SLIGO COUNTY COUNCIL
17 JUN 2021
PLANNING

Recommencement and Deepening of Existing Quarry and Associated Processing Area

AGHAMORE NEAR, AGHAMORE FAR AND CARROWNAMADDOO TOWNLANDS, COUNTY SLIGO

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

MAY 2021

Applicant: Lagan Materials Ltd.

SCANNED
25 JUN 2021

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LAGAN
Part of the Breedon Group

1. Introduction

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INTRODUCTION

1.1 This Environmental Impact Assessment Report (EIAR) provides supporting information to accompany a planning application to Sligo County Council submitted by Lagan Materials Ltd. in respect of their existing quarry and processing area at Aghamore Near, Aghamore Far and Carrownamaddoo townlands, Co. Sligo.

1.2 The application site extends to c. 22.5 hectares – refer to Figures 1.1 and 1.2.

1.3 The proposed development being applied for under this current planning application is shown on **Figure 2-1** and is similar to that previously granted under Sligo County Council Ref. No 02/271 and will consist of:

- Recommencement of quarry operations within the previously permitted quarry extraction area (c. 10.9ha);
- Deepening of the previously permitted quarry area by 2 no. extractive benches from c. -21m OD to -50m OD;
- Recommencement of aggregate processing (crushing and screening) within the existing processing area, located to the east of the local road that bisects the site;
- The provision of a settlement lagoon (c. 2,830m²);
- The provision of 2 no. wheelwashes;
- The Provision of a double stacked portacabin office;
- The Provision of a wastewater treatment system;
- Additional stockproof / trespass proof boundary fencing;
- All within an application area of c. 22.5 Ha.

1.4 The application is made in accordance with the requirements of the Planning and Development Regulations 2001-2015 (as amended).

Background

1.5 A Planning Application was submitted to Sligo County Council (Plan File Ref. No. 18/345: ABP Ref. 305821-19) in August 2018 for similar development to that proposed as part of this application. In October 2019 Sligo County Council granted planning permission for the development (subject to 23 no. conditions). 2 no. third party appeals of the decision by Sligo County Council to grant permission for the proposed quarry development were made to An Bord Pleanala (ABP-305821-19).

1.6 An Bord Pleanala refused permission for the proposed development on the 30th June 2020 for the following 2 no. reasons:

1. *On the basis of the information provided with the planning application and the appeal, including the Natura impact statement, the Board is not satisfied that the proposed development either individually, or in combination with other plans or projects would not adversely affect the integrity of Lough Gill Special Area of Conservation (Site Code: 001976), Cummeen Strand Special Protection Area (Site Code: 004035), Cummeen Strand/Drumcliff Bay (Sligo Bay) Special Area of Conservation (Site Code: 000627), Ballysadare Bay Special Protection Area (Site Code: 004129) and Ballysadare Bay Special Area of Conservation (Site Code: 000622), in view of the conservation objectives of these sites. The Board noted, in particular, the absence of information in relation to the impact of reduced groundwater resulting from dewatering arising from the proposed development and to the cumulative impacts of the proposed development and the adjacent associated processing area. In such circumstances, the Board is precluded from granting permission.*

2. *Notwithstanding local planning policy supporting quarrying on the site, having regard to the nature, scale and extent of the proposed development, and the inadequacy of information to comprehensively identify and demonstrate the cumulative impacts on the environment of the proposed development and the adjacent associated processing area, in particular in relation to water quality and biodiversity, it is considered that, in the absence of such adequate information, the proposed development could be detrimental to receiving freshwater habitats and could be prejudicial to public water supplies sourced from Lough Gill and could lead to loss or disturbance of habitat and/or species in the adjacent associated processing area. It has not, therefore, been demonstrated that the proposed development would not be prejudicial to public health and be contrary to the proper planning and sustainable development of the area.*

1.7 The Applicant, and their advisors, have reviewed Sligo County Council's decision, An Bord Pleanala's decision and associated Inspectors Report. This revised planning application and EIAR has been prepared to comprehensively address the reasons for refusal stated by the Board.

Additional Information Provided

1.8 A heading titled 'Additional Information' has been provided, where relevant, in each Chapter of this EIAR to identify the additional surveys / site investigations, field work and assessments that have been carried out to address the previous reasons for refusal associated with Plan File Ref. No. 18/345 / ABP Ref. 305821-19.

1.9 In summary, the following additional information has been included with this application to address the previous reasons for refusal:

- The processing area where aggregate processing (crushing and screening) will be undertaken (located on the eastern side of the local road that bisects the site) is included within the planning application area and has been fully assessed in the EIAR and NIS;
- An updated hydrogeological assessment has been undertaken by TMS Environment Ltd. that includes the following:
  - A detailed description of Sligo's regional hydrological and hydrogeological regimes and Karst features has been provided from Suzanne Tynan of Tynan Environmental;

  - In response to the Irish Water response to scoping, Dr. Pamela Bartley of Hydro-G Hydrogeological & Hydrological Consulting was invited to assist in the impact assessment for the potential threat posed to the Public Water Supply Sources (PWSS's) abstracted each day from Lough Gill;
  - Dr. Pamela Bartley of Hydro-G Hydrogeological & Hydrological Consulting was also contracted by Lagan to carry out a peer review of the Water Chapter of the EIAR;
  - Installation of 6 additional boreholes within the quarry area;
  - Installation of 5 new boreholes within the processing area;
  - Installation of dataloggers (level loggers) in the new wells to monitor groundwater levels;
  - Further surface water and groundwater sampling;
  - A geophysical survey of the existing quarry floor and land to the northeast of the quarry was carried out;
  - Two biological assessments of the Aghamore Stream have been carried out;
  - Proposed water management plan for the processing area.

- A Natura Impact Statement (NIS) has been prepared to assess the impact of the proposed development, including the cumulative impacts of the quarry and the associated processing area on designated sites.

- This Environmental Impact Assessment Report has been updated to comprehensively assess the cumulative impacts on the environment of the quarry and the associated processing area, with particular regard to water quality and biodiversity.

- In addition to the quarry and associated processing area, the cumulative impact assessment includes the asphalt production plant which is located within the landholding.

THE SITE

Site Location

1.10 The lands which are the subject of this application comprise c. 22.5 hectares and are located in the townlands of Aghamore Near, Aghamore Far and Carrownamaddoo, Co. Sligo (refer to Figure 1.1). The proposed development is located wholly within the existing quarry and associated processing area (located on the eastern side of the local road that bisects the application site) and no lateral extension of the development is proposed.

1.11 The application site is located near two regional roads, the R287 to the South and the R284 to the East. The site occupies ground with elevations ranging between -21m OD (Quarry Floor) and 34m OD. The lower quarry floor is currently at -21 m OD, with the previous planning permission (Plan File Ref. No 02/271) authorising extraction to -34.5m OD. The application area forms the existing

CHAPTER 1

INTRODUCTION

quarry area, along with the associated processing area located on the eastern side of the local road that bisects the application site. The processing area occupies ground with elevations at c. 15 mOD.

Site Description

1.12 The quarry operation will comprise of the extraction of limestone using conventional blasting techniques and the processing (crushing and screening) of the fragmented rock using mobile plant and equipment to produce aggregates.

1.13 The application site relates to the quarry extraction area, as previously permitted under Planning Ref. No. 02/271, and the processing area located on the eastern part of the application site. Activities on the eastern part of the landholding commenced in the 1950's, with a further planning permission being granted for these lands and associated plant in 1965 (Plan File Ref. No. 285).

1.14 Material extracted from the quarry area will be processed within the quarry void using mobile processing plant and transported to the processing area for further processing using mobile processing plant. The processed material will then be stockpiled pending transport off-site to the local and regional market or used in the existing asphalt plant.

1.15 Existing ancillary facilities at the site include the weighbridge & weighbridge office and a garage / workshop. These facilities are located within the processing area on the eastern part of the application site.

1.16 An existing asphalt plant is located adjacent to the processing area – refer to Figure 1.2.

1.17 Concrete production was historically carried out at the site by the previous owner and operator, CEMEX (ROI) Ltd. (Cemex). This activity ceased in 2014 and the concrete production plant located within the landholding is now obsolete. The applicant does not intend to undertake concrete production at the site and as such this activity has not been assessed as part of the cumulative impact assessment within the relevant chapters of the Environmental Impact Assessment Report that accompanies this planning application. The cumulative impact assessment includes the quarrying activities, processing activities and asphalt production activities.

Site Access

1.18 The site is located in close proximity to Sligo Town, being approximately 5 km southeast and is accessed by the R284 and the R287 regional roads via the Drumiskabole crossroads and the Aghamore crossroads respectively.

1.19 The quarry and the processing area are located on opposite sides of a local road. Material from the quarry will be transported by dump trucks to the processing area via an existing access that forms a crossroads with the access to the quarry.

1.20 There is a second separate access to the processing area used mainly by HGV traffic delivering processed material to market and for staff accessing the site. This access has been improved with road widening and upgrade works being made under Plan File Ref. No. 02/271 (see Condition no. 9).

1.21 All HGV traffic accesses and egresses the site via site office / weighbridge / wheelwash (proposed).

Surrounding Land-Use

1.22 The quarry area is surrounded by agricultural lands (improved agricultural grassland and arable). There are numerous industrial uses within 1 km of the quarry.

1.23 Residences within the general area consist of one-off rural houses, farmsteads with some ribbon development along the local road network – refer to EIAR Chapter 4 Population and Human Health.

THE APPLICANT

1.24 The applicant, Lagan Materials Limited ('Lagan'), is part of Breedon Group plc. Breedon is a public company with ordinary shares traded on the Alternative Investment Market (AIM). Throughout the UK and Ireland, the company employs approximately 3,000 people and operates 2 cement plants, 70 quarries, 40 asphalt plants, 200 ready-mixed concrete plants, 9 concrete and clay products plants, 4 contract surfacing businesses, 6 import/export terminals and 2 slate production facilities.

1.25 Lagan and the wider Breedon Group are fully committed to sustainability and social responsibility. This commitment is one of the six pillars of the company's growth strategy, as publicised in their most recent Annual Report. In September 2020 the company made a commitment which aims to achieve net zero carbon emissions by 2050.

1.26 In June 2020, the company appointed their first Group Head of Sustainability, who has retained responsibility for developing and implementing an effective sustainability strategy to shape the Group's practices and performance, ultimately improving the sustainability of their operations, products and services.

1.27 The company has a "Sustainability Working Group", which aims to ensure that the company can sustain long-term success, ensuring positive social, environmental and/or economic impact through their actions and activities. The Sustainability Group assists the company's Executive Committee in its oversight of the company's compliance with applicable legal and regulatory requirements in relation to sustainability and in monitoring the decisions and actions of management in achieving the company's aspiration to be a sustainable organisation.

1.28 The company recently published new policy statements covering the key pillars of sustainability including Environment, Biodiversity, Social Responsibility, Health, Safety & Wellbeing and Responsible Resource Use. The policy statements are enclosed in Appendix 1.1.

EIA SCREENING

1.29 Part 1 and Part 2 of Schedule 5 of the Planning and Development Regulations 2001 (as amended) set out the forms of development that require an environmental impact assessment report (EIAR).

1.30 Paragraph 19 of Part 1 of Schedule 5 states that the following form of development requires an EIA

"Quarries and open-cast mining where the surface of the site exceeds 25 hectares.

1.31 Paragraph 22 relates to changes or extensions. It states:

"Any change or extension of projects listed in this Annex where such a change or extension in itself meets the thresholds, if any set out in this Annex."

1.32 Paragraph 2 of Part 2 of Schedule 5 refers to extractive industry and part (b) of that section states that the following requires an EIA

"Extraction of stone, gravel, sand or clay, where the area of extraction would be greater than 5 hectares."

1.33 In addition, paragraph 13(a) of Part 1 requires EIA in respect of:

"Any change or extension of development already authorised, executed or in the process of being executed (not being a change or extension refer to in Part 1) which would:-

i. result in the development being of a class listed in Part 1 or paragraphs 1 to 12 of Part 2 of this Schedule and

ii. result in an increase in size greater than –

25 per cent, or

an amount equal to 50 per cent of the appropriate threshold,

whichever is the greater.

1.34 The proposed development relates to the recommencement of operations and deepening of an existing quarry within an application area of c. 22.5 ha, which also includes the existing processing area. The extraction area of the quarry is greater than 5 hectares. On this basis the extraction area of the quarry exceeds the area stated under Part 2, and an EIAR is therefore required.

EIA SCOPING

1.35 In preparing this Environmental Impact Assessment Report a Pre-planning Consultation document was issued to the following NGOs and stakeholders in September 2020 (refer to Table 1.1 (summary) and Appendix 1.2 for responses):

- Sligo County Council (Planning and Environment Sections);
- Development Applications Unit at the Department of Culture, Heritage and the Gaeltacht;
- An Taisce;
- An Chomhairle Oidhreachta (The Heritage Council);
- Inland Fisheries Ireland;
- Geological Survey of Ireland;

- Environmental Protection Agency (EPA);
- Transport Infrastructure Ireland (TII);
- Uisce Éireann/Irish Water;
- Health Service Executive (HSE).

1.36 Pre-planning consultation meetings were held between officials of Sligo County Council and representatives of SLR Consulting and Lagan Materials Ltd. on:

- 4th September 2020;
- 19th November 2020;
- 7th November 2020.

Table 1 - 2

Pre-Submission Consultation Responses to the Consultation Letter Issued 29th September 2020 – refer to Appendix 1.2 for full consultation responses

Consultee	Date of Response	Response/Issues Raised	Chapter of the Revised EIS Where Issues Raised are Addressed
Dept. of Tourism, Culture, Arts, Gaeltacht, Sport and Media	**30th November 2020**	• Consult the NPWS website; • Recommendations for completing the EIAR are provided, specifically in relation to Ecology surveys; • It is recommended that a Construction Management Plan is provided; • Recommendations for carrying out an Appropriate Assessment are provided.	**Chapter 2 (Project Description) and Chapter 5 (Biodiversity) and the Natura Impact Statement**
Geological Survey of Ireland	**15th October 2020**	• There are no County Geological Sites (CGS) in the vicinity of the quarry. With the current plan, there are no envisaged impacts on the integrity of current CGSs by the proposed development. • The quarry is underlain by a 'Regionally Important Aquifer – Karstified (conduit)'. The Groundwater	**Chapter 6 (Land Soils and Geology) and Chapter 7 (Water)**

		• Vulnerability map indicates the area covered is variable. We would therefore recommend use of the • Groundwater Viewer to identify areas of High to Extreme Vulnerability and 'Rock at or near surface' which can be used to inform appropriate mitigation measures. • We recommend using the Geological Survey Ireland's GWFlood tools. • We recommend that geohazards be taken into consideration, especially when developing areas where these risks are prevalent, and we encourage the use of our data when doing so. • Geological Survey Ireland would much appreciate a copy of reports detailing any site investigations carried out.
Transport Infrastructure Ireland (TII)	**20th October 2020**	The developer should have regard, *inter alia*, to the following; • identify the methods/techniques proposed for any works traversing/in proximity to the national road network in order to demonstrate that the development can proceed complementary to safeguarding the capacity, safety and operational efficiency of that network. • Consultations should be had with the relevant Local Authority/National Roads Design Office with regard to locations of existing and future national road schemes. • Clearly identify haul routes proposed and fully assess the network to be traversed. • Traffic and Transport Assessment be carried out in accordance with relevant guidelines. • TII Standards should be consulted to determine the requirement for Road Safety

		Audit (RSA) and Road Safety Impact Assessment (RSIA). • The developer, in conducting Environmental Impact Assessment, should have regard to TII Environment Guidelines that deal with assessment and mitigation measures for varied environmental factors and occurrences . In particular; • TII's Environmental Assessment and Construction Guidelines, including the *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (National Roads Authority, 2006), • The EIAR should consider the Environmental Noise Regulations 2006 (SI 140 of 2006) and, in particular, how the development will affect future action plans by the relevant competent authority.	
Sligo County Council	**4th September 2020**	• 10 year permission • Consultation with Irish Water, Inland Fisheries Ireland and NPWS required; • Follow on consultation required.	**Refer to Chapters 2, 5 and 7.**
Inland Fisheries	**1st December 2020**	• This site is directly hydrologically connected to Lough Gill Special Area of Conservation; The assessment of potential impacts should include the following: • Water quality • Surface water hydrology and Ground water hydrology • Fish spawning and nursery areas • Passage of migratory fish • Areas of natural heritage importance including geological heritage sites	**Refer to Chapter 5, Chapter 7 and the Natura Impact Statement.**

		• Biological diversity • Ecosystem structure and functioning • Sport and commercial fishing and angling • Amenity and recreational areas • Sediment transport The following information / assessment will also be required: • hydrological impacts of any proposed dewatering of the quarry and subsequent discharge to the Aghamore Stream must be assessed – including an assessment of the erosion and sediment regime within the channel and the impact on the salmonid spawning substrate downstream; • Impact of proposed discharge on flooding in the area; • Demonstrate that there will be no negative impact on the Aghamore stream. Information in relation to the proposed site infrastructure, Planning History, in combination effects and invasive species is also requested.	
Irish Water	**7th January 2021**	• All risks shall be mitigated to the IW lake source to ensure there is no net loss of water to the lake and the water quality is not impaired; • clearly demonstrate there is no net loss of water to the lake and that the water quality is not impaired and that appropriate mitigations are in place to ensure protection of the drinking water source; • There are a number of comments and queries relating to hydrogeology and water quality & treatability and the risks to IW which need to be addressed ahead of any planning application.	**Refer to Chapter 7 and the Natura Impact Statement.**

1.37 Other consultations and informal discussions held by contributors in undertaking their environmental impact assessments are detailed in the specialist environmental chapters of the EIAR, together with details of relevant archives and documentation held by state agencies and organisations.

