This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required.*"

Given that there have been no successful groundwater strikes in 11 boreholes attempted within this quarry because the limestone is the competent Burren Formation Limestone. The aquifer is mapped as a Regionally Important Karst Conduit Aquifer. No groundwater transmissive conduits were discovered in the drilling completed on the floor of the operational quarry. Therefore there is nothing to report with respect to this Condition of the Licence.

5.0 Compliance with Licence Conditions

5.1 With respect to the Volumetric ELV Conditions: The site's flow is now fully recorded. Data presented in Table 1 suggests that the mean daily discharge is compliant with the specified ELV for mean daily volume of 1,483 m3/d, on an annual average basis. Discharge values ranged from 26m3/d to 65m3/d.

5.2 With respect to Water Quality ELVs: Results presented in Table 2 indicates that the prescribed ELVs were complied with for many parameters analysed. However, Suspended Solids were reported to be elevated and there is a certain gross laboratory error in the 6.3 mg/l Ammonium value reported by the laboratory. The fact that BOD is reported at <0.1 mg/l suggests that there is ZERO biochemical loading in the water. IF there actually was 6 mg/l of Ammonium, there would be BOD at greater than 0.01 mg/l.

6.0 Difficulties Encountered

6.1 As part of previous evaluations, Hydro-G supervised the drilling of eleven boreholes on the floor of the quarry and no groundwater was encountered. Therefore, there is no groundwater quality to report.

6.3 A gross laboratory error in the 6.3 mg/l Ammonium value reported by the laboratory. The fact that BOD is reported at <0.1 mg/l suggests that there is ZERO biochemical loading in the water. IF there actually was 6 mg/l of Ammonium, there would be BOD at greater than 0.01 mg/l. It was an oversight to have missed following up on this.

7.0 Register of Incidents

Apart from the gross reporting for Ammonia, which is confidently asserted to be a laboratory error, there were no 'serious incidents' to report with respect to this discharge during this reported period.

8.0 Conclusions

The site is in compliance with almost all Conditions of the Section 4 Discharge Licence W/502/22. The fact that BOD is reported at <0.1 mg/l suggests that there is ZERO biochemical loading in the water. IF there actually was 6 mg/l of Ammonium, there would be BOD at greater than 0.01 mg/l. It was an oversight to have missed following up on this.

Pamela Bartley

Dr. Pamela Bartley B.Eng, M.SC., Ph.D. MIEI

Appendix A

Laboratory Certificates of Analysis

Routine Quarterly Monitoring at the Site

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Certificate of Analysis

Customer:	Harrington Concrete and Quarries	**Project:**	Water/Dust Monitoring
Address:	Kilkelly Co Mayo	**Site**	
		Date Received:	05/09/2024
		Condition of Sample:	Satisfactory
Report to:	Amanda Tarpey	**Date Analysed:**	06/09/2024 - 16/10/2024
Customer PO		**Issue Date:**	10/10/2024
Quote No.	Q24-00756	**BATCH NUMBER:**	**24-47350**

Natalia Zur

Natalia Zur
Laboratory Analyst

Index to symbols used & Notes

*	Analysis is not INAB accredited
**	Adapted from Standard Methods for the Examination of Water and Wastewater.
***	Customer specific limits
(F)	Analysis carried out at our Farranfore Laboratory.
(D)	Analysis carried out at our Dunrine Laboratory.
LOQ	Parameter Limit of Quantification
Note 6	Subcontracted Parameter.

Notes

- **The results relate only to the items tested.**
- **Opinions and interpretations expressed herein are outside the scope of INAB accreditation.**
- **The analysis report shall not be reproduced except in full without written approval of the laboratory.**
- **Sampling is outside the scope of the laboratory activities.**

Notes for Drinking Water samples

Note A	The water should not be aggressive
Note B	Compliance must be ensured with the conditions that [NO3]/50 + [NO2]/3 =1
Note C	Acceptable to customers and no abnormal change
Note D	In the case of surface water treatment, a parametric value not exceeding 1 NTU in the water ex treatment works must be strived for
Note F	Fluoridated supplies 0.8 mg/L; Natural supplies 1.5 mg/L.

southern scientific services ltd.

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Customer Sample Ref:	G-WD-1	**Customer Sample Code:**	
Project:	Water/Dust Monitoring	**Sampled By:**	Customer
Our Reference:	143769 (24-47350)	**Sample Matrix:**	Surface Water
Date Sampled:	05/09/2024	**Time Sampled:**	13:00

Method:		Parameter:	Units	LOQ	Result
		Chemical Analysis: (F)			
SCP 052		Hydrogen Ion (pH)	pH units	*4.0*	7.7
SCP 015		Biological Oxygen Demand (BOD)	mg/L	*1.0*	< 1.0
SCP 010		Suspended Solids	mg/L	*2*	16
SCP 027A		Total Ammonia	mg/L N	*0.02*	6.30
SCP 027G		Nitrate	mg/L N	*0.25*	1.56
SCP 027F		Nitrite	mg/L N	*0.005*	0.033
SCP 016		Chemical Oxygen Demand (COD)	mg/L	*10*	11
SCP 115A		Total Petroleum Hydrocarbons (C10 - C40)	µg/L	*10.0*	< 10.0
		PAH's Water (default)			
		Chemical Analysis: (F)			
SCP 060B		Acenaphthene	µg/L	*0.005*	< 0.005
SCP 060B		Acenaphthylene	µg/L	*0.005*	< 0.005
SCP 060B		Anthracene	µg/L	*0.005*	< 0.005
SCP 060B		Benz(a)anthracene	µg/L	*0.005*	< 0.005
SCP 060B		Benzo(a)pyrene	µg/L	*0.005*	< 0.005
SCP 060B		Benzo(b)fluoranthene	µg/L	*0.005*	< 0.005
SCP 060B		Benzo(k)fluoranthene	µg/L	*0.005*	< 0.005
SCP 060B		Sum Benzo (b)&(k) fluoranthene	µg/L	*0.005*	< 0.005
SCP 060B		Benzo(ghi)perylene	µg/L	*0.005*	< 0.005
SCP 060B		Chrysene	µg/L	*0.005*	< 0.005
SCP 060B		Dibenz(a,h)anthracene	µg/L	*0.005*	< 0.005
SCP 060B	*	Fluoranthene	µg/L	*0.005*	< 0.005
SCP 060B		Fluorene	µg/L	*0.005*	< 0.005
SCP 060B		Indeno(1,2,3-cd)pyrene	µg/L	*0.005*	< 0.005
SCP 060B		Naphthalene	µg/L	*0.005*	< 0.005
SCP 060B		Phenanthrene	µg/L	*0.005*	< 0.005
SCP 060B		Pyrene	µg/L	*0.005*	< 0.005
SCP 060B		Total PAH's (sum of 16)	µg/L	*0.078*	< 0.078

Sample Comments

Revised due to error in logging sample - required analysis added.

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registered in ireland no 323196 | vat reg no IE 6343196 M

Appendix B

Entire Record of Results Reported

Green Highligt in Cells = Compliant								
			Q2 2023	Q3 2023	Q4 2023	Q1 2024 February	Q2 2024 May	Q3 2024
Parameter:	Units	W/502/22 Emission Limit Value	07 June 2023	04 July 2023	04 December 2023	06 February 2024	03 May 2024	05 September 2024
Hydrogen Ion (pH)	pH units	6 to 9	8.0	8.1	7.8	8.0	8.1	7.7
Biological Oxygen Demand (BOD)	mg/L	10.0	< 1.0	< 1.0	1.2	< 1.0	<0.1	<0.1
Suspended Solids	mg/L	10	< 4	< 4	< 4	<4	< 4	16
Ammonium	mg/L N	0.03	0.03	< 0.02	0.03	0.04	0.02	6.30
Nitrate	mg/L N	18.00	1.47	1.22	1.73	not reported	10.24	1.56
Nitrite	mg/L N	0.05	0.012	< 0.005	< 0.005	not reported	0.020	0.03
Chemical Oxygen Demand (COD)	mg/L	15	< 10	< 10	< 10	<10	< 10	11.00
Benzo(a)pyrene	µg/L	0.1	not analysed	not analysed	not analysed	not reported	< 0.003	< 0.005
Total Hydrocarbons	µg/L	10	not analysed	not analysed	not analysed	not reported	not reported	< 10.0
Total PAHs	µg/L	0.1	not analysed	not analysed	not analysed	not reported	not reported	< 0.005
Southern Scientific Laboratory Reference			93347 (23-29240)	96104 (23-30235)	113177 (23-36432)	118896 (24-38390)	129163 (24-41909)	143769 (24-47350)

Hydro-G

Data Report 7

Q4 (2024)

Section 4 Discharge Licence W/502/22

(issued 7th June 2023)

at

Harrington Concrete and Quarries Ltd

Ardgaineen, Claregalway, Co. Galway

Prepared by Consultant Dr. Pamela Bartley, Hydro-G

Hydro-G

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Project No.: 25-14 Harringtons Ardgaineen

Report Status: ISSUE_V1

Report Title: Data Report 7: Q4 (2024) Harringtons Concrete and Products Ltd. Discharge Licence W/502/22.

Pamela Bartley

Prepared by: ___________________________

Dr. Pamela Bartley B.Eng, M.SC., Ph.D.

NOTES:

This report is for the use solely of the party to whom it is addressed and no responsibility is accepted to any third party.

About the Author

Pamela Bartley is a water focussed civil engineer. She has 30 years of field-based practice in borehole drilling, groundwater monitoring and abstraction point management in limestone karst environments. Her Ph.D was a field based karst limestone environment study. She has also completed training with the GSI at their karst specialist course run in the Burren. Her primary qualification is a Diploma in Water and Wastewater Technology at Sligo RTC. She then completed her primary degree in Civil Engineering at Queens University, Belfast, followed by an M.Sc. in Environmental Engineering, followed by a field-based hydrogeologically focussed Ph.D. within the School of Civil Engineering at Trinity College, Dublin. Her key work areas are: groundwater development from large scale water supply boreholes, hydrogeological assessment of quarries and the evaluation of discharges to groundwater and surface waters. Pamela Bartley's company is Bartley Hydrogeology ltd., registered to trade as Hydro-G.

Pamela has successfully completed post doctorate 'Professional Development' formal course training in the areas of:

- PSDP & PSCS (IOSH certified, 2016);
- Karst Hydrogeology (GSI, 2013);
- On Site Wastewater & Water Services Amendment Act 2012 (IE, Western Region 6-week programme 2012 & Dublin 2012);
- Zero Discharge Willow Wastewater Systems Design Courses (Denmark 2008 & 2011 & Ireland 2012);
- Expert Witness (IE, 2011);
- Planning & Development Act (IE, 2010);
- Surface Water Regulations 2009 (DoE, 2010 & 2011);
- Sustainable Drainage (Wallingford/CIRIA, 2005 & 2008);
- Source Protection Zone Delineation (IGI/GSI, 2007);
- Groundwater & Contaminant Microbiology (IGI/GSI, 2006);
- Applied Groundwater Modelling (ESI, UK, 2000);
- Site Suitability Assessment (FETAC, 2002).

As a result of work in evaluating planning appeals, Pamela has become specialist in planning evaluations in the context of enacted Irish Regulation and EU Directives concerning the water environment such as the Groundwater Regulations (S.I. No. 9 of 2010), Surface Water Regulations (S.I. No. 272 of 2009), Water Framework and Habitats' Directives. Pamela is a qualified and certified 'Site Assessor' and interviewer of examination candidates in respect of eligibility for the Site Suitability FETAC Qualification. In the past, she has lectured in third level institutions (WIT, CIT, 1996 – 1999), delivered practical laboratory instruction in the assessment of subsoils for the FETAC Site Assessor programme and demonstrated hydraulics laboratory modules at Trinity College Dublin (1996). She has been an invited guest speaker at An Board Pleanála, The Irish Concrete Federation, The Health Service Executive, Environmental Health Officers National Conference, The Irish Planning Institute's National Conference, The International Association of Hydrogeologists National Conference (Irish Branch) and has delivered hydrogeological lectures to the public during Science Week.

Hydro-G is the registered trading name of Pamela Bartley's company Bartley Hydrogeology Ltd., a company registered in Galway Ireland. The company holds requisite employer's and public liability insurances. In addition, the company holds professional indemnity insurance of €2million.

Pamela is qualified and IOSH certified to act as PSDP (Project Supervisor Design Phase) & PSCS (Project Supervisor Construction Stage) as defined by the Construction Regulations. The company is a registered Irish Water Supplier (no. 1855) and Pamela Bartley is HSQE approved within Irish Water.

Contents

1.0 Introduction

Hydro G was commissioned by Harringtons Concrete and Products Ltd to prepare a Data Report for the 4^{th} **Quarter 2024** Discharge Licence in place for the quarry operation at Ardgaineen, Claregalway, Co. Galway (Galway County Council Licence Ref. No: W/502/22, issued 7^{th} June 2023). This report has been prepared to fulfil this requirement and pertains to the **7^{th}** reporting period since the Licence was issued.

It is acknowledged that Licence W/502/22 stipulates return of results on a Quarterly basis and this practice will be put in place going forward.

2.0 Discharge Licence Conditions

Licence conditions relevant to this report include the following:

1. **Scope**

This Licence refers to the attenuation sump discharge of Harrington Concrete and Quarries located at Ardgaineen, Claregalway, Co. Galway. Surface water run-off and ground water collected in the quarry attenuation sump are pumped to a Wetland Vegetation Area, *via* a petrol/oil interceptor, where water percolates to ground. This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required. **The maximum permitted discharge is 1,483m3 per day.**

2. **Attenuation Sump Discharge.**

2.1 **Discharge:** The Licencee shall not discharge, cause or permit the discharge, of any contaminated surface water or process water directly to any surface water or groundwater without prior treatment.

2.2 **Treated Discharge:** The discharge shall be discharged to groundwater without posing a pollution risk.

2.3 **Discharge Performance Standards:** The treated discharge, **prior to its release** to the Wetland Vegetation Area, shall comply with the following standards:

(a) The **Total Suspended Solids** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(b) The **Biochemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(c) The **Chemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 15 mg/l.

(d) The **Nitrate (NO_3-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 18 mg/l.

(e) The **Nitrite (NO_2-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.05 mg/l.

(f) The **Total Hydrocarbon** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.01 mg/l.

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(g) The **Total Ammonia** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.03mg/l.

(h) The **Benzo (a) pyrene** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(i) The **Total PAH** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(j) The **pH** of the Discharge from the attenuation sump and oil interceptor shall be in the range 6 - 9 pH units.

(k) The **Flow** of the Discharge from the attenuation sump and oil interceptor shall not exceed 1,483 m3/day.

(l) The **Colour** of the Discharge from the attenuation sump should not change significantly from day to day nor shall there be any evidence of oil or excess solids on visual inspection.

(m) The **Conductivity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

(n) The **Turbidity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

3. Discharge Analysis

Analysis of the treated water prior to discharge shall be carried out by an approved accredited laboratory where readings are not taken on site. The frequency of analysis and the parameters are outlined below. Quarterly results shall be forwarded to the environment section.

Parameter	**Monitoring Frequency**	**Analysis to be performed by accredited laboratory**
Flow	Continuous - Daily	
Colour and Visual inspection	Daily	
Conductivity	Continuous - Daily	
Turbidity	Continuous - Daily	
pH	Continuous - Daily	
Total Suspended Solids	Quarterly	√
Nitrates NO_3^-	Quarterly	√
Nitrites NO_2^-	Quarterly	√
Chemical Oxygen Demand	Quarterly	√
Biochemical Oxygen Demand	Quarterly	√
Total Ammonia	Quarterly	√
Total PAH	Quarterly	√
Benzo (a) Pyrene	Quarterly	√
Total Hydrocarbons including Diesel Range Organics and Petroleum Range Organics	Quarterly	√

4. Groundwater Analysis

Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory. The following parameters shall be measured and analysis of same forwarded to the Environment Section of Galway County Council:

Parameter	Units
(a) Water Level	mAOD
(b) pH	pH units
(c) Conductivity	uS/cm
(d) Suspended Solids	mg/l
(e) Nitrates	mg/l No_3^-
(f) Total Hydrocarbons	mg/l

Where quarrying activities are found to adversely affect local water supplies the provisions of the EPA Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)', Section 3.3.1 shall apply, and the quarry shall provide a replacement water supply.

5. Petrol / Oil Interceptor

The petrol / oil interceptor should be inspected each working day to ensure it is operating correctly and daily records kept of this. These records should be made available to Galway County Council if requested.

Other matters in the licence include details about the following. Readers are referred to the Licence itself for specific detail.

6. Attenuation sump, petrol/oil interceptor & wetland area

6.1 Treatment Process – must be able to achieve the Treatment Standards of Condition 2.3.
6.2 Metering – Install Flow Meter, record Daily Discharge, report Quarterly. Limit 1,483m3/d.
6.3 Ready Access – must be allowed for Authorised Persons under the Water Pollution Acts.
6.4 Sampling – Sampling Chamber after treatment and before wetland. Plus access required.
6.5 Caretaker – Day to Day Inspection. Notified Person named and details supplied to GCC.
6.6 Notification of Non-Compliance – Make GCC aware, record details of noncompliance.

7. EPA Guidelines

All works must be carried out in accordance with the EPA Guidelines 'Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)'.

8. Annual Contribution

€550 due annually. Shall be adjusted with the Customer Price Index value. GCC can increase.

9. Changes in Ownership

GCC to be notified in writing if change in company ownership or Trading Name.

3.0 Person Responsible for Caretaking at the Site

Mr. John Gibbons, the quarry manager, is responsible for inspections and maintenance of the infrastructure associated with the discharge. Mr. Gibbons' contact details are on file with Galway County Council.

4.0 Site Data - Monitoring Results

4.1 Flow Data

The site's flow was fully automated on the 7th of February 2024. Results are presented in Table 1.

Table 1 Daily discharge volumes (m3/d) Q4 2024 & Statistics: Max, Min, Mean Daily

2024	Q4 (m3/d) Totals			ELV MAX (m3/d)
Day	Oct-24	Nov-24	Dec-24	
1	23.33	0.00	0.00	1,438
2	17.58	0.00	0.00	1,438
3	10.66	0.00	0.00	1,438
4	24.06	0.00	0.00	1,438
5	40.11	0.00	0.00	1,438
6	41.01	0.00	0.00	1,438
7	32.29	0.00	0.00	1,438
8	31.92	0.00	0.00	1,438
9	26.36	0.00	0.00	1,438
10	25.59	0.00	0.00	1,438
11	23.28	0.00	0.00	1,438
12	27.67	0.00	3.11	1,438
13	27.83	0.79	0.00	1,438
14	22.61	2.54	0.00	1,438
15	22.02	15.37	0.00	1,438
16	10.71	1.54	0.00	1,438
17	3.39	0.00	0.00	1,438
18	3.53	0.00	0.00	1,438
19	0.00	0.06	0.00	1,438
20	0.50	0.00	0.00	1,438
21	0.00	0.00	0.00	1,438
22	13.06	0.00	0.00	1,438
23	0.00	0.00	0.00	1,438
24	0.00	0.06	0.00	1,438
25	0.00	0.00	0.00	1,438
26	0.00	0.00	0.00	1,438
27	0.00	0.00	0.00	1,438
28	0.00	0.00	0.00	1,438
29	0.00	0.00	0.00	1,438
30	0.00	0.00	0.00	1,438
31	0.00		0.00	1,438
MAX m3/d	41	15	3	
MIN m3/d	0.00	0.00	0.00	m3/d
AVERAGE m3/d	14	1	0	

It is noted that the site has ceased discharge because they need to conserve the water on the floor for dust suppression and site functioning.

4.2 Discharge Water's Quality Data

As is required by Licence W/502/22, the site monitors water quality of the final discharge from the settlement lagoons on a routine Quarterly basis. The laboratory Certificates of Analysis is presented in Appendix A.

Discharge water's quality results are presented in Table 2 with each parameter's ELV for the monitoring period.

Table 2 Ardgaineen Quarry Final Discharge Quality Q4 2024.

Green Highligt in Cells = Compliant			
			Q4 2024
Parameter:	Units	W/502/22 Emission Limit Value	13 November 2024
Hydrogen Ion (pH)	pH units	6 to 9	7.8
Biological Oxygen Demand (BOD)	mg/L	10.0	<0.1
Suspended Solids	mg/L	10	12
Ammonium	mg/L N	0.03	0.03
Nitrate	mg/L N	18.00	11.38
Nitrite	mg/L N	0.05	0.05
Chemical Oxygen Demand (COD)	mg/L	15	< 10
Benzo(a)pyrene	µg/L	0.1	< 0.005
Total Hydrocarbons	µg/L	10	< 10.0
Total PAHs	µg/L	0.1	< 0.005
Southern Scientific Laboratory Reference			153060 (24-50550)

With reference to the results presented in Table 1, and the associated Certificates of Analysis in Appendix A, commentary is as follows:

- The pH of the Discharge is 7.8pH and this is within the 6 to 9 pH Emission Limit Value.
- The discharge's results are below the limit of detection of the laboratory analyser for BOD, COD, Benzo(a)pyrene, Hydrocarbons and Total PAHs. This suggests good Discharge Quality.
- Parameters are within the Licence Limits (ELVs) for pH, BOD, Nitrates, Nitrites, COD, Benzo(a)pyrene, Total Hydrocarbons and Total PAHs. The exception is a small exceedance of Suspended Solids.
- No environmental impact is expected from a 12 mg/l Suspended Solids concentration because the discharge passes over a vegetated wetland type system after the discharge sampling location and interception will further treat the water before infiltration to ground.

4.3 Continuous Data Recording

The site's discharge is now instrumented with a continuous flow meter with physiochemical sensors for parameters as specified in the Licence as follows:

- Flow
- pH
- Turbidity
- Conductivity

Data are collected at 5 minute intervals and reported to the service provider's telemetric data service HydroVU. The data service provider is Capital Water Solutions Limited, Co. Roscommon.

The quarry manager is responsible for daily log in to the telemetric system, visual inspections of the discharge and day to day management.

Given the very low flow rates from the site, the probes are not reporting for continuously flowing water.

The results for continuous monitoring show, as follows:

- pH is within the 6 to 9 pH units ELV of the Licence.
- Electrical Conductivity is within the expected range for a limestone environment at 680 to 700 uS/cm.

4.4 Groundwater Data

Condition 4 of the Licence states that "Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory". However, there are no wells on the operational quarry to which the Discharge Licence relates. Hydro-G has previously reported 11 Site Investigation boreholes on the floor of the quarry and none of those boreholes encountered groundwater strike.

There are site investigation greenfield boreholes for the lands to the east of the quarry but they are not within the operational quarry.

The "1. Scope" detail of the Opening of W/502/22 Discharge Licence states that

> "*This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required."*

Given that there have been no successful groundwater strikes in 11 boreholes attempted within this quarry because the limestone is the competent Burren Formation Limestone. The aquifer is mapped as a Regionally Important Karst Conduit Aquifer. No groundwater transmissive conduits were discovered in the drilling completed on the floor of the operational quarry. Therefore there is nothing to report with respect to this Condition of the Licence.

5.0 Compliance with Licence Conditions

5.1 With respect to the Volumetric ELV Conditions: The site's flow is now fully recorded. Data presented in Table 1 suggests that the mean daily discharge is compliant with the specified ELV for mean daily volume of 1,483 m3/d, on an annual average basis. Discharge values ranged from 0m3/d to 41m3/d. It is noted that the site has ceased discharge because they need to conserve the water on the floor for dust suppression and site functioning.

5.2 With respect to Water Quality ELVs: Results presented in Table 2 indicates that the prescribed ELVs were complied with for many parameters analysed. However, Suspended Solids were reported to be elevated slightly at 12 mg/l when the ELV is 10mg/l. No environmental impact is expected from a 12 mg/l Suspended Solids concentration because the discharge passes over a vegetated wetland type system after the discharge sampling location and interception will further treat the water before infiltration to ground. Parameters are within the Licence Limits (ELVs) for pH, BOD, Nitrates, Nitrites, COD, Benzo(a)pyrene, Total Hydrocarbons and Total PAHs. The exception is a small exceedance of Suspended Solids.

6.0 Difficulties Encountered

6.1 As part of previous evaluations, Hydro-G supervised the drilling of eleven boreholes on the floor of the quarry and no groundwater was encountered. Therefore, there is no groundwater quality to report.

6.3 A gross laboratory error in the 6.3 mg/l Ammonium value reported by the laboratory. The fact that BOD is reported at <0.1 mg/l suggests that there is ZERO biochemical loading in the water. IF there actually was 6 mg/l of Ammonium, there would be BOD at greater than 0.01 mg/l. It was an oversight to have missed following up on this.

7.0 Register of Incidents

Apart from the gross reporting for Ammonia, which is confidently asserted to be a laboratory error, there were no 'serious incidents' to report with respect to this discharge during this reported period.

8.0 Conclusions

The site is in compliance with almost all Conditions of the Section 4 Discharge Licence W/502/22.
It is noted that the site has ceased discharge because they need to conserve the water on the floor for dust suppression and site functioning. Parameters are within the Licence Limits (ELVs) for pH, BOD, Nitrates, Nitrites, COD, Benzo(a)pyrene, Total Hydrocarbons and Total PAHs. The exception is a small exceedance of Suspended Solids. There was a small exceedance of SS but no impact is expected.

Pamela Bartley

Dr. Pamela Bartley B.Eng, M.SC., Ph.D. MIEI

Appendix A

Laboratory Certificates of Analysis

Routine Quarterly Monitoring at the Site

southern scientific services ltd.

RECEIVED: 27/08/2025

Certificate of Analysis

Customer:	Harrington Concrete and Quarries	**Project:**	G WD 1 Surface Water
Address:	Kilkelly Co Mayo	**Site**	Ardgainee
		Date Received:	13/11/2024
		Condition of Sample:	Satisfactory
Report to:	Amanda Tarpey	**Date Analysed:**	13/11/2024 - 06/12/2024
Customer PO		**Issue Date:**	06/12/2024
Quote No.	Q24-00756	**BATCH NUMBER:**	**24-50550**

Aoife Moriarty

Aoife Moriarty
Organics Laboratory Manager

Index to symbols used & Notes

*	Analysis is not INAB accredited
**	Adapted from Standard Methods for the Examination of Water and Wastewater.
***	Customer specific limits
(F)	Analysis carried out at our Farranfore Laboratory.
(D)	Analysis carried out at our Dunrine Laboratory.
LOQ	Parameter Limit of Quantification
Note 6	Subcontracted Parameter.

Notes

- **The results relate only to the items tested.**
- **Opinions and interpretations expressed herein are outside the scope of INAB accreditation.**
- **The analysis report shall not be reproduced except in full without written approval of the laboratory.**
- **Sampling is outside the scope of the laboratory activities.**

Notes for Drinking Water samples

Note A	The water should not be aggressive
Note B	Compliance must be ensured with the conditions that [NO3]/50 + [NO2]/3 =1
Note C	Acceptable to customers and no abnormal change
Note D	In the case of surface water treatment, a parametric value not exceeding 1 NTU in the water ex treatment works must be strived for
Note F	Fluoridated supplies 0.8 mg/L; Natural supplies 1.5 mg/L.

(registered office)
4 park business centre | farranfore | county kerry | ireland | telephone +353 66 976 3588 | fax +353 66 976 3589
dunrine | killarney | county kerry | ireland | telephone +353 64 66 33922 | fax +353 64 66 39022

web site www.southernscientificireland.com | e-mail info@southernscientificireland.com

directors: K. Murphy, M. Murphy & C. Murphy
registered in ireland no 323196 | vat reg no IE 6343196 M

southern scientific services ltd.

RECEIVED: 27/08/2025

Report No. 24-50550 Rev 0

Customer Sample Ref:	GWD-1	**Customer Sample Code:**	
Project:	G WD 1 Surface Water	**Sampled By:**	Amanda Tarpey
Our Reference:	153060 (24-50550)	**Sample Matrix:**	Surface Water
Date Sampled:	13/11/2024	**Time Sampled:**	13:00

Method:	Parameter:	Units	LOQ	Result
	Chemical Analysis: (F)			
SCP 052	Hydrogen Ion (pH)	pH units	*4.0*	7.8
SCP 015	Biological Oxygen Demand (BOD)	mg/L	*1.0*	< 1.0
SCP 010	Suspended Solids	mg/L	*2*	12
SCP 027A	Total Ammonia	mg/L N	*0.02*	0.03
SCP 027G	Nitrate	mg/L NO3	*1.11*	11.38
SCP 027F	Nitrite	mg/L NO2	*0.016*	0.053
SCP 016	Chemical Oxygen Demand (COD)	mg/L	*10*	< 10
SCP 060B	Benzo(a)pyrene	µg/L	*0.005*	< 0.005
SCP 115A	Total Petroleum Hydrocarbons (C10 - C40)	µg/L	*10.0*	< 10.0
	PAH's Water (default)			
	Chemical Analysis: (F)			
SCP 060B	Acenaphthene	µg/L	*0.005*	< 0.005
SCP 060B	Acenaphthylene	µg/L	*0.005*	< 0.005
SCP 060B	Anthracene	µg/L	*0.005*	< 0.005
SCP 060B	Benz(a)anthracene	µg/L	*0.005*	< 0.005
SCP 060B	Benzo(b)fluoranthene	µg/L	*0.005*	< 0.005
SCP 060B	Benzo(k)fluoranthene	µg/L	*0.005*	< 0.005
SCP 060B	Sum Benzo (b)&(k) fluoranthene	µg/L	*0.005*	< 0.005
SCP 060B	Benzo(ghi)perylene	µg/L	*0.005*	< 0.005
SCP 060B	Chrysene	µg/L	*0.005*	< 0.005
SCP 060B	Dibenz(a,h)anthracene	µg/L	*0.005*	< 0.005
SCP 060B *	Fluoranthene	µg/L	*0.005*	< 0.005
SCP 060B	Fluorene	µg/L	*0.005*	< 0.005
SCP 060B	Indeno(1,2,3-cd)pyrene	µg/L	*0.005*	< 0.005
SCP 060B	Naphthalene	µg/L	*0.005*	< 0.005
SCP 060B	Phenanthrene	µg/L	*0.005*	< 0.005
SCP 060B	Pyrene	µg/L	*0.005*	< 0.005
SCP 060B	Total PAH's (sum of 16)	µg/L	*0.078*	< 0.078

Appendix B

Entire Record of Results Reported

Green Highligt in Cells = Compliant									
			Q2 2023	Q3 2023	Q4 2023	Q1 2024 February	Q2 2024 May	Q3 2024	Q4 2024
Parameter:	Units	W/502/22 Emission Limit Value	07 June 2023	04 July 2023	04 December 2023	06 February 2024	03 May 2024	05 September 2024	13 November 2024
Hydrogen Ion (pH)	pH units	6 to 9	8.0	8.1	7.8	8.0	8.1	7.7	7.8
Biological Oxygen Demand (BOD)	mg/L	10.0	< 1.0	< 1.0	1.2	< 1.0	<0.1	<0.1	<0.1
Suspended Solids	mg/L	10	< 4	< 4	< 4	<4	< 4	16	12
Ammonium	mg/L N	0.03	0.03	< 0.02	0.03	0.04	0.02	6.30	0.03
Nitrate	mg/L N	18.00	1.47	1.22	1.73	not reported	10.24	1.56	11.38
Nitrite	mg/L N	0.05	0.012	< 0.005	< 0.005	not reported	0.020	0.03	0.05
Chemical Oxygen Demand (COD)	mg/L	15	< 10	< 10	< 10	<10	< 10	11.00	< 10
Benzo(a)pyrene	µg/L	0.1	not analysed	not analysed	not analysed	not reported	< 0.003	< 0.005	< 0.005
Total Hydrocarbons	µg/L	10	not analysed	not analysed	not analysed	not reported	not reported	< 10.0	< 10.0
Total PAHs	µg/L	0.1	not analysed	not analysed	not analysed	not reported	not reported	< 0.005	< 0.005
Southern Scientific Laboratory Reference			93347 (23-29240)	96104 (23-30235)	113177 (23-36432)	118896 (24-38390)	129163 (24-41909)	143769 (24-47350)	153060 (24-50550)

Hydro-G

Data Report 8

Q1 (2025)

Section 4 Discharge Licence W/502/22

(issued 7th June 2023)

at

Harrington Concrete and Quarries Ltd

Ardgaineen, Claregalway, Co. Galway

Prepared by Consultant Dr. Pamela Bartley, Hydro-G

Hydro-G

50 Henry St.

Galway

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091 449950

087 8072744

Project No.: 25-14 Harringtons Ardgaineen

Report Status: ISSUE_V1

Report Title: Data Report 8: Q1 (2025) Harringtons Concrete and Products Ltd. Discharge Licence W/502/22.

Prepared by: Pamela Bartley
____

Dr. Pamela Bartley B.Eng, M.SC., Ph.D.

NOTES:

This report is for the use solely of the party to whom it is addressed and no responsibility is accepted to any third party.

About the Author

Pamela Bartley is a water focussed civil engineer. She has 30 years of field-based practice in borehole drilling, groundwater monitoring and abstraction point management in limestone karst environments. Her Ph.D was a field based karst limestone environment study. She has also completed training with the GSI at their karst specialist course run in the Burren. Her primary qualification is a Diploma in Water and Wastewater Technology at Sligo RTC. She then completed her primary degree in Civil Engineering at Queens University, Belfast, followed by an M.Sc. in Environmental Engineering, followed by a field-based hydrogeologically focussed Ph.D. within the School of Civil Engineering at Trinity College, Dublin. Her key work areas are: groundwater development from large scale water supply boreholes, hydrogeological assessment of quarries and the evaluation of discharges to groundwater and surface waters. Pamela Bartley's company is Bartley Hydrogeology ltd., registered to trade as Hydro-G.

Pamela has successfully completed post doctorate 'Professional Development' formal course training in the areas of:

- PSDP & PSCS (IOSH certified, 2016);
- Karst Hydrogeology (GSI, 2013);
- On Site Wastewater & Water Services Amendment Act 2012 (IE, Western Region 6-week programme 2012 & Dublin 2012);
- Zero Discharge Willow Wastewater Systems Design Courses (Denmark 2008 & 2011 & Ireland 2012);
- Expert Witness (IE, 2011);
- Planning & Development Act (IE, 2010);
- Surface Water Regulations 2009 (DoE, 2010 & 2011);
- Sustainable Drainage (Wallingford/CIRIA, 2005 & 2008);
- Source Protection Zone Delineation (IGI/GSI, 2007);
- Groundwater & Contaminant Microbiology (IGI/GSI, 2006);
- Applied Groundwater Modelling (ESI, UK, 2000);
- Site Suitability Assessment (FETAC, 2002).

As a result of work in evaluating planning appeals, Pamela has become specialist in planning evaluations in the context of enacted Irish Regulation and EU Directives concerning the water environment such as the Groundwater Regulations (S.I. No. 9 of 2010), Surface Water Regulations (S.I. No. 272 of 2009), Water Framework and Habitats' Directives. Pamela is a qualified and certified 'Site Assessor' and interviewer of examination candidates in respect of eligibility for the Site Suitability FETAC Qualification. In the past, she has lectured in third level institutions (WIT, CIT, 1996 – 1999), delivered practical laboratory instruction in the assessment of subsoils for the FETAC Site Assessor programme and demonstrated hydraulics laboratory modules at Trinity College Dublin (1996). She has been an invited guest speaker at An Board Pleanála, The Irish Concrete Federation, The Health Service Executive, Environmental Health Officers National Conference, The Irish Planning Institute's National Conference, The International Association of Hydrogeologists National Conference (Irish Branch) and has delivered hydrogeological lectures to the public during Science Week.

Hydro-G is the registered trading name of Pamela Bartley's company Bartley Hydrogeology Ltd., a company registered in Galway Ireland. The company holds requisite employer's and public liability insurances. In addition, the company holds professional indemnity insurance of €2million.

Pamela is qualified and IOSH certified to act as PSDP (Project Supervisor Design Phase) & PSCS (Project Supervisor Construction Stage) as defined by the Construction Regulations. The company is a registered Irish Water Supplier (no. 1855) and Pamela Bartley is HSQE approved within Irish Water.

Contents

1.0 Introduction

Hydro G was commissioned by Harringtons Concrete and Products Ltd to prepare a Data Report for the 1st **Quarter 2025** Discharge Licence in place for the quarry operation at Ardgaineen, Claregalway, Co. Galway (Galway County Council Licence Ref. No: W/502/22, issued 7th June 2023). This report has been prepared to fulfil this requirement and pertains to the **8th** reporting period since the Licence was issued.

It is acknowledged that Licence W/502/22 stipulates return of results on a Quarterly basis and this practice will be put in place going forward.

2.0 Discharge Licence Conditions

Licence conditions relevant to this report include the following:

1. Scope

This Licence refers to the attenuation sump discharge of Harrington Concrete and Quarries located at Ardgaineen, Claregalway, Co. Galway. Surface water run-off and ground water collected in the quarry attenuation sump are pumped to a Wetland Vegetation Area, *via* a petrol/oil interceptor, where water percolates to ground. This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required. **The maximum permitted discharge is 1,483m3 per day.**

2. Attenuation Sump Discharge.

2.1 **Discharge:** The Licencee shall not discharge, cause or permit the discharge, of any contaminated surface water or process water directly to any surface water or groundwater without prior treatment.

2.2 **Treated Discharge:** The discharge shall be discharged to groundwater without posing a pollution risk.

2.3 **Discharge Performance Standards:** The treated discharge, **prior to its release** to the Wetland Vegetation Area, shall comply with the following standards:

(a) The **Total Suspended Solids** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(b) The **Biochemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(c) The **Chemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 15 mg/l.

(d) The **Nitrate (NO_3-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 18 mg/l.

(e) The **Nitrite (NO_2-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.05 mg/l.

(f) The **Total Hydrocarbon** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.01 mg/l.

(g) The **Total Ammonia** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.03mg/l.

(h) The **Benzo (a) pyrene** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(i) The **Total PAH** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(j) The **pH** of the Discharge from the attenuation sump and oil interceptor shall be in the range 6 - 9 pH units.

(k) The **Flow** of the Discharge from the attenuation sump and oil interceptor shall not exceed 1,483 m3/day.

(l) The **Colour** of the Discharge from the attenuation sump should not change significantly from day to day nor shall there be any evidence of oil or excess solids on visual inspection.

(m) The **Conductivity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

(n) The **Turbidity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

3. Discharge Analysis

Analysis of the treated water prior to discharge shall be carried out by an approved accredited laboratory where readings are not taken on site. The frequency of analysis and the parameters are outlined below. Quarterly results shall be forwarded to the environment section.

Parameter	Monitoring Frequency	Analysis to be performed by accredited laboratory
Flow	Continuous - Daily	
Colour and Visual inspection	Daily	
Conductivity	Continuous - Daily	
Turbidity	Continuous - Daily	
pH	Continuous - Daily	
Total Suspended Solids	Quarterly	√
Nitrates NO_3^-	Quarterly	√
Nitrites NO_2^-	Quarterly	√
Chemical Oxygen Demand	Quarterly	√
Biochemical Oxygen Demand	Quarterly	√
Total Ammonia	Quarterly	√
Total PAH	Quarterly	√
Benzo (a) Pyrene	Quarterly	√
Total Hydrocarbons including Diesel Range Organics and Petroleum Range Organics	Quarterly	√

4. Groundwater Analysis

Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory. The following parameters shall be measured and analysis of same forwarded to the Environment Section of Galway County Council:

Parameter	Units
(a) Water Level	mAOD
(b) pH	pH units
(c) Conductivity	uS/cm
(d) Suspended Solids	mg/l
(e) Nitrates	mg/l No_3^-
(f) Total Hydrocarbons	mg/l

Where quarrying activities are found to adversely affect local water supplies the provisions of the EPA Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)', Section 3.3.1 shall apply, and the quarry shall provide a replacement water supply.

5. Petrol / Oil Interceptor

The petrol / oil interceptor should be inspected each working day to ensure it is operating correctly and daily records kept of this. These records should be made available to Galway County Council if requested.

Other matters in the licence include details about the following. Readers are referred to the Licence itself for specific detail.

6. Attenuation sump, petrol/oil interceptor & wetland area

6.1 Treatment Process – must be able to achieve the Treatment Standards of Condition 2.3.
6.2 Metering – Install Flow Meter, record Daily Discharge, report Quarterly. Limit 1,483m3/d.
6.3 Ready Access – must be allowed for Authorised Persons under the Water Pollution Acts.
6.4 Sampling – Sampling Chamber after treatment and before wetland. Plus access required.
6.5 Caretaker – Day to Day Inspection. Notified Person named and details supplied to GCC.
6.6 Notification of Non-Compliance – Make GCC aware, record details of noncompliance.

7. EPA Guidelines

All works must be carried out in accordance with the EPA Guidelines 'Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)'.

8. Annual Contribution

€550 due annually. Shall be adjusted with the Customer Price Index value. GCC can increase.

9. Changes in Ownership

GCC to be notified in writing if change in company ownership or Trading Name.

3.0 Person Responsible for Caretaking at the Site

Mr. John Gibbons, the quarry manager, is responsible for inspections and maintenance of the infrastructure associated with the discharge. Mr. Gibbons' contact details are on file with Galway County Council.

4.0 Site Data - Monitoring Results

4.1 Flow Data

The site's flow was fully automated on the 7th of February 2024. Results are presented in Table 1.

Table 1 Daily discharge volumes (m3/d) Q1 2025 & Statistics: Max, Min, Mean Daily

2025	Q1 (m3/d) Totals			
Day	Jan-25	Feb-25	Mar-25	ELV MAX (m3/d)
1	0.00	0.00	0.00	1,438
2	0.00	0.00	0.00	1,438
3	0.00	0.00	0.00	1,438
4	0.00	0.00	0.00	1,438
5	0.00	0.00	0.00	1,438
6	0.00	0.00	0.00	1,438
7	0.00	0.00	0.00	1,438
8	0.00	0.00	0.00	1,438
9	0.00	0.00	0.00	1,438
10	0.00	0.00	0.00	1,438
11	0.00	0.00	0.00	1,438
12	0.00	0.00	0.00	1,438
13	0.00	0.00	0.00	1,438
14	0.00	0.00	0.00	1,438
15	0.00	0.00	0.00	1,438
16	0.00	0.00	0.00	1,438
17	0.00	0.00	0.00	1,438
18	0.00	0.00	0.00	1,438
19	0.00	0.00	0.00	1,438
20	0.00	0.00	0.00	1,438
21	0.00	0.00	0.00	1,438
22	0.00	0.00	0.00	1,438
23	0.00	0.00	0.00	1,438
24	0.00	0.00	0.00	1,438
25	0.00	0.00	0.00	1,438
26	0.00	0.00	0.00	1,438
27	0.00	0.00	0.00	1,438
28	0.00	0.00	0.00	1,438
29	0.00	0.00	0.00	1,438
30	0.00	0.00	0.00	1,438
31	0.00	0.00	0.00	1,438
MAX	0.00	0.00	0.00	m3/d
MIN	0.00	0.00	0.00	
AVERAGE	0.00	0.00	0.00	

It is noted that the site has ceased discharge because they need to conserve the water on the floor for dust suppression and site functioning.

4.2 Discharge Water's Quality Data

As is required by Licence W/502/22, the site monitors water quality of the final discharge from the site on a Quarterly basis. The laboratory Certificate of Analysis is presented in Appendix A. Discharge Licence W/502/22 specifies ELVs for the **final discharge** after the attenuation system and oil and petrol interceptor. However, in the absence of a pumped discharge, a sample of the floor's sump waters was collected and is presented in Table 2 with each parameter's ELV for the monitoring period.

Table 2 Ardgaineen Quarry Floor Sump Q1 2025

Green Highligt in Cells = Compliant			
			Q1 2025
Parameter:	Units	W/502/22 Emission Limit Value	21 January 2025
Hydrogen Ion (pH)	pH units	6 to 9	7.8
Biological Oxygen Demand (BOD)	mg/L	10.0	1.1
Suspended Solids	mg/L	10	< 4
Ammonium	mg/L N	0.03	< 0.02
Nitrate	mg/L N	18.00	9.77
Nitrite	mg/L N	0.05	0.02
Chemical Oxygen Demand (COD)	mg/L	15	< 10
Benzo(a)pyrene	µg/L	0.1	< 0.005
Total Hydrocarbons	µg/L	10	< 10.0
Total PAHs	µg/L	0.1	< 0.005
Southern Scientific Laboratory Reference			160311 (25-00882)

With reference to the results presented in Table 1, and the associated Certificates of Analysis in Appendix A, commentary is as follows:

- The pH of the floor's sump waters is 7.8pH and this is within the 6 to 9 pH Emission Limit Value.

- The floor's sump water's results are below the limit of detection of the laboratory analyser for Suspended Solids, Ammonium, COD, Benzo(a)pyrene, Total Hydrocarbons and Total PAHs. These suggest no contamination on the floor of the quarry.

- The floor's sump water's results for all parameters are within the Licence Limits (ELVs) for the Discharge, were there to be one, for pH, BOD, Nitrates, Nitrites and all parameters.

4.3 Continuous Data Recording

Given that there is no discharge from the site, there are no physiochemical results to report.

4.4 Groundwater Data

Condition 4 of the Licence states that "Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory". However, there are no wells on the operational quarry to which the Discharge Licence relates. Hydro-G has previously reported 11 Site Investigation boreholes on the floor of the quarry and none of those boreholes encountered groundwater strike.

There are site investigation greenfield boreholes for the lands to the east of the quarry but they are not within the operational quarry.

The "1. Scope" detail of the Opening of W/502/22 Discharge Licence states that

> "*This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required.*"

Given that there have been no successful groundwater strikes in 11 boreholes attempted within this quarry because the limestone is the competent Burren Formation Limestone. The aquifer is mapped as a Regionally Important Karst Conduit Aquifer. No groundwater transmissive conduits were discovered in the drilling completed on the floor of the operational quarry. Therefore there is nothing to report with respect to this Condition of the Licence.

5.0 Compliance with Licence Conditions

5.1 With respect to the Volumetric ELV Conditions: The site has ceased discharge, for the moment, because they need to conserve the water on the floor for dust suppression and site functioning.

5.2 With respect to Water Quality ELVs: Results presented in Table 2 indicates that the prescribed ELVs for the discharge were complied with for the floor's sump waters. If there were a discharge, the discharge would be compliant with the conditions of the licence.

6.0 Difficulties Encountered

6.1 As part of previous evaluations, Hydro-G supervised the drilling of eleven boreholes on the floor of the quarry and no groundwater was encountered. Therefore, there is no groundwater quality to report.

7.0 Register of Incidents

There were no 'serious incidents' to report with respect to this discharge during this reported period.

8.0 Conclusions

The site has ceased discharge for the moment. However, analysis of the floor's sump waters suggests that if there were a discharge, it would be compliant with the hydrochemical ELVs of the Licence.

Pamela Bartley

Dr. Pamela Bartley B.Eng, M.SC., Ph.D. MIEI

Appendix A

Laboratory Certificates of Analysis

Routine Quarterly Monitoring at the Site

southern scientific services ltd.

Certificate of Analysis

Customer:	Harrington Concrete and Quarries	**Project:**	G WD 1 Surface Water
Address:	Kilkelly Co Mayo	**Site**	Ardgainee
		Date Received:	22/01/2025
		Condition of Sample:	Satisfactory
Report to:	Amanda Tarpey	**Date Analysed:**	22/01/2025 - 05/02/2025
Customer PO		**Issue Date:**	05/02/2025
Quote No.	Q24-00756	**BATCH NUMBER:**	**25-00882**

Jake Grunfield
Laboratory Analyst

Index to symbols used & Notes

*	Analysis is not INAB accredited
**	Adapted from Standard Methods for the Examination of Water and Wastewater.
***	Customer specific limits
(F)	Analysis carried out at our Farranfore Laboratory.
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LOQ	Parameter Limit of Quantification
Note 6	Subcontracted Parameter.

Notes

- **The results relate only to the items tested.**
- **Opinions and interpretations expressed herein are outside the scope of INAB accreditation.**
- **The analysis report shall not be reproduced except in full without written approval of the laboratory.**
- **Sampling is outside the scope of the laboratory activities.**

Notes for Drinking Water samples

Note A	The water should not be aggressive
Note B	Compliance must be ensured with the conditions that [NO3]/50 + [NO2]/3 =1
Note C	Acceptable to customers and no abnormal change
Note D	In the case of surface water treatment, a parametric value not exceeding 1 NTU in the water ex treatment works must be strived for
Note F	Fluoridated supplies 0.8 mg/L; Natural supplies 1.5 mg/L.

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southern scientific services ltd.