DIFFICULTIES ENCOUNTERED WITH EIAR COMPILATION

1.38 This Environmental Impact Assessment Report was compiled on the basis of published regional and local data and site-specific field surveys. No difficulties were encountered in compiling the required information.

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR)

1.39 An Environmental Impact Assessment Report (EIAR) *"means a statement of the effects, if any, which the proposed development, if carried out, would have on the environment"*. As such, it is a systematic analysis and assessment of the potential effects of a proposed project on the receiving environment.

1.40 The principal objectives of an Environmental Impact Assessment Report are to:

- Identify and / or predict the significant effects impacts of a development.
- Identify what mitigation measures should be incorporated into the development to eliminate or reduce the perceived impacts.
- Interpret and communicate the above information on the impact of the proposed development, in both technical and non-technical terms.
- Assist the Local Planning Authority in the decision making process with respect to the associated planning application.

Format of the Environmental Impact Assessment Report (EIAR)

1.41 To facilitate clarity, this EIAR has been prepared in accordance with the Environmental Protection Agency (EPA) Guidelines (Draft – May 2017). The EIAR is sub divided into fifteen parts. As an overview, they comprise of:

Chapter 1: Introduction

1.42 An introduction to the development and a brief explanation of the aims and format of the EIAR. It also identifies the various professional consultants who have contributed to this EIAR and the screening / scoping process carried out.

Chapter 2: Project Description

1.43 Chapter 2 provides:

- details of the physical characteristics of the whole project, including, where relevant, demolition works, the land-use requirements during construction and operation as well as other works that are integral to the project;
- the main characteristics of the operational phase of the project e.g. nature and quantity of materials and natural resources;
- an estimate, by type and quantity, of the expected residues and emissions produced during the construction, operational and restoration phases of the proposed development.

Chapter 3: Reasonable Alternatives

1.44 Chapter 3 provides a description of the reasonable alternatives studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects.

Chapters 4 - 15

1.45 These Chapters provide detailed information on all aspects of the existing (baseline) environment, identifies, describes and presents an assessment of the likely significant impacts of the proposed project on the environment, recommends mitigation and monitoring measures to reduce or alleviate these impacts and describes the residual impacts and conclusions. They are grouped under the following Chapters:

Chapter 4:	Population and Human Health
Chapter 5:	Biodiversity
Chapter 6:	Land, Soils and Geology
Chapter 7:	Water
Chapter 8:	Air
Chapter 9:	Climate
Chapter 10:	Noise and Vibration
Chapter 11:	Material Assets
Chapter 12:	Cultural Heritage
Chapter 13:	Landscape
Chapter 14:	Traffic and Transport
Chapter 15:	Interactions

1.46 The associated references, plates, figures and appendices are provided at the end of each Section 1 – 15.

1.47 A *"Non-Technical Summary of the Environmental Impact Statement"*, incorporating all of the above chapters, is provided as a separate and self-contained document.

CONTRIBUTORS

1.48 Lagan Materials Ltd. appointed SLR Consulting Ireland to prepare this Environmental Impact Assessment Report (EIAR) in support of its Planning Application for the proposed development at Aghamore Near, Aghamore Far and Carrownamaddo townlands, Co. Sligo.

1.49 The contributors who have assisted in the preparation of this EIAR are identified in **Table 1-1** below. Each contributor has the appropriate qualifications, experience and competence for their topic.

Table 1 - 3
List of Contributors

TOPIC	CONTRIBUTOR	COMPANY
Introduction	Peter Kinghan BSc, Dipl. Env. Eng., MiM, MSCSI, MRICS	SLR Consulting Ireland
Description of Development	Peter Kinghan MiM, BSc, Dipl. Env. Eng., MSCSI, MRICS	SLR Consulting Ireland
Alternatives	Peter Kinghan MiM, BSc, Dipl. Env. Eng., MSCSI, MRICS	SLR Consulting Ireland
Population and Human Health	Peter Kinghan BSc, Dipl. Env. Eng., MiM, MSCSI, MRICS	SLR Consulting Ireland
Biodiversity	Nic Faulks BSc (Hons) MSc MCIEEM	SLR Consulting Ireland
Land, Soils and Geology	John Kelly PhD, PGeo, EurGeol	SLR Consulting Ireland
Water	Craig O'Connor MSc PGeo EurGeol Pamela Bartley PhD, MSc, BEng, Dipl. Suzanne Tynan MSc, BSc	TMS Environment Hydro-G Tynan Environmental
Air	Aldona Binchy MSc. (Eng)	SLR Consulting Ireland

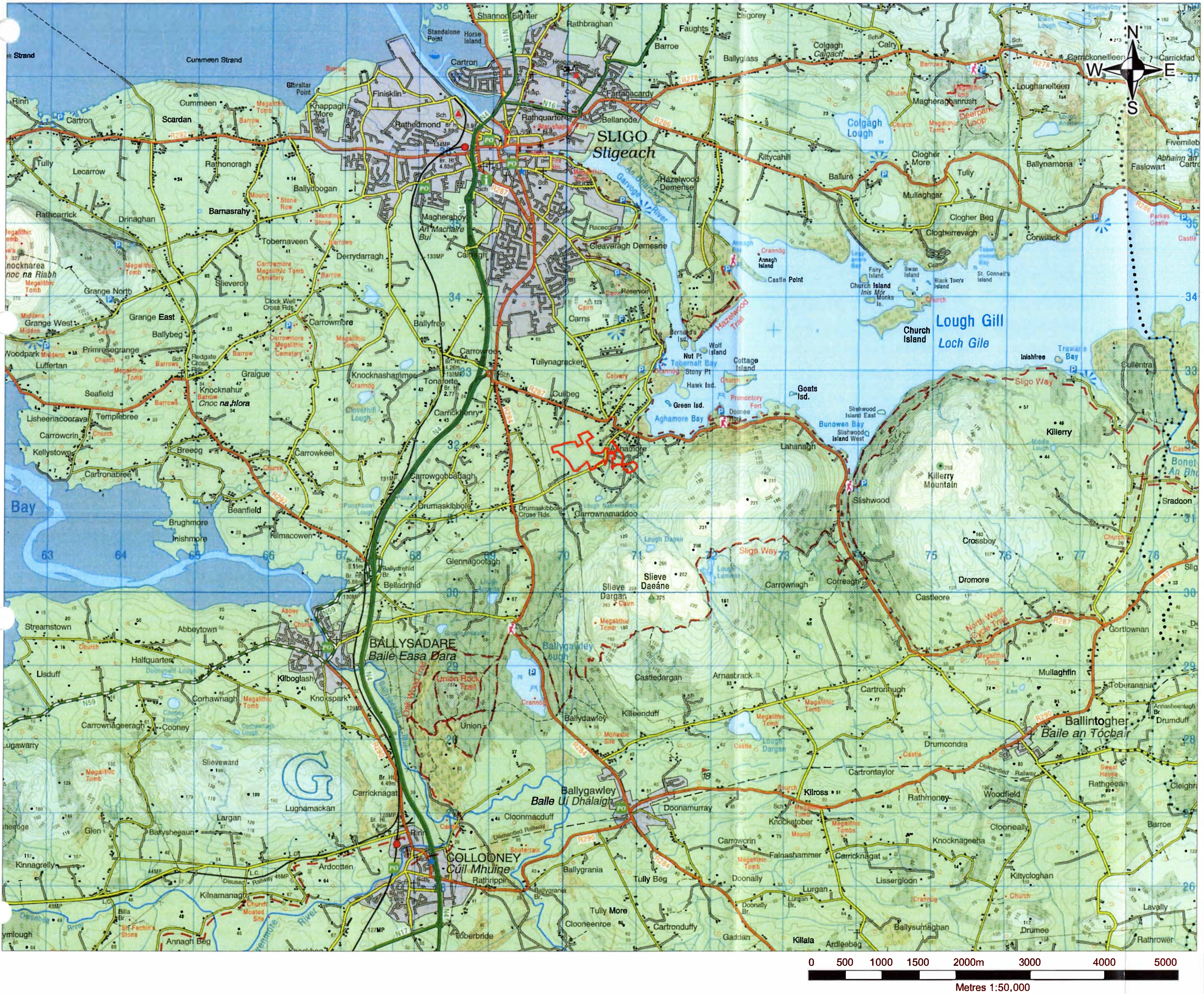
TOPIC	CONTRIBUTOR	COMPANY
Climate	Aldona Binchy MSc. (Eng)	SLR Consulting Ireland
Noise and Vibration	Aldona Binchy MSc. (Eng)	SLR Consulting Ireland
Material Assets	Peter Kinghan BSc, Dipl. Env. Eng., MiM, MSCSI, MRICS	SLR Consulting Ireland
Cultural Heritage	Dr. Charles Mount M.A., Ph.D.	Consultant
Landscape	Anne Merkle MSc, Dipl. Ing (FH) MILI	SLR Consulting Ireland
Traffic and Transport	Alan O'Reilly Chartered Engineer, BA, BAI, MSc, RSA Cert Comp, MIEI	PMCE Consultants
Co-ordination of EIA	Peter Kinghan MiM, BSc, Dipl. Env. Eng., MSCSI, MRICS	SLR Consulting Ireland

1.50 Each contributor has been fully briefed about the proposal and the background to it. They have also visited the site and are familiar with the local environment.

1.51 In addition to the contributors above, the previous planning application and associated documentation (EIAR, NIS, FI Responses and ABP submissions), An Bord Pleanala's Inspectors Report, Order and Direction along with this EIAR and associated Planning Application and NIS have been reviewed by David Mulcahy Planning Consultants Ltd.

1.52 SLR Consulting Ireland, formerly John Barnett and Associates, have been preparing Environmental Impact Assessment reports (previously EIS) relating to Quarry developments since implementation of the EIA Directive in 1990.

FIGURES



NOTES

1. EXTRACT FROM 1:50,000 O.S DISCOVERY MAP NO. 25
2. ORDNANCE SURVEY IRELAND LICENCE NO. CYAL50167032 (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND

LEGEND

▭ SITE LOCATION

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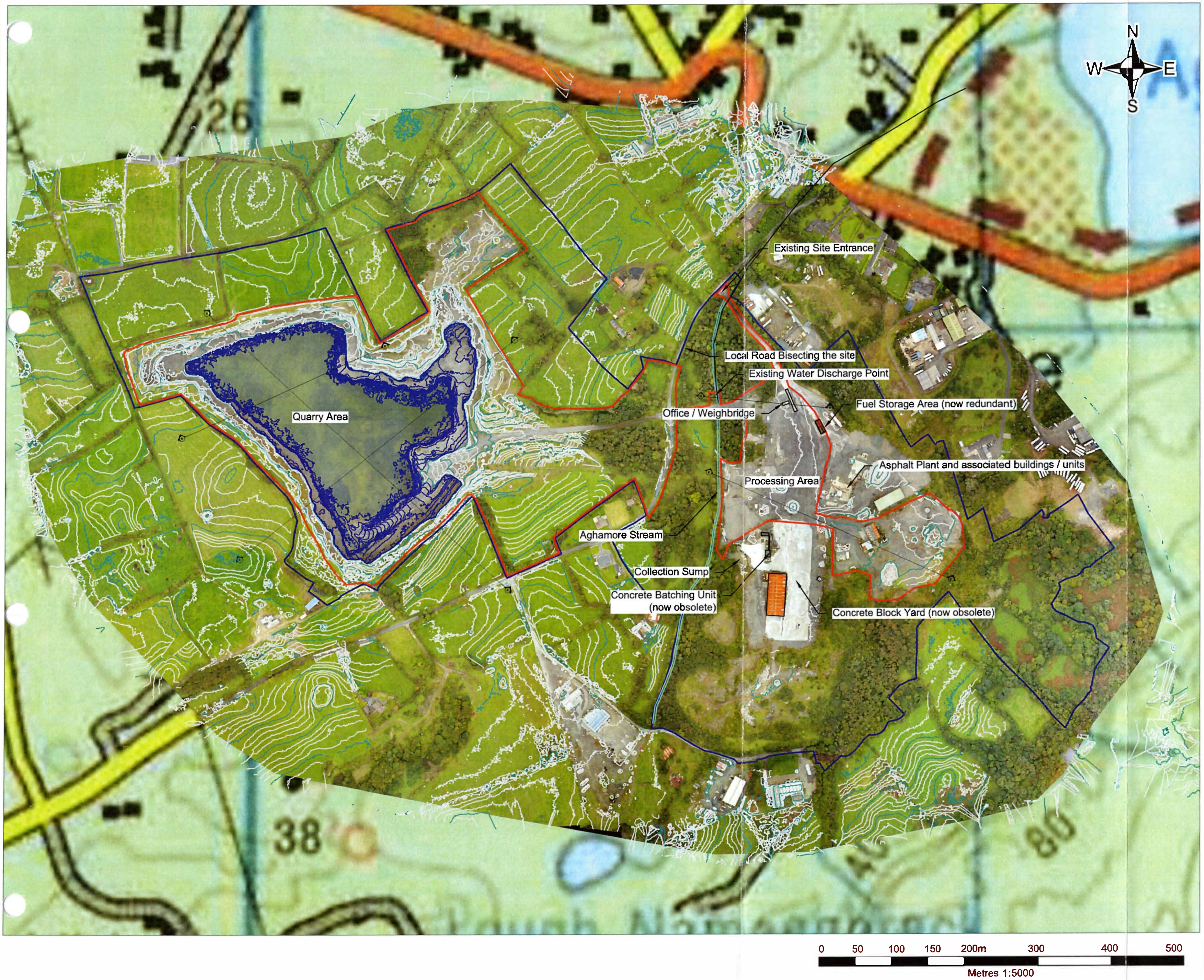
AGHAMORE NEAR, AGHAMORE FAR AND CARROWNAMADDOO TOWNLANDS, CO. SLIGO

SITE LOCATION

FIGURE 1.1

Scale	Date
1:50,000 @ A3	MAY 2021



NOTES

1. ORDNANCE SURVEY IRELAND LICENCE NO. CYAL50167032 (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND
2. AERIAL PHOTOGRAPHY CARRIED OUT BY SLR CONSULTING SEPTEMBER 2020

LEGEND

LAND OWNERSHIP

APPLICATION AREA (c. 22.5 Ha.)

CROSS SECTION LOCATION - REFER TO DRAWING 6

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EXISTING SITE LAYOUT

FIGURE 1.2

Scale	Date
1:5,000 @ A3	MAY 2021

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2. Project Description

CHAPTER 2

PROJECT DESCRIPTION

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ADDITIONAL INFORMATION

2.1 As outlined in Chapter 1 a planning application was submitted to Sligo County Council (Plan File Ref. No. 18/345 / ABP Ref. 305821-19) in August 2018 for similar development to that proposed as part of this application. In October 2019 Sligo County Council granted planning permission for the development (subject to 23 no. conditions). 2 no. third party appeals of the decision by Sligo County Council to grant permission for the proposed quarry development were made to An Bord Pleanala (ABP-305821-19). An Bord Pleanala refused permission for the proposed development on the 30th June 2020 for the 2 no. reasons – refer to Chapter 1 for further details.