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Customer Sample Ref:	GWD-1	**Customer Sample Code:**	
Project:	G WD 1 Surface Water	**Sampled By:**	Amanda Tarpey
Our Reference:	160311 (25-00882)	**Sample Matrix:**	Surface Water
Date Sampled:	21/01/2025	**Time Sampled:**	:

Method:		**Parameter:**	**Units**	**LOQ**	**Result**
		Chemical Analysis: (F)			
SCP 052		Hydrogen Ion (pH)	pH units	*4.0*	7.8
SCP 015		Biological Oxygen Demand (BOD)	mg/L	*1.0*	1.1
SCP 010		Suspended Solids	mg/L	*2*	< 4
SCP 027A		Total Ammonia	mg/L N	*0.02*	< 0.02
SCP 027G		Nitrate (calculated)	mg/L NO3	*1.11*	9.77
SCP 027F		Nitrite	mg/L NO2	*0.016*	0.016
SCP 016		Chemical Oxygen Demand (COD)	mg/L	*10*	< 10
SCP 060B		Benzo(a)pyrene	µg/L	*0.005*	< 0.005
SCP 115A		Total Petroleum Hydrocarbons (C10 - C40)	µg/L	*10.0*	< 10.0
		PAH's Water (default)			
		Chemical Analysis: (F)			
SCP 060B		Acenaphthene	µg/L	*0.005*	< 0.005
SCP 060B		Acenaphthylene	µg/L	*0.005*	< 0.005
SCP 060B		Anthracene	µg/L	*0.005*	< 0.005
SCP 060B		Benz(a)anthracene	µg/L	*0.005*	< 0.005
SCP 060B		Benzo(b)fluoranthene	µg/L	*0.005*	< 0.005
SCP 060B		Benzo(k)fluoranthene	µg/L	*0.005*	< 0.005
SCP 060B		Sum Benzo (b)&(k) fluoranthene	µg/L	*0.005*	< 0.005
SCP 060B		Benzo(ghi)perylene	µg/L	*0.005*	< 0.005
SCP 060B		Chrysene	µg/L	*0.005*	< 0.005
SCP 060B		Dibenz(a,h)anthracene	µg/L	*0.005*	< 0.005
SCP 060B	*	Fluoranthene	µg/L	*0.005*	< 0.005
SCP 060B		Fluorene	µg/L	*0.005*	< 0.005
SCP 060B		Indeno(1,2,3-cd)pyrene	µg/L	*0.005*	< 0.005
SCP 060B		Naphthalene	µg/L	*0.005*	< 0.005
SCP 060B		Phenanthrene	µg/L	*0.005*	< 0.005
SCP 060B		Pyrene	µg/L	*0.005*	< 0.005
SCP 060B		Total PAH's (sum of 16)	µg/L	*0.078*	< 0.078

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Appendix B

Entire Record of Results Reported

Green Highligt in Cells = Compliant										
			Q2 2023	Q3 2023	Q4 2023	Q1 2024 February	Q2 2024 May	Q3 2024	Q4 2024	Q1 2025
Parameter:	**Units**	**W/502/22 Emission Limit Value**	**07 June 2023**	**04 July 2023**	**04 December 2023**	**06 February 2024**	**03 May 2024**	**05 September 2024**	**13 November 2024**	**21 January 2025**
Hydrogen Ion (pH)	pH units	**6 to 9**	8.0	8.1	7.8	8.0	8.1	7.7	7.8	7.8
Biological Oxygen Demand (BOD)	mg/L	**10.0**	< 1.0	< 1.0	1.2	< 1.0	<0.1	<0.1	<0.1	1.1
Suspended Solids	mg/L	**10**	< 4	< 4	< 4	<4	< 4	**16**	**12**	< 4
Ammonium	mg/L N	**0.03**	0.03	< 0.02	0.03	**0.04**	0.02	**6.30**	0.03	< 0.02
Nitrate	mg/L N	**18.00**	1.47	1.22	1.73	not reported	10.24	1.56	11.38	9.77
Nitrite	mg/L N	**0.05**	0.012	< 0.005	< 0.005	not reported	0.020	0.03	0.05	0.02
Chemical Oxygen Demand (COD)	mg/L	**15**	< 10	< 10	< 10	<10	< 10	11.00	< 10	< 10
Benzo(a)pyrene	µg/L	**0.1**	not analysed	not analysed	not analysed	not reported	< 0.003	< 0.005	< 0.005	< 0.005
Total Hydrocarbons	µg/L	**10**	not analysed	not analysed	not analysed	not reported	not reported	< 10.0	< 10.0	< 10.0
Total PAHs	µg/L	**0.1**	not analysed	not analysed	not analysed	not reported	not reported	< 0.005	< 0.005	< 0.005
Southern Scientific Laboratory Reference			93347 (23-29240)	96104 (23-30235)	113177 (23-36432)	118896 (24-38390)	129163 (24-41909)	143769 (24-47350)	153060 (24-50550)	160311 (25-00882)

Hydro-G

Data Report 9

Q2 (2025)

Section 4 Discharge Licence W/502/22

(issued 7th June 2023)

at

Harrington Concrete and Quarries Ltd

Ardgaineen, Claregalway, Co. Galway

Prepared by Consultant Dr. Pamela Bartley, Hydro-G

Hydro-G

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Project No.: 25-14 Harringtons Ardgaineen

Date: 18th July 2025

Report Status: ISSUE_V1

Report Title: Data Report 9: Q2 (2025) Harringtons Concrete and Products Ltd. Discharge Licence W/502/22.

Pamela Bartley

Prepared by: ___________________________

Dr. Pamela Bartley B.Eng, M.SC., Ph.D.

NOTES:

This report is for the use solely of the party to whom it is addressed and no responsibility is accepted to any third party.

About the Author

Pamela Bartley is a water focussed civil engineer. She has 30 years of field-based practice in borehole drilling, groundwater monitoring and abstraction point management in limestone karst environments. Her Ph.D was a field based karst limestone environment study. She has also completed training with the GSI at their karst specialist course run in the Burren. Her primary qualification is a Diploma in Water and Wastewater Technology at Sligo RTC. She then completed her primary degree in Civil Engineering at Queens University, Belfast, followed by an M.Sc. in Environmental Engineering, followed by a field-based hydrogeologically focussed Ph.D. within the School of Civil Engineering at Trinity College, Dublin. Her key work areas are: groundwater development from large scale water supply boreholes, hydrogeological assessment of quarries and the evaluation of discharges to groundwater and surface waters. Pamela Bartley's company is Bartley Hydrogeology ltd., registered to trade as Hydro-G.

Pamela has successfully completed post doctorate 'Professional Development' formal course training in the areas of:

- PSDP & PSCS (IOSH certified, 2016);
- Karst Hydrogeology (GSI, 2013);
- On Site Wastewater & Water Services Amendment Act 2012 (IE, Western Region 6-week programme 2012 & Dublin 2012);
- Zero Discharge Willow Wastewater Systems Design Courses (Denmark 2008 & 2011 & Ireland 2012);
- Expert Witness (IE, 2011);
- Planning & Development Act (IE, 2010);
- Surface Water Regulations 2009 (DoE, 2010 & 2011);
- Sustainable Drainage (Wallingford/CIRIA, 2005 & 2008);
- Source Protection Zone Delineation (IGI/GSI, 2007);
- Groundwater & Contaminant Microbiology (IGI/GSI, 2006);
- Applied Groundwater Modelling (ESI, UK, 2000);
- Site Suitability Assessment (FETAC, 2002).

As a result of work in evaluating planning appeals, Pamela has become specialist in planning evaluations in the context of enacted Irish Regulation and EU Directives concerning the water environment such as the Groundwater Regulations (S.I. No. 9 of 2010), Surface Water Regulations (S.I. No. 272 of 2009), Water Framework and Habitats' Directives. Pamela is a qualified and certified 'Site Assessor' and interviewer of examination candidates in respect of eligibility for the Site Suitability FETAC Qualification. In the past, she has lectured in third level institutions (WIT, CIT, 1996 – 1999), delivered practical laboratory instruction in the assessment of subsoils for the FETAC Site Assessor programme and demonstrated hydraulics laboratory modules at Trinity College Dublin (1996). She has been an invited guest speaker at An Board Pleanála, The Irish Concrete Federation, The Health Service Executive, Environmental Health Officers National Conference, The Irish Planning Institute's National Conference, The International Association of Hydrogeologists National Conference (Irish Branch) and has delivered hydrogeological lectures to the public during Science Week.

Hydro-G is the registered trading name of Pamela Bartley's company Bartley Hydrogeology Ltd., a company registered in Galway Ireland. The company holds requisite employer's and public liability insurances. In addition, the company holds professional indemnity insurance of €2million.

Pamela is qualified and IOSH certified to act as PSDP (Project Supervisor Design Phase) & PSCS (Project Supervisor Construction Stage) as defined by the Construction Regulations. The company is a registered Irish Water Supplier (no. 1855) and Pamela Bartley is HSQE approved within Irish Water.

Contents

1.0 Introduction

Licence W/502/22 stipulates return of results on a Quarterly basis. Hydro G was commissioned by Harringtons Concrete and Products Ltd to prepare this Licence Conditions Compliance & Data Report for the **2nd Quarter 2025** Discharge Licence in place for the quarry operation at Ardgaineen, Claregalway, Co. Galway (Galway County Council Licence Ref. No: W/502/22, issued 7th June 2023). This report has been prepared to fulfil this requirement and pertains to the **9th** reporting period since the Licence was issued.

2.0 Discharge Licence Conditions

Licence conditions relevant to this report include the following:

1. Scope

This Licence refers to the attenuation sump discharge of Harrington Concrete and Quarries located at Ardgaineen, Claregalway, Co. Galway. Surface water run-off and ground water collected in the quarry attenuation sump are pumped to a Wetland Vegetation Area, *via* a petrol/oil interceptor, where water percolates to ground. This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required. **The maximum permitted discharge is 1,483m3 per day.**

2. Attenuation Sump Discharge.

2.1 **Discharge:** The Licencee shall not discharge, cause or permit the discharge, of any contaminated surface water or process water directly to any surface water or groundwater without prior treatment.

2.2 **Treated Discharge:** The discharge shall be discharged to groundwater without posing a pollution risk.

2.3 **Discharge Performance Standards:** The treated discharge, **prior to its release** to the Wetland Vegetation Area, shall comply with the following standards:

(a) The **Total Suspended Solids** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(b) The **Biochemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 10 mg/l.

(c) The **Chemical Oxygen Demand** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 15 mg/l.

(d) The **Nitrate (NO_3-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 18 mg/l.

(e) The **Nitrite (NO_2-)** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.05 mg/l.

(f) The **Total Hydrocarbon** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.01 mg/l.

(g) The **Total Ammonia** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.03mg/l.

(h) The **Benzo (a) pyrene** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(i) The **Total PAH** concentration of the Discharge from the attenuation sump and oil interceptor shall not exceed 0.00001 mg/l.

(j) The **pH** of the Discharge from the attenuation sump and oil interceptor shall be in the range 6 - 9 pH units.

(k) The **Flow** of the Discharge from the attenuation sump and oil interceptor shall not exceed 1,483 m3/day.

(l) The **Colour** of the Discharge from the attenuation sump should not change significantly from day to day nor shall there be any evidence of oil or excess solids on visual inspection.

(m) The **Conductivity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

(n) The **Turbidity** of the Discharge from the attenuation sump and oil interceptor shall not change significantly from day to day.

3. Discharge Analysis

Analysis of the treated water prior to discharge shall be carried out by an approved accredited laboratory where readings are not taken on site. The frequency of analysis and the parameters are outlined below. Quarterly results shall be forwarded to the environment section.

Parameter	Monitoring Frequency	Analysis to be performed by accredited laboratory
Flow	Continuous - Daily	
Colour and Visual inspection	Daily	
Conductivity	Continuous - Daily	
Turbidity	Continuous - Daily	
pH	Continuous - Daily	
Total Suspended Solids	Quarterly	√
Nitrates NO_3^-	Quarterly	√
Nitrites NO_2^-	Quarterly	√
Chemical Oxygen Demand	Quarterly	√
Biochemical Oxygen Demand	Quarterly	√
Total Ammonia	Quarterly	√
Total PAH	Quarterly	√
Benzo (a) Pyrene	Quarterly	√
Total Hydrocarbons including Diesel Range Organics and Petroleum Range Organics	Quarterly	√

4. Groundwater Analysis

Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory. The following parameters shall be measured and analysis of same forwarded to the Environment Section of Galway County Council:

Parameter	Units
(a) Water Level	mAOD
(b) pH	pH units
(c) Conductivity	uS/cm
(d) Suspended Solids	mg/l
(e) Nitrates	mg/l No_3^-
(f) Total Hydrocarbons	mg/l

Where quarrying activities are found to adversely affect local water supplies the provisions of the EPA Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)', Section 3.3.1 shall apply, and the quarry shall provide a replacement water supply.

5. Petrol / Oil Interceptor

The petrol / oil interceptor should be inspected each working day to ensure it is operating correctly and daily records kept of this. These records should be made available to Galway County Council if requested.

Other matters in the licence include details about the following. Readers are referred to the Licence itself for specific detail.

6. Attenuation sump, petrol/oil interceptor & wetland area

6.1 Treatment Process – must be able to achieve the Treatment Standards of Condition 2.3.
6.2 Metering – Install Flow Meter, record Daily Discharge, report Quarterly. Limit 1,483m3/d.
6.3 Ready Access – must be allowed for Authorised Persons under the Water Pollution Acts.
6.4 Sampling – Sampling Chamber after treatment and before wetland. Plus access required.
6.5 Caretaker – Day to Day Inspection. Notified Person named and details supplied to GCC.
6.6 Notification of Non-Compliance – Make GCC aware, record details of noncompliance.

7. EPA Guidelines

All works must be carried out in accordance with the EPA Guidelines 'Environmental Management Guidelines 'Environmental Management in the Extractive Industry (non-scheduled Minerals)'.

8. Annual Contribution

€550 due annually. Shall be adjusted with the Customer Price Index value. GCC can increase.

9. Changes in Ownership

GCC to be notified in writing if change in company ownership or Trading Name.

3.0 Person Responsible for Caretaking at the Site

Mr. John Gibbons, the quarry manager, is responsible for inspections and maintenance of the infrastructure associated with the discharge. Mr. Gibbons' contact details are on file with Galway County Council.

4.0 Site Data - Monitoring Results

4.1 Flow Data

The site's flow was fully automated on the 7th of February 2024. Results are presented in Table 1.

Table 1 Daily discharge volumes (m3/d) Q1& Q2 2025 & Statistics: Max, Min, Mean Daily

Day	Jan-25	Feb-25	Mar-25	Apr-25	May-25	Jun-25	
1	0.0	0.0	0.0	0.0	108.1	34.7	
2	0.0	0.0	0.0	0.0	150.4	35.0	
3	0.0	0.0	0.0	0.0	169.0	88.8	
4	0.0	0.0	0.0	0.0	188.0	56.4	
5	0.0	0.0	0.0	0.0	70.0	58.5	
6	0.0	0.0	0.0	0.0	67.3	27.1	
7	0.0	0.0	0.0	0.0	131.4	2.3	
8	0.0	0.0	0.0	0.0	136.0	4.1	
9	0.0	0.0	0.0	0.0	84.3	17.7	
10	0.0	0.0	0.0	0.0	64.2	17.5	
11	0.0	0.0	0.0	0.0	73.4	12.6	
12	0.0	0.0	0.0	0.0	245.0	19.0	
13	0.0	0.0	0.0	7.0	185.6	13.7	
14	0.0	0.0	0.0	30.7	132.6	14.5	
15	0.0	0.0	0.0	6.5	47.9	1.2	
16	0.0	0.0	0.0	0.6	13.8	15.0	
17	0.0	0.0	0.0	0.6	16.2	14.4	
18	0.0	0.0	0.0	0.2	0.1	15.1	
19	0.0	0.0	0.0	0.0	0.0	32.0	
20	0.0	0.0	0.0	0.0	16.2	73.0	
21	0.0	0.0	0.0	0.0	13.7	77.8	
22	0.0	0.0	0.0	0.0	91.3	29.7	
23	0.0	0.0	0.0	0.0	191.4	16.5	
24	0.0	0.0	0.0	85.9	264.5	20.2	
25	0.0	0.0	0.0	103.2	255.7	39.8	
26	0.0	0.0	0.0	34.2	228.7	34.3	
27	0.0	0.0	0.0	31.0	97.2	58.5	**Total Volume Discharged Q2 m3**
28	0.0	0.0	0.0	30.1	56.0	21.4	
29	0.0		0.0	**18.4**	62.1	36.6	
30	0.0		0.0	35.6	49.2	135.8	
31	0.0		0.0		35.9		**4,653**
MAXIMUM PERMITTED (m3/d)	**1,483**	**1,483**	**1,483**	**1,483**	**1,483**	**1,483**	
Maximim Discharged m3/d	**0.0**	**0.0**	**0.0**	**103.2**	**264.5**	**135.8**	
Minimum Discharged m3/d	0.0	0.0	0.0	0.0	0.0	1.2	
Average Discharged m3/d	0.0	0.0	0.0	12.8	104.7	34.1	

With respect to the data presented in Table 1 for Daily Discharge and associated characteristics:

- It is noted that the site sometimes cease discharge because they need to conserve the water on the floor for dust suppression and site functioning. There was no discharge in Q1.
- In Q2, Daily Discharge volume complied with the Emission Limit Value for discharge volume, which is 1,483m3/d.
- In Q2, the maximum volume discharged in any one day was 264.5m3/d and the minimum was zero.
- Overall, it is concluded that the licencee is compliant with the ELV for Volume.
- In Table 1 the discharge volume for the 29th of April 2025 is emphasised with **BOLD** text because on that day a discharge sample was taken for analysis at an accredited laboratory. It is noted that the site had been discharging for 5 consecutive days in advance of the sample collection.

4.2 Discharge Water's Quality Data

As is required by Licence W/502/22, the site monitors water quality of the final discharge from the site on a Quarterly basis. The laboratory Certificate of Analysis is presented in Appendix A. Discharge Licence W/502/22 specifies ELVs for the **final discharge** after the attenuation system and oil and petrol interceptor. Results are presented in Table 2 with each parameter's ELV for the monitoring period.

Table 2 Ardgaineen Quarry Discharge Quality Q2 2025 & Licence ELVs and comments.

Harringtons Ardgaineen Discharge Quality		DISCHARGE RESULT Q2 2025 (April 2025)	W/502/22 Emission Limit Value	Hydro-G Comment Q2 2025
Hydrogen Ion (pH)	pH units	7.7	6 to 9	Q2 Compliant & Always Compliant
Biological Oxygen Demand	mg/L	< 1.0	10.0	BOD is <1.0= Compliant and excellent quality.
Suspended Solids	mg/L	< 4	10	SS is <LOD of Analyser = Compliant and excellent quality
Total Ammonia	mg/L N	< 0.02	0.03	<LOD of Analyser = Compliant and excellent quality
Nitrate	mg/L N	2.13	18.00	Lab reporting of Nitrate as 2.13 mg/l NO3-N = 9.4 mg/l as NO3, where the licnce ELV is 18 mg/l as NO3. COMPLIANT.
Nitrite	mg/L N	< 0.005	0.05	Compliant. Result is an Order of Magnitude lower than permitted
Chemical Oxygen Demand	mg/L	< 10	15	Always Compliant, Always <LOD
Benzo(a)pyrene	µg/L	< 0.005	0.1	Always Compliant, Always <LOD
Total Hydrocarbons	µg/L	< 10.0	10	Hydrocarebons are <LOD = Compliant
Total PAHs	µg/L	< 0.078	0.1	Total PAHs are > LOD and Always Compliant
Laboratory Report Reference		25-06005	Overall Comment = Good Quality and ELVs of the Licence Compliant.	

With reference to the results presented in Table 2, and the associated Certificates of Analysis in Appendix A, commentary is as follows:

- The pH of the discharge is 7.7pH and this is within the 6 to 9 pH Emission Limit Value.

- The results for discharge quality are below the limit of detection of the laboratory analyser for BOD, Suspended Solids, Total Ammonia, Nitrite, COD, Benzo(a)pyrene, Total Hydrocarbons and Total PAHs. These results suggest a good quality discharge.

- The discharge results for all parameters are within the Licence Limits (ELVs) and the site is fully compliant on a hydrochemical basis.

4.3 Continuous Data Recording

The site's discharge is instrumented with a continuous flow meter with physiochemical sensors for parameters as specified in the Licence as follows:

- Flow
- pH
- Turbidity
- Conductivity

Data are collected at 5 minute intervals and reported to the service provider's telemetric data service HydroVU. The data service provider is Capital Water Solutions Limited (CWSL), Co. Roscommon.

The quarry manager is responsible for daily log in to the telemetric system, visual inspections of the discharge and day to day management. CWSL also have alarms on their system that notify the office of issues relating to the instruments. The full data record is held in excel file format in Hydro-G's offices because there are 26,217 excel rows of data associated with 5 minute intervals for the reporting period. A graphical presentation of the data is shown in Graph 1, below.

The results for continuous monitoring show, as follows:

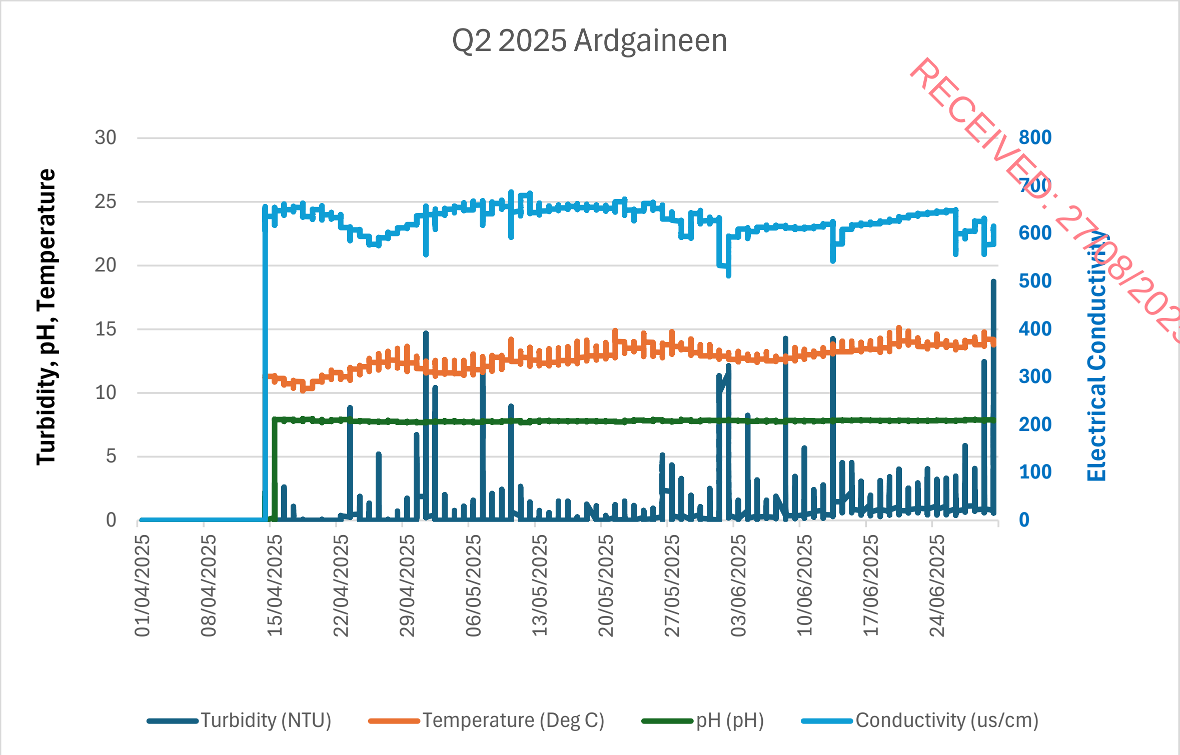
- Turbidity increases when the pumps start and this is a normal and expected phenomenon associate with the turbid flow condition in pipes. There is no receiving environmental significance to the range of results returned because after the sampling location the water flows over a Nature Based Solution vegetated system and any turbidity in the water, which is a result of pipe hydraulics, will have dissipated before discharge to groundwater.

- Temperature signal is slightly elevated but weather was very warm in Q2 2025. Again, the benefit of the discharge across the area of the Nature Based Solution, and percolation through subsoil to groundwater, mitigates potential for impact.

- pH is relatively constant in the 7.6 – 7.9 pH range and within the 6 to 9 pH units ELV of the Licence.

- Electrical Conductivity is within the expected range for a limestone environment.

- The instruments naturally 'drift' but this is expected and will be routinely rectified.



Graph 1 Continuous record for field physiochemical parameters.

4.4 Groundwater Data

Condition 4 of the Licence states that "Quarterly analysis of groundwater monitoring wells will be carried out be an approved accredited laboratory". However, there are no wells on the operational quarry to which the Discharge Licence relates. Hydro-G has previously reported 11 Site Investigation boreholes on the floor of the quarry and none of those boreholes encountered groundwater strike.

There are site investigation greenfield boreholes for the lands to the east of the quarry but they are not within the operational quarry.