2.2 In order to comprehensively address the reasons for refusal, and further comments contained within the An Bord Pleanala Inspectors Report a number of additional surveys / site investigations, field work and assessments have been carried out.

2.3 This Chapter 2 of the EIAR has been updated as follows:

- Description of the Existing Development has been updated to include the aggregate processing area located on the eastern side of the local road that bisects the site;
- Description of the Proposed Development has been updated to include:
    - recommencement of aggregate processing activities on the eastern side of the road, along with provision of a new double stack portacabin and associated wastewater treatment system;
    - any further information that was requested throughout the planning process during the previous application (Plan File Ref. No. 18/345 / ABP Ref. 305821-19);
    - the proposed surface water management plan for the aggregate processing area on the eastern side of the local road;
    - restoration proposals for the eastern side of the road.

EXISTING DEVELOPMENT

2.4 The site occupies ground with elevations ranging between -21m OD and 34m OD. The lower quarry floor is currently at -21 m OD, with the previous planning permission authorising extraction to -34.5m OD. The application area forms the existing quarry area, along with the associated aggregate processing area located on the eastern side of the local road that bisects the application site. The aggregate processing area occupies ground with elevations at c. 15 m OD.

2.5 The existing quarry does not currently have the benefit of planning permission due to the expiry of planning ref. 02/271. The quarry operation will, as before, comprise of the extraction of limestone using conventional blasting techniques. Material extracted from the quarry area will be processed within the quarry void using mobile processing plant and transported to the aggregate processing area for further processing using mobile plant. The materials will then be stockpiled, pending transport off-site to market.

2.6 Existing facilities at the site include the weighbridge & weighbridge office and a garage / workshop. These facilities are located within the processing area on the eastern part of the application site.

2.7 The cumulative impacts associated with the existing asphalt production plant at the site, located adjacent to the aggregate processing area, have been assessed in the relevant chapters of this EIAR.

2.8 Concrete production was historically carried out at the site by the previous owner and operator, CEMEX (ROI) Ltd. (Cemex). This activity ceased in 2014 and the concrete production plant located within the landholding is now obsolete. The applicant does not intend to undertake concrete production at the site and as such this activity has not been assessed as part of the cumulative impact assessment within the relevant chapters of the Environmental Impact Assessment Report that accompanies this planning application. The cumulative impact assessment includes the quarrying activities, processing activities on the eastern side of the application site and asphalt production activities.

PROPOSED DEVELOPMENT

Development Overview

Operational Phase (Limestone Extraction & Processing)

2.9 The proposed development being applied for under this current planning application is shown on **Figure 2-1** and is similar to that previously granted under Sligo County Council Ref. No 02/271 and will consist of:

- Recommencement of quarry operations within the previously permitted quarry extraction area (c. 10.9ha);
- Deepening of the previously permitted quarry area by 2 no. extractive benches from c. -21m OD to -50m OD;
- Recommencement of aggregate processing (crushing and screening) within the existing processing area, located to the east of the local road that bisects the site;
- The provision of a settlement lagoon (c. 2,830m2);
- The provision of 2 no. wheelwashes;
- The Provision of a double stacked portacabin office;
- The Provision of a wastewater treatment system;
- Additional stockproof / trespass proof boundary fencing;
- All within an application area of c. 22.5 Ha.

2.10 Materials extracted from the quarry will be processed within the quarry void and transported to the existing aggregate processing area located on the eastern side of the Local road for further processing and stockpiling, pending transport off-site to market – refer to Figure 2.1.

2.11 There will be no lateral extension of the quarry void as part of this application, with all future extraction to take place by deepening of the existing quarry floor. Similarly, all development on the eastern side of the road will be wholly within the lands where activities commenced in the 1950's.

2.12 The proposed development is consistent with the policies set out in the National Planning Guidelines for the sector; the Regional Planning Guidelines and the Sligo County Development plan which recognise the requirement for:

- A secure supply of construction aggregates is necessary for the continued development of the region;
- Proven aggregate reserves need to be safeguarded for future extraction;
- 'Best environmental management practice' to be implemented within quarry developments.

Restoration (Reinstatement to Nature Conservation Habitat Areas)

2.13 Upon completion of extractive operations, it is proposed to restore the quarry area on the western site of the local road to natural habitat after-uses. The processing area on the eastern side of the local road will also be restored to natural habitat after-uses – refer to Figure 2.2. This proposed after-use is compatible with the applicant's Biodiversity Policy (copy provided in Appendix 1.1).

2.14 Where feasible, restoration of exhausted and redundant areas of the application site will be carried out at the earliest opportunity. However, it is envisaged that the majority of restoration proposals will be carried out after extractive operations at the site have ceased.

Aggregate Reserve Assessment

2.15 The total recoverable reserve of limestone from within the proposed extraction area is assessed at c. 2 million tonnes – refer to Table 2-1. These reserves lie below the quarry floor and will be extracted by deepening the existing floor by 2 no. quarry benches that will be approx. 15 metre in height.

Duration of Extraction

2.16 An outline of the proposed extraction plan and the final ground level contours is shown in Figure 2-1. Cross-sections through the final landform are shown in Figure 2-3.

Table 2-1
Material Quantities

Material	Quantity
Topsoil / Overburden	0 m^3
Limestone	2 Million Tonnes

2.17 The duration of quarrying activities at the application site will largely be dictated by the rate at which approximately 2 million tonnes of limestone is extracted from the site. There are many factors which will influence this, including, but not limited to the:

- Prevailing economic climate and related construction industry output;
- Distance of construction projects from the facility (and scale of activity).

2.18 It is noted that there are a large number of construction related projects proposed for Sligo Town in the Regional Spatial and Economic Strategy (RSES) for the Northern and Western Region, in which the town is identified as having the vision and capacity to be a Regional Growth Centre of scale. These projects include housing (RPO 3.7.37 and RPO 3.7.38), road infrastructure (RPO 3.7.40, RPO 3.7.41, RPO 3.7.43 and RPO 3.7.54).

2.19 The ambitious plans and projects set out in the RSES, and referenced above, are reliant on a secure supply of aggregates and associated quarry products. At the current time the region is limited to only one operational quarry of sufficient scale to supply the region. The proposed recommencement of quarry operations at this site are required to ensure a continued reliable and competitive supply of quarry products to enable development and completion of the plans and projects set out in the RSES.

2.20 In light of these and other variables, calculation of output rates and duration is not an exact science. It is anticipated that the annual extraction rate will range from 150,000 – 300,000 Tonnes. (Note: under planning permission PL02/271, an average annual extraction rate of 300,000 tonnes was permitted).

2.21 In consideration of the above, a planning permission duration of 10 years is sought by the applicant.

Site Screening

2.22 The application site has been in existence since the 1950's and is an established part of the landscape. The processing area is surrounded on all sides by existing mature vegetation that prevents views into this part of the landholding from public roads in the vicinity of the site – refer to computer generated flyover included on the CD enclosed with this EIAR.

2.23 Existing views into the quarry and associated aggregate processing area on the eastern side of the local road would be unchanged by the proposed recommencement of quarrying operations and deepening of the existing quarry void as no lateral extension of the development is proposed – refer to EIAR Chapter 13 (Landscape).

Removal of Topsoil and Overburden Soils

2.24 Within the planning application boundary, an area of 10.9 hectares has been used for the extraction of limestone and therefore has been completely stripped of overburden and topsoil materials.

2.25 There will be no removal of topsoil / overburden required to facilitate the recommencement of operations and deepening of the existing quarry or to recommence processing activities on the eastern part of the landholding. The only removal of topsoil / overburden that will be undertaken, will be the removal of material to facilitate the installation of the proposed settlement lagoon. This material will be stored at the location shown on Figure 2.2.

Site Drainage

2.26 A hydrological / hydrogeological assessment has been carried out taking into consideration the existing water regime at the quarry site and the aggregate processing area located to the east of the local road. Mitigation measures are proposed to eliminate and/or minimise the potential impacts, if any, on surface water and groundwater – refer to Chapter 7 – Water.

Stability of the Quarry

2.27 Industry standard slope angles, bench heights, and bench widths will be used for extraction operations at the site.

Method of Extraction

2.28 Blasting will continue to be used within the quarry area to fragment the stone prior to processing (crushing / screening etc.).

2.29 The type of explosive to be used at the quarry is Kemex 70. Kemex 70 is supplied by Irish Industrial Explosives (IIE) and is a waterproof, pumped emulsion product, which is designed for wet conditions. It is a site manufactured explosive whereby non-explosive materials are transported to site in a specifically designed pump truck. The materials are blended on-site and pumped directly into the blast holes by trained and experienced operators.

2.30 IIE provides blasting services to all of the applicant's quarry operations throughout Ireland. IIE operates an ISO9000 Quality Management System and its occupational health and safety management system is based on OHSAS 18001. IIE carries out all blasting activities in accordance with its Quarry Blasting Procedure. IIE's blasting procedure controls the loading of the explosive product into the drill holes and two points of initiation are used in each drill hole to ensure that initiation occurs, and the explosive product is fully consumed.

2.31 A copy of the applicants blasting procedures can be found in Appendix 2.1.

Processing Methods

2.32 The processing of the extracted rock, into aggregate products, will consist of crushing and screening by mobile processing plant within the quarry void. Materials will then be transported to the aggregate processing area on the opposite side of the local road for further processing using mobile plant, followed by stockpiling prior to transport off-site to market or for use in the asphalt production activities located adjacent to the aggregate processing area.

Quarry Working Hours

2.33 The proposed working hours for the development are 0700-1800hrs Monday to Friday and 0800-1400hrs on Saturdays. The quarry will not operate on Sundays or Bank Holidays, except in emergency situations.

Employment

2.34 The proposed development will provide employment of up to 6 people directly on-site, in addition to a number of indirect employees such as crushing contractors, HGV drivers, maintenance contractors, etc.

SITE INFRASTRUCTURE

Site Access

2.35 The quarry and the processing area are located on opposite sides of the local road. Material from the quarry will be transported by dump trucks to the processing area via an existing access that forms a crossroads with the access to the quarry. Historically this is how the quarry has operated.

2.36 There is a separate access to the aggregate processing area used mainly by HGV traffic delivering processed material to market. This access has been improved with road widening and upgrade works being made under Plan File Ref. No. 02/271: Condition no. 9.

2.37 All HGV traffic will access and egresses the site via the weighbridge and the proposed wheelwash (with associated closed lagoon water system).

Site Security / Landscape and Boundary Treatment

2.38 Lockable gates are provided at all entrances to the site. Please refer to Planning Drawing 3, which outlines the existing boundary treatment at the application site.

2.39 It is proposed to reinforce and replace sections of the existing fencing along the north-western and western boundaries, identified as Sections 1 & 2 on Planning Drawing 3.

2.40 It is proposed to replace the entire fence along the south-eastern boundary, (identified as Section 5 on Planning Drawing 3). This fence will be replaced to replicate the fencing provided at Sections 1 & 2.

2.41 There is significant vegetation located along part of the northern boundary, identified as Section 3 on Figure 1.2. A replacement stockproof fence was erected along Section 3 in October 2017.

2.42 Existing stockproof fencing will be reinforced and replaced, as required along the eastern boundary, identified as Section 4 on Planning Drawing 3.

2.43 Remotely monitored CCTV is in place at the site.

Site Roads, Parking and Hardstanding Areas

2.44 All HGVs utilising the quarry will be confined within the Applicant's landholding. HGVs access the site from the Local road that is c. 400 meters south of the R287 regional road and travel west over a section of paved internal roadway within the application site.

2.45 Adequate car parking provision for employees and visitors is provided at the existing weighbridge office as indicated in Figure 2.1.

Weighbridge

2.46 In order to monitor and record the amount of material exiting the quarry, all HGV traffic will be directed across the existing weighbridge, the location of which is indicated on the site infrastructure layout in Figure 2.1.

Wheelwash

2.47 It is proposed to install a wheel wash system within the existing quarry in the location shown on Planning Drawing 4 and Figure 2.1. A second wheel wash will be installed before the weighbridge located within the aggregate processing area to the east of the quarry. Both wheelwash systems will be closed loop systems, meaning that the water used to clean the HGVs will be recycled and reused rather than being discharged – refer to Planning Drawing 8 for wheelwash design drawings.

Offices and Ancillary Facilities

2.48 Existing facilities at the site include the weighbridge & weighbridge office and a garage / workshop. These facilities are located within the processing area on the eastern part of the application site.

2.49 It is proposed to replace the existing weighbridge office with a new double stacked office (with associated wastewater treatment system) at the location shown on Figure 2.1. Refer to Planning Drawing 9 for Portacabin details.

Quarry Ancillary Facilities and Activities

2.50 Ancillary manufacturing facilities at the site, located adjacent to the processing area, include asphalt production.

2.51 As outlined above, concrete production was historically carried out at the site by the previous owner and operator, CEMEX (ROI) Ltd. (Cemex). This activity ceased in 2014 and the concrete production plant located within the landholding is now obsolete. The applicant does not intend to undertake concrete production at the site and as such this activity has not been assessed as part of the cumulative impact assessment within the relevant chapters of the Environmental Impact Assessment Report that accompanies this planning application. The cumulative impact assessment includes the quarrying activities, processing activities on the eastern side of the application site and asphalt production activities.

Utilities and Services

2.52 Electrical power is currently provided to the application site via mains supply. Electricity will provide the principal source of energy for office lighting and heating.

2.53 Site based staff at the application site will be contactable by mobile phone, landline and email and broadband connections to the site office are provided via a mobile network.

2.54 It is proposed to install a new wastewater treatment system that will service toilets from the proposed double stacked portacabin office – refer to Site Characterisation report submitted with the Planning Application documentation, and Figure 2.1 showing the proposed location. Details of the proposed system (Oakstown BAF 6 PE wastewater treatment system) are provided with the Site Characterisation report.

2.55 A supply well in the processing area will be used for water supply (see **Figure 7-1**); water from the well will be used for wheelwashes, dust suppression and non-potable use in the office canteen and toilets.

2.56 Potable water will be provided to the site via a water cooler dispenser system.

2.57 Given the lack of combustible waste materials at this site, it is considered highly unlikely that a fire will break out during quarry operations. A range of fire extinguishers (water, foam and CO_2) will be maintained at the site office to deal with any localised small-scale fires which might occur. Additional fire-fighting capacity can be provided by storing water in a mobile bowser on unsealed hardstand areas around the infrastructure area.

Lighting

2.58 Sufficient lighting will be provided at the site to ensure safe operations during winter periods.

2.59 Security lighting will comprise low level spot lighting and will be directed towards the vehicle loading area and operational area, for safety purposes.

Fuel & Oil Storage

2.60 There will be no bulk fuels stored at the application site. Existing fuel storage tanks present at the site (identified on Figure 1.2) are redundant and will not be used by the applicant as part of the recommencement of operations.

2.61 All fuels required to serve mobile plant and machinery will be brought to site on an as required basis by local fuel suppliers. A number of spill kits will be provided at the site. In addition, it is proposed to provide a dedicated hardstand area, with associated hydrocarbon interceptor, at the site for refuelling activities – refer to Figure 2.1.

2.62 The only hydrocarbons to be held at the site are small quantities of lubricating oils / hydraulic oils, which will be stored in the existing workshop / store, located within the aggregate processing area - refer to Figure 2.1 enclosed. The volume of oils / chemicals to be held at the site will be minimal and they will be stored within the existing bunded areas provided in the workshop. Any oils not stored within the bunded area, will be held on dedicated spill trays. Dedicated storage bins will also be provided in the workshop for oil filters and oily rags.

WASTE MANAGEMENT

Extractive Waste Management

2.63 Almost all products and by-products arising from the aggregate processing have commercial value. Any waste materials from the site are stored, collected, recycled and/or disposed of in accordance with any requirements of Sligo County Council.

General Waste Management

2.64 Lagan Materials Ltd. are a member of the Irish Concrete Federation and commits themselves to the principles of the Federations Environmental Code. The code states:-

2.65 "ICF members will minimise production of waste and where appropriate consider its beneficial use including recycling. They will deal with all waste in accordance with the relevant legislation and other controls in place, including using waste contractors with valid Waste Collection Permits"

2.66 An Environmental Monitoring / Management Plan for the quarry site is enclosed in Appendix 2.3. Specific Depot Procedures are provided in the Environmental Monitoring / Management Plan, which deal with waste management (Depot Procedure DP003) and fuel / oils & chemical storage (Depot Procedure DP006).

2.67 Potential waste produced and the measures used to control it are described as follows -

- **Scrap Metal** – these materials are chiefly produced from the maintenance of plant equipment and can cause a nuisance if allowed to build up in an uncontrolled manner. A designated scrap metal area will be demarcated on site and the build-up of scrap will be controlled by the regular removal by licensed scrap metal dealers.

- **Used Oil / Oil Filters** – any used oil filters that may arise from servicing of plant equipment will be held within the workshop/store in dedicated storage bins pending removal by a licensed waste contractor. Used oils will be stored in a bunded tank within the workshop/store, pending removal by a licensed waste contractor. Dedicated storage bins will also be provided in the workshop for oil filters and oily rags.

- **Used Batteries** – end of life batteries will be stored in a dedicated battery box in the workshop/store, pending removal from site by a licensed waste contractor.

- **Canteen Waste** – domestic waste generated at the offices / canteen will be collected by a licensed waste collection contractor.

ENVIRONMENTAL CONTROLS

General

2.68 Extraction, processing and ultimately restoration activities at the application site require a number of environmental controls to eliminate or minimise the potential nuisance to the public arising from the extraction and processing operations. The environmental control measures in place at the site are outlined in the relevant EIAR Chapters.

2.69 The previous operations at the site were regulated by conditions attaching to Sligo County Council Ref. No 02/271 planning permission.

2.70 Any additional control measures, over and above those already in place and/or outlined below, which may be instructed on foot of the proposed planning application, will also be implemented.

Bird Control

2.71 As the process of limestone extraction and aggregate production is free of putrescible (food / kitchen) waste, site activities are unlikely to attract scavenging birds such as gulls and crows for the duration of works. Accordingly, it is not intended to implement any specific bird control measures at the site as is the case at present.

Traffic Control

2.72 As the planning application relates to the recommencement / deepening of the existing quarry operation and recommencement of aggregate processing within the existing processing area, the proposed development will continue to utilise the existing site entrances and established haul routes.

Litter Control

2.73 As the proposed development will be largely free of litter, the daily operational activities are unlikely to give rise to problems with windblown litter. Accordingly, there is no requirement to implement any specific litter control measures at the site.

2.74 In the unlikely event that any litter waste is identified, it will be immediately removed off-site to an authorised waste disposal or recovery site.

Odour Control

2.75 As the limestone extraction activities at the site are not biodegradable and do not therefore emit odorous gases, site activities do not give rise to odour nuisance. No odour control is required.

Vermin Control

2.76 As the proposed development is free of putrescible (food / kitchen) waste, on-site activities will not attract vermin for the duration of the extraction or subsequent restoration operations. Accordingly, no specific vermin control measures are required.

Fire Control

2.77 In the unlikely event that a fire does occur, the local fire station in Sligo town will be contacted and emergency response procedures will be implemented. Fire extinguishers (water and foam) are provided at all offices to deal with any small outbreaks which may occur.

Surface Water and Groundwater Management

Quarry Extraction Area

2.78 The current water management within the quarry involves pumping a combination of rainwater and groundwater from the quarry floor to the Aghamore Stream. This is an interim measure agreed with Sligo County Council as there is no activity on site and no sources of potential water pollution remain within the quarry void (refer to EIAR Chapter 7).

2.79 It is proposed that all surface water & storm water run-off from within the quarry area will be directed to a separate quarry sump for dewatering stormwater, as shown on Figure 2.1. All water from this stormwater sump will be directed to the proposed settlement lagoon, prior to discharge off site to the Aghamore Stream. No surface water run-off or stormwater from the quarry area will bypass the proposed settlement lagoon.

2.80 It is proposed that all groundwater inflows into the quarry void will be intercepted as it enters the excavation and directed to a separate quarry sump for dewatering clean groundwater (refer to Figure 2.1) via a system of cut-off drains located along the toe of the excavation faces. These drains will be maintained separate from the quarry floor. Water from the dewatering sump will be discharged directly to the Aghamore Stream via a sediment trap – refer to Figure 2.1 for proposed location.

2.81 As stated in Chapter 7: Paragraph 7.133 of the EIAR groundwater inflows into the quarry are delineated by calcium-carbonate deposits on the quarry faces (yellow-white staining). Inflows tend to be diffuse through a network of bedding and joint planes, with more seepage in some areas than others (fracture controlled). On this basis it will be a relatively straightforward task to establish a system of groundwater interception drains as the dominant point sources of groundwater inflows to the quarry void will be readily identifiable.

2.82 All water (stormwater and groundwater inflows) pumped from the quarry void will be discharged in compliance with the requirements of discharge licence ref no DL(W)151 and in accordance with the emission limit values specified under the discharge licence.

Proposed Settlement Lagoon

2.83 It is proposed to install a settlement lagoon of c. 2,830m^2 (see area calculations in Chapter 7) in advance of quarrying activities recommencing at the site to treat stormwater run-off pumped from the quarry floor before being discharged to the Aghamore Stream. The settlement lagoon will have a water depth of 1.5m, a minimum freeboard of 0.5m and will be lined to prevent leakage. Interceptors will be installed close to areas of potential risk such as the hardstand area and refuelling station.

2.84 A Construction Environmental Management Plan (CEMP) that outlines how potential adverse impacts on the water environment that may arise during the construction of the proposed settlement lagoon will be managed is provided in Appendix 2.2. Planning Drawing 7 shows the proposed settlement lagoon plans and details. Planning Drawing 7 also provides details on the proposed settlement lagoon liner.

2.85 The discharge point from the settlement lagoon will remain at the current location (see **Figure 2.1**). A reno mattress will be provided at the discharge point to prevent scouring of the stream bed (as recommended by IFI – refer to EIAR Chapter 1: Table 1.1).

2.86 Any sediment contained in the discharge waters will be collected from surface-water run-off only. Primary settlement of any sediment within the discharge waters will take place within the quarry sumps on the quarry floor. Due to the nature of the proposed development, and proposed water management system, it is not considered that there will be any significant build-up of sediment within the settlement lagoon.

2.87 Desludging of the lagoon will be carried out periodically (typically bi-annually, or as required). Sediment will be excavated from the settlement lagoons, dried out in thin layers prior to use in the restoration of the previously extracted quarry area – refer to Figure 2.2.

2.88 The quarry operator will conduct daily documented checks of the lagoon to ensure there are no signs of leaks or instability. The lagoons will also be inspected every 2 years by a geotechnical engineer as part of the geotechnical assessment of the quarry.

Processing Area to the East of the Local Road

2.89 Rainfall across the processing area infiltrates the permeable subsoils (sands), which underlie this area of the site (refer to EIAR Chapter 7: Plates 7-3 and 7-4, Appendix 7-8).

2.90 There is currently no point discharge arising from the processing area of the site (located to the east of the public road) as this area of the site is also inactive. Any historical discharges arising from the processing area would have originated from the wash-water associated with concrete production activities. This plant has not operated since the site was purchased by the applicant from Cemex (ROI) Ltd. in 2014 and is now obsolete. The applicant does not intend to recommence the production of concrete products at the site.

2.91 There will be no point discharges arising from the processing area of the site at any point in the future. Consequently, there will be no requirement for the treatment and disposal of run-off and wastewater from the processing area of the site.

2.92 Any surface water run-off arising from the processing area will continue to naturally infiltrate to ground. These lands are underlain by sand and gravel material with a significant unsaturated zone – refer to Chapter 7.

2.93 To mitigate the potential for cumulative impact in combination with runoff from the area where the obsolete concrete production plant is located, a berm will be constructed across the open perimeter of the processing area where runoff from a collection sump overflows the Aghamore Stream – refer to Figure 2.1 for location. The berm will prevent any direct discharge to surface water from the processing area. Ponded runoff in the collection sump will be pumped to a soakaway nearby and allowed to infiltrate to ground.

Dust Generation and Control

2.94 In dry, windy weather conditions, site activities may give rise to dust blows across and beyond the existing or planned development site areas.

2.95 The incidence of fugitive dust outside of the operation is reduced by some of the mobile crushing and screening plant being located within the quarry void. Generation of fugitive dust is generally limited to periods of very low rainfall (refer to Chapter 8 – Air Quality). Dust generation occurs from three main sources.

- Point sources – such as operating plant and machinery.
- Line sources – such as roads and conveyors.
- Dispersed Sources– such as quarry floors and stockpiles.

2.96 In order to control dust emissions, the following measures will be implemented:-

- Water will be sprayed from a tractor drawn bowser on dry exposed surfaces and stockpiles (paved roads, unsealed haul roads and hardstand areas);
- Provision of a fixed sprinkler system along the internal roads;
- Dust blows at the existing site are largely screened by the side walls of the existing quarry void;
- Areas of bare or exposed soils will, insofar as practicable, be kept to a minimum;
- The amount of dust or fines carried onto the public road network will be reduced by periodic sweeping of internal paved site roads and surrounding public roads as required;
- Emission of fugitive dust from machinery such as mobile processing plant will be minimised by utilising dust suppression and by locating such plant within the quarry area, where possible.

2.97 Dust deposition monitoring will be carried out as part of the environmental monitoring programme (refer to conditions 19 & 22 of the previous planning permission). Monitoring results will be submitted to Sligo County Council on an annual basis - refer to EIAR Chapter 8.

2.98 Mitigation measures will be provided in accordance with the DoEHLG (2004) guidelines for the sector and EPA (2006), refer to EIAR Chapter 8.

Noise Generation & Control

2.99 The sources of noise located within the planning application area are primarily related to machinery / plant operation.

2.100 The potential for noise generation from the quarry extraction area is reduced by the mobile crushing and screening plant being located within the quarry void. This means that the potential for noise generation from activities associated with the operation of the plant such as movement of vehicles and maintenance has been reduced – refer to Chapter 10.

2.101 In addition to the above the following good house-keeping measures are put in place in order to reduce noise emitted from plant and machinery as much as possible:

- All machinery used will be CE certified for compliance with EU noise control limits;
- The machinery will be regularly maintained. This includes regularly checking any muffler systems and servicing or replacing as required. It also ensures any loose or damaged panels or covers that suppress noise is fixed or replaced immediately;
- If there are further noise-reducing modifications available for any machinery, they will be fitted wherever practical (e.g. rubber-decked screens, rubber chute linings etc.)
- Haul road grades are kept as low as possible (</= 1:10) to reduce engine / brake noise from heavy vehicles.

2.102 Mitigation measures will be provided in accordance with the DoEHLG (2004) and EPA (2006) guidelines for the sector.

2.103 A noise monitoring programme will be implemented at the site and routine noise monitoring will be carried out as part of the environmental monitoring programme, refer to Section 2.106 below. Monitoring results will be submitted to Sligo County Council on an annual basis or in accordance with any timeline specified in any planning permission issued.

Blasting Control

2.104 Blasting mitigation measures will form part of the Environmental Management System for the quarry site. These measures relate to blasting procedures such as quantity of explosive and charge-hole spacing along rock face. Measures at the quarry will include:

- Geological considerations in blast design.
- There will be no blasting outside the hours of 11:00 and 18:00 during Monday to Friday and none taking place at the weekend or public holidays.
- Optimise blast design along the rock-face with adequately spaced charges.
- Minimise air overpressure through proper blast design, spacing and timing of multiple charges.
- Inform nearby residents on day prior to planned blasting schedule using house-calls, written note/signage at entrance (or combination). A warning siren will be sounded prior to a blast taking place.
- It is proposed to carry out a breeding bird survey at the quarry during the first season of quarry activity and then use the results to inform the quarry operator to avoid or reduce certain activities in areas during the breeding season – refer to EIAR Chapter 5.

ENVIRONMENTAL MONITORING

General

2.105 When previously operational the site had an established environmental monitoring programme on site – refer to Condition No. 22 imposed under Plan File Ref. No. PL02/271.

2.106 Water, noise, dust and blast monitoring will be carried out on a regular basis, to demonstrate that the development is not having an adverse impact on the surrounding environment.

2.107 Refer to Appendix 2.3 for the Environmental Monitoring Plan for the site.

Dust Monitoring

2.108 Dust deposition monitoring will be carried out at the application site. Dust monitoring locations shall be reviewed and revised where necessary. The results of the dust monitoring will be submitted to Sligo County Council on a regular basis for review and record purposes.

Noise Monitoring

2.109 Noise monitoring will be carried out at the application site. Noise monitoring locations shall be reviewed and revised where necessary. The results of the noise monitoring will be submitted to Sligo County Council on a regular basis for review and record purposes.

Water Monitoring

2.110 The site was granted a Trade Effluent Discharge Licence (TEDL) from Sligo County Council in December 2011 (DL(W)139) to discharge water from the quarry to the Aghamore Stream, subject to conditions. This licence was reviewed by Sligo County Council, and an updated licence was granted on the 24th January 2020 – refer to EIAR Chapter 7: Appendix 7.3.

2.111 A programme of surface water monitoring is currently ongoing at the site, which includes sampling of the quarry discharge, sampling of the Aghamore Stream upstream and downstream of the discharge and monitoring of discharge flows and streamflows in the Aghamore Stream. The full environmental monitoring programme will resume on site prior to activities recommencing, as notified to Sligo County Council in 2015 (see EIAR Chapter 7).

PROPOSED FINAL RESTORATION

Proposed Restoration Scheme

2.57 The restoration scheme for the planning application area is shown on the restoration plan Figure 2-2.

2.58 The application area will be restored to a natural habitat, which is one of the beneficial after uses listed in the EPA Guidelines: 'Environmental Management in the Extractive Industry' (2006). This will be achieved by the following measures:

- The application area will be left for natural recolonisation by locally occurring grass and shrub/scrub species and the quarry void will fill with water.
- All existing boundary fences and hedgerows will be retained to ensure that the site is secure.
- All plant and machinery will be removed from the quarry void.

2.59 The restoration works will be carried out in accordance with the EPA Guidelines (2006).

Site Management and Supervision

2.112 The Applicant will clearly define the management responsibility for the site restoration work and will ensure that this person has the necessary information (from the planning application) and authority to manage the whole restoration process. Relevant staff will be briefed on the scheme and will be adequately supervised / controlled. A system of record keeping for the key restoration activities will be put in place.

Long Term Safety and Security

2.113 Existing hedges surrounding the development will be gapped up and thickened where required. These combined with fencing and the secure and locked entrance gates to the development will prevent unauthorised third party access.

Long Term Surface Water and Groundwater

2.114 Surface water in the processing area on the eastern side of the local road will continue to percolate to ground. Surface water in the quarry area will percolate to ground or be directed to the water body within the void created by quarrying – refer to EIAR Chapter 7.