The "1. Scope" detail of the Opening of W/502/22 Discharge Licence states that

> "*This licence is for the exiting extraction are of 4.35ha granted under Substitute Consent (Ref SU0053) in February 2017. If planning permission is granted for an extension to the quarry, or there is an increase in quarrying discharge, a full review of this licence will be required.*"

Given that there have been no successful groundwater strikes in 11 boreholes attempted within this quarry because the limestone is the competent Burren Formation Limestone. The aquifer is mapped as a Regionally Important Karst Conduit Aquifer. No groundwater transmissive conduits were discovered in the drilling completed on the floor of the operational quarry. Therefore there is nothing to report with respect to this Condition of the Licence.

5.0 Compliance with Licence Conditions

5.1 With respect to the Volumetric ELV Conditions:

- Overall, it is concluded that the licencee is compliant with the ELV for Volume.
- In Q2, the maximum volume discharged in any one day was 264.5m3/d and the minimum was zero.
- In Q2, the total volume discharged was 4,653m3 over the course of 90 days. That value of 4,653m3 total is equivalent to a volume permitted over the course of c.3.1 days.
- Assimilation capacity simulations for the characteristics of the receiving environment presented for the site at the time of Licence application demonstrated that groundwater, and associated downgradient surface water, could assimilate a total daily volume of 1,483 m3/d without risk or compromise of WFD Objectives.
- Given that the site discharges a fraction of this and has demonstrated its capacity to attenuate all waters arising, risk is deemed negligible.

5.2 With respect to Water Quality ELVs:

- Accredited laboratory results presented in Table 2 suggest that the discharge's results for all parameters are within the Licence Limits (ELVs) and the site is fully compliant on a hydrochemical basis.
- Continuous Monitoring data for pH, Temperature, Electrical Conductivity and Turbidity demonstrate that the site's discharge presents no risk to the receiving environment by virtue of the fact that the flow of the discharge across the area of the Nature Based Solution, that is its discharge mechanism to groundwater, will dissipate the occasional turbidity spikes that results from pipe hydraulics when the pumps are turned on and also mitigates against the slightly higher than normal temperatures resulting from hot weather.

6.0 Difficulties Encountered

6.1 As part of previous evaluations, Hydro-G supervised the drilling of 11 boreholes on the floor of the quarry and no groundwater was encountered. Therefore, there is no groundwater quality to report. Other than that, there were no difficulties encountered.

7.0 Register of Incidents

There were no 'serious incidents' to report with respect to this discharge during this reported period.

8.0 Conclusions

The site is in full compliance with the ELVs for volume and hydrochemical quality.

Pamela Bartley

Dr. Pamela Bartley B.Eng, M.SC., Ph.D. MIEI

Appendix A

Laboratory Certificates of Analysis

Routine Quarterly Monitoring at the Site

southern scientific services ltd.

RECEIVED: 27/08/2025

Certificate of Analysis

Customer:	Harrington Concrete and Quarries	**Project:**	G WD 1 Surface Water
Address:	Kilkelly Co Mayo	**Site**	Ardgainee
		Date Received:	29/04/2025
		Condition of Sample:	Satisfactory
Report to:	Amanda Tarpey	**Date Analysed:**	29/04/2025 - 26/05/2025
Customer PO		**Issue Date:**	26/05/2025
Quote No.	Q24-00756	**BATCH NUMBER:**	**25-06005**

Aoife Moriarty

Aoife Moriarty
Chemistry Laboratory Manager

Index to symbols used & Notes

*	Analysis is not INAB accredited
**	Adapted from Standard Methods for the Examination of Water and Wastewater.
***	Customer specific limits
(F)	Analysis carried out at our Farranfore Laboratory.
(D)	Analysis carried out at our Dunrine Laboratory.
LOQ	Parameter Limit of Quantification
Note 6	Subcontracted Parameter.

Notes

- **The results relate only to the items tested.**
- **Opinions and interpretations expressed herein are outside the scope of INAB accreditation.**
- **The analysis report shall not be reproduced except in full without written approval of the laboratory.**
- **Sampling is outside the scope of the laboratory activities.**

Notes for Drinking Water samples

Note A	The water should not be aggressive
Note B	Compliance must be ensured with the conditions that [NO3]/50 + [NO2]/3 =1
Note C	Acceptable to customers and no abnormal change
Note D	In the case of surface water treatment, a parametric value not exceeding 1 NTU in the water ex treatment works must be strived for
Note F	Fluoridated supplies 0.8 mg/L; Natural supplies 1.5 mg/L.

(registered office)
4 park business centre | farranfore | county kerry | ireland | telephone +353 66 976 3588 | fax +353 66 976 3589
dunrine | killarney | county kerry | ireland | telephone +353 64 66 33922 | fax +353 64 66 39022

web site www.southernscientificireland.com | e-mail info@southernscientificireland.com

directors: K. Murphy, M. Murphy & C. Murphy
registered in ireland no 323196 | vat reg no IE 6343196 M

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.194T

southern scientific services ltd.

Report No. 25-06005 Rev 0

Customer Sample Ref:	GWD-1	**Customer Sample Code:**	
Project:	G WD 1 Surface Water	**Sampled By:**	Amanda Tarpey
Our Reference:	174672 (25-06005)	**Sample Matrix:**	Surface Water
Date Sampled:	29/04/2025	**Time Sampled:**	13:00

Method:		Parameter:	Units	LOQ	Result
		Chemical Analysis: (F)			
SCP 052		Hydrogen Ion (pH)	pH units	*4.0*	7.7
SCP 015		Biological Oxygen Demand (BOD)	mg/L	*1.0*	< 1.0
SCP 010		Suspended Solids	mg/L	*2*	< 4
SCP 027A		Total Ammonia	mg/L N	*0.02*	< 0.02
SCP 027G		Nitrate (calculated)	mg/L N	*0.25*	2.13
SCP 027F		Nitrite	mg/L N	*0.005*	< 0.005
SCP 016		Chemical Oxygen Demand (COD)	mg/L	*10*	< 10
SCP 115A		Total Petroleum Hydrocarbons (C10 - C40)	µg/L	*10.0*	< 10.0
		PAH's Water (default)			
		Chemical Analysis: (F)			
SCP 060B		Acenaphthene	µg/L	*0.005*	< 0.005
SCP 060B		Acenaphthylene	µg/L	*0.005*	< 0.005
SCP 060B		Anthracene	µg/L	*0.005*	< 0.005
SCP 060B		Benz(a)anthracene	µg/L	*0.005*	< 0.005
SCP 060B		Benzo(a)pyrene	µg/L	*0.005*	< 0.005
SCP 060B		Benzo(b)fluoranthene	µg/L	*0.005*	< 0.005
SCP 060B		Benzo(k)fluoranthene	µg/L	*0.005*	< 0.005
SCP 060B		Sum Benzo (b)&(k) fluoranthene	µg/L	*0.005*	< 0.005
SCP 060B		Benzo(ghi)perylene	µg/L	*0.005*	< 0.005
SCP 060B		Chrysene	µg/L	*0.005*	< 0.005
SCP 060B		Dibenz(a,h)anthracene	µg/L	*0.005*	< 0.005
SCP 060B	*	Fluoranthene	µg/L	*0.005*	< 0.005
SCP 060B		Fluorene	µg/L	*0.005*	< 0.005
SCP 060B		Indeno(1,2,3-cd)pyrene	µg/L	*0.005*	< 0.005
SCP 060B		Naphthalene	µg/L	*0.005*	< 0.005
SCP 060B		Phenanthrene	µg/L	*0.005*	< 0.005
SCP 060B		Pyrene	µg/L	*0.005*	< 0.005
SCP 060B		Total PAH's (sum of 16)	µg/L	*0.078*	< 0.078

Appendix B

Entire Record of Results Reported

Harringtons Ardgaineen Discharge Quality		Q1 2024 February	Q1 2024 March	Q2 2024 May	Q3 2024 September	Q4 2024 (November)	Q1 2025 (January)	DISCHARGE RESULT Q2 2025 (April 2025)	W/502/22 Emission Limit Value
Hydrogen Ion (pH)	pH units	8	8.1	8.1	7.7	7.8	7.8	**7.7**	**6 to 9**
Biological Oxygen Demand	mg/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.1	**< 1.0**	**10.0**
Suspended Solids	mg/L	<4	4	< 4	**16**	**12**	< 4	**< 4**	**10**
Total Ammonia	mg/L N	**0.04**	< 0.02	0.02	**6.30**	0.03	< 0.02	**< 0.02**	**0.03**
Nitrate	mg/L N	not reported	1.63	10.24	1.56	11.38	9.77	**2.13**	**18.00**
Nitrite	mg/L N	not reported	< 0.005	0.02	0.03	0.05	0.02	**< 0.005**	**0.05**
Chemical Oxygen Demand	mg/L	<10	< 10	< 10	11	< 10	< 10	**< 10**	**15**
Benzo(a)pyrene	µg/L	not reported	< 0.003	< 0.003	< 0.005	< 0.005	< 0.005	**< 0.005**	**0.1**
Total Hydrocarbons	µg/L	not reported	**33.7**	not reported	< 10.0	< 10.0	< 10.0	**< 10.0**	**10**
Total PAHs	µg/L	not reported	< 0.078	not reported	< 0.078	< 0.078	< 0.078	**< 0.078**	**0.1**
Laboratory Report Reference		**24-38390**	**24-39473**	**24-41909**	**24-47350**	**24-50550**	**25-00882**	**25-06005**	**Licence**

Appendix 8.2

Uisce Eireann's Response to Scoping and Hydro-G's Responses

For the attention of Peter Kinghan
Quarry Consulting
Unit 3, Cedar Crescent,
Cedar Park,
Westport,
Co. Mayo, F28 PN47.

Uisce Éireann
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Baile Átha Cliath 1
D01 WA07
Éire

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PO Box 6000
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T: +353 1 89 25000
F: +353 1 89 25001
www.water.ie

Date: 23rd August 2023

By Email: pkinghan@quarryconsulting.ie

Re: EIA Scoping Request – Proposed Extension of an Existing Limestone Quarry.

Dear Peter Kinghan,

Uisce Éireann has received notification of your Environmental Impact Assessment (EIA) scoping request relating to Harrington Concrete & Quarries Ltd.'s forthcoming application which comprises of an 8.7 Ha lateral extension to an existing limestone quarry, the main area of which lies immediately to the northeast of the existing site.

Please see attached, Uisce Éireann's scoping opinion in relation to Water Services. On receipt of the planning referral, Uisce Éireann will review the finalised Environmental Impact Assessment Report (EIAR) as part of the planning process.

Queries relating to the terms and the EIA scoping opinions below should be directed to planning@water.ie

PP. *Ali Robinson*

Yvonne Harris

Connections and Developer Services

Uisce Éireann's Response to EIA Scoping Requests

At present, Uisce Éireann does not have the capacity to advise on the scoping of individual projects. However, in general the following aspects of Water Services should be considered in the scope of an EIA where relevant;

a) Where the development proposal has the potential to impact an Uisce Éireann Drinking Water Source(s), the applicant shall provide details of measures to be taken to ensure that there will be no negative impact to Uisce Éireann's Drinking Water Source(s) during the construction and operational phases of the development. Hydrological / hydrogeological pathways between the applicant's site and receiving waters should be identified as part of the report.

b) Where the development proposes the backfilling of materials, the applicant is required to include a waste sampling strategy to ensure the material is inert.

c) Mitigations should be proposed for any potential negative impacts on any water source(s) which may be in proximity and included in the environmental management plan and incident response.

d) Any and all potential impacts on the nearby reservoir as public water supply water source(s) are assessed, including any impact on hydrogeology and any groundwater/ surface water interactions.

e) Impacts of the development on the capacity of water services (*i.e. do existing water services have the capacity to cater for the new development*). This is confirmed by Uisce Éireann in the form of a Confirmation of Feasibility (COF). If a development requires a connection to either a public water supply or sewage collection system, the developer is advised to submit a Pre-Connection Enquiry (PCE) enquiry to Uisce Éireann to determine the feasibility of connection to the Uisce Éireann network.

   All pre-connection enquiry forms are available from https://www.water.ie/connections/connection-steps/.

f) The applicant shall identify any upgrading of water services infrastructure that would be required to accommodate the proposed development.

g) In relation to a development that would discharge trade effluent – any upstream treatment or attenuation of discharges required prior to discharging to an Uisce Éireann collection network.

h) In relation to the management of surface water; the potential impact of surface water discharges to combined sewer networks and potential measures to minimise and or / stop surface waters from combined sewers.

i) Any physical impact on Uisce Éireann assets – reservoir, drinking water source, treatment works, pipes, pumping stations, discharges outfalls etc. including any relocation of assets.

j) When considering a development proposal, the applicant is advised to determine the location of public water services assets, possible connection points from the applicant's site / lands to the public network and any drinking water abstraction catchments to ensure these are included and fully assessed in any pre-planning proposals. Details, where known, can be obtained by emailing an Ordnance Survey map identifying the proposed location of the applicant's intended development to datarequests@water.ie

k) Other indicators or methodologies for identifying infrastructure located within the applicant's lands are the presence of registered wayleave agreements, visible manholes, vent stacks, valve chambers, marker posts etc. within the proposed site.

l) Any potential impacts on the assimilative capacity of receiving waters in relation to Uisce Éireann discharge outfalls including changes in dispersion / circulation characterises. Hydrological / hydrogeological pathways between the applicant's site and receiving waters should be identified within the report.

m) Any potential impact on the contributing catchment of water sources either in terms of water abstraction for the development (*and resultant potential impact on the capacity of the source*) or the potential of the development to influence / present a risk to the quality of the water abstracted by Uisce Éireann for public supply should be identified within the report.

n) Where a development proposes to connect to an Uisce Éireann network and that network either abstracts water from or discharges wastewater to a "protected"/ sensitive area, consideration as to whether the integrity of the site / conservation objectives of the site would be compromised should be identified within the report.

o) Mitigation measures in relation to any of the above ensuring a zero risk to any Uisce Éireann drinking water sources (Surface and Ground water).

This is not an exhaustive list.

Please note:

- Where connection(s) to the public network is required as part of the development proposal, applicants are advised to complete the Pre-Connection Enquiry process and have received a Confirmation of Feasibility letter from Uisce Éireann ahead of any planning application.

- Uisce Éireann will not accept new surface water discharges to combined sewer networks.

Key points from returned by Uisce *Éireann*'s response, to Quarry Consulting's Pre Planning Scoping, dated the 23rd August 2023, are responded to by Hydro-G, as follows:

"At present, Uisce Éireann does not have the capacity to advise on the scoping of individual projects. However, in general the following aspects of Water Services should be considered in the scope of an EIA where relevant:

***Uisce Éireann** a) Where the development proposal has the potential to impact an Uisce Éireann Drinking Water Source(s), the applicant shall provide details of measures to be taken to ensure that there will be no negative impact to Uisce Éireann's Drinking Water Source(s) during the construction and operational phases of the development. Hydrological / hydrogeological pathways between the applicant's site and receiving waters should be identified as part of the report.*

Hydro-G's Response:

(i) The development does not have the potential to impact on an Uisce Éireann Drinking Water Source(s).

(ii) The above statement is confidently asserted because the development has a Section 4 Discharge Licence for 1,483 m3/day permitted Emission Limit Volume (discharge) as specified in the Section 4 Discharge licence W/502/22. The 1,483 m3/d ELV was sanctioned in 2023 by Galway County Council because it was proven to be Groundwater, Surface Water and Birds and Habitats Regulations compliant.

(iii) Although Lough Corrib is a source for Public Water Supply with Uisce Eireann WTPs and associated intakes at Luimnagh and at Terryland, the application site's water balance component is miniscule compared to the volume of waters entering Lough Corrib from the Corrib catchment.

(iv) With respect to the 'Source > Pathway > Receptor' pathway model, the following can be stated:

a. The application site is not connected to the Luimnagh intake because groundwater flow direction from the quarry is to the south west and the Luimnagh intake is north west of the quarry.

b. There is a sufficiently robust control on the 'Source' at the quarry, by virtue of the hydrocarbon interceptor installed as a Condition of the Section 4 Discharge licence W/502/22 and the 'Pathway' volume of water in Lough Corrib precludes impact at the Terryland location.

***Uisce Éireann** b) Where the development proposes the backfilling of materials, the applicant is required to include a waste sampling strategy to ensure the material is inert.*

Hydro-G's Response: *For now, the proposal under consideration is extraction. The Restoration Phase will include a waste sampling strategy to ensure the material is inert.*

Uisce Éireann *c) Mitigations should be proposed for any potential negative impacts on any water source(s) which may be in proximity and included in the environmental management plan and incident response.*

Hydro-G's Response*: The* Section 4 Discharge licence W/502/22 sanctioned in 2023 by Galway County Council provides for Mitigation by Conditioned operation. The Environmental Management Plan and Incident Response system is a company procedure already adopted and established by the operation of the adjacent working quarry site.

Uisce Éireann *d) Any and all potential impacts on the nearby reservoir as public water supply water source(s) are assessed, including any impact on hydrogeology and any groundwater/ surface water interactions.*

Hydro-G's Response: There are no structural reservoirs in proximity to the application area or adjacent operational site. The EIA process has been completed and the EIAR has concluded no potentials for impact on hydrogeology and any groundwater/ surface water interactions.

Uisce Éireann *e) Impacts of the development on the capacity of water services (i.e. do existing water services have the capacity to cater for the new development). This is confirmed by Uisce Éireann in the form of a Confirmation of Feasibility (COF). If a development requires a connection to either a public water supply or sewage collection system, the developer is advised to submit a Pre-Connection Enquiry (PCE) enquiry to Uisce Éireann to determine the feasibility of connection to the Uisce Éireann network. All pre-connection enquiry forms are available from https://www.water.ie/connections/connection-steps/*

Hydro-G's Response: This is not applicable to the application site. With respect to water supply, the site has a metered connection with Irish Water, which serves mains supply on all perimeter roads to the quarry. The application is for extension to work new materials. There will be no intensification. No increase in water usage is envisaged.

Uisce Éireann *f) The applicant shall identify any upgrading of water services infrastructure that would be required to accommodate the proposed development.*

Hydro-G's Response: Again, this is not applicable to the application site. No upgrading of water services infrastructure is envisaged. The application is for extension to work new materials. There will be no intensification. No increase in water usage is envisaged.

Uisce Éireann *g) In relation to a development that would discharge trade effluent – any upstream treatment or attenuation of discharges required prior to discharging to an Uisce Éireann collection network.*

Hydro-G's Response: The applicant does not and will not need to discharge to any Uisce Éireann collection network. The site is self-sufficient with respect to wastewater arisings and the treatment and discharge are EPA (1999 and 2021 CoP) compliant. The site holds a valid Section 4 Discharge licence for the management of waters arising on the floor of the quarry. Discharge is to Groundwater *via* a Nature Based System wetland, with an oil interceptor and constant monitoring for flow, pH, Electrical Conductivity and Turbidity.

Uisce Éireann *h) In relation to the management of surface water; the potential impact of surface water discharges to combined sewer networks and potential measures to minimise and or / stop surface waters from combined sewers.*

Hydro-G's Response: This is not applicable to the site. The area is not serviced by an *Uisce Éireann collection network of any form of sewer.*

Uisce Éireann *i) Any physical impact on Uisce Éireann assets – reservoir, drinking water source, treatment works, pipes, pumping stations, discharges outfalls etc. including any relocation of assets.*

Hydro-G's Response: No interference or impact on Uisce Éireann assets will occur. The reasoning being that there are no Uisce Éireann assets within the application site or in surrounding lands. In addition, the Uisce Eireann Drinking Water Source and abstraction intakes on Lough Corrib are either not in hydrogeological connection with the site

Uisce Éireann *j) When considering a development proposal, the applicant is advised to determine the location of public water services assets, possible connection points from the applicant's site / lands to the public network and any drinking water abstraction catchments to ensure these are included and fully assessed in any pre-planning proposals. Details, where known, can be obtained by emailing an Ordnance Survey map identifying the proposed location of the applicant's intended development to datarequests@water.ie*

Hydro-G's Response: The site is existing development and all asset locations are known: there are no public water services assets. As outlined in the detail of the EAR's Water Chapter, the application site sits in the Corrib Hydrometric Area [30], the catchment of Lough Corrib and overlies the Clare Corrib Groundwater Body feeding Lough Corrib. The application site is therefore in the overall drinking water abstraction catchment of Lough Corrib. However, the application of the 'Source > Pathway > Receptor' pathway model, enabled a conclusion of no potential for impact of the proposed development. The application site is adjacent to a working quarry that has been in operation for a long time and there has never been an incident with respect to EPA WFD compliance or any water contamination.

Uisce Éireann *k) Other indicators or methodologies for identifying infrastructure located within the applicant's lands are the presence of registered wayleave agreements, visible manholes, vent stacks, valve chambers, marker posts etc. within the proposed site.*

Hydro-G's Response: This is not applicable to the application site, with respect to public water services water or wastewater assets. The application site is greenfield and currently in grass pasture with potential for low intensity grazing. There is no potential for mains network within the application site because there are no roads and no connected dwellings using services that would require field crossing mains.

Uisce Éireann *l) Any potential impacts on the assimilative capacity of receiving waters in relation to Uisce Éireann discharge outfalls including changes in dispersion / circulation characterises. Hydrological / hydrogeological pathways between the applicant's site and receiving waters should be identified within the report.*

Hydro-G's Response: The Hydro-G (2022) assimilation capacity report supporting the application for and grant of the Section 4 Discharge Licence W/502/22 demonstrated no potential for impact and no potential for alteration of the assimilative capacity of the receiving underlying Clare Corrib Groundwater Body. Upon due consideration of the Hydro-G Report (2022) Galway County Council granted the licence in 2023. Therefore, the works and assessment are current and in compliance with current legislation regarding water. The Hydro-G (2022) report is presented as Appendix 8.1 with a copy of the W/502/22 Discharge Licence. A previously stated, the application of the 'Source > Pathway > Receptor' pathway model, enabled a conclusion of no potential for impact of the proposed development. The application site is adjacent to a working quarry that has been in operation for a long time and there has never been an incident with respect to EPA WFD compliance or any water contamination.

Uisce Éireann *m) Any potential impact on the contributing catchment of water sources either in terms of water abstraction for the development (and resultant potential impact on the capacity of the source) or the potential of the development to influence / present a risk to the quality of the water abstracted by Uisce Éireann for public supply should be identified within the report.*

***Hydro-G's Response**: The site does not abstract water and therefore there will be no quantitative impact and there is no potential to impact on the capacity of the source. Lough Corrib is the largest lake in the Republic of Ireland. The west of Ireland is the wettest part of Ireland. There is no potential for the quarry to quantitatively affect the volume of water available in Lough Corrib as a source of public water supply. In addition, as outlined above in the Hydro-G Response to **Uisce Éireann** a):*

(i) The development does not have the potential to impact on an Uisce Éireann Drinking Water Source(s).

(ii) The above statement is confidently asserted because the development has a Section 4 Discharge Licence for 1,483 m3/day permitted Emission Limit Volume (discharge) as specified in the Section 4 Discharge licence W/502/22. The 1,483 m3/d ELV was sanctioned in 2023 by Galway County Council because it was proven to be Groundwater, Surface Water and Birds and Habitats Regulations compliant.

(iii) Although Lough Corrib is a source for Public Water Supply with Uisce Eireann WTPs and associated intakes at Luimnagh and at Terryland, the application site's water balance component is miniscule compared to the volume of waters entering Lough Corrib from the Corrib catchment.

(iv) With respect to the 'Source > Pathway > Receptor' pathway model, the following can be stated:

a. The application site is not connected to the Luimnagh intake because groundwater flow direction from the quarry is to the south west and the Luimnagh intake is north west of the quarry.

b. There is a sufficiently robust control on the 'Source' at the quarry, by virtue of the hydrocarbon interceptor installed as a Condition of the Section 4 Discharge licence W/502/22 and the 'Pathway' volume of water in Lough Corrib precludes impact at the Terryland location.

Uisce Éireann *n) Where a development proposes to connect to an Uisce Éireann network and that network either abstracts water from or discharges wastewater to a "protected"/ sensitive area, consideration as to whether the integrity of the site / conservation objectives of the site would be compromised should be identified within the report.*

Hydro-G's Response: The applicant already has a connection that serves the staff and the staff numbers will not increase. Therefore, there is no potential to affect any change on Lough Corrib SAC and SPA, which is Uisce Éireann's source in proximity. The recent upgrade to Terryland's WTP intake and the operation of Luimnagh WTP and intake on Lough Corrib would have been subjected to robust assessment by Uisce Éireann. The applicant is of no significance in the scale of the total volumes of abstractions sent to the public in Galway city and the towns and private dwellings surrounding the application site.

Uisce Éireann *o) Mitigation measures in relation to any of the above ensuring a zero risk to any Uisce Éireann drinking water sources (Surface and Ground water).*

Hydro-G's Response: There is zero residual risk presented to Uisce Éireann drinking water sources (Surface and Ground water). This is how the Environmental Impact process is governed by Europe: Identification of Risk, Mitigation measure design, Residual Risk Assessment. This has been completed for the application site. On Site Management Controls and compliance with the Section 4 Discharge Licence W/502/22 enables a zero residual risk conclusion.

Uisce Éireann *This is not an exhaustive list.*

Hydro-G's Response: Accepted. The EIAR has assessed the Total Environment and concluded that it is reasonable and justified to lodge an application for Planning Consent.

Uisce Éireann *Please note:*

Uisce Éireann • *Where connection(s) to the public network is required as part of the development proposal, applicants are advised to complete the Pre-Connection Enquiry process and have received a Confirmation of Feasibility letter from Uisce Éireann ahead of any planning application.*

Hydro-G's Response: Not applicable to this application.

Uisce Éireann • *Uisce Éireann will not accept new surface water discharges to combined sewer networks.*

Hydro-G's Response: Acknowledged and the applicant does not propose any *surface water discharges to combined sewer networks.*

Appendix 8.3

On-Site WWTP Details

Hydro Klenze

All life depends on water. Almost 97% of the world's water is salt water. A further 2% is locked up in polar ice caps and glaciers. The remaining 1% of the world's water is fresh water, which is reused time and time again to sustain human existence, meeting all domestic, agricultural, industrial and recreational needs. The cost of water and its infrastructure has risen dramatically. The quality of our rivers and aquifers deteriorate rapidly as human pollution activity continues relentlessly. **Hydro Klenze** Systems are designed to protect surface and ground waters, thereby safeguarding the environment and helping achieve –

Cleaner Waters for a Cleaner World.





The **Hydro Klenze** System was successfully tested in accordance with the EU harmonized EN 12566 Standard part 3 (Small wastewater treatment systems), obtaining CE Mark status permitting its installation in any EU State.

Appointed Distributer

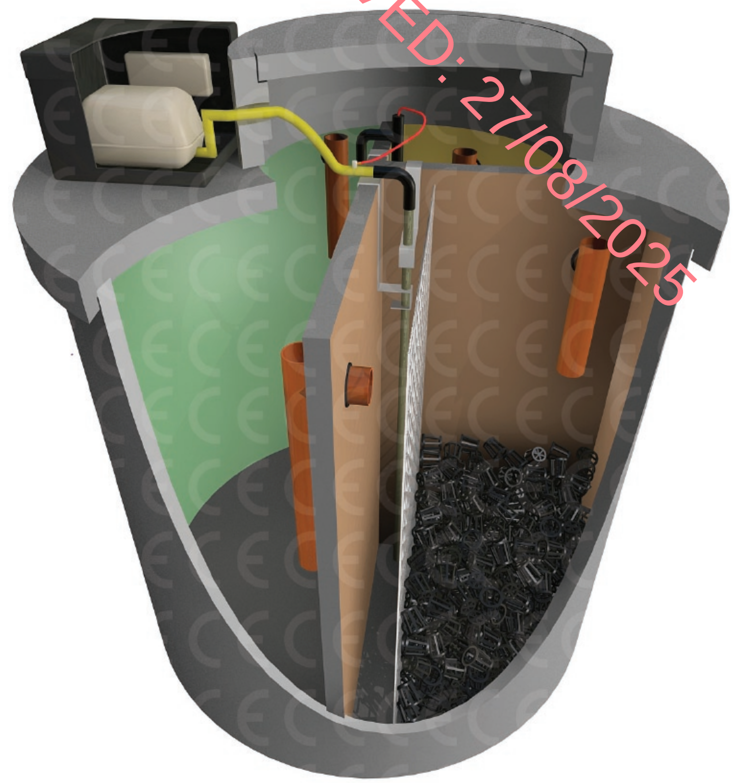
Harrington
• QUARRY, CONCRETE, TARMACADAM & ASPHALT PRODUCTS • CIVIL ENG. CONTRACTORS •

Hydro Klenze
a product of the
Wastewater Division
Harrington Concrete
Kilkelly Co. Mayo
Tel: 094 9367072 Fax: 094 9367347
Email: hydroklenze@harringtonconcrete.ie
Website: www.harringtonconcrete.ie

CE CE

Hydro Klenze

A Biological Wastewater Treatment System by Harrington Concrete







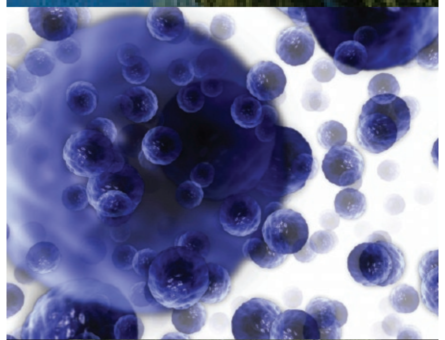
Harrington
• QUARRY, CONCRETE, TARMACADAM & ASPHALT PRODUCTS • CIVIL ENG. CONTRACTORS •

Cleaner Waters for a Cleaner World

Hydro Klenze

Cleaner Waters for a Cleaner World



Hydro Klenze Systems – Affordable & Easy to Install

Hydro Klenze systems are designed to process all the wastewater from single dwellings in rural or unsewered areas. The Hydro Klenze System was successfully tested in accordance with the EN harmonised EN 12566 part 3 (Small Wastewater Treatment Systems), obtaining CE Mark status permitting its installation in any EU State. The standard format of a Hydro Klenze system is the HydroFlo Aeration Treatment Unit.

The HydroFlo Aeration Treatment Unit uses affordable, proven technology that is safe and reliable. The HydroFlo unit is based on a monolithic single structure, multi compartment, dry cast concrete tank 60N/mm2 strength, reinforced with DRAMIX ® steel fibers. The main body of the tank is cast in a single pour / no joints. The tanks are installed without the need for concrete bases or concrete backfilling, assuring a fast, convenient, easy and low cost installation. The HydroFlo system design assures a compact arrangement, with a small footprint, which is neat and unobtrusive when installed

HydroFlo – Remarkable & Reliable Technology

HydroFlo Aeration Treatment is a multi process technology, based on sound environmental engineering principles, which are proven to be effective and efficient. Initial separation takes place followed by biological treatment and then final settlement, before the treated cleansed effluent is discharged into the environment. The biological treatment processes occur in an anti-flush Biological Treatment (Bioreactor) Chamber, which allows both attached growth and suspended growth to take place simultaneously. These two biological processes provide the microbiological cleansing activity. Aerobic bacteria and other microorganisms break down organic materials into inorganic carbon dioxide, water, and minerals. The design of the anti-flush Biological Treatment (Bioreactor) Chamber prohibits the flush out of the cleansing microorganisms during high flow activity.

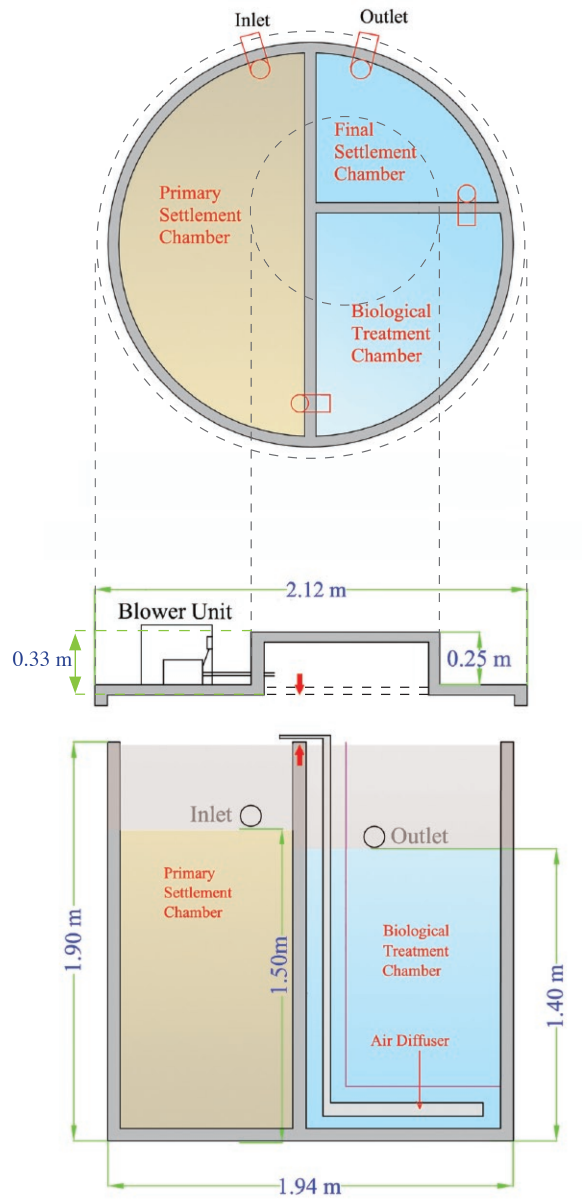
Low Cost Operation & Maintenance

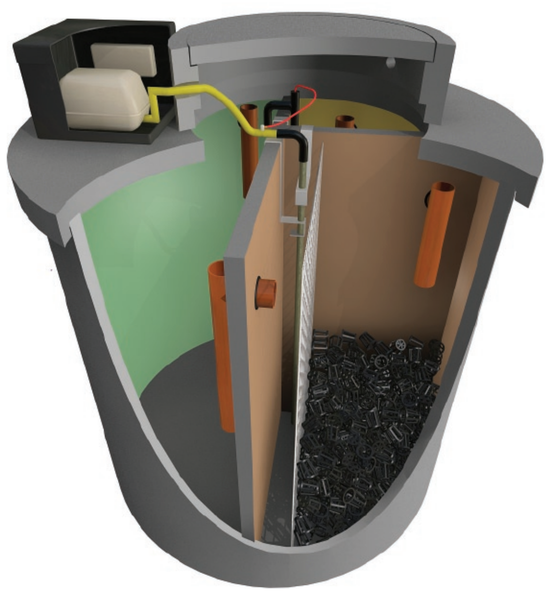
There are no mechanical working parts inside a Hydro Klenze system. The aeration blower unit is externally located, above ground, in a separate housing on the tank lid, enabling easy access. The low energy blower that provides the air for the biological process is an 80 watt linear type unit. The absence of moving parts within the tank allows for a minimum, simple, low cost maintenance plan.

Installation (Guideline Only)

The installation location should adhere to local planning authority requirements, whilst allowing for convenient access, routine maintenance and desludging. The excavation required is a 3m x 3m hole with a level compacted hardcore base. The depth of the excavation, approximately 2.5m minimum, must take into account the level of the waste outfall pipe from the house and the gradient of the connecting pipe line to be installed to the inlet on the Hydro Klenze tank. The inlet of the Hydro Klenze tank has an invert height of 1.5m.

The main body of the tank (3 tonne) is lifted into the hole, orienting the inlet to receive the waste outfall pipe and the outlet to the discharge pipe leading to the percolation area. The lid section (1 tonne) is then placed onto the tank, lining up the marking on the lid to the marking on the tank. This will ensure correct placement of the lid, permitting adequate access into all chambers for desludging. Backfill the excavation with the onsite spoil removing any heavy boulders. The blower housing is then installed on the main lid section beside the hole in the access riser. The air hose in the tank is connected to the blower via the hole in the riser. The power supply is terminated into the weatherproof double socket unit in the blower housing. All electrical installations must be carried out, by a qualified electrician, to a recognised national code of practice





How Does the Hydroflo System Work?

1. The HydroFlo Aeration Treatment system provides both primary and secondary sewage treatment, for the removal of suspended solids and biodegradable organics, using the process of sedimentation, followed by biological processes.

2. As wastewater enters the system natural separation and settlement takes place in the **Primary Settlement Chamber**. Heavy matter settles on the floor of the primary chamber, eventually forming bio-solids which are retained there for periodic desludging. Light particle matter floats to the surface some of which remain entrained within the bulk liquid as suspended solids. As influent enters, settled clarified bulk liquid is discharged into the **Biological Treatment** (Bioreactor) **Chamber**.

3. The Blower Unit, which delivers the air via an airline to the Air Diffuser, is external above ground. The Air Diffuser is of a fine pore anti-clog design, and is located beneath the submerged anti-flush random media within the **Biological Treatment** (Bioreactor) **Chamber**. The Air Diffuser discharges small air bubbles into the wastewater providing a robust, vigorous and three dimensional circulation of the bulk liquid throughout the HydroFlo anti-flush random media. The dissolved oxygen within the air bubbles transfers into the bulk liquid reacting with the bacteria. Colonies of microorganisms are produced by the resultant biological reaction within the Bioreactor. The microorganisms create a suspended floating, bio-floc entrained within the bulk liquid and a fixed bio-film that forms on the random media. The microorganisms grow and multiply, achieving a self consuming microbiological cleansing activity. The incoming waste metabolizes achieving the cleansed treated effluent.

4. The cleansed treated effluent passes into the **Final Settlement Chamber** where suspended solids settle out of the treated effluent. An airlift sludge return passes sludge that settles on the floor of the final settlement chamber back into the primary settlement chamber. The simultaneous return of aerated treated wastewater, back into the primary settlement chamber also eliminates any bad foul odours. The sludge return is controlled by a speed control valve that regulates the rate of return flow. As influent enters the system settled treated effluent is discharged out of the treatment system by gravity or if required by pump.

5. The treated discharged effluent is passed into a percolation area, designed to facilitate even dispersion of the treated effluent into the soil structure. Final tertiary cleansing treatment, further reducing the level of nutrients and suspended solids, takes place in the soil structure before entering ground waters.

Optional HydroFlo Filtration & Disinfection Modules

6. If required, for environmentally sensitive areas, the treated effluent discharged can receive further tertiary treatment in a special additional HydroFlo Filtration Module. The filtered permeate is treated to a quality that far exceeds the Bathing Water directive requirement (<5mg/l Biological Oxygen Demand (BOD) and <5mg/l Suspended Solids (SS)). It can be discharged directly to surface waters or to ground waters via a much reduced in size percolation area. Ask for details.

7. The filtered permeate can be further treated with additional disinfection methodologies which will completely purify the filtered permeate, removing all residual contaminates, providing ultra clean safe water.

APPENDIX 8.4

EPA Data

EPA Surface Water Hydrochemistry Data

EPA Biological Monitoring Data

EPA Groundwater Quality Data

Sources of data: www.catchments.ie & Envision Mapping


Application Quarry
Corrandulla Groundwater Monitoring Station @ 1.8km D/S of quarry.
EPA Station [Bridge near Drumgriffin] @ c.4km D/S of site = CLOSEST stn. with published hydrochemical and Biological data (Q4 2024).
L6218
BALLINDUFF STREAM_010
CLARE (GALWAY)_070
CORRIB_010
CREGG_010
N84
L2129
L2117
Cluain Bú
L2118
CREGG_020
L2132
Lackagh
L2133
R354
Tuam Road
CLARE (GALWAY

Table A1(a) EPA WQ @ Bridge near Drumgriffin: Stn ID [RS30C030100]: **2007 – 2015 subset 1**

Environmental Quality Objective Surface Water Regulations 2009 (as amended)	**High Status 0.04 to 0.09 mg/l & Good Status 0.065 to 0.14 mg/l**	**High Status 1.3 to 2.2 mg/l & Good Status 1.5 to 2.6 mg/l**	**High Status 0.025 to 0.045 mg/l & Good Status 0.035 to 0.075 mg/l**	**6 to 9pH**	**no greater than 1.5oC change above usual**	**not specified**	**not specified**
EPA WQ @ Bridge near Drumgriffin: Stn ID [RS30C030100]	Ammonia-Total (mg/l as N)	BOD (mg/l)	ortho-Phosphate as P (mg/l)	pH	Temperature oC	Alkalinity-total (mg/l as CaCO3)	Chloride (mg/l)
14/02/2007	0.015	0.5	0.037	7.3	9.9	276	25
08/05/2007	0.015	0.5	0.025	7.6	12	320	23
30/07/2007	0.015	0.5	0.04	7.3	12.6	316	20
16/10/2007	0.015	0.5	0.039	7.2	11.6	324	21
14/02/2008	0.015	0.5	0.052	7.3	10.6	300	23
29/04/2008	0.015	0.5	0.024	7.4	11.2	308	23
30/06/2008	0.015	0.5	0.035	7.5	12.7	296	23
08/10/2008	0.015	0.5	0.058	7.1	11.7	352	16
26/11/2008	0.015	0.5	0.049	7.1	11.1	344	18
08/01/2009	0.015	0.5	0.048	7.2	9.6	324	19
02/04/2009	0.015	0.5	0.031	7.3	11.6	320	20
09/06/2009	0.015	0.5	0.03	7.3	12.5	356	19
30/09/2009	0.015	0.5	0.042	7.4	12.2	352	18
21/01/2010	0.015	0.5	0.044	7.3	10.1	296	18
31/03/2010	0.015	0.5	0.053	7.4	10	328	18
05/08/2010	0.015	0.5	0.026	7.7	13.9	296	19
10/11/2010	0.015	0.5	0.042	7.3	10.9	308	15
06/01/2011	0.015	0.5	0.045	7.3	9.7	312	17
10/03/2011	0.015	0.5	0.048	7.4	10	324	18
15/09/2011	0.015	0.5	0.048	7.1	11.7	320	15
21/11/2011	0.015	0.5	0.045	7.2	10.9	340	16
05/01/2012	0.015	0.5	0.049	7.2	10.4	320	17
29/02/2012	0.015	0.5	0.022	7.2	10.6	320	19
27/09/2012	0.015	0.5	0.017	7.2	11.8	364	16
19/11/2012	0.015	0.5	0.028	7	10.7	372	15
03/01/2013	0.015	0.5	0.022	7	10.6	344	15
15/04/2013	0.015	0.5	0.012	7.3	11.2	356	19
14/10/2013	0.015	0.5	0.017	7.5	10.1	320	22
14/11/2013	0.01	0.5	0.021	7.3	10.8	324	20
09/06/2014	0.01	0.5	0.016	7.3	11.9	308	22
15/07/2014	0.071	0.5	0.014	7.6	14.5	344	21
20/10/2014	0.01	0.5	0.005	7.6	12	284	22
19/01/2015	0.01	0.5	0.017	7.3	9.9	272	22
07/05/2015	0.01	0.5	0.016	7.3	11	258	21
23/09/2015	0.01	0.5	0.019	7.1	11.4	315	19
05/11/2015	0.01	0.5	0.021	7.1	11.4	338	19

Table A1(b) EPA WQ @ Bridge near Drumgriffin: Stn ID [RS30C030100]: **2007 – 2015 subset 2**

Environmental Quality Objective Surface Water Regulations 2009 (as amended)	**not specified**	**80 to 120 % Saturation**	**not specified**	**not specified**	**not specified**	**not specified**	**not specified**
EPA WQ @ Bridge near Drumgriffin: Stn ID [RS30C030100]	Conductivity (uS/cm)	Dissolved Oxygen % Saturation	Nitrate N (mg/l)	Nitrite N (ug/l)	Total Hardness (as CaCO3)	Total Oxidised Nitrogen (as N)	True Colour
14/02/2007	624	86		2	324	3.7	13
08/05/2007	673	100		2	344	2.1	16
30/07/2007	665	74		2	328	2.4	33
16/10/2007	679	52		26.4	348	2.1	28
14/02/2008	671	77		2	344	3.3	5
29/04/2008	694	93		43.5	340	2.4	18
30/06/2008	650	82		14.4	336	2.1	24
08/10/2008	712	70		2	356	2	21
26/11/2008	709	66		2	368	2	12
08/01/2009	721	70		2	368	2.3	15
02/04/2009	711	90		2	356	1.9	13
09/06/2009	734	95		2	384	1.7	13
30/09/2009	739	72		19.9	380	1.6	34
21/01/2010	649	68		2	316	2	28
31/03/2010	644	77		2	344	2	27
05/08/2010	619	102		2	316	1.1	31
10/11/2010	626	81		2	320	3	12
06/01/2011	668	80		2	356	3	12
10/03/2011	657	86		2	340	2.5	18
15/09/2011	666	72		2	368	2.6	20
21/11/2011	702	74		2	356	2.4	24
05/01/2012	655	79		31	348	2.2	36
29/02/2012	693	77		10	356	2.6	6
27/09/2012	726	57		2	368	1.5	22
19/11/2012	740	64		11.1	376	1.7	14
03/01/2013	703	66		2	384	1.7	10
15/04/2013	709	85		10.8	400	1.3	5
14/10/2013	685	58		2	356	0.8	9
14/11/2013	695	70		2	372	2.7	15
09/06/2014	724	92		9.96	360	3.3	10
15/07/2014	710	110			360	0.35	12
20/10/2014	657	63			332	0.83	15
19/01/2015	621	83			308	2.8	19
07/05/2015	634	76			297	1	32
23/09/2015	731	59			375	1.9	16
05/11/2015	717	81			362	1.7	25

Table A1(c) EPA WQ @ Bridge near Drumgriffin: Stn ID [RS30C030100]: **2007 – 2015 SUMMARY**

Environmental Quality Objective Surface Water Regulations 2009 (as amended)	**High Status 0.04 to 0.09 mg/l & Good Status 0.065 to 0.14 mg/l**	**High Status 1.3 to 2.2 mg/l & Good Status 1.5 to 2.6 mg/l**	**High Status 0.025 to 0.045 mg/l & Good Status 0.035 to 0.075 mg/l**	**6 to 9pH**	**no greater than 1.5oC change above usual**	**not specified**	**not specified**	**not specified**	**80 to 120 % Saturation**	**not specified**	**not specified**	**not specified**	**not specified**	**not specified**	
EPA WQ @ Bridge near Drumgriffin: Stn ID [RS30C030100]	Ammonia-Total (mg/l as N)	BOD (mg/l)	ortho-Phosphate as P (mg/l)	pH	Temperature oC	Alkalinity-total (mg/l as CaCO3)	Chloride (mg/l)	Conductivity (uS/cm)	Dissolved Oxygen % Saturation	Nitrate N (mg/l)	Nitrite N (ug/l)	Total Hardness (as CaCO3)	Total Oxidised Nitrogen (as N)	True Colour	
MAX	0.071	0.5	0.058	7.7	14.5	372	25	740	110	not measured	43.5	400	3.7	36	**All EPA Data 2007 - 2015**
MIN	0.01	0.5	0.005	7.0	9.6	258	15	619	52		2	297	0.35	5	
Mean	0.02	0.5	0.032	7.3	11.2	321	19.3	684	77		7.30	351	2.1	18	

Hydro-G Comments re 2007 to 2015 EPA Data @ 4km downstream in 'surface water' (rising as a spring 2km from quarry):

- Ammonia = High Status compliant
- BOD = High Status compliant
- Ortho-P = Good Status compliant
- pH compliant
- Range of Temperatures = not 1.5oC range
- Other indicators suggest:
  - VERY Hard water = usual for limestone environments.
  - Dissolved Oxygen can be low = hence 'hydromorphological' risk conclusion of EPA.
  - Colour very variable
  - Total Oxidised N = not too bad.
  - Nitrate N Max = VERY HIGH, Mean = normal baseline

Table A2(a) EPA WQ @ Bridge near Drumgriffin: Stn ID [RS30C030100]: **2016 – 2021 Subset 1**