2.115 On completion of extraction, a lake will be formed in the quarry void as groundwater returns to its natural level.

Decommissioning of Plant and Machinery

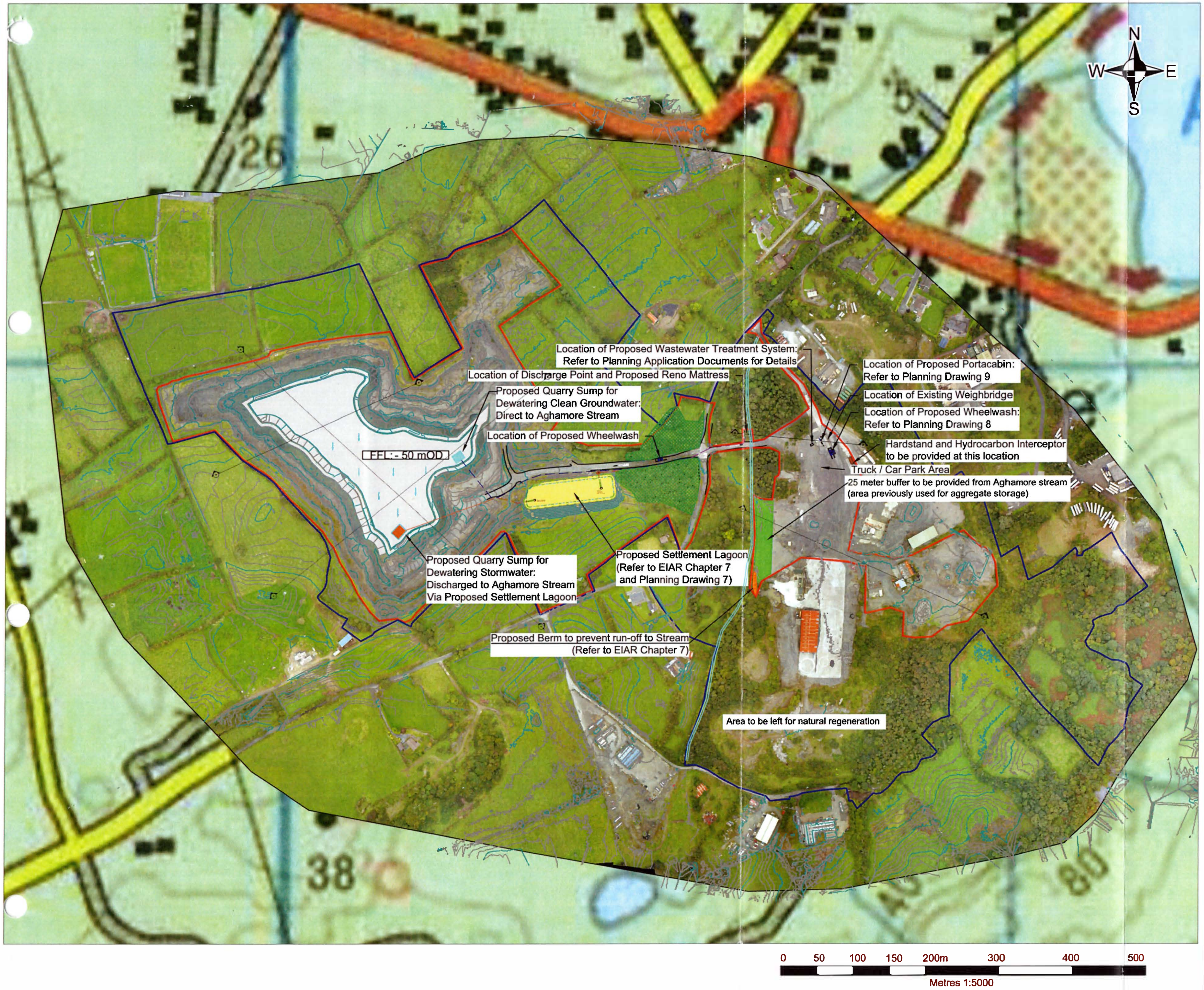
2.116 Redundant structures, plant equipment and stockpiles will be removed from site on permanent cessation of extraction activity. Machinery and buildings will either be utilised by the applicant on other sites or be sold as working machinery or scrap.

2.117 As part of the overall decommissioning process, all oil storage and septic / effluent treatment tanks within the existing site will be removed from the site by a licensed waste contractor. Therefore, there will be no potential for fuel, oil or sewage to cause long-term water pollution following completion of extraction activities.

Aftercare and Monitoring

2.118 No aftercare or monitoring is required for the restoration proposals for the application area.

FIGURES



NOTES

1. ORDNANCE SURVEY IRELAND LICENCE NO. CYAL50167032 (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND
2. AERIAL PHOTOGRAPHY CARRIED OUT BY SLR CONSULTING SEPTEMBER 2020

LEGEND

▭	APPLICATION AREA (c. 22.5 Ha.)
🟩	CROSS SECTION LOCATION

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LAGAN MATERIALS LTD.

LIMESTONE QUARRY AND AGGREGATE PROCESSING YARD
AGHAMORE NEAR, AGHAMORE FAR AND
CARROWNAMADDOO TOWNLANDS, CO. SLIGO

PROPOSED SITE LAYOUT

FIGURE 2.1

Scale
1:5,000 @ A3

Date
MAY 2021

PROPOSED LANDSCAPE MITIGATION AND RESTORATION SCHEME

The existing quarry and processing area at Aghamore Near, amore Far and Carrownamaddoo townlands in Co. Sligo substantially screened by existing dense boundary vegetation, as well as the undulating topography of the site and area immediately surrounding it. The aim of the landscape mitigation works is to retain all existing screening vegetation, as well as augment this further, with additional native woodland infill and hedge planting.

The benificial afteruse proposed for the site, in line with the 2006 EPA Guidelines - Environmental Management in the Extractive Industry (Non-Scheduled Minerals), is as a **Natural habitat**, consisting of areas of grassland, woodland areas and hedgerows, areas for natural regeneration and a wetland area, created by the quarry void, which will naturally flood on cessation of the extraction works.

The proposed works will also be of a high biodiversity value.

Landscape Mitigation Planting:
The proposed landscape mitigation planting works will be carried out on re-commencement of the proposed development in the locations indicated below and as per the planting details to the right.

Restoration Works:
The restoration works will be carried out on completion of all extraction works. At this point the quarry and processing areas will be cleared of all structures, plant and machinery.
The settlement lagoon to the east of the quarry void will be decomissioned.
All bare and relatively level areas surrounding the quarry void will be broken up, leveled and seeded with a suitable native wildflower mix.
The upper quarry faces and benches, which will ultimately retain above the water level within the quarry void, will be left for natural regeneration with locally occurring grass and scrub species.
The processing area will also be broken up, with the aim to create varied ground conditions, including heaps of stones and shallow dips, which will temporarily fill with water. This will create multiple habitats for local wildlife species. The area will then be left for natural regeneration with locally occurring species,.

PLANTING DETAILS

Tree/Shrub Species: Native species present in the local landscape were chosen. These species will also be of biodiversity value.

Planting Spec:
Native Woodland Infill Mix (as per the table to right) to be planted at 2m centres (i.e. 1 plant/4m²; approx. 3,200m² in total = 800 plants). To be planted randomly with no more than 4-6 plants of the same species in one group and to be supplied with spiral guards.
Native Hedge Mix (as per the table to right) to be planted in two staggered rows with row 0.4m apart and plants within rows 0.4m apart(i.e. 2.5 plants/m; approx. 800m in total = 2,000 plants). Transplants to be planted randomly with no more than 4-6 plants of the same species in one group. Pedunculate oak to be planted every 8m and single staked and maintained as hedgerow trees.

Plant Handling & Protection: All plant handling, planting and establishment works will be carried out in accordance with current best practice and will take place in the appropriate planting season (e.g. bareroot planting: November to March only) and in favourable weather conditions. The planting will be carried out by a suitably qualified landscape contractor. All plants to be protected with spiral guards or alternatively with rabbit proof fencing.

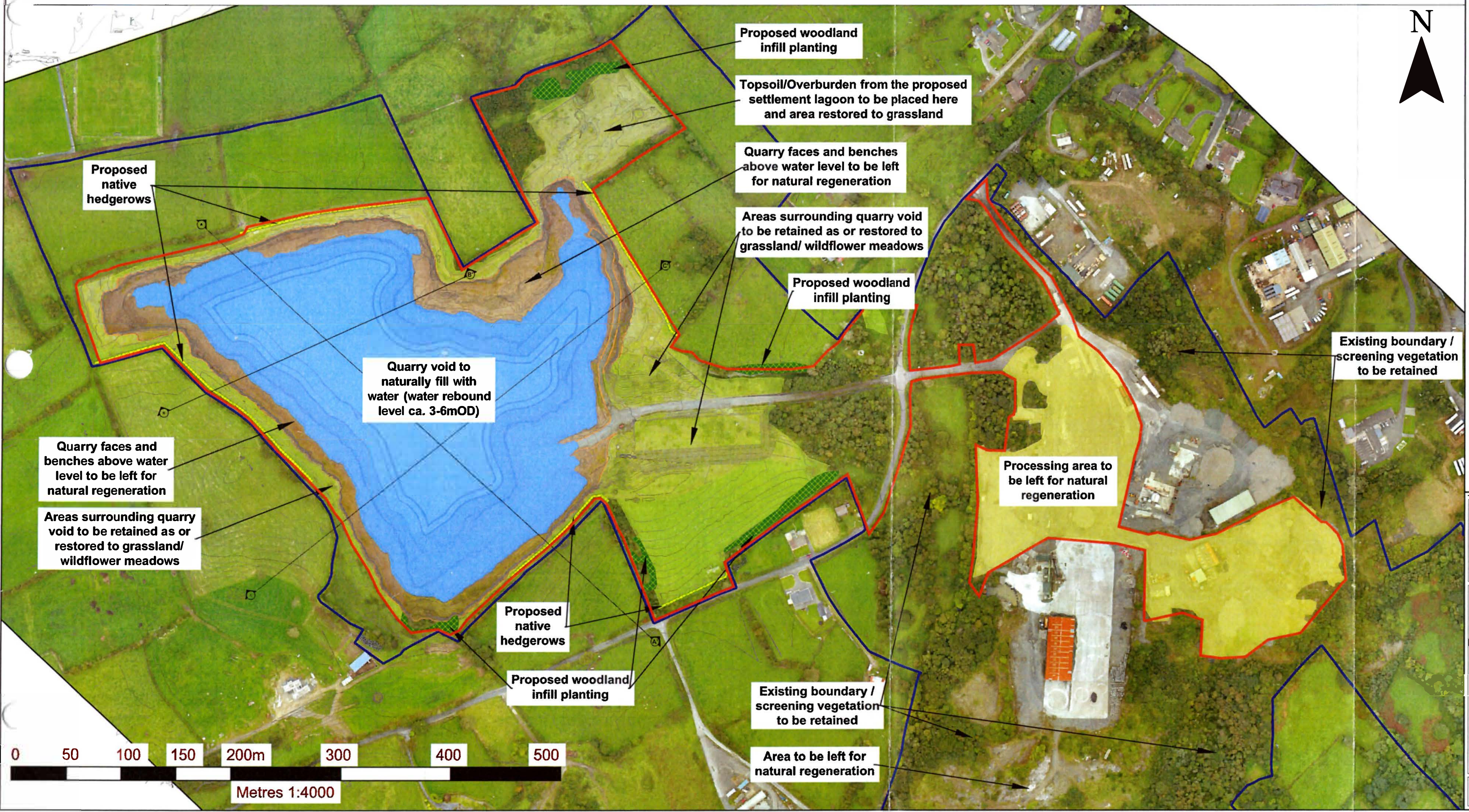
Aftercare: Establishment maintenance will be carried out for 2 years following the planting works (minimum 3 maintenance visits per year; i.e. spring, summer and autumn). This will include weed control, replacement planting where required and the adjustment/removal of tree ties and spiral guards.

NATIVE WOODLAND INFILL MIX

No.	*Plant Name*	*Common Name*	*Height (cm)*	*Age*	*%*
Transplants					
160	Alnus glutinosa	Common alder	60-90	1+1	20
160	Betula pubescens	Downy birch	60-90	1+1	20
160	Crataegus monogyna	Hawthorn	60-90	1+1	20
160	Prunus spinosa	Blackthorn	60-90	1+0	20
160	Quercus robur	Pedunculate oak	60-90	1+1	20

NATIVE HEDGEROW MIX

No.	*Plant Name*	*Common Name*	*Height (cm)*	*Age*	*%*
Transplants/Feathered Trees					
800	Crataegus monogyna	Hawthorn	60-90	1+1	40
600	Prunus spinosa	Blackthorn	60-90	1+0	30
100	Quercus robur	Pedunculate oak	175-200	2xTR	05
500	Salix cinerea	Sally	60-90	1+0	25



00584.00019.Aghamore_Figure 2.2.Proposed Restoration Plan.REV.0.dwg

NOTES
1. Aerial Photography flown **September 2020** by SLR Consulting Ireland.
2. Ordnance Survey Ireland Licence No. **CYAL50167032** © Ordnance Survey & Government of Ireland.

LEGEND

▭	LAND INTEREST BOUNDARY
▭	PLANNING APPLICATION AREA
▨	EXISTING ACCESS ROAD TO BE RETAINED

MITIGATION MEASURES
(TO BE IMPLEMENTED ON RE-COMMENCEMENT OF THE PROPOSED DEVELOPMENT)

🟩	Existing woodland/ scrub vegetation to be retained.
▨	Proposed woodland infill planting to augment existing woodland/ scrub vegetation
🟥	Proposed hedgerows to fully enclose the quarry site with vegetation.

RESTORATION MEASURES
(TO BE IMPLEMENTED ON COMPLETION OF ALL EXTRACTION WORKS)

🟫	Upper quarry faces and benches to be allowed to regenerate naturally with locally occurring grass and scrub species (note: some of the flatter areas have already developed into areas of grassland).
🟦	Quarry void to be left to naturally fill with water, creating a permanent waterbody (water rebound level ca. 3 - 6 mOD).
🟩	Existing grassland areas surrounding the quarry void to be retained and areas of existing bare ground (including proposed settlement lagoon) to be restored to grassland/ wildflower meadows
🟨	Hardstanding areas within processing yard to be cleared (including plant/ structures), broken up and left for natural regeneration with locally occuring grass and scrub species.

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LAGAN MATERIALS LTD.
ENVIRONMENTAL IMPACT ASSESSMENT REPORT

LIMESTONE QUARRY AND AGGREGATE PROCESSING YARD
AGHAMORE NEAR, AGHAMORE FAR AND
CARROWNAMADDOO TOWNLANDS, CO. SLIGO

LANDSCAPE MITIGATION AND RESTORATION PLAN

FIGURE 2-2

Scale: 1:4,000 @ A3
Date: MAY 2021

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3. Alternatives

CHAPTER 3

ALTERNATIVES

ALTERNATIVES 3

CONTENTS

INTRODUCTION

3.1 In the consideration of alternatives below, the issues of alternative sources of aggregates; and alternative site locations / designs / layouts have been addressed.

3.2 The current planning application is for recommencement / deepening of an existing quarry and recommencement of stone processing (crushing and screening) in the existing processing area. The existing quarry area is located in an area favourable to extraction activities, due to, *inter alia:*

- Established long history of extraction and related activities at this location (activities commenced at this location in the 1950's);
- Proven limestone reserves – refer to EIAR Chapter 6;
- Located with direct access to the regional and national roads network – refer to EIAR Chapter 14;
- Best practice industry standard extraction and processing methods being used;
- Low development costs due to existing infrastructure already in place at the site and the application is for recommencement and extension (by deepening) of a long established quarry development.

3.3 The application site is within an area covered by the Sligo & Environs Development Plan 2010-2016. Appendix A to the Sligo County Development Plan 2017-2023 states that the written statement and the objectives maps, including zoning objectives, pertaining to the Sligo & Environs Development Plan 2010-2016, have been appended to the County Development Plan.

3.4 The majority of the application area is assigned the land-use zoning 'NR – natural/mineral resource reservation' within the Sligo & Environs Plan, and part of the site is assigned the land-use zoning 'BUF – buffer zone'.

3.5 Section 6.8 of the appended Sligo & Environs Plan also addresses mineral extraction and natural resources and includes specific objective (O-NR-1) to protect the natural resource reservation and existing quarrying operations at Aghamore Near, Aghamore Far and Carrownamadoo.

3.6 It is noted that there are a large number of construction related projects proposed for Sligo Town in the Regional Spatial and Economic Strategy (RSES) for the Northern and Western Region, in which the town is identified as having the vision and capacity to be a Regional Growth Centre of scale. These projects include housing (RPO 3.7.37 and RPO 3.7.38), road infrastructure (RPO 3.7.40, RPO 3.7.41, RPO 3.7.43 and RPO 3.7.54) – refer to separate Planning Report submitted with the Planning Application. A secure supply of aggregates is critical to implementation of these plans.

ADDITIONAL INFORMATION

3.7 As outlined in Chapter 1 a planning application was submitted to Sligo County Council (Plan File Ref. No. 18/345 / ABP Ref. 305821-19) in August 2018 for similar development to that proposed as part of this application. In October 2019 Sligo County Council granted planning permission for the development (subject to 23 no. conditions). 2 no. third party appeals of the decision by Sligo County Council to grant permission for the proposed quarry development were made to An Bord Pleanala

(ABP-305821-19). An Bord Pleanala refused permission for the proposed development on the 30th June 2020 for 2 no. reasons – refer to Chapter 1 for further details.

3.8 In order to comprehensively address the reasons for refusal, and further comments contained within the An Bord Pleanala Inspectors Report a number of additional surveys / site investigations, field work and assessments have been carried out.

3.9 This Chapter 3 of the EIAR has been updated as follows:

- Alternative locations section has been updated to include the recently published Regional Spatial and Economic Strategy (RSES) for the Northern and Western Region;
- Alternative design / layouts section has been updated to include the aggregate processing area.

DO NOTHING ALTERNATIVE

3.10 If no further works within the planning application area were carried out, the existing site would be restored to natural habitat after-uses as per the previously permitted proposals.

ALTERNATIVE SOURCES OF AGGREGATES

3.11 In the medium term there are no real alternatives to the current land-based sources of construction aggregates.

3.12 Until such time as end of waste criteria in respect of Construction & Demolition materials is agreed, these materials cannot be relied upon and for the foreseeable future there are no real alternatives to primary land-won aggregates.

3.13 Notwithstanding the above, the volume of C&D materials suitable for recycling into secondary aggregates would be considered very low in comparison to the overall demand for aggregates. The demographic spread of the population results in only the large urban centres potentially being capable of generating sufficient volumes of construction and demolition (C&D) waste to justify a commercial operation producing secondary aggregates going forward.

3.14 In the longer term (>25 years), there may be some scope for extraction of minerals from marine sources.

3.15 In the absence of significant volumes of aggregates from recycled / secondary and marine sources, it is clear that land-based deposits (such as the proven reserves at Aghamore Near, Aghamore Far and Carrownamaddoo townlands) will continue to be the main source of construction aggregates in Ireland, including Sligo and the northwest / west region.

ALTERNATIVE LOCATIONS

3.16 The current planning application is for the recommencement / deepening of an existing established quarry and recommencement of aggregate processing (crushing and screening) within the existing processing area, located to the east of the local road that bisects the site.

3.17 The alternatives available to the Applicant relate to:

- Further development (into lands that do not currently have the benefit of an established quarry land use) and final restoration of the existing established quarry;

  or

- Development of a new replacement 'greenfield' quarry in Sligo to serve the established clients and markets in this region.

3.18 At the current time, there is no suitable alternative replacement quarry location available to the applicant in County Sligo. It is generally accepted that the overall timeframe for development of a 'greenfield' quarry site (from initial site selection, land acquisition, preparation of a planning application and accompanying EIAR, through planning process and site development to extraction of aggregates) takes between 5 and 10 years.

3.19 Notwithstanding the above, recommencement and deepening of the existing quarry would be beneficial in planning terms by eliminating the need for:

- Continued extraction of materials from other quarries within the county, should the applicant be unable to develop a new 'greenfield' site in the event that the existing quarry is not authorised to recommence operations. This would result in faster depletion of aggregate resources at these other quarry locations and potentially result in future intensification of those operations;
- Development of a 'greenfield' site at some other location within the county where there is little or no previous extractive industry land use;
- Haulage of materials by road from other quarries within, and outside the county, with potentially longer haulage distances and increased traffic levels on the wider road network.

3.20 The development of the existing limestone quarry at Aghamore Near, Aghamore Far and Carrownamaddoo townlands will assist in facilitating extraction from an existing established and proven aggregate resource, with no significant increase in environmental emissions.

3.21 This development is not like a factory for example that can be located at many locations; this is a resource tied development. Aggregates can only be worked where they exist and where the environmental effects of working such resources can be managed to an acceptable level.

3.22 The ambitious plans and projects set out in the RSES, and referenced above, are reliant on a secure supply of aggregates and associated quarry products. At the current time the region is limited to only one operational quarry of sufficient scale to supply the region. The proposed recommencement of quarry operations at this site are required to ensure a continued reliable and competitive supply of quarry products to enable development and completion of the plans and projects set out in the RSES.

Reduction in Greenhouse Gas Emissions

3.23 Typical greenhouse gas emissions for HGV's are 0.71266 kgCO2e/km.

3.24 The quarry at Aghamore is located in close proximity (c. 5 km) to Sligo town and is the closest quarry of sufficient scale to supply aggregates to construction projects in the town.

3.25 The recommencement of quarrying activities at the application site would see a reduction in GHG emissions from aggregates being delivered to construction projects in Sligo town, resulting in a net gain in respect to the existing situation where aggregates are hauled over greater distances than is proposed as part of this development.

3.26 On the basis of the above, it is considered that the recommencement of development (and final restoration) of the existing quarry, subject to continued implementation of best environmental management practice and compliance with appropriate planning controls (i.e. planning conditions and recommended emission limit values for the sector) is preferable in an overall planning context, compared to the development of a new replacement 'greenfield' site at some alternative location in Sligo.

ALTERNATIVE DESIGNS / LAYOUTS

3.27 Alternative designs, including alternative layouts within the site were considered. No changes to the previously permitted quarry extraction area have been proposed as part of this EIAR. Quarry deepening will be carried out within the previously permitted area only (no lateral extension proposed) and this is considered to best minimise the potential impacts on the environment from noise, dust, visual impacts.

Extraction Area

3.28 Lands adjoining the quarry extraction area are owned by the applicant – refer to Figure 1.2, and these lands may be suitable for rock extraction at a future date.

3.29 These adjoining lands are currently in agricultural use and have not previously been used, or proposed to be used, for quarry development. Extensive site investigations will be required to prove the limestone reserves within these lands. Any future planning application to allow extraction within these lands will require an Environmental Impact Assessment to be carried out. This process (site investigations and EIAR) will take a minimum of 2 – 3 years to complete.

3.30 The most immediate available and suitable stone reserves available for extraction at the quarry are the proven reserves contained within the footprint of the existing quarry extraction area, below the current quarry floor level – refer to Chapter 6: Soils and Geology. These reserves have previously been permitted to an extraction level of – 34.5mOD and have been subject to recent extensive environmental assessments and site investigations.

3.31 Extraction of the stone reserves from below the quarry floor will not result in any additional land-take and will not result in any significant environmental impact. This EIAR demonstrates that the proposed recommencement and deepening of the existing quarry development, and recommencement of activities within the associated processing area, can be carried out without any significant impact on the surrounding environment, and within the recommended environmental emission threshold values for these types of development.

Aggregate Processing Area

3.32 The existing aggregate processing area is located on the eastern side of the local road. Previously, when operational, activities in this area were undertaken adjacent to the Aghamore stream. As part of this application it is proposed to provide a buffer strip, c. 25 metres in width, between the processing area and the Aghamore stream, along with construction of a berm to ensure that no surface water run-off from the processing area enters the stream. No activities (processing, stockpiling, etc.) will be carried out within the buffer strip.

ALTERNATIVE PROCESSES

3.33 Lagan Materials Ltd. are a company with expertise and experience in the field of quarrying and aggregates production.

3.34 As this planning application is for recommencement / deepening of an existing established quarry and the recommencement of aggregate processing within the existing processing area, alternative processes are not considered relevant in this instance.

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4. Population & Human Health

4. Population &
Human Health

CHAPTER 4

POPULATION AND HUMAN HEALTH

Lagan Materials Ltd.
Aghamore Near, Aghamore Far and Carrownamaddoo townlands, County Sligo
EIAR – Recommencement and Deepening of Existing Quarry and Associated Processing Area
May 2021

SLR

CONTENTS

TABLES

FIGURES

INTRODUCTION

4.1 This chapter of the Environmental Impact Assessment Report (EIAR) relates to the potential effects of the recommencement / deepening of the existing quarry and recommencement of aggregate processing activities at Aghamore Near, Aghamore Far and Carrownamaddoo townlands in Co. Sligo on population and human health.

4.2 For further details of the proposed development and the application site context, refer to chapters 1 and 2 of this EIAR.

Scope of Work

4.3 The EPA guidelines in relation to the preparation of EIAR[1] note the following in respect of population and human health:

- assessment of land-use planning and demographic issues or detailed socio-economic analysis is not generally required;
- economic development or settlement patterns are only relevant if they give rise to new development and associated effects;
- human health should be considered in the context of the relevant environmental topics addressed by the EIAR;
- the effects on human health via relevant pathways (such as air, soil and water) should be considered in the context of accepted standards for exposure, dose or risk;
- other health and safety issues are addressed under other EU directives.

4.4 On the basis of the guidelines, the scope of this chapter of the EIAR is limited to a consideration of population, employment, amenity and human health in the context of the topics addressed by this EIAR.

Consultations / Consultees

4.5 Consultation was not undertaken in the preparation of this chapter of the EIAR.

Contributors / Author(s)

4.6 This chapter of the EIAR was prepared by Peter Kinghan, who is a Technical Director with SLR Consulting Ireland. Peter is a Chartered Mineral Surveyor and has worked previously on several extractive industry planning applications and EIARs.

Limitations / Difficulties Encountered

4.7 No limitations or difficulties were encountered in the preparation of this chapter of the EIAR.

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[1] Environmental Protection Agency (2017). *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.* Draft dated May 2017. Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford.

REGULATORY BACKGROUND

Legislation

4.8 There is no specific legislation relevant to this chapter of the EIAR. Legislation, if any, that is relevant to each pathway (noise, air, soil, water, etc.) is addressed elsewhere in this EIAR.

Planning Policy and Development Control

4.9 The current county development plan is Sligo County Development Plan 2017 – 2023.

4.10 The application site is within an area covered by the Sligo & Environs Development Plan 2010-2016. Appendix A to the Sligo County Development Plan 2017-2023 states that the written statement and the objectives maps, including zoning objectives, pertaining to the Sligo & Environs Development Plan 2010-2016, have been appended to the County Development Plan.

4.11 The majority of the application area is assigned the land-use zoning 'NR – natural/mineral resource reservation' within the Sligo & Environs Plan, and part of the site is assigned the land-use zoning 'BUF – buffer zone'.

4.12 Section 6.8 of the appended Sligo & Environs Plan also addresses mineral extraction and natural resources and includes specific objective (O-NR-1) to protect the natural resource reservation and existing quarrying operations at Aghamore Near, Aghamore Far and Carrownamadoo.

4.13 The County Development Plan sets out the settlement strategy and policies for the sustainable development of Sligo.

4.14 Section 4.3.4 of the county development plan relates specifically to mineral extraction and quarries. It states that Sligo County Council recognises the importance of the aggregate and concrete products industry to the economy, employment and the provision of essential construction materials. The following policies apply:

- P-MEQ-1 Protect all known unworked deposits from development that might limit their scope for extraction (e.g. one-off housing)
- P-MEQ-2 Ensure that extraction and associated processes are carried out in a sustainable manner, which minimises the impact on residential amenities, natural environment and water quality, and do not impinge on existing rights-of-way or walking routes.
- P-MEQ-3 Seek the reuse of worked out quarries for recreational, industrial, ecological and other uses, following appropriate restoration.
- P-MEQ-4 In respect of development proposals on or in the proximity of quarry sites, the Council will require that appropriate investigations are carried out into the nature and extent of old quarries (where applicable), the nature and extent of soil and groundwater contamination and the risks associated with site development works. Adequate measures to mitigate these risks shall be submitted as part of the planning application.

4.15 Policy P-RDD 1 generally seeks to facilitate resource based rural enterprise. The county development plan also includes policies that seek to maintain water quality in accordance with the requirements of the Water Framework Directive (P-WQ-1 and P-WQ-4), ensure that existing and new development does not contribute to a deterioration in air quality (P-AQ-2) and ensure that proposals with the potential to generate noise will protect the amenity of noise sensitive developments by incorporating appropriate measures (P-CN-1).

Guidelines

4.16 As outlined above, this chapter of the EIAR has been prepared on the basis of the draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports by the EPA (2017).

Technical Standards

4.17 There are no technical standards relevant to this chapter of the EIAR. Technical standards, if any, that are relevant to each pathway (noise, air, soil, water, etc.) are addressed elsewhere in this EIAR.

RECEIVING ENVIRONMENT

Study Area

4.18 The study area relates to the vicinity of the application site and to those dwellings and buildings on the roads surrounding the application site.

Baseline Study Methodology

4.19 The baseline study comprises a desk-top review of online and published resources, information provided by the applicant and information contained in the other chapters of this EIAR. A review of existing residential housing and sensitive receptors in the vicinity of the application site was undertaken. Ordnance Survey maps and aerial photography were also examined.

Sources of Information

4.20 Baseline information was obtained from the following sources:

- Myplan.ie (http://myplan.ie/index.html);
- Historic Environment Viewer (http://webgis.archaeology.ie/historicenvironment/);
- Sligo County Development Plan 2017;
- The environmental topic chapters of this EIAR;
- OSi Maps;
- Aerial Photographs;
- Openstreetmap.org;
- Live Register Statistics;
- Census 2016.

Context

4.21 The application site is located south of Sligo town, off the R287 regional road in the town lands of Aghamore Near, Aghamore Far and Carrownamaddoo. Although there is a dispersed pattern of housing development in the vicinity, there is no distinctive village or settlement in the immediate vicinity.

4.22 The quarry area on the western side of the local road that bisects the application site is bounded on all sides by agricultural land and there are a number of dwellings located along the roads in the vicinity. The processing area located on the eastern side of the road is bounded by agricultural lands to the East, and industrial land uses to the North and South. There is a sports ground located to the northwest of the application area. The site is accessed from a local road (L3603). Lough Gill is located c. 360m north-east of the application site.

4.23 Existing facilities at the site include the weighbridge & weighbridge office and a garage / workshop. These facilities are located within the processing area on the eastern part of the application site. There is an existing asphalt production plant located to adjacent to the aggregate processing area.

4.24 The planning application includes the following:

- The provision of a settlement lagoon (c. 2,800m2);
- The provision of 2 no. wheelwashes;
- The Provision of a double stacked portacabin office;
- The Provision of a wastewater treatment system;
- Additional stockproof / trespass proof boundary fencing;

Environmental and Heritage Designations

4.25 There are seven Natura 2000 sites within 5 km of the boundary of the application area. Lough Gill SAC (Site code 001976) is 360 metres north east from the access track to the Processing Area, or 780 metres north east of the Quarry Area. Ballysadare Bay SAC (Site code 000622) and SPA (Site code 004129) are approximately 3.3 km south west of the site, while the Unshin River SAC (Site code 001898) is approximately 3.7 km south west of the Site. Union Wood SAC (Site code 000638) is approximately 2.79 km south of the Site. Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC (Site code 000627) and Cummeen Strand SPA (Site code 004035) are approximately 4.41 km north and west of the Site at Aghamore.

4.26 The Record of Monuments and Places includes the following recorded monuments within and in the vicinity of the application area:

- Ref. SL020-094 – A hachured enclosure located on the access road into the application area. This record is noted as having been removed by quarrying;
- Ref. SL020-093 – A ringfort or rath;
- Ref. SL020-086 – A ringfort or rath.

There are no recorded monuments within the application area.

4.27 There are no buildings on the National Inventory of Architectural Heritage in the vicinity. According to the OPW model, part of the quarry void is noted as being at risk of pluvial flooding and all of the void is at risk of coastal flooding.

Population

4.28 The review of population is based on the electoral divisions of Ballintogher West and Calry, in which the application site is located. The change in population from 2011 to 2016, as per Census 2016[2] for the electoral divisions, the county, the province and the state is outlined in the table below.

Table 4-1
Population 2011 - 2016

	2011	2016	% Change
Ballintogher West ED	435	443	1.8%
Calry	1,806	1,702	-5.8%
County Sligo	65,393	65,535	0.2%
Connaght	542,547	550,668	1.5%
Ireland	4,588,252	4,757,976	3.7%

4.29 The census results indicate that population growth in Ballintogher West, Sligo and Connacht, is significantly slower than at the national level and the population is in decline in Calry electoral division.

Employment

4.30 According the August 2017 Live Register statistics[3], there were 3,160 persons in Sligo town on the live register. This figure has dropped from 3,724 in August 2016 and 4,009 in August 2015. Notwithstanding the downward trend, the current figure remains high compared to the August 2006 figure of 1,735. The current figure of 3,160 is an 82% increase on the August 2006 figure.

4.31 The application area is located in the electoral divisions of Ballintogher West and Calry.

4.32 According to the 2016 census results[4], Ballintogher West has a total population of 443. Of the 371 people aged 15 years or older, some 217 were at work, 3 were looking for their first job and 14 were unemployed. Others were students, working at home, retired, unable to work or other.