Environmental Quality Objective Surface Water Regulations 2009 (as amended)	**High Status 0.04 to 0.09 mg/l & Good Status 0.065 to 0.14 mg/l**	**High Status 1.3 to 2.2 mg/l & Good Status 1.5 to 2.6 mg/l**	**High Status 0.025 to 0.045 mg/l & Good Status 0.035 to 0.075 mg/l**	**6 to 9pH**	**no greater than 1.5oC change above usual**	**not specified**	**not specified**	
EPA WQ @ Bridge near Drumgriffin: Stn ID [RS30C030100]	Ammonia-Total (mg/l as N)	BOD (mg/l)	ortho-Phosphate as P (mg/l)	pH	Temperature oC	Alkalinity-total (mg/l as CaCO3)	Chloride (mg/l)	
31/03/2016	**0.01**	**0.5**	**0.027**	**7.2**	**8**	**28**	**20.4**	
01/06/2016	**0.031**	**1.2**	**0.005**	**7.4**	**14.7**	**278**	**19.3**	
27/07/2016	**0.03**	**0.5**	**0.01**	**7.4**	**13.3**	**298**	**19.3**	
21/09/2016	**0.01**	**0.5**	**0.023**	**7.3**	**12**	**358**	**18.3**	
22/11/2016	**0.024**	**0.5**	**0.023**	**7.1**	**10.4**	**352**	**17.5**	
29/03/2017	**0.01**	**0.5**	**0.015**	**7.3**	**8.9**	**341**	**19.3**	
25/05/2017	**0.061**	**1.6**	**0.01**	**7.6**	**15.5**	**300**	**19.4**	
26/07/2017	**0.025**	**0.5**	**0.015**	**7.3**	**12.7**	**313**	**18.2**	
28/09/2017	**0.01**	**0.5**	**0.028**	**7.1**	**11.3**	**363**	**17.4**	
22/11/2017	**0.01**	**0.5**	**0.022**	**7.2**	**10.6**	**353**	**16.7**	
27/03/2018	**0.01**	**0.5**	**0.014**	**7.3**	**10.3**	**336**	**20.5**	
01/05/2018	**0.01**	**0.5**	**0.005**	**7.3**	**10.8**	**355**	**19.7**	
25/07/2018	**0.039**	**1.5**	**0.017**	**7.6**	**14.3**	**316**	**21.9**	
06/09/2018	**0.02**		**0.01**	**7.4**	**12.5**	**302**	**20.2**	
27/11/2018	**0.72**	**0.5**	**0.023**	**7.2**	**10.5**	**308**	**20.1**	
26/03/2019	**0.01**	**1.2**	**0.017**	**7.2**	**9.9**	**336**	**19.6**	
09/05/2019	**0.021**	**0.5**	**0.015**	**7.4**	**10.8**	**331**	**19.8**	
24/07/2019	**0.01**	**1**	**0.013**	**7.4**	**13.6**	**317**	**22.1**	
11/09/2019	**0.01**	**1.1**	**0.017**	**7.3**	**10.8**	**316**	**16.9**	
14/11/2019	**0.01**	**0.5**	**0.026**	**7.2**	**10.2**	**316**	**15.4**	
26/03/2020	**0.01**	**0.5**	**0.017**	**7.3**	**10.6**	**296**	**21.3**	
26/05/2020	**0.04**	**3.8**	**0.005**	**7.7**	**13.7**	**300**	**20.3**	
20/07/2020	**0.01**	**7.5**	**0.025**	**7.4**	**13.6**	**263**	**20.9**	
21/09/2020	**0.01**	**0.5**	**0.019**	**7.3**	**11.3**	**367**	**21.2**	
24/11/2020	**0.01**	**0.5**	**0.024**	**7.2**	**10.7**	**348**	**20.4**	
23/03/2021	**0.01**	**0.5**	**0.019**	**7.3**	**8.6**	**331**	**17**	
11/05/2021	**0.01**	**0.5**	**0.013**	**7.4**	**11.3**	**326**	**18**	
22/07/2021	**0.041**	**0.5**	**0.011**	**7.7**	**17.8**	**290**	**18.2**	
08/09/2021	**0.01**	**2.1**	**0.012**	**7.6**	**16.4**	**274**	**21**	
23/11/2021	**0.01**	**0.5**	**0.018**	**7.4**	**9.5**	**363**	**16.9**	
MAX	0.72	7.5	0.028	7.7	17.8	367	22.1	**3rd Cycle Data 2016 - 2021**
MIN	0.01	0.5	0.005	7.1	8.0	28	15.4	
Mean	0.04	1.1	0.017	7.4	11.8	313	19.2	

Table A2(b) EPA WQ @ Bridge near Drumgriffin: Stn ID [RS30C030100]: **2016 – 2021 Subset 2**

Environmental Quality Objective Surface Water Regulations 2009 (as amended)	**not specified**	**80 to 120 % Saturation**	**not specified**	**not specified**	**not specified**	**not specified**	**not specified**	
EPA WQ @ Bridge near Drumgriffin: Stn ID [RS30C030100]	Conductivity (uS/cm)	Dissolved Oxygen % Saturation	Nitrate N (mg/l)	Nitrite N (ug/l)	Total Hardness (as CaCO3)	Total Oxidised Nitrogen (as N)	True Colour	
31/03/2016	**646**	**98**	**1.5**		**33**	**1.5**	**88**	
01/06/2016	**645**	**101**	**1.1**		**354**	**1.2**	**18**	
27/07/2016	**692**	**94**	**0.99**		**352**	**0.99**	**23**	
21/09/2016	**718**	**58**	**1.7**		**388**	**1.7**	**22**	
22/11/2016	**740**	**50**	**2.2**		**391**	**2.2**	**17**	
29/03/2017	**737**	**73**	**2.1**		**407**	**2.1**	**13**	
25/05/2017	**669**	**91**	**1.4**		**333**	**1.4**	**25**	
26/07/2017	**668**	**69**	**1.9**		**352**	**1.9**	**26**	
28/09/2017	**739**	**65**	**2.2**		**405**	**2.2**	**22**	
22/11/2017	**745**	**65**	**1.9**		**395**	**1.9**	**20**	
27/03/2018	**714**	**84**	**1.6**		**376**	**1.6**	**15**	
01/05/2018	**705**	**82**	**1.5**		**373**	**1.5**	**17**	
25/07/2018	**683**	**71**	**0.8**		**349**	**0.82**	**14**	
06/09/2018	**639**	**40**	**1.4**		**329**	**1.4**	**34**	
27/11/2018	**727**	**73**	**2.5**		**377**	**2.5**	**13**	
26/03/2019	**680**	**79**	**2.2**		**353**	**2.2**	**11**	
09/05/2019	**696**	**98**	**1.9**		**333**	**1.9**	**20**	
24/07/2019	**677**	**80**	**1.2**		**351**	**1.2**	**21**	
11/09/2019	**692**	**74**	**1.8**		**364**	**1.8**	**21**	
14/11/2019	**704**	**72**	**1.8**		**372**	**1.8**	**17**	
26/03/2020	**666**	**72**	**1.4**		**353**	**1.4**	**8**	
26/05/2020	**643**	**71**	**0.81**		**336**	**0.83**	**11**	
20/07/2020	**598**	**78**	**0.93**		**305**	**0.94**	**37**	
21/09/2020	**713**	**74**	**1.7**		**411**	**1.7**	**21**	
24/11/2020	**685**	**90**	**2**		**361**	**2**	**12**	
23/03/2021	**674**	**82**	**1.5**		**350**	**1.5**	**13**	
11/05/2021	**655**	**98**	**1.2**		**334**	**1.2**	**26**	
22/07/2021	**620**	**73**	**0.41**		**307**	**0.46**	**16**	
08/09/2021	**613**	**35**	**0.47**		**294**	**0.48**	**18**	
23/11/2021	**708**	**79**	**1.8**		**388**	**1.8**	**14**	
MAX	745	101	2.5		411	2.5	88	**3rd Cycle Data 2016 - 2021**
MIN	598	35	0.41		33	0.46	8	
Mean	683	76	1.53		348	1.5	21	

Hydro-G Comments re 2016 to 2021 (3rd Cycle) EPA Data @ 4km downstream in 'surface water' (rising as a spring 2km from quarry):

- Ammonia = One event indicator of gross contamination. Mean value is High Status compliant.
- BOD = Similarly, BOD has one event indicator of gross contamination. Mean value is High Status compliant

- Ortho-P = Range is High Status compliant
- pH compliant
- Range of Temperatures = not 1.5oC range
- Other indicators suggest:
    - VERY Hard water = usual for limestone environments.
    - Dissolved Oxygen can be low = hence 'hydromorphological' risk conclusion of EPA.
    - Colour very variable
    - Total Oxidised N = not too bad.
    - Nitrate N Max = range is normal baseline.

Table A3(a) EPA WQ @ Bridge near Drumgriffin: Stn ID [RS30C030100]: **2022 – 2025** Subset 1

Environmental Quality Objective Surface Water Regulations 2009 (as amended)	High Status 0.04 to 0.09 mg/l & Good Status 0.065 to 0.14 mg/l	High Status 1.3 to 2.2 mg/l & Good Status 1.5 to 2.6 mg/l	High Status 0.025 to 0.045 mg/l & Good Status 0.035 to 0.075 mg/l	6 to 9pH	no greater than 1.5oC change above usual	not specified	not specified	
EPA WQ @ Bridge near Drumgriffin: Stn ID [RS30C030100]	Ammonia-Total (mg/l as N)	BOD (mg/l)	ortho-Phosphate as P (mg/l)	pH	Temperature oC	Alkalinity-total (mg/l as CaCO3)	Chloride (mg/l)	
21/03/2022	0.01	0.5	0.017	7.3	9.9	363	20.1	
10/05/2022	0.023	0.5	0.01	7.6	11.8	328	19.9	
21/07/2022	0.01	1.8	0.005	7.7	17.1	298	20.5	
07/09/2022	0.01	0.5	0.018	7.7	14.4	333	21.1	
14/11/2022	0.01	0.5	0.024	7.4	10.9	329	20.6	
22/03/2023	0.01	0.5	0.024	7.3	9.9	301	18.6	
30/05/2023	0.01	0.5	0.005	7.5	13.4	334	18.5	
18/08/2023	0.01	0.5	0.019	7.4	12.5	347	15.6	
19/10/2023	0.01	0.5	0.027	7.2	11.5	333	15.2	
20/02/2024	0.01	0.5	0.024	7.4	10.6	300	16.6	
22/04/2024	0.01	0.5	0.016	7.5	12	323	14.9	
09/07/2024	0.041	1.7	0.005	7.7	15.1	346	17.8	
22/10/2024	0.01	0.5	0.019	7.5	11.9	363	17.5	
17/02/2025	0.01	0.5	0.02	7.5	9.7	374	22.5	
21/05/2025	0.04	0.5	0.011	7.8	13.8	354	22.1	
MAX	0.041	1.8	0.027	7.8	17.1	374	22.5	**Latest EPA Data 2022 - 2025**
MIN	0.01	0.5	0.005	7.2	9.7	298	14.9	
Mean	0.01	0.7	0.016	7.5	12.3	335	18.8	
Hydro-G Comment	latest EPA Data (2022 - 2025) suggests High Status Ammonia-N in the River in the Max, Min, Average states. Historically, Mean values have been High Status and problematic Peaks. Appparently resolved.	latest data suggests High Status BOD condition. Very High BOD peaks are correlated to Temperature Peaks, which is why hydromorphology is the Risk and reason for the Poor Status and At Risk EPA Mapping.	Generally High Status compliant for ortho-P.	pH compliant	high peaks in temeperature due to channelisation of the river bed.	Signifies a VERY Hard Water. Not Specified in the SW Regs. No environmental significance to the WQ Data. Signafies Groundwater signal.	Not a SW Reg paramter but range in results are normal.	

Table A3(b) EPA WQ @ Bridge near Drumgriffin: Stn ID [RS30C030100]: **2022 – 2025** Subset 2

Environmental Quality Objective Surface Water Regulations 2009 (as amended)	**not specified**	**not specified**	**80 to 120 % Saturation**	**not specified**	**not specified**	**not specified**	**not specified**	**not specified**	
EPA WQ @ Bridge near Drumgriffin: Stn ID [RS30C030100]	Chloride (mg/l)	Conductivity (uS/cm)	Dissolved Oxygen % Saturation	Nitrate N (mg/l)	Nitrite N (ug/l)	Total Hardness (as CaCO3)	Total Oxidised Nitrogen (as N)	True Colour	
21/03/2022	**20.1**	**691**	**99**	**2.3**		**357**	**2.3**	**14**	
10/05/2022	**19.9**	**684**	**95**	**1.5**		**343**	**1.5**	**17**	
21/07/2022	**20.5**	**627**	**74**	**0.59**		**310**	**0.62**	**16**	
07/09/2022	**21.1**	**684**	**71**	**0.76**		**389**	**0.77**	**64**	
14/11/2022	**20.6**	**682**	**73**	**2.3**		**342**	**2.3**	**26**	
22/03/2023	**18.6**	**619**	**99**			**298**	**1.9**	**14**	
30/05/2023	**18.5**	**690**	**119**			**358**	**1.2**	**13**	
18/08/2023	**15.6**	**684**	**70**			**351**	**1.6**	**73**	
19/10/2023	**15.2**	**706**	**65**			**375**	**2.1**	**17**	
20/02/2024	**16.6**	**652**	**84**			**337**	**1.7**	**8**	
22/04/2024	**14.9**	**679**	**80**			**365**	**1.6**	**6**	
09/07/2024	**17.8**	**669**	**76**			**355**	**0.51**	**13**	
22/10/2024	**17.5**	**698**	**65**			**364**	**1.4**	**121**	
17/02/2025	**22.5**	**741**	**66**			**411**	**2**	**16**	
21/05/2025	**22.1**	**719**	**74**			**366**	**1.4**	**14**	
MAX	22.5	741	119	2.3		411	2.3	121	**Latest EPA Data 2022 - 2025**
MIN	14.9	619	65	0.59		298	0.51	6	
Mean	18.8	682	81	1.49		355	1.5	29	
Hydro-G Comment	Not a SW Reg paramter but range in results are normal.	Strong Groundwater signal. No environ. significance other than the fact that the quarry discharges to groundwater.	very low Dissolved Oxygen signal. This is morphological impact - low flow in the altered state.	Very low Nitrate N	not specified in the SW Regs but it is a parameter of the GW regs: compliant as ug/l TV	Signifies a VERY Hard Water. Not Specified in the SW Regs. No environmental significance to the WQ Data. Signafies Groundwater signal.	No significnt Nitrogen content.	colour peaks very high in October 2024	

Plate EPA BIOLOGICAL MONITORING DATA

Table A4 Biological Monitoring Data for Bridge near Drumgriffin EPA Station

Latest River Q Values **RS30C030100**	
StationCode	RS30C030100
StationName	Bridge near Drumgriffin
StationTypeEDEN	RIVER_STATION
RiverWaterbodyName	CREGG_010
EntityName	CREGG
EntityCode	30C03
Year	2024
QValueScore	4
QValueStatus	Good
WFDWISECODE	IEMRRS30C030100
WBWFDWISECODE	IE_WE_30C030150
LocalAuthority	GALWAY COUNTY COUNCIL
EPAStationTypeWFD	Operational
Typeofwatermonitored	River Water
RiverBasinDistrict	Western
SegCd	30_3212
Media	WATER
DataSource	FCT
URL	View the Data Page
Easting	135390
Northing	237859

Table A5(a) EPA GROUNDWATER @1.8km Downstream of Quarry: **Ten Years 2016 – 2025**

EPA GW Mon Stn Corrandulla GWIE_WE_G_002 012000008	GW Alkalinity mg/l as CaCO3	GW Ammonia-Total (mg/l as N)	GW Chloride mg/l	GW Electrical Conductivity uS/cm	GW Nitrate N mg/l	GW Nitrite N ug/l	GW Ortho-P as P filtered mg/l	GW pH	GW Temperature oC	GW TOC (mg/l)	GW Total Organic Nitrogen (mg/l)	GW Total Phosphorus (mg/l)
12/04/2016	338	0.01	19.3	664	1.4		0.023	7.1	10.2	3.2	1.4	0.027
19/07/2016	321	0.01	18.1	639	0.87		0.019	7	11.8	6.2	0.87	0.019
11/10/2016	380	0.01	18.7	724	1.7		0.019	6.9	11.2	4.6	1.7	0.021
12/04/2017	377	0.01	16.8	720	1.4	2	0.005	7	10.5	3.2	1.4	0.017
31/07/2017	343	0.01	17.6	658	2.1	2	0.027	6.9	11.7	6.2	2.1	0.024
10/10/2017	396	0.01	17.3	751	2.2	2	0.017	6.9	11.1	4	2.2	0.025
28/08/2018	317	0.01	19.1	628	1.8	2	0.018	7	12.3	6.6	1.8	0.026
15/10/2018	362	0.01	21.2	686	1.8	2	0.017	7	11.4	5.4	1.8	0.017
21/11/2018	347	0.022	21.3	696	3.2	2	0.022	7	10.8	4.4	3.2	0.02
20/03/2019	321	0.01	18.4	623	2.6	2	0.021	7	10.3	2.1	2.6	0.02
02/07/2019	338	0.01	19.8	662	1.3	2	0.016	7.1	11.7	5	1.3	0.018
18/09/2019	340	0.01	17.4	658	1.9	9.79	0.025	6.9	11.4	4.6	1.9	0.022
21/07/2020	282	0.01	21.9	600	1.3	2	0.014	7.1	11.9	6.5	1.3	0.021
03/11/2020	348	0.01	22.1	685	2.3	2	0.021	6.9	10.9	3	2.3	0.026
22/03/2021	351	0.01	13.9	660	1.6	2	0.018	6.9	10.1	2.8	1.6	0.029
14/06/2021	341	0.01	17.6	668	1.1	2		6.9	11	3.9	1.1	0.023
04/10/2021	351	0.01	15.6	645	2	2	0.022	6.9	11.2	5	1.9	0.032
08/06/2022	337	0.01	20.5	659	1.2	4.47	0.014	7.1	11.5	4.5	1.2	0.015
02/08/2022	332	0.01	20.4	616	1.4	2	0.016	7.1	12.2	4.5	1.4	0.023
01/11/2022	342	0.01	21.5	668	2.6	2	0.024	6.9	11.3	3.9	2.6	0.029
03/04/2023	325	0.01	19.5	638	1.6	2	0.018	6.9	10.5	2.6	1.6	0.022
31/07/2023	334	0.01	17.1	661	2.1	2	0.023	6.6	11.7	4.6	2.1	0.025
09/10/2023	359	0.01	14.2	669	2	2	0.023	6.6	11.5	0.5	2	0.027
27/03/2024	333	0.01	15.2	617	1.9	2	0.023	6.7	10.6	3	1.9	0.027
24/07/2024	342	0.01	17.9	662	0.85	6.21	0.014	6.9	11.9	5.5	0.86	0.038
16/10/2024	362	0.01	16.8	684	1.5	2	0.018	7	11.5	5.7	1.5	0.023
02/04/2025	355	0.022	23	692	2.3	2	0.022	7	10.6	5.4	2.3	0.02

Table A5(b) EPA GROUNDWATER @1.8km Downstream of Quarry: **Ten Years 2016 – 2025 SUMMARY STATISTICS & Hydro-G Comments**

EPA GW Mon Stn Corrandulla GWIE_WE_G_002 012000008	GW Alkalinity mg/l as CaCO3	GW Ammonia-Total (mg/l as N)	GW Chloride mg/l	GW Electrical Conductivity uS/cm	GW Nitrate N mg/l	GW Nitrite N ug/l	GW Ortho-P as P filtered mg/l	GW pH	GW Temperature oC	GW TOC (mg/l)	GW Total Organic Nitrogen (mg/l)	GW Total Phosphorus (mg/l)	
MAX	396	0.022	22.1	751	3.2	9.79	0.027	7.1	12.3	6.6	3.2	0.032	3rd Cycle Data 2016 - 2021
MIN	282	0.01	13.9	600	0.87	2	0.005	6.9	10.1	2.1	0.87	0.017	
Mean	344	0.01	18.6	669	1.8	2.6	0.019	7.0	11.1	4.5	1.8	0.023	
MAX	362	0.022	23	692	2.6	6.21	0.024	7.1	12.2	5.7	2.6	0.038	Latest EPA Data 2022 - 2025
MIN	325	0.01	14.2	616	0.85	2	0.014	6.6	10.5	0.5	0.86	0.015	
Mean	342	0.01	18.6	657	1.7	2.7	0.020	6.9	11.3	4.0	1.7	0.025	
Threshold Values of the Groundwater Regulations 2010 (as amended)	**not specified**	**65 - 175 ug/l = 0.065 to 0.175 as mg/l**	**24 mg/l**	**800 - 1875 uS/cm**	**37.5 mg/l as NO3**	**375 ug/l**	**35ug/l = 0.035 mg/l**	**not specified**	**not specified**	**not specified**	**not specified**	**not specified**	
Hydro-G Comment	Results are normal for VERY Hard water = normal for limestone	Groundwater Ammonia is Always compliant & a FRACTION of TV.	Always Compliant	Always Compliant	Nitrate N reported is always a fraction as NO3 TV. Low values. Always compliant	Nitrite is a SMALL fraction of the TV. Always compliant	Always Compliant for ortho-P	GW Regs do not specify a pH range - the GW here is in range for downstream SW receptors: 6 to 9pH	typical GW temperature range.	High average TOC. Surface influence.	low Total Organic Nitrogen.	not a specified paramter. Results are not overly high as Total P.	
EPA GW Mon Stn Corrandulla GWIE_WE_G_002 012000008	**GW Alkalinity mg/l as CaCO3**	**GW Ammonia-Total (mg/l as N)**	**GW Chloride mg/l**	**GW Electrical Conductivity uS/cm**	**GW Nitrate N mg/l**	**GW Nitrite N ug/l**	**GW Ortho-P as P filtered mg/l**	**GW pH**	**GW Temperature oC**	**GW TOC (mg/l)**	**GW Total Organic Nitrogen (mg/l)**	**GW Total Phosphorus (mg/l)**	

Appendix 8.5

Greenfield Groundwater Quality

COYLE ENVIRONMENTAL LTD.

Baseline Groundwater Monitoring Report for Harrington Concrete and Quarries, Ardgaineen, Co. Galway

1st & 2nd Floor Kilmurry House, Main Street,
Castlerea, Co. Roscommon, F45 DK58

Tel: 094 962 1258 **Website**: www.coyleenv.ie

About Coyle Environmental Ltd.

Coyle Environmental Ltd are a highly respected and progressive Environmental Monitoring & Consulting practice.

For over two decades, Coyle Environmental Ltd has been a trusted provider of professional Environmental Monitoring and Consulting Services throughout Ireland.

Our reputation is built on innovative work practices, cost-effective solutions, and unwavering client dedication.

Operating nationwide from our base in the West of Ireland we pride ourselves on delivering consistently high-quality services, ensuring that projects are completed on time and within budget. Our commitment to Continuous Professional Development (CPD) and investment in the latest technology keeps us at the forefront of the industry.

We deliver to our valued clients a consistently excellent quality of service.

We offer a specialist range of services comprising:

- Environmental Monitoring
- Environmental Consulting
- Environmental Project Management

Coyle Environmental Ltd ability to provide a cost-efficient professional service coupled with a proven track record on project completion and delivery ensures that we remain an industry leader in our areas of expertise.

Our progressive and innovative work practices, together with our commitment to CPD (Continuous Professional Development) ensure that our workforce are consistently upgrading their professional skills and that the company is constantly investing in the most recent technology and equipment.

Domestic Sewage & Percolation Testing

Commercial Wastewater Management

Environmental Project Management

Environmental Monitoring

Environmental Permits & Compliance

AMTIVO ISO 9001 Certified Quality Management

AMTIVO ISO 45001 Certified Occupational Health & Safety Management

Document Control

Project Title:	Baseline Groundwater Monitoring Report for Harrington Concrete and Quarries, Galway.
Project Reference No:	24-042
Project Description:	Baseline Groundwater Monitoring Report for Harrington Concrete and Quarries, Ardgaineen, Co. Galway
Status:	FINAL
Client Details:	Harrington Concrete and Quarries
Issued By:	Coyle Environmental Ltd., 1st & 2nd Floor Kilmurry House, Castlerea, Co. Roscommon F45 DK58.

Document Production & Approval

	Name	Date	Position
Prepared by:	Jessica Halloran	30/06/25	Environmental Technician
Approved by:	Fergal Coyle	04/07/25	Environmental Consultant

Revision History

Rev	Status	Date
0		00/00/00

Table of Contents

1.0 Introduction

Coyle Environmental Ltd. were commissioned by Harrington Concrete and Quarries to undertake baseline groundwater monitoring for a proposed extension to the quarry. The following report presents the results from a groundwater monitoring event consisting of three groundwater samples and one discharge sample taken at Harrington Concrete and Quarries, Ardgaineen, Co. Galway.

Monitoring took place on the 29th of May 2025 and was carried out by Jessica Halloran (Environmental Technician) and Fergal Coyle (Environmental Consultant). The aim of the environmental work carried out was to help establish the groundwater quality at each of the specific locations at the Harrington Concrete and Quarries site at Ardgaineen, Co. Galway.

2.0 Site Location and Sampling Points

Harrington Concrete and Quarry, Galway is located in a rural area within the townland of Ardgaineen. Access to the site is just off the national road, N83. The site is approximately 7.5km North of Claregalway. A map of the sampling points is demonstrated in Figure 2.

3.0 Methodology

The monitoring involved the sampling of 3 groundwater boreholes, 1 discharge pipe and subsequent laboratory analysis of the samples taken. See monitoring procedure below.

A laboratory analysis of samples was carried out by IAS Lab, Carlow.

4.0 Method of Monitoring

The following monitoring protocol (EPA Guidance 2002) should be followed when sampling ground or surface water:

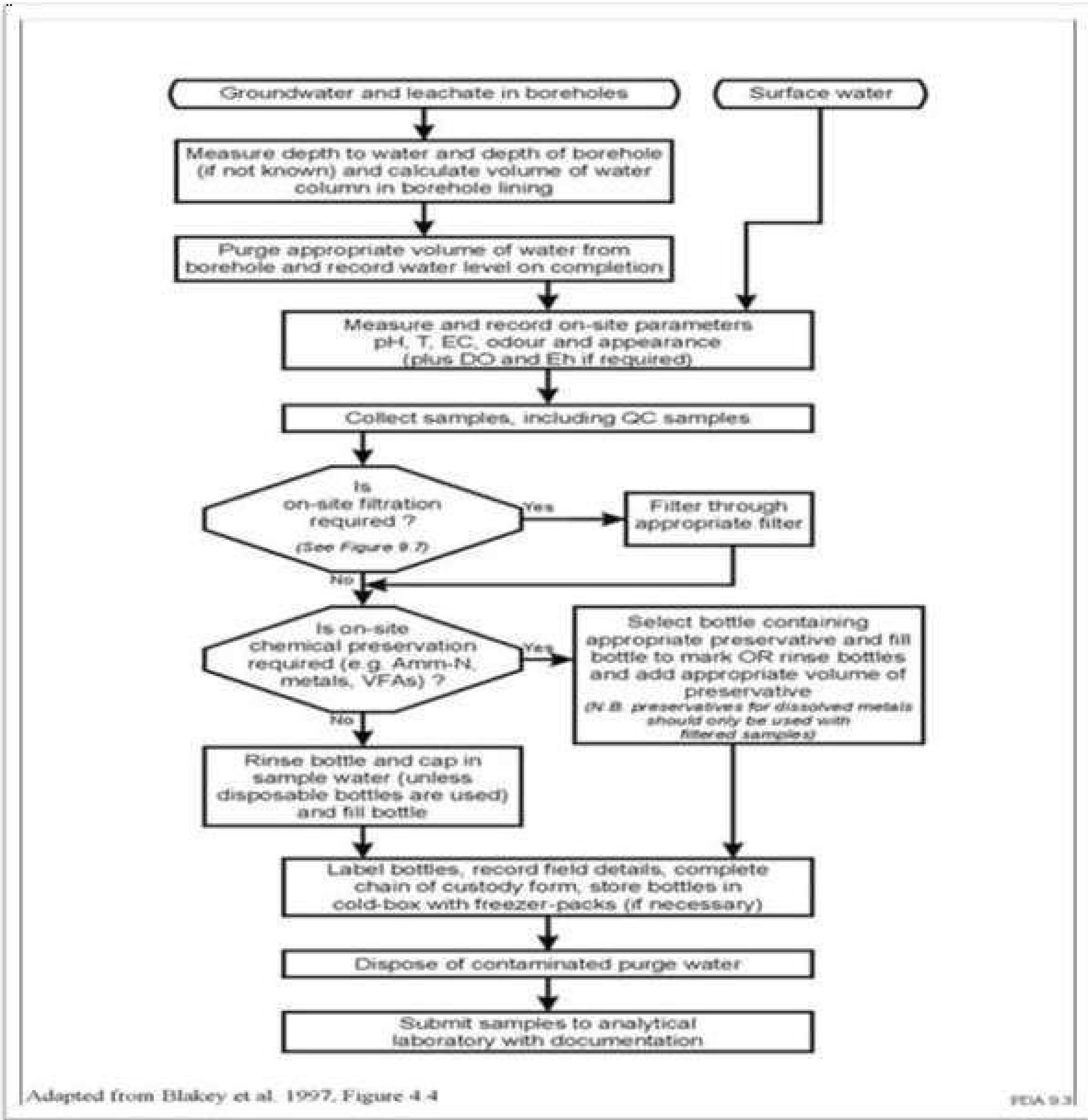


Figure 1: Monitoring Guidelines for Standpipes

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4.1 Determination of Water Level:

Using the dip meter record the water level in the borehole:

- The dip meter probe has a sensitivity control dial on the side of the meter reel – ensure this is at about the halfway point to ensure you hear the probe's water level indicated beep.
- Lower the dip probe into the borehole until it emits a continuous sounding beep This indicates the water level in the borehole.
- Take the reading from the tip of the borehole.
- If the top of the borehole is broken and/or uneven take the reading from the highest point of the pipe.
- Record the reading to 2 decimal points in the field sheet.
- The total depth of the borehole is recorded by lowering the dip meter to the bottom of the borehole and recording to two decimal places the depth at which the probe hits the base of the borehole.

4.2 Wasp Pump Purging method:

- First, ensure that the pump is clean and free of debris. It's also a good idea to flush the pump with water to remove any contaminants or residue.
- Attach the pump to a length of tubing that is long enough to reach the bottom of the borehole. The tubing should be of a suitable diameter to fit the pump, and it should be made of a material that is resistant to the chemicals that may be encountered in the borehole.
- Lower the pump into the borehole until it reaches the water level. The tubing should remain straight and not be bent or kinked.
- To operate the pump, attach the cables to the external battery. This activates the pump and creates a vacuum that draws water up through the tubing and into the pump.
- Purge the borehole for the required amount of time based on the depth of the borehole and the water level present.
- Using 500ml sterilised plastic bottles collect two samples.
- After use, clean the pump thoroughly with water and store it in a clean, dry place.
- It's important to note that the exact method for using a wasp pump may vary depending on the specific model and manufacturer. Always consult the manufacturer's instructions for proper use and maintenance of the pump.

5.0 Equipment Used

The following equipment was used when sampling groundwater boreholes:

- Water level 'Dip meter'
- Tubing for submersible pump
- 5 stage - WASP submersible water pump
- Sterilized plastic bottles
- Field sheets
- Map with location of standpipes
- Hanna Probe Multi-parameter 6090081101
- PPE

6.0 Results

Table 1: Groundwater Results for Harringtons Concrete and Quarry - Galway 29th of May 2025

Parameters	Units	BH1 - Discharge	BH2 GW	BH3 GW	BH4 GW
Aluminium	µg/l	14	479	30	<10
Alkalinity	mg/l $CaCO_3$	155.61	111.07	212.92	145.59
Benzo(a)pyrene	µg/l	<0.010	<0.010	<0.010	<0.010
Biochemical Oxygen Demand	mg/l	1	1	<1	2
Cadmium	µg/l	<0.5	<0.05	<0.5	<0.5
Chloride	mg/l	18.27	15.16	15.93	46.34
Chemical Oxygen Demand	mg/l	7	<5	<5	12
Conductivity	µS/cm 20°C	540	689	611	693
Diesel Range Organics	µg/l	<10	<10	<10	<10
Mercury	µg/l	<0.01	<0.01	<0.01	<0.01
Ammonium	mg/l NH_4	0.04	0.01	0.03	0.05
Nitrite	mg/l NO_2	0.03	0.03	<0.03	<0.03
Nitrate	mg/l NO_3	6.38	13.11	5.06	8.18
Orthophosphate P	mg/l P	0.03	0.04	0.01	0.01
Total PAH	µg/l	0.012	0.014	0.013	<0.010
pH	pH units	7.8	7.1	7.1	7.3
Petrol Range Organics	µg/l	<10	<10	<10	<10
Sulphate	mg/l	17.22	<2.5	6.12	5.94
Total Suspended Solids	mg/l	<5	<5	<5	7
Total Petroleum Hydrocarbons	µg/l	<10	<10	<10	19
Zinc	µg/l	<10	<10	<10	<10

Table 2: Field Data Results for Harrington Concrete and Quarries – Galway Boreholes and Discharge Pipe 29th of May 2025							
Date	**Sample ID**	**Borehole Depth (m)**	**Static Water Level (m)**	**Purge Time (Min)**	**pH**	**Temp °C**	**Sp.Cond µS/cm**
29/05/25	**BH1 - Discharge**	-	-	-	6.25	14.18	616
29/05/25	**BH2 - GW**	43	23.80	30	6.26	13.19	754
29/05/25	**BH3 – GW**	45	26.34	60	6.23	12.15	691
29/05/25	**BH4 - GW**	45	16.79	30	6.27	13.66	802

7.0 Discussion

This report presents the results for groundwater monitoring of standpipes in the surrounding area of Harringtons Quarry Galway, Ardgaineen which was carried out on the 29th of May 2025. Groundwater boreholes and a discharge pipe were monitored for BOD, COD, Conductivity, Nitrate, Nitrite, pH, Aluminum, Alkalinity, Benzo(a)pyrene, Cadmium, Chloride, Diesel Range Organics, Mercury, Ammonium, Orthophosphate P, Total PAHs, Petrol Range Organics, Sulphate, Total Suspended Solids, Total Petroleum, Hydrocarbons and Zinc.

Samples were successfully obtained and sent to an external laboratory (IAS) for analysis. The lab and field data results achieved for the groundwater samples taken at the referenced locations are found in tables 1.0 and 2.0.

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8.0 Harringtons Quarry Galway Map

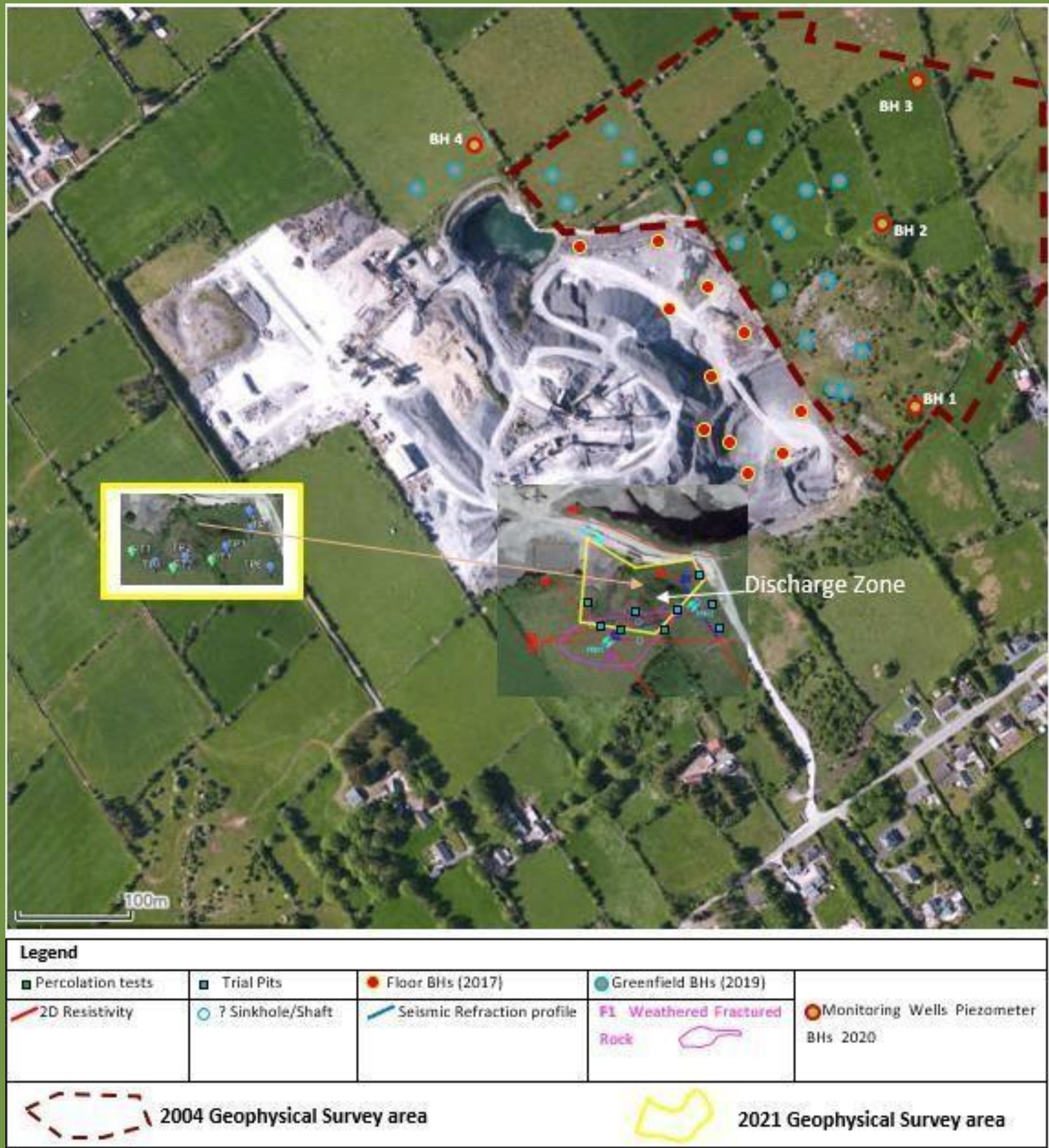

Figure 2: Site Map and Monitoring Locations

9.0 Photo Gallery

Figure 3: Groundwater Sampling - Borehole 2

Figure 5: Groundwater Sampling - Borehole 3

Figure 4: Groundwater Sampling - Borehole 4

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Appendix 1

IAS Lab Results and Field Data Sheet

Independent Analytical Supplies

Test Report

IAS LABORATORIES

Lab Report Number: 46717S002

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Customer ID:	COYL.FJ	**Analysis Type:**	99A (99A)
Contact Name:	JESSICA HALLORAN	**Delivery By:**	CUSTOMER
Company Name:	COYLE ENVIRONMENTAL LTD	**Sample Card Number:**	0306-COYL1
Address:	1ST/2ND FLR, KILMURRY HSE MAIN STREET CASTLEREA CO ROSCOMMON	**Condition on Receipt:** **Sample Date:** **Sample Time:** **Date Sample Received:**	Acceptable 29/05/2025 03/06/2025
Sample Type:	EFFLUENT	**Date Analysis Commenced:**	03/06/2025
Sample Reference:	HARRINGTONS GALWAY	**Date Certificate Issued:**	23/06/2025
Sample Description:	BH1 DISCHARGE HARRINGTONS		

Parameter	Method	Result	Unit
Aluminium	SOP 2125	14	µg/l
Alkalinity	SOP 2064	155.61	mg/l $CaCO_3$
Biochemical Oxygen Demand	SOP 2006	1	mg/l
Cadmium	SOP 2125	<0.5	µg/l
Chloride	SOP 2065	18.27	mg/l
Chemical Oxygen Demand	SOP 2005	7	mg/l
Conductivity	SOP 2076	540	µS/cm 20°C
Diesel Range Organics*^	Subcontracted	<10	µg/l
Mercury*^	Subcontracted	<0.01	µg/l
Ammonium	SOP 2057	0.04	mg/l NH_4
Nitrite	SOP 2059	0.03	mg/l NO_2
Nitrate	SOP 2060	6.38	mg/l NO_3
Orthophosphate P	SOP 2061	0.03	mg/l P
TOTAL PAH*^	Subcontracted	0.012	µg/l
pH	SOP 2004	7.8	pH units
Petrol Range Organics*^	Subcontracted	<10	µg/l
Sulphate	SOP 2062	17.22	mg/l
Total Suspended Solids	SOP 2016	<5	mg/l
Total Petroleum Hydrocarbons*^	Subcontracted	<10	µg/l
Zinc*	SOP 2125	<10	µg/l
Benzo(a)pyrene*^	Subcontracted	<0.010	µg/l

Signed: Laura Kavanagh　　Date: 23/06/2025

Laura Kavanagh - Site Lead

*** = not INAB Accredited　　^ = Subcontracted**

Opinions and interpretations expressed herein are outside the scope of INAB accreditation.
Uncertainty of Measurement is not taken into account for any test results reported.

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.275T

Independent Analytical Supplies

Test Report

Lab Report Number: **46717S001**

RECEIVED: 27/08/2025

Customer ID:	COYL.FJ	**Analysis Type:**	99A (99A)
Contact Name:	JESSICA HALLORAN	**Delivery By:**	CUSTOMER
Company Name:	COYLE ENVIRONMENTAL LTD	**Sample Card Number:**	0306-COYL1
Address:	1ST/2ND FLR, KILMURRY HSE MAIN STREET CASTLEREA CO ROSCOMMON	**Condition on Receipt:** **Sample Date:** **Sample Time:** **Date Sample Received:**	Acceptable 29/05/2025 03/06/2025
Sample Type:	GROUND WATER	**Date Analysis Commenced:**	03/06/2025
Sample Reference:	HARRINGTONS GALWAY	**Date Certificate Issued:**	23/06/2025
Sample Description:	BH2 G/W HARRINGSTOWN GALWAY		

Parameter	Method	Result	Unit
Aluminium	SOP 2125	479	µg/l
Alkalinity	SOP 2064	111.07	mg/l $CaCO_3$
Biochemical Oxygen Demand	SOP 2006	1	mg/l
Cadmium	SOP 2125	<0.5	µg/l
Chloride	SOP 2065	15.16	mg/l
Chemical Oxygen Demand	SOP 2005	<5	mg/l
Conductivity	SOP 2076	689	µS/cm 20°C
Diesel Range Organics*^	Subcontracted	<10	µg/l
Mercury*^	Subcontracted	<0.01	µg/l
Ammonium	SOP 2057	0.01	mg/l NH_4
Nitrite	SOP 2059	0.03	mg/l NO_2
Nitrate	SOP 2060	13.11	mg/l NO_3
Orthophosphate P	SOP 2061	0.04	mg/l P
TOTAL PAH*^	Subcontracted	0.014	µg/l
pH	SOP 2004	7.1	pH units
Petrol Range Organics*^	Subcontracted	<10	µg/l
Sulphate	SOP 2062	<2.5	mg/l
Total Suspended Solids	SOP 2016	<5	mg/l
Total Petroleum Hydrocarbons*^	Subcontracted	<10	µg/l
Zinc*	SOP 2125	<10	µg/l
Benzo(a)pyrene*^	Subcontracted	<0.010	µg/l

Signed: Laura Kavanagh   Date: 23/06/2025

Laura Kavanagh - Site Lead

*** = not INAB Accredited**   **^ = Subcontracted**

Opinions and interpretations expressed herein are outside the scope of INAB accreditation.
Uncertainty of Measurement is not taken into account for any test results reported.

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.275T

Independent Analytical Supplies

Test Report

RECEIVED: 27/08/2025

Lab Report Number: 46721S001

Customer ID:	COYL.FJ	**Analysis Type:**	99A (99A)
Contact Name:	JESSICA HALLORAN	**Delivery By:**	COURIER
Company Name:	COYLE ENVIRONMENTAL LTD	**Sample Card Number:**	0306-COYL3
Address:	1ST/2ND FLR, KILMURRY HSE MAIN STREET CASTLEREA CO ROSCOMMON	**Condition on Receipt:**	Acceptable
		Sample Date:	29/05/2025
		Sample Time:	
		Date Sample Received:	03/06/2025
Sample Type:	GROUND WATER	**Date Analysis Commenced:**	03/06/2025
Sample Reference:	HARRINGTON CONCRETE & QUARRY	**Date Certificate Issued:**	23/06/2025
Sample Description:	BH3 G/W HARRINGTONS GALWAY		

Parameter	Method	Result	Unit
Aluminium	SOP 2125	30	µg/l
Alkalinity	SOP 2064	212.92	mg/l $CaCO_3$
Benzo(a)pyrene*^	Subcontracted	<0.010	µg/l
Biochemical Oxygen Demand	SOP 2006	<1	mg/l
Cadmium	SOP 2125	<0.5	µg/l
Chloride	SOP 2065	15.93	mg/l
Chemical Oxygen Demand	SOP 2005	<5	mg/l
Conductivity	SOP 2076	611	µS/cm 20°C
Diesel Range Organics*^	Subcontracted	<10	µg/l
Mercury*^	Subcontracted	<0.01	µg/l
Ammonium	SOP 2057	0.03	mg/l NH_4
Nitrite	SOP 2059	<0.03	mg/l NO_2
Nitrate	SOP 2060	5.06	mg/l NO_3
Orthophosphate P	SOP 2061	0.01	mg/l P
TOTAL PAH*^	Subcontracted	0.013	µg/l
pH	SOP 2004	7.1	pH units
Petrol Range Organics*^	Subcontracted	<10	µg/l
Sulphate	SOP 2062	6.12	mg/l
Total Suspended Solids	SOP 2016	<5	mg/l
Total Petroleum Hydrocarbons*^	Subcontracted	<10	µg/l
Zinc*	SOP 2125	<10	µg/l

Signed: Laura Kavanagh   Date: 23/06/2025

Laura Kavanagh - Site Lead

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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.275T

Independent Analytical Supplies

Test Report

RECEIVED: 27/08/2025

Lab Report Number: **46721S002**

Customer ID:	COYL.FJ	**Analysis Type:**	99A (99A)
Contact Name:	JESSICA HALLORAN	**Delivery By:**	COURIER
Company Name:	COYLE ENVIRONMENTAL LTD	**Sample Card Number:**	0306-COYL3
Address:	1ST/2ND FLR, KILMURRY HSE MAIN STREET CASTLEREA CO ROSCOMMON	**Condition on Receipt:**	Acceptable
		Sample Date:	29/05/2025
		Sample Time:	
		Date Sample Received:	03/06/2025
Sample Type:	GROUND WATER	**Date Analysis Commenced:**	03/06/2025
Sample Reference:	HARRINGTON CONCRETE & QUARRY	**Date Certificate Issued:**	23/06/2025
Sample Description:	BH4 G/W HARRINGTONS GALWAY		

Parameter	Method	Result	Unit
Aluminium	SOP 2125	<10	µg/l
Alkalinity	SOP 2064	145.59	mg/l $CaCO_3$
Benzo(a)pyrene*^	Subcontracted	<0.010	µg/l
Biochemical Oxygen Demand	SOP 2006	2	mg/l
Cadmium	SOP 2125	<0.5	µg/l
Chloride	SOP 2065	46.34	mg/l
Chemical Oxygen Demand	SOP 2005	12	mg/l
Conductivity	SOP 2076	693	µS/cm 20°C
Diesel Range Organics*^	Subcontracted	<10	µg/l
Mercury*^	Subcontracted	<0.01	µg/l
Ammonium	SOP 2057	0.05	mg/l NH_4
Nitrite	SOP 2059	<0.03	mg/l NO_2
Nitrate	SOP 2060	8.18	mg/l NO_3
Orthophosphate P	SOP 2061	0.01	mg/l P
TOTAL PAH*^	Subcontracted	<0.010	µg/l
pH	SOP 2004	7.3	pH units
Petrol Range Organics*^	Subcontracted	<10	µg/l
Sulphate	SOP 2062	5.94	mg/l
Total Suspended Solids	SOP 2016	7	mg/l
Total Petroleum Hydrocarbons*^	Subcontracted	19	µg/l
Zinc*	SOP 2125	<10	µg/l

Signed: Laura Kavanagh Date: 23/06/2025

Laura Kavanagh - Site Lead

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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO.275T

FS 003

Issue date:	16.01.20
Issue no:	1
Issued by:	JW
Sheet name:	FS 003 - GW + Wells

Coyle ENVIRONMENTAL

Domestic Wells (SOP Ref No: ENV_002)

Pre Use Check - In-Situ Dip Meter

Date	Time	Check Level / Commemts	Signature

Pre Use Check - Hanna 98129 Hydrochemistry Measurement Probe

Date	Time	pH 4.01	pH 7.01	pH 10.01	Cond 1413 µS/cm	Cond 1413 µS/cm	Signature

Field Data

Sample I.D.	Date	Parameter							
		Borehole Depth (m)	Static water level (mbgl)	Purge Time (Min)	pH	Temp °C	Sp.Cond µS/cm	DO (mg/l)	Comments
BH1	29/05/25				6.25	14.18	616		
BH 2	29/05/25	43m	23.80m	30min	6.26	13.19	754		
BH 3	29/05/25	45m	26.34m	60min	6.23	12.15	691		
BH4	29/05/25	45m	16.79m	30min	6.27	19.68	802		

Sample Submission

Date	Delivery Time	No. Samples	Accepted By / Signature

Laboratory Acceptence

Date	Delivery Time	No. Samples	Accepted By / Signature

1st & 2nd Floor Kilmurry House, Main Street,
Castlerea, Co. Roscommon, F45 DK58

Tel: 094 962 1258 **Website**: www.coyleenv.ie

COYLE ENVIRONMENTAL

Element Materials Technology
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Zone 3
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Deeside
CH5 2UA

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W: www.element.com

RECEIVED: 27/08/2025

Bluerock Environmental Limited
Coláiste Pádraic Mac Piarais
Na Forbacha
Galway
Ireland
H91 YD2T

UKAS TESTING 4225

ISO 14001 Environmental Management CERTIFIED

Attention :	Paul Cummins
Date :	14th June, 2024
Your reference :	Harringtons Quarry (4)
Our reference :	Test Report 24/9579 Batch 1
Location :	Harringtons Quarry (Claregalway)
Date samples received :	5th June, 2024
Status :	Final Report
Issue :	202406141102

One sample was received for analysis on 5th June, 2024 and was scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