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[2] http://census.cso.ie/sapmap/

[3] http://www.cso.ie/px/pxeirestat/Statire/SelectVarVal/Define.asp?Maintable=LRM07&Planguage=0

[4] http://census.cso.ie/sapmap2016/Results.aspx?Geog_Type=ED3409&Geog_Code=2AE196291A2613A3E05500000000001

4.33 According to the 2016 census results[5], Calry has a total population of 1,702. Of the 1,433 people aged 15 years or older, some 719 were at work, 17 were looking for their first job and 51 were unemployed. Others were students, working at home, retired, unable to work or other.

4.34 The population in Ballintogher West and Calry and Sligo is categorised by occupation as per table 4.2. This shows that the trend in Ballintogher West and Calry is broadly similarly to that in the wider county, albeit that a higher proportion of people are engaged in managerial, professions and administrative and secretarial occupations in Calry than in Sligo and a higher proportion of people are engaged in technical and skilled occuptations in Ballintogher West than in Sligo.

Table 4-2
Population of Ballintogher West and Calry by Occupation

	Ballintogher West		Calry		County Sligo	
Occupation	**No.**	**%**	**No.**	**%**	**No.**	**%**
Managers, Directors and Senior Officials	8	3.46	76	9.87	1,927	6.46
Professional Occupations	35	15.15	193	25.07	5,151	17.28
Associate Professional and Technical Occupations	32	13.85	95	12.34	2,911	9.76
Administrative and Secretarial Occupations	21	9.09	88	11.43	3,034	10.18
Skilled Trades Occupations	46	19.91	86	11.17	5,049	16.93
Caring, Leisure and Other Service Occupations	25	1082	60	7.79	2 ,671	8.96
Sales and Customer Service Occupations	17	7.36	37	4.81	1 ,816	6.09
Process, Plant and Machine Operatives	14	6.06	40	5.2	2,087	7.00
Elementary Occupations	17	7.36	64	8.31	2,563	8.60
Not stated	16	6.93	31	4.03	2,605	8.74

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[5] http://census.cso.ie/sapmap2016/Results.aspx?Geog_Type=ED3409&Geog_Code=2AE1962919A913A3E055000000000001#SAPMAP_T8_801

Total	231	100	770	100	29,814	100.00

4.35 A breakdown of the industry in which those at work are employed is provided below as per table 4.3. This shows that:

a) a higher proportion of the population in Ballintogher West is likely to be engaged in building and construction, commerce and trade, transport and communications, and professional services than in Sligo and that a lower proportion is engaged in agriculture, forestry and fishing, manufacturing and public administration than in Sligo;

b) a higher proportion of the population in Calry is likely to be engaged in commerce and trade, transport and communications, public administration and professional services than in Sligo and that a lower proportion is engaged in agriculture, forestry and fishing, building and construction and manufacturing than in Sligo.

Table 4-3
Persons at work in Ballintogher West and Calry by industry

	Ballintogher West		Calry		County Sligo	
Industry	**No.**	**%**	**No.**	**%**	**No.**	**%**
Agriculture, forestry and fishing	12	5.53	27	3.76	1,868	7.18
Building and construction	22	10.14	27	3.76	1,165	4.48
Manufacturing industries	21	9.68	73	10.15	3,262	12.55
Commerce and trade	46	21.2	137	19.05	4,894	18.82
Transport and communications	17	7.83	34	4.73	1,224	4.71
Public administration	12	5.53	66	9.18	1,952	7.51
Professional services	64	29.5	244	33.94	7,203	27.70
Other	23	10.6	111	15.44	4,434	17.05
Total	217	100	719	100	26,002	100

Sensitive Receptors

4.36 The application site is located is a rural area, but the nearby roads and in particular the roads to the north-east and north-west display a pattern of ribbon development. There is a more dispersed pattern of residential development along the local road to the south of the site north. There are a number of industrial and commercial developments to the south-east of the site associated with the manufacturing area of the site and the nearby business park.

4.37 The closest residential dwelling to the development area is located approx. 105 metres to the south of the access road of the quarry area. There are no residences within 150 metres of the quarry void.

4.38 There are no schools, churches or shops in the vicinity. The St John's Football Club is located to the north-west of the application site.

4.39 Figure 4.1 identifies residential properties, community facilities and commercial operations within the locality and shows 500m and 1km bands from the application boundary.

IMPACT ASSESSMENT

Evaluation Methodology

4.40 The evaluation of effects on employment, human health and amenity comprises a qualitative assessment based on the quantitative and qualitative analysis of potential effects on the environment undertaken in other chapters of this EIAR. The assessment also takes into account a review of relevant literature and professional judgement in relation to impact on population and human health.

Employment

Operational Stage Impacts

4.41 The proposed development will provide employment of up to 6 people directly on-site, in addition to a number of indirect employees including hauliers, sub-contractors, materials suppliers and maintenance contractors. In addition, the proposed development will contribute indirectly to sustaining and developing the local and regional economy through continued supply of construction aggregates.

4.42 This is a medium-term and positive impact that would not have significant effects on the environment.

Post – Operational Stage Impacts

4.43 Following the cessation of operations, the application site will be restored to natural habitat. This would result in the loss of jobs within the quarry and related operations. Some short-term employment would be provided in relation to the aftercare of the restored site – refer to Figure 2.2.

Human Health

4.44 The key pathways in relation to human health in this instance are air, noise, water and soil.

Construction / Operational Stage Impacts

4.45 The construction and operational phase of the development relates to the construction of the settlement lagoon, berm, wheelwashes & portacabin along with extraction and primary processing of aggregates within the quarry area using conventional quarrying techniques, secondary processing of aggregates in the processing area to the east of application site and the restoration of the quarry to natural habitat after-uses. This stage of operations has the potential to generate impacts that would have effects on human health through the pathways of noise, vibration, dust, soil and water.

4.46 As outlined in chapter 6 regarding land, soils and geology, chapter 7 regarding water, chapter 8 regarding air and chapter 10 regarding noise & vibration, a number of mitigation measures are proposed, and the residual effect of the proposed development is predicted to be negligible to acceptable.

4.47 On this basis, it is considered that there would be no likely significant temporary or permanent effects on human health during the construction and operational stage following mitigation.

Post – Operational Stage Impacts

4.48 Following restoration, the potential effects on noise, vibration, dust, soil and water.would cease owing to the cessation of quarrying operations and restoration operations.

4.49 As outlined in chapters 6 (land, soils and geology), 7 (water), 8 (air) and 9 (noise and vibration) mitigation measures are proposed. Based on the proposed mitigation measures, the potential for residual effects is predicted to be negligible. On this basis, it is considered that there would be no likely significant effect on human health during the post-operational stage.

Amenity

4.50 The key matters in relation to amenity in this instance are noise, vibration, dust, water., landscape and traffic.

Construction / Operational Stage Impacts

4.51 The construction & operational phase would require the extraction of aggregates, which has the potential to generate impacts that would have effects on amenity through the pathways of noise, vibration, dust and water. In addition, there would be vehicle movements associated with the quarry.

4.52 As outlined in chapters 7 (water), 8 (air), 10 (noise and vibrations), 13 (landscape) and 14 (traffic), mitigation measures are proposed. Based on the proposed mitigation measures, the potential for residual effects during the construction and operational phase is likely to be negligible to acceptable. On this basis, it is considered that there would be no likely significant effect on amenity during the operational stage.

Post – Operational Stage Impacts

4.53 Following restoration, the potential effects on water, air, noise, vibration, and traffic would cease owing to the cessation of quarrying and restoration operations, the cessation of machinery operation and the growth of vegetation.

4.54 Clearly, following the cessation of the proposed works, the appearance of the application site will have altered as the site is restored. As outlined in chapter 13 relating to landscape, the effects of the restored development would be beneficial compared to the current baseline.

4.55 Based on the anticipated outcomes of the proposed development, the potential for residual effects during the post-operational phase is likely to be low. On this basis, it is considered that there would be no likely significant effect on amenity during the post-operational stage.

Unplanned Events

4.56 According to the EPA guidelines, unplanned events, such as accidents, can include *"spill from traffic accidents, floods or land-slides affecting the site, fire, collapse or equipment failure on the site"*. The 2014 EIA directive refers to *"major accidents, and/or natural disasters (such as flooding, sea level rise, or earthquakes)"*.

4.57 In this instance, the vulnerability of the proposed development to accidents, unplanned events or natural disasters is relatively limited owing to the relatively simple nature of the development works, the established nature of the techniques, regulations and procedures to be followed, the material to be handled on site and the relatively rural location of the proposed works.

4.58 Unplanned events in relation to the proposed development could potentially relate to:

- instability following the extraction of rock;
- spill from traffic accidents;
- flooding.

4.59 Adhering to the HSA Safe Quarry Guidelines to the Safety Health and Welfare at Work (Quarries) Regulations 2008 should limit the potential for unplanned events in the form of instability in the quarry faces. In any event, instability following the extraction of rock would be unlikely to have any significant impacts on employment, human health or amenity, particularly beyond the site. The final restoration will provide for the restoration of the quarry to a mixture of natural habitat, a water body, naturally regenerating quarry benches and woodland.

4.60 Chapter 7 (water) notes that spillages of fuels or chemicals during site activities could happen without proper control and supervision. Discharged water off-site could potentially breach water quality limits without monitoring. Pump failure in the quarry could result in the quarry floor flooding leading to the potential for groundwater pollution by plant and equipment; uncontrolled discharge of water to the Aghamore Stream could potentially lead to localised flooding off-site in the worst case. Appropriate mitigation measures and monitoring have been proposed to ensure that there are no potential impacts on the water environment as a result of unplanned events at the site.

4.61 The traffic and transport assessment, carried out as part of the EIAR (Chapter 14), indicates that existing road network can accommodate the proposed development. Chapter 14 also recommends the erection of warning signage and the improvement of sightlines at the entrance to the application area. It is considered that the risk of an accident resulting in a spillage would be no greater in relation to this development than it is for any other form of development that relies on the transportation of goods and materials by HGVs. The potential for significant impacts on employment, human health in the wider population or amenity as a result of a road spillage is likely to be low and any such effects would be temporary.

Cumulative / Synergistic Impacts

4.62 A search of the Sligo County Council online planning search facility indicates that there are no other planned developments in the vicinity of the application site and in the adjoining townlands of Carrownamaddoo, Cuilbeg, Aghamore Near, Tullynagracken South, Drumiskabole, Ballydawley, Castledargan, which were granted planning permission in the last five years[6] and have the potential to have any significant adverse cumulative impacts on the local environment. It is noted that planning permission has recently been granted for development consisting of the filling of lands with construction and demolition waste in Carrownamaddoo townland c. 450 metres from the application area (Plan File Ref. No. 18/49) subject to 7 no. conditions. This proposed development is considered small scale, short term in duration (5 years) and is located sufficient distance from the application area and therefore no cumulative impacts are considered.

4.63 It is considered that the only impact that has the potential for significant cumulative impact on population and human health and in particular on amenity is traffic. The traffic impact of the proposed development, along with cumulative impact from the existing asphalt plant, is assessed and discussed in chapter 14 of this EIAR. The assessment concludes that the relevant junctions and links will have sufficient capacity for the traffic generated by the quarry development.

Transboundary Impacts

4.64 It is not anticipated that the impacts of the proposed development would have any significant transboundary effects on population and human health.

Interaction with Other Impacts

4.65 It is not anticipated that the effects of the proposed development on population and human health would interact significantly with other impacts.

'Do-nothing Scenario'

4.66 If planning permission is not approved for the proposed recommencement of quarry operations, the site would be restored in accordance with the permitted restoration scheme. This would result in a cessation of impacts related to noise, air, dust, water, vibration and traffic. This would also result in an adverse effect on employment, because the workforce that would have otherwise been employed by the quarry would not exist.

MITIGATION MEASURES

Operational Stage

4.67 Mitigation measures to be adopted in relation to population and human health during the operational stage will relate to minimising the effect of the development on surrounding sensitive receptors in relation to air, noise, water, soil, traffic and landscape. These measures relate primarily to avoidance, prevention and reduction and are discussed in the relevant chapters of the EIAR.

4.68 These mitigation measures include the following:

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[6] Planning search conducted on 21st April 2021 on Sligo County Council website.

Table 4-5
Construction & Operational Stage Mtigation Measures

Topic	Mitigation Measure
Soil	In order to limit the effects of erosion on any existing excavated soil material from the proposed settlement lagoon the following mitigation measures will be used on site during handling: • Soil material will be placed in permanent or temporary locations at a safe angle of repose; • Screening berms will be re-vegetated where they are in place for a sufficient length of time to justify such measures; and • The re handling of soil material will be minimised as much as possible in order to preserve the integrity of the soil material; this is also an economically prudent practice.
Water	• Groundwater monitoring of installed monitoring wells; • All petroleum-based products (lubricating oils, waste oils, etc.) will be stored in a bunded area to prevent pollution by accidental leaks; • All plant used on site will be inspected regularly for signs of leaks. Mobile plant will only be serviced on a hardstand refuelling area draining to an interceptor to prevent uncontrolled releases of pollutants to ground (refer to Fgiure 2.1 for proposed location). No refuelling or servicing of mobile plant will be undertaken within the quarry void. Where refuelling of semi mobile plant and machinery is required (e.g. crushers and screeners within the quarry void) spill kits and drip trays will be provided.; • Spill kits will be maintained on site to prevent the migration of any accidental spillages, should they occur; • Oil interceptors and separators shall be fitted, with the capacity to deal with the 2020 licensed discharge volume of 3,500m^3/d [DL(W)151]. • A settlement lagoon will be installed to reduce suspended solids levels in the discharges; • No pumping will occur during flooding events which eliminates the slight risk from flooding during extreme events.
Dust	• Minimise drop heights when handling materials. Avoid working in adverse/ windy conditions. • Minimise drop heights when handling material, protection from wind where possible. Use of water sprays / tractor & bowser to moisten surfaces during dry weather. • Minimise distances of onsite haul routes. • Restrict vehicle speeds through signage / staff training. • Location of haul routes away from sensitive receptors. • Use of road sweeper to reduce the amount of available material for re-suspension. • Used of paved access roads.

Topic	Mitigation Measure
	- Avoid working in adverse weather conditions. - Limit mechanical disturbance. - Retention of hedgerows - Retention of perimeter berms
Noise	- Existing screening berms and screen planting shall be retained to act as acoustic barriers. Berms will be inspected on a regular basis and maintained as necessary. - Plant:- ○ all mobile plant used at the development will have noise emission levels that comply with the limiting levels defined in EC Directive 86/662/EEC and any subsequent amendments; ○ all plant items will be properly maintained and operated according to the manufacturers' recommendations, in such a manner as to avoid causing excessive noise (i.e. all moving parts are kept well lubricated, all cutting edges are kept sharpened, the integrity of silencers and acoustic hoods are maintained); ○ all plant will be subject to regular maintenance, i.e. all moving parts are kept well lubricated, all cutting edges are kept sharpened, the integrity of silencers and acoustic hoods are maintained; ○ all plant will be fitted with effective exhaust silencers which are maintained in good working order to meet manufacturers' noise rating levels. Any defective silencers will be replaced immediately. - Traffic:- ○ any deliveries will be programmed to arrive during daytime hours only; ○ care will be taken when unloading vehicles to reduce or minimise potential disturbance to local residents. ○ access / internal haul roads will be kept clean and maintained in a good state of repair, i.e. any potholes filled and large bumps removed, to avoid unwanted rattle and "body-slap" from heavy goods vehicles; ○ vehicles waiting within the quarry will be prohibited from leaving their engines running and there should be no unnecessary revving of engines.
Vibration	- Blast notifications will be provided by advance notification to all residences located within 500 metres of the site. - All blasting operations will be carried out by a certified 'shotfirer' in accordance with the relevant health and safety regulations.

Topic	Mitigation Measure
	- The optimum blast ratio will maintained and the maximum instantaneous charge is optimised. - To avoid any risk of damage to properties in the vicinity of the site, the groundborne vibration levels from blasting wil lnot exceed a peak particle velocity of 12 mm/sec.
Traffic	The erection of warning signage on the approach roads. The improvement of sightlines at the quarry entrance.
Landscape	Hedgerow and woodland planting using nat ivespecies is proposed along the boundaries of the application area which, along with vegetation to be retained would mitigate landscape and visual effects. The post operational stage mitigation comprises a restoration plan to be implemented at the end of the life of the quarry. The restoration plan includes a range of measures to restore the quarry site to an afteruse which would be more sympathetic with the surrounding landscape. Details of the restoration plan are presented in Figure 2.2.