The greenhouse gas emissions generated (in Carbon – Co2e) to obtain the results in this report are estimated as:

Scope 1&2 emissions - 2.244 kg of CO2

Scope 1&2&3 emissions - 5.304 kg of CO2

Authorised By:

D. Bower

Darcey Bower MESci
Project Co-ordinator

Please include all sections of this report if it is reproduced

Element Materials Technology

Client Name: Bluerock Environmental Limited
Reference: Harringtons Quarry (4)
Location: Harringtons Quarry (Claregalway)
Contact: Paul Cummins
EMT Job No: 24/9579

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

RECEIVED: 27/08/2025

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-4			
Sample ID	BH4			
Depth				
COC No / misc				
Containers	V P G			
Sample Date	29/05/2024			
Sample Type	Ground Water			
Batch Number	1			
Date of Receipt	05/06/2024	LOD/LOR	Units	Method No.
Dissolved Aluminium #	<20	<20	ug/l	TM30/PM14
Dissolved Arsenic #	<2.5	<2.5	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5	<0.5	ug/l	TM30/PM14
Dissolved Calcium #	124.1	<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	<1.5	<1.5	ug/l	TM30/PM14
Dissolved Copper #	<7	<7	ug/l	TM30/PM14
Total Dissolved Iron #	<20	<20	ug/l	TM30/PM14
Dissolved Lead #	<5	<5	ug/l	TM30/PM14
Dissolved Magnesium #	5.2	<0.1	mg/l	TM30/PM14
Dissolved Manganese #	<2	<2	ug/l	TM30/PM14
Dissolved Mercury #	<1	<1	ug/l	TM30/PM14
Dissolved Nickel #	<2	<2	ug/l	TM30/PM14
Dissolved Phosphorus #	150	<5	ug/l	TM30/PM14
Dissolved Potassium #	2.1	<0.1	mg/l	TM30/PM14
Dissolved Sodium #	8.5	<0.1	mg/l	TM30/PM14
Dissolved Zinc #	11	<3	ug/l	TM30/PM14
Total Hardness Dissolved (as CaCO3)	332	<1	mg/l	TM30/PM14
PAH MS				
Naphthalene #	<0.1	<0.1	ug/l	TM4/PM30
Acenaphthylene #	<0.005	<0.005	ug/l	TM4/PM30
Acenaphthene #	<0.005	<0.005	ug/l	TM4/PM30
Fluorene #	<0.005	<0.005	ug/l	TM4/PM30
Phenanthrene #	<0.005	<0.005	ug/l	TM4/PM30
Anthracene #	<0.005	<0.005	ug/l	TM4/PM30
Fluoranthene #	<0.005	<0.005	ug/l	TM4/PM30
Pyrene #	<0.005	<0.005	ug/l	TM4/PM30
Benzo(a)anthracene #	<0.005	<0.005	ug/l	TM4/PM30
Chrysene #	<0.005	<0.005	ug/l	TM4/PM30
Benzo(bk)fluoranthene #	<0.008	<0.008	ug/l	TM4/PM30
Benzo(a)pyrene #	<0.005	<0.005	ug/l	TM4/PM30
Indeno(123cd)pyrene #	<0.005	<0.005	ug/l	TM4/PM30
Dibenzo(ah)anthracene #	<0.005	<0.005	ug/l	TM4/PM30
Benzo(ghi)perylene #	<0.005	<0.005	ug/l	TM4/PM30
PAH 16 Total #	<0.173	<0.173	ug/l	TM4/PM30
Benzo(b)fluoranthene	<0.008	<0.008	ug/l	TM4/PM30
Benzo(k)fluoranthene	<0.008	<0.008	ug/l	TM4/PM30
PAH Surrogate % Recovery	92	<0	%	TM4/PM30
MTBE #	<5	<5	ug/l	TM36/PM12
Benzene #	<5	<5	ug/l	TM36/PM12
Toluene #	<5	<5	ug/l	TM36/PM12
Ethylbenzene #	<5	<5	ug/l	TM36/PM12
m/p-Xylene #	<5	<5	ug/l	TM36/PM12

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Element Materials Technology

Client Name: Bluerock Environmental Limited
Reference: Harringtons Quarry (4)
Location: Harringtons Quarry (Claregalway)
Contact: Paul Cummins
EMT Job No: 24/9579

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-4	LOD/LOR	Units	Method No.
Sample ID	BH4			
Depth				
COC No / misc				
Containers	V P G			
Sample Date	29/05/2024			
Sample Type	Ground Water			
Batch Number	1			
Date of Receipt	05/06/2024			
o-Xylene #	<5	<5	ug/l	TM36/PM12
TPH CWG				
Aliphatics				
>C5-C6 (HS_1D_AL) #	<10	<10	ug/l	TM36/PM12
>C6-C8 (HS_1D_AL) #	<10	<10	ug/l	TM36/PM12
>C8-C10 (HS_1D_AL) #	<10	<10	ug/l	TM36/PM12
>C10-C12 (EH_CU_1D_AL) #	<5	<5	ug/l	TM5/PM16/PM30
>C12-C16 (EH_CU_1D_AL) #	<10	<10	ug/l	TM5/PM16/PM30
>C16-C21 (EH_CU_1D_AL) #	<10	<10	ug/l	TM5/PM16/PM30
>C21-C35 (EH_CU_1D_AL) #	<10	<10	ug/l	TM5/PM16/PM30
Total aliphatics C5-35 (EH_CU+HS_1D_AL) #	<10	<10	ug/l	TM5/TM36/PM12/PM16/PM30
Aromatics				
>C5-EC7 (HS_1D_AR) #	<10	<10	ug/l	TM36/PM12
>EC7-EC8 (HS_1D_AR) #	<10	<10	ug/l	TM36/PM12
>EC8-EC10 (HS_1D_AR) #	<10	<10	ug/l	TM36/PM12
>EC10-EC12 (EH_CU_1D_AR) #	<5	<5	ug/l	TM5/PM16/PM30
>EC12-EC16 (EH_CU_1D_AR) #	<10	<10	ug/l	TM5/PM16/PM30
>EC16-EC21 (EH_CU_1D_AR) #	<10	<10	ug/l	TM5/PM16/PM30
>EC21-EC35 (EH_CU_1D_AR) #	<10	<10	ug/l	TM5/PM16/PM30
Total aromatics C5-35 (EH_CU+HS_1D_AR) #	<10	<10	ug/l	TM5/TM36/PM12/PM16/PM30
Total aliphatics and aromatics(C5-35) (EH_CU+HS_1D_Total) #	<10	<10	ug/l	TM5/TM36/PM12/PM16/PM30
Sulphate as SO4 #	6.2	<0.5	mg/l	TM38/PM0
Chloride #	7.1	<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	1.6	<0.2	mg/l	TM38/PM0
Nitrite as NO2 #	0.03	<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4 #	<0.06	<0.06	mg/l	TM38/PM0
Ammoniacal Nitrogen as N #	0.04	<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4 #	0.05	<0.03	mg/l	TM38/PM0
Total Alkalinity as CaCO3 #	336	<1	mg/l	TM75/PM0
Electrical Conductivity @25C #	625	<2	uS/cm	TM76/PM0
pH #	8.14	<0.01	pH units	TM73/PM0
Total Organic Carbon #	<2	<2	mg/l	TM60/PM0
Total Suspended Solids #	128	<10	mg/l	TM37/PM0

Element Materials Technology

Client Name: Bluerock Environmental Limited
Reference: Harringtons Quarry (3)
Location: Harringtons Quarry (Claregalway)
Contact: Paul Cummins
EMT Job No: 24/9580

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

RECEIVED: 27/08/2025

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-4												
Sample ID	BH3												
Depth													
COC No / misc													
Containers	V P G												
Sample Date	29/05/2024												
Sample Type	Ground Water												
Batch Number	1												
Date of Receipt	05/06/2024										LOD/LOR	Units	Method No.
Dissolved Aluminium #	<20										<20	ug/l	TM30/PM14
Dissolved Arsenic #	<2.5										<2.5	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5										<0.5	ug/l	TM30/PM14
Dissolved Calcium #	129.1										<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	<1.5										<1.5	ug/l	TM30/PM14
Dissolved Copper #	<7										<7	ug/l	TM30/PM14
Total Dissolved Iron #	<20										<20	ug/l	TM30/PM14
Dissolved Lead #	<5										<5	ug/l	TM30/PM14
Dissolved Magnesium #	4.8										<0.1	mg/l	TM30/PM14
Dissolved Manganese #	<2										<2	ug/l	TM30/PM14
Dissolved Mercury #	<1										<1	ug/l	TM30/PM14
Dissolved Nickel #	<2										<2	ug/l	TM30/PM14
Dissolved Potassium #	4.0										<0.1	mg/l	TM30/PM14
Dissolved Sodium #	11.1										<0.1	mg/l	TM30/PM14
Dissolved Zinc #	16										<3	ug/l	TM30/PM14
Total Mercury	<1										<1	ug/l	TM30/PM14
Total Phosphorus	349										<5	ug/l	TM30/PM14
Total Hardness Dissolved (as CaCO3)	343										<1	mg/l	TM30/PM14
PAH MS													
Naphthalene #	<0.1										<0.1	ug/l	TM4/PM30
Acenaphthylene #	<0.005										<0.005	ug/l	TM4/PM30
Acenaphthene #	<0.005										<0.005	ug/l	TM4/PM30
Fluorene #	<0.005										<0.005	ug/l	TM4/PM30
Phenanthrene #	<0.005										<0.005	ug/l	TM4/PM30
Anthracene #	<0.005										<0.005	ug/l	TM4/PM30
Fluoranthene #	<0.005										<0.005	ug/l	TM4/PM30
Pyrene #	<0.005										<0.005	ug/l	TM4/PM30
Benzo(a)anthracene #	<0.005										<0.005	ug/l	TM4/PM30
Chrysene #	<0.005										<0.005	ug/l	TM4/PM30
Benzo(bk)fluoranthene #	<0.008										<0.008	ug/l	TM4/PM30
Benzo(a)pyrene #	<0.005										<0.005	ug/l	TM4/PM30
Indeno(123cd)pyrene #	<0.005										<0.005	ug/l	TM4/PM30
Dibenzo(ah)anthracene #	<0.005										<0.005	ug/l	TM4/PM30
Benzo(ghi)perylene #	<0.005										<0.005	ug/l	TM4/PM30
PAH 16 Total #	<0.173										<0.173	ug/l	TM4/PM30
Benzo(b)fluoranthene	<0.008										<0.008	ug/l	TM4/PM30
Benzo(k)fluoranthene	<0.008										<0.008	ug/l	TM4/PM30
PAH Surrogate % Recovery	91										<0	%	TM4/PM30
MTBE #	<5										<5	ug/l	TM36/PM12
Benzene #	<5										<5	ug/l	TM36/PM12
Toluene #	<5										<5	ug/l	TM36/PM12
Ethylbenzene #	<5										<5	ug/l	TM36/PM12

Element Materials Technology

Client Name: Bluerock Environmental Limited
Reference: Harringtons Quarry (3)
Location: Harringtons Quarry (Claregalway)
Contact: Paul Cummins
EMT Job No: 24/9580

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

RECEIVED: 27/08/2025

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-4	LOD/LOR	Units	Method No.
Sample ID	BH3			
Depth				
COC No / misc				
Containers	V P G			
Sample Date	29/05/2024			
Sample Type	Ground Water			
Batch Number	1			
Date of Receipt	05/06/2024			
m/p-Xylene #	<5	<5	ug/l	TM36/PM12
o-Xylene #	<5	<5	ug/l	TM36/PM12
TPH CWG				
Aliphatics				
>C5-C6 (HS_1D_AL) #	<10	<10	ug/l	TM36/PM12
>C6-C8 (HS_1D_AL) #	<10	<10	ug/l	TM36/PM12
>C8-C10 (HS_1D_AL) #	<10	<10	ug/l	TM36/PM12
>C10-C12 (EH_CU_1D_AL) #	<5	<5	ug/l	TM5/PM16/PM30
>C12-C16 (EH_CU_1D_AL) #	<10	<10	ug/l	TM5/PM16/PM30
>C16-C21 (EH_CU_1D_AL) #	<10	<10	ug/l	TM5/PM16/PM30
>C21-C35 (EH_CU_1D_AL) #	<10	<10	ug/l	TM5/PM16/PM30
Total aliphatics C5-35 (EH_CU+HS_1D_AL) #	<10	<10	ug/l	TM5/TM36/PM12/PM16/PM30
Aromatics				
>C5-EC7 (HS_1D_AR) #	<10	<10	ug/l	TM36/PM12
>EC7-EC8 (HS_1D_AR) #	<10	<10	ug/l	TM36/PM12
>EC8-EC10 (HS_1D_AR) #	<10	<10	ug/l	TM36/PM12
>EC10-EC12 (EH_CU_1D_AR) #	<5	<5	ug/l	TM5/PM16/PM30
>EC12-EC16 (EH_CU_1D_AR) #	<10	<10	ug/l	TM5/PM16/PM30
>EC16-EC21 (EH_CU_1D_AR) #	<10	<10	ug/l	TM5/PM16/PM30
>EC21-EC35 (EH_CU_1D_AR) #	<10	<10	ug/l	TM5/PM16/PM30
Total aromatics C5-35 (EH_CU+HS_1D_AR) #	<10	<10	ug/l	TM5/TM36/PM12/PM16/PM30
Total aliphatics and aromatics(C5-35) (EH_CU+HS_1D_Total) #	<10	<10	ug/l	TM5/TM36/PM12/PM16/PM30
Sulphate as SO4 #	14.2	<0.5	mg/l	TM38/PM0
Chloride #	18.8	<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	24.0	<0.2	mg/l	TM38/PM0
Nitrite as NO2 #	<0.02	<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4 #	0.14	<0.06	mg/l	TM38/PM0
Ammoniacal Nitrogen as N #	<0.03	<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4 #	<0.03	<0.03	mg/l	TM38/PM0
Total Alkalinity as CaCO3 #	376	<1	mg/l	TM75/PM0
Electrical Conductivity @25C #	718	<2	uS/cm	TM76/PM0
pH #	7.50	<0.01	pH units	TM73/PM0
Total Organic Carbon #	<2	<2	mg/l	TM60/PM0
Total Suspended Solids #	338	<10	mg/l	TM37/PM0

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Element Materials Technology

Client Name: Bluerock Environmental Limited
Reference: Harringtons Quarry (2)
Location: Harringtons Quarry (Claregalway)
Contact: Paul Cummins
EMT Job No: 24/9581

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-4										LOD/LOR	Units	Method No.
Sample ID	BH2												
Depth													
COC No / misc													
Containers	V P G												
Sample Date	29/05/2024												
Sample Type	Ground Water												
Batch Number	1												
Date of Receipt	05/06/2024												
Dissolved Aluminium #	<20										<20	ug/l	TM30/PM14
Dissolved Arsenic #	<2.5										<2.5	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5										<0.5	ug/l	TM30/PM14
Dissolved Calcium #	124.2										<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	<1.5										<1.5	ug/l	TM30/PM14
Dissolved Copper #	<7										<7	ug/l	TM30/PM14
Total Dissolved Iron #	<20										<20	ug/l	TM30/PM14
Dissolved Lead #	<5										<5	ug/l	TM30/PM14
Dissolved Magnesium #	5.7										<0.1	mg/l	TM30/PM14
Dissolved Manganese #	<2										<2	ug/l	TM30/PM14
Dissolved Mercury #	<1										<1	ug/l	TM30/PM14
Dissolved Nickel #	<2										<2	ug/l	TM30/PM14
Dissolved Potassium #	1.2										<0.1	mg/l	TM30/PM14
Dissolved Sodium #	7.5										<0.1	mg/l	TM30/PM14
Dissolved Zinc #	5										<3	ug/l	TM30/PM14
Total Mercury	<1										<1	ug/l	TM30/PM14
Total Phosphorus	11										<5	ug/l	TM30/PM14
Total Hardness Dissolved (as CaCO3)	334										<1	mg/l	TM30/PM14
PAH MS													
Naphthalene #	<0.1										<0.1	ug/l	TM4/PM30
Acenaphthylene #	<0.005										<0.005	ug/l	TM4/PM30
Acenaphthene #	<0.005										<0.005	ug/l	TM4/PM30
Fluorene #	<0.005										<0.005	ug/l	TM4/PM30
Phenanthrene #	<0.005										<0.005	ug/l	TM4/PM30
Anthracene #	<0.005										<0.005	ug/l	TM4/PM30
Fluoranthene #	<0.005										<0.005	ug/l	TM4/PM30
Pyrene #	<0.005										<0.005	ug/l	TM4/PM30
Benzo(a)anthracene #	<0.005										<0.005	ug/l	TM4/PM30
Chrysene #	<0.005										<0.005	ug/l	TM4/PM30
Benzo(bk)fluoranthene #	<0.008										<0.008	ug/l	TM4/PM30
Benzo(a)pyrene #	<0.005										<0.005	ug/l	TM4/PM30
Indeno(123cd)pyrene #	<0.005										<0.005	ug/l	TM4/PM30
Dibenzo(ah)anthracene #	<0.005										<0.005	ug/l	TM4/PM30
Benzo(ghi)perylene #	<0.005										<0.005	ug/l	TM4/PM30
PAH 16 Total #	<0.173										<0.173	ug/l	TM4/PM30
Benzo(b)fluoranthene	<0.008										<0.008	ug/l	TM4/PM30
Benzo(k)fluoranthene	<0.008										<0.008	ug/l	TM4/PM30
PAH Surrogate % Recovery	90										<0	%	TM4/PM30
MTBE #	<5										<5	ug/l	TM36/PM12
Benzene #	<5										<5	ug/l	TM36/PM12
Toluene #	<5										<5	ug/l	TM36/PM12
Ethylbenzene #	<5										<5	ug/l	TM36/PM12

Client Name:	Bluerock Environmental Limited	**Report :**	**Liquid**
Reference:	Harringtons Quarry (2)		
Location:	Harringtons Quarry (Claregalway)		
Contact:	Paul Cummins	**Liquids/products:**	V=40ml vial, G=glass bottle, P=plastic bottle
EMT Job No:	24/9581		$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

RECEIVED: 27/08/2025

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-4												
Sample ID	BH2												
Depth													
COC No / misc													
Containers	V P G												
Sample Date	29/05/2024												
Sample Type	Ground Water												
Batch Number	1												
Date of Receipt	05/06/2024										LOD/LOR	Units	Method No.
m/p-Xylene #	<5										<5	ug/l	TM36/PM12
o-Xylene #	<5										<5	ug/l	TM36/PM12
TPH CWG													
Aliphatics													
>C5-C6 (HS_1D_AL) #	<10										<10	ug/l	TM36/PM12
>C6-C8 (HS_1D_AL) #	<10										<10	ug/l	TM36/PM12
>C8-C10 (HS_1D_AL) #	<10										<10	ug/l	TM36/PM12
>C10-C12 (EH_CU_1D_AL) #	<5										<5	ug/l	TM5/PM16/PM30
>C12-C16 (EH_CU_1D_AL) #	<10										<10	ug/l	TM5/PM16/PM30
>C16-C21 (EH_CU_1D_AL) #	<10										<10	ug/l	TM5/PM16/PM30
>C21-C35 (EH_CU_1D_AL) #	<10										<10	ug/l	TM5/PM16/PM30
Total aliphatics C5-35 (EH_CU+HS_1D_AL) #	<10										<10	ug/l	TM5/TM36/PM12/PM16/PM30
Aromatics													
>C5-EC7 (HS_1D_AR) #	<10										<10	ug/l	TM36/PM12
>EC7-EC8 (HS_1D_AR) #	<10										<10	ug/l	TM36/PM12
>EC8-EC10 (HS_1D_AR) #	<10										<10	ug/l	TM36/PM12
>EC10-EC12 (EH_CU_1D_AR) #	<5										<5	ug/l	TM5/PM16/PM30
>EC12-EC16 (EH_CU_1D_AR) #	<10										<10	ug/l	TM5/PM16/PM30
>EC16-EC21 (EH_CU_1D_AR) #	<10										<10	ug/l	TM5/PM16/PM30
>EC21-EC35 (EH_CU_1D_AR) #	<10										<10	ug/l	TM5/PM16/PM30
Total aromatics C5-35 (EH_CU+HS_1D_AR) #	<10										<10	ug/l	TM5/TM36/PM12/PM16/PM30
Total aliphatics and aromatics(C5-35) (EH_CU+HS_1D_Total) #	<10										<10	ug/l	TM5/TM36/PM12/PM16/PM30
Sulphate as SO4 #	4.4										<0.5	mg/l	TM38/PM0
Chloride #	9.6										<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	2.1										<0.2	mg/l	TM38/PM0
Nitrite as NO2 #	<0.02										<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4 #	<0.06										<0.06	mg/l	TM38/PM0
Ammoniacal Nitrogen as N #	<0.03										<0.03	mg/l	TM38/PM0
Ammoniacal Nitrogen as NH4 #	<0.03										<0.03	mg/l	TM38/PM0
Total Alkalinity as CaCO3 #	346										<1	mg/l	TM75/PM0
Electrical Conductivity @25C #	658										<2	uS/cm	TM76/PM0
pH #	7.65										<0.01	pH units	TM73/PM0
Total Organic Carbon #	<2										<2	mg/l	TM60/PM0
Total Suspended Solids #	38										<10	mg/l	TM37/PM0

Harringtons Argaineen Groundwater Quality Data			Historic GW Quality CLS & City Analysts 2020 - 2021						
			1116747	1154855	1154852	1154853	1154854	579211	
Parameter	Units	GROUNDWATER Regulation's THRESHOLD VALUES 2010, as amended (Column's 3 & 4 TVs = General Quality & Human Consumption)	MW04 December 2020	MW04 March 2021	MW01 March 2021	MW02 March 2021	MW03 March 2021	MW04 May 2021	Historic Compliance
PH	pH Unit	6 < pH < 9	7.2	7.2	7.1	7.2	7.2	7.0	Compliant
Electrical Conductivity	uS/cm	1875 uS/cm	578	565	784	677	593	596	Compliant
Chloride	mg/l	187.5	NA	7.16	15.1	21.6	12.1	< 10.0	Compliant
Sulphate	mg/l	187.5 mg/l	NA	<5	<5	5.34	<5	< 20.0	Compliant
Nitrate as N03	mg/l	37.5 mg/l as NO3	3.2	2.18	11.3	31.8	5.66	< 8.90	Compliant
Nitrite as N02	mg/l	375 ug/l as NO2	<0.002	0.039	0.044	<0.017	<0.017	< 0.066	Compliant
Ammonia as N	mg/l	175 ug/l NH4-N	0.013	0.026	0.02	0.013	0.01	< 0.010	Compliant
Orthophosphate as P04-P	mg/l	35 ug/l = 0.035 mg/l	0.018	<0.01	<0.01	<0.01	<0.01	< 0.025	Compliant
Aluminium	ug/l	150 µg/l	lab issue					56.4	Compliant
Cadmium	ug/l	150 ug/l	NA	<0.6	<0.6	<0.6	<0.6	0.2	Compliant
Zinc	ug/l	75 ug/l	25	<6	<6	24	<6	3.6	Compliant
Mercury	µg/l	0.75	NA	<0.01	<0.01	<0.01	<0.01	< 0.05	Compliant
TPH >C6 - C10	µg/l	7.5	individual TPH sinatures not reported until change of lab to City Analysts in May 2021					< 0.10	Compliant
TPH >C10 - C21	µg/l							< 0.10	Compliant
TPH >C21 - C40	µg/l							< 0.10	Compliant
TPH >C6 - C40	µg/l		<10	<20	" **Unknown Patterns "			< 10	Compliant
Benzo(a)pyrene	ug/l	0.0075	NA	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	Compliant
Total PAH	ug/l	0.075	NA	0.065	0.048	0.082	0.057	< 0.01	Compliant
Alkalinity CaCO3	mg/l	not specified	333	357	435	404	359	331	n/a
Total Organic Carbon	mg/l	not specified	3.14	2.59	3.74	2.33	1.34	2.76	n/a
Potassium	mg/l	not specified	NA	3	5	5	1	3.29	
Sodium	mg/l	not specified	NA	10	10	12	8	9.31	
K:Na calcuation	ratio	hydrogeologist's tool	NA	0.3	0.5	0.42	0.13	0.4	
Magnesium	mg/l	not specified	NA	6	12	7	4	5.64	
Iron	ug/l	not specified	NA	274	890	3532	381	50.4	
Manganese	ug/l	not specified	NA	20	35	86	12	3.8	
Cobalt - Total	µg/l	not specified	NA		not analysed			< 1	

NOTE: Certs of Analysis were presented in Hydro-G (2022)'s Assimilation Capacity Report for the Site.