Post – Operational Stage

4.69 The majority of effects of the proposed development will diminish or cease following the cessation of operations. No specific mitigation measures are proposed in relation to the post operational phase.

RESIDUAL IMPACT ASSESSMENT

Operational Stage

4.70 As outlined in chapters 6 (land, soils and geology), 7 (water), 8 (air), 10 (noise and vibration), 13 (landscape) and 14 (traffic) of this EIAR, the mitigation measures would successfully reduce the effects of the proposed development during the operational phase as follows:

- Land, Soils and Geology: None
- Water: None
- Dust: Insignificant to Acceptable
- Noise: Negligible to Minor
- Vibration: None
- Traffic: The assessments have concluded that the links and junctions will operate within capacity for each of the assessment years.
- Landscape: Very small and beneficial

4.71 No specific mitigation measures are proposed in relation to human health and population.

Post – Operational Stage

4.72 As outlined in chapters 6 (land, soils and geology), 7 (water), 8 (air), 10 (noise and vibration), 13 (landscape) and 14 (traffic) of this EIAR, the mitigation measures would successfully reduce the effects of the proposed development during the post operational phase as follows:

- Land, Soils and Geology: None
- Water: None
- Dust: Insignificant to Acceptable
- Noise: Negligible to Minor
- Vibration: None
- Traffic: None – all associated traffic will cease.
- Landscape: Beneficial following restoration when compared with the existing baseline.

4.73 No specific mitigation measures are proposed in relation to human health and population.

MONITORING

4.74 As outlined in chapters 2 (description of the development), 7 (water), 8 (air) and 10 (noise and vibration), monitoring in relation to the proposed development will be undertaken in respect of water, noise, air and vibrations. On this basis, no specific monitoring is required in relation to population and human health

Environmental Monitoring Programme

4.75 When previously operational the site had an established environmental monitoring programme– refer to Condition No. 22 imposed under Plan File Ref. No. PL02/271 and Appendix 2-3. Water, noise, dust and blast monitoring was carried out on a regular basis (when operational), to demonstrate that the development was not having an adverse impact on the surrounding environment and could operate within the permitted environmental emission limit values.

Water

4.76 All surface water monitoring required under the existing Trade Effluent Discharge Licence is currently being carried out. Flowmeters are already installed in the discharge pipes from the quarry sump and a flowmeter installed upstream of the quarry discharge to the Aghamore Stream.

4.77 Groundwater levels will be monitored in the existing monitoring wells as the quarry is developed to confirm the drawdown and estimated radius of influence. Monitoring of groundwater levels by datalogger with periodic site visits to download data will be required.

4.78 Groundwater quality monitoring will continue to be carried out on a biannual basis from a representative number of monitoring wells around the quarry.

4.79 Water levels at Culvert 4 (by the entrance of the Top Coast Oil depot) will be monitored during periods of high rainfall to assess the likelihood of flooding onto the adjacent road. As noted above, discharges will be discontinued during periods of elevated rainfall to eliminate the slight potential risk at this location.

Dust and Air

4.80 Dust deposition monitoring will be carried out at the application site. Dust monitoring locations shall be reviewed and revised where necessary. The results of the dust monitoring will be submitted to Sligo County Council on a regular basis for review and record purposes.

Noise

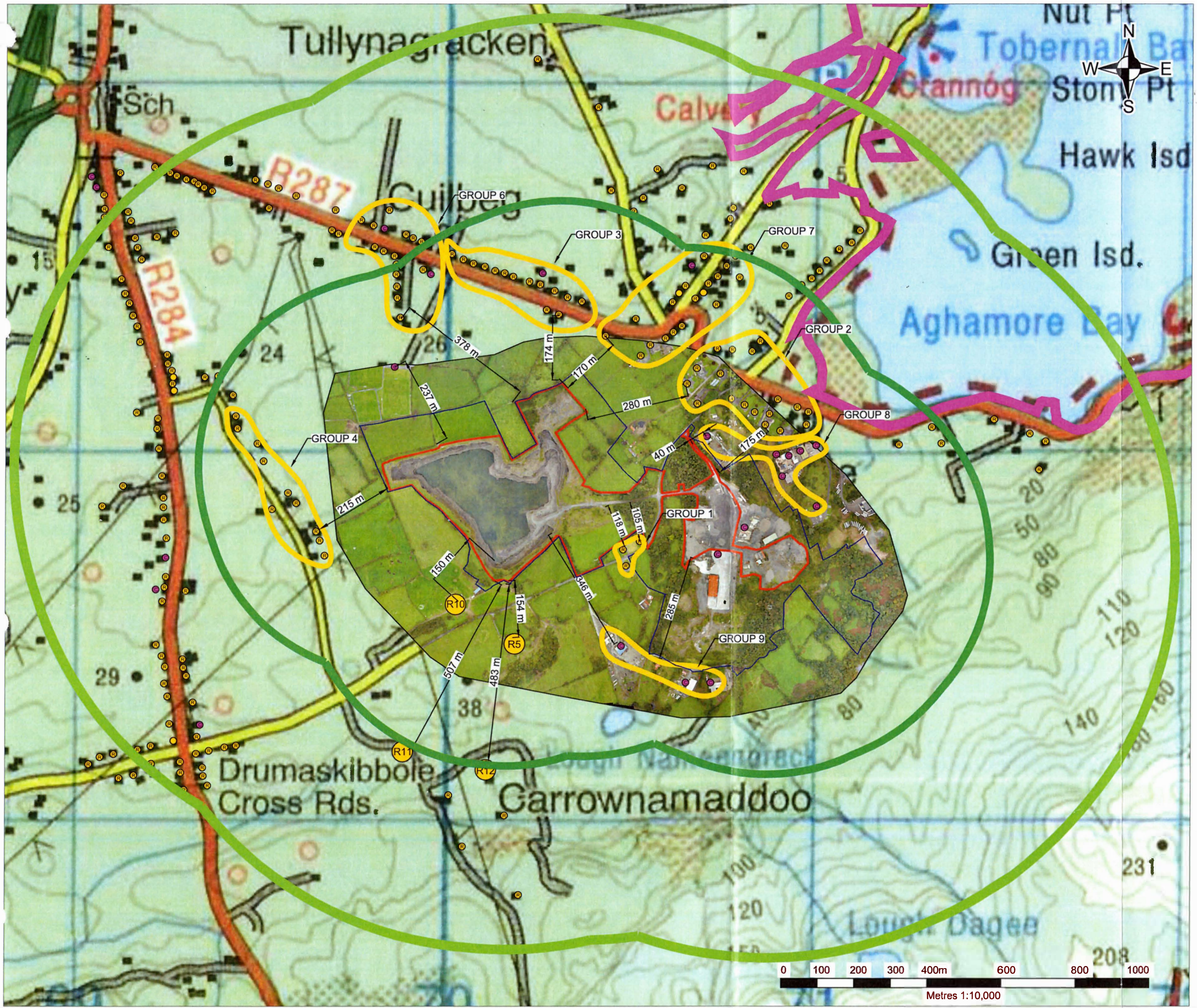
4.81 Noise monitoring will be undertaken at the application site. Noise monitoring locations shall be reviewed and revised where necessary. The results of the noise monitoring will be submitted to Sligo County Council on a regular basis for review and record purposes.

Vibration

4.82 Monitoring of blasts (both for groundborne vibration and air overpressure) will be carried out at the site. The blast monitoring results will be submitted on a regular basis to Sligo County Council for record purposes.

FIGURES

Figure 4-1: Residences, Community Facilities and Commercial Operations



NOTES

1. ORDNANCE SURVEY IRELAND LICENCE NO. CYAL50167032 (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND
2. AERIAL PHOTOGRAPHY CARRIED OUT BY SLR CONSULTING SEPTEMBER 2020

LEGEND

APPLICATION AREA
Ⓡ RESIDENCE
● COMMERCIAL
1 KM OFFSET
500 M OFFSET
GROUPS OF RECEPTORS
LOUGH GILL SAC

SLR CONSULTING IRELAND
7 DUNDRUM BUSINESS PARK
WINDY ARBOUR
DUBLIN 14
T: +353-1-2964667
F: +353-1-2964676
www.slrconsulting.com

LAGAN MATERIALS LTD.

LIMESTONE QUARRY AND AGGREGATE PROCESSING YARD
AGHAMORE NEAR, AGHAMORE FAR AND
CARROWNAMADDOO TOWNLANDS, CO. SLIGO

LOCAL RECEPTORS

FIGURE 4.1

Scale
1:10,000 @ A3

Date
MAY 2021

LAGAN
Part of the Breedon Group

5. Biodiversity

CHAPTER 5

BIODIVERSITY

CONTENTS

TABLES

FIGURES

APPENDICES

INTRODUCTION

5.1 This chapter provides an Ecological Impact Assessment (EcIA) undertaken by SLR Consulting Ireland (SLR) to inform the wider Environmental Impact Assessment (EIA) process and preparation of the Environmental Impact Assessment Report (EIAR) on the likely significant impacts on biodiversity from the proposed recommencement and deepening of the existing limestone quarry and adjacent processing area at Aghamore Near, Aghamore Far and Carrownamaddoo townlands, Co. Sligo.

5.2 A previous Planning Application was submitted to Sligo County Council (Plan File Ref. No. 18/345 & ABP Ref. 305821-19) in August 2018. SLR Consulting Ireland (SLR) was subsequently commissioned by Lagan Bitumen Ltd. in 2019 to prepare the response to a Request for Further Information (RFI) from Sligo County Council (Planning Reference No. 18/345) for the proposed continued use and deepening of the existing permitted quarry at Aghamore, Co. Sligo. Two of the relevant RFIs to Biodiversity concerned bats and raptors. For completeness they have been included as Appendix 5-B and 5-C.

5.3 Following this, An Bord Pleanala refused permission for the proposed development on the 30th June 2020. This chapter has therefore been updated to support the reapplication for a similar development to that originally proposed and to provide additional information to address the previous reasons for refusal of permission.

Site Description

5.4 Aghamore Quarry ("the Site") is located in the townlands of Aghamore Near, Aghamore Far and Carrownamaddoo, approximately 3.5 km south of Sligo Town. The quarry is set in an agricultural landscape with the most common land use in the surrounding area being pasture for grazing animals. There are also a number of industrial type developments in the vicinity of the site.

5.5 The Site comprises two sections, the 'Quarry Area', which relates to the existing quarry extraction area, and the existing aggregate 'Processing Area'. A local road bisects the two areas (see **Figure 5.2**), with the Quarry Area located to the west and the Processing Area to the east of this road.

5.6 The Quarry Area is screened by planted trees at the entrance and a short distance along either side of the access track. The northernmost corner of the Quarry Area is also well vegetated with dense scrub and well-structured field boundaries. The remaining length of the Quarry Area perimeter is delineated by stock proof fencing with occasional semi-mature trees present – refer to Planning Drawing 3. The quarry void is itself largely unvegetated with occasional ruderal species growing sparsely.

5.7 The Processing Area is also surrounded by trees, likely to have been planted, but now many are mature with a developed ground flora. The Processing Area itself, is located on a mix of hardstanding, hardcore stone and other compacted substrates. The made ground consists of inert material, with limited pioneer vegetation species.

Details of the Proposed Development

5.8 The applicants are seeking planning permission for the following development:

- Recommencement of quarry operations within the previously permitted quarry extraction area (c. 10.9ha);

- Deepening of the previously permitted Quarry Area by 2 no. extractive benches from c. -21m OD to -50m OD;
- Recommencement of aggregate processing (crushing and screening) within the existing Processing Area, located to the east of the local road that bisects the site;
- The provision of a settlement lagoon (c. 2,830m2);
- The provision of 2 no. wheelwashes;
- The Provision of a double stacked portacabin office;
- The Provision of a wastewater treatment system;
- Additional stockproof / trespass proof boundary fencing;
- All within an application area of c. 22.5 Ha.

5.9 Upon the cessation of extraction operations, it is proposed to return the worked lands to natural habitat[1] after-uses. Where feasible, restoration of exhausted and redundant areas will be carried out at the earliest opportunity. However, it is envisaged that the majority of restoration proposals will only be carried out after extraction operations at the site have ceased and will be undertaken over a two-year period.

5.10 The proposed development / project is described in more detail in Chapter 2 of the Environmental Impact Assessment Report (EIAR) prepared for this planning application.

Purpose of this Report

5.11 The purpose of this Biodiversity chapter is to describe the baseline ecological conditions at the Site and to identify potential significant effects associated with the proposed project. Where necessary appropriate mitigation measures will be set out to reduce identified effects.

5.12 This chapter forms part of the EIAR that will be submitted with the planning application to assist the competent authority, in this case Sligo County Council, to carry out an Environmental Impact Assessment (EIA) of the proposed project.

Evidence of Technical Competence and Experience

5.13 SLR ecologist Nicola Faulks MCIEEM, CEcol., prepared this chapter and carried out the supporting field surveys in August 2020. Elaine Dromey MCIEEM carried out the technical review of this chapter and the 2017 site surveys for biodiversity. The 2016 site survey was undertaken by Steve Judge (now retired), an Associate Ecologist at SLR Consulting Ireland with 17 years' experience in ecological and environmental consultancy.

5.14 Nicola Faulks holds a BSc in Plant Biology from University of East Anglia and an MSc in Environmental Consultancy from Newcastle University. She is a full and chartered member of the Chartered Institute of Ecology and Environmental Management and has worked as an ecological consultant for 16 years.

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[1] Natural habitat (lake, wetland – nature conservation) as defined by the EPA Environmental Management Guidelines for the Extractive Industry (2006)

5.15 Elaine Dromey holds a BSc in Earth Science from University College Cork and an MSc in Vegetation Survey and Assessment from the University of Reading, UK. She is a full member of the Chartered Institute of Ecology and Environmental Management and has worked as an ecological consultant for 16 years.

Relevant Legislation and Policy

Legislation

5.16 The main pieces of legislation in terms of ecology in regard to developments such as this are as follows;

- The EIA Directive (2014/52/EU)
- The Habitats Directive (92/43/EEC)
- The Wildlife Acts 1976 to 2012
- The Floral (Protection) Order 2015

5.17 The details of these are summarised in **Appendix 5-A:** Relevant legislation and Planning Policy**,** of this report.

Local Policy

5.18 The relevant local planning policies have been extracted from the Volume 1 of Sligo County Development Plan 2017 – 2023 and have been placed in **Appendix 5-A** of this report. These policies are concerned with the protection and/or enhancement the ecology of County Sligo. In broad terms these objectives and policies aim to ensure correct measures are put in place to identify and protect natural heritage and important environmental features within Sligo County.

ADDITIONAL INFORMATION

5.19 As outlined in Chapter 1, a planning application was submitted to Sligo County Council (Plan File Ref. No. 18/345 / ABP Ref. 305821-19) in August 2018 for similar development to that proposed as part of this application. In October 2019 Sligo County Council granted planning permission for the development (subject to 23 no. conditions). 2 no. third party appeals of the decision by Sligo County Council to grant permission for the proposed quarry development were made to An Bord Pleanala (ABP-305821-19). An Bord Pleanala refused permission for the proposed development on the 30th June 2020 for the 2 no. reasons – refer to Chapter 1 for further details.

5.20 In order to comprehensively address the reasons for refusal, and further comments contained within the An Bord Pleanala Inspectors Report a number of additional surveys / site investigations, field work and assessments have been carried out.

5.21 This Chapter 5 of the EIAR has been updated as follows:

- In 2020 a walkover survey was undertaken by Nicola Faulks (MCIEEM) as the application boundary had changed, and the field survey needed to include the Processing Area to the east of the road and to include Aghamore Stream, from upstream of the Site down to Lough Gill where accessible. The site visit also included an updated survey of the Quarry Area, for completeness;
- An additional bat survey was carried out in August 2020;

- An additional breeding bird survey was carried out in May 2021;
- Aquatic Surveys of the Aghamore Stream were carried out in September 2020 and November 2020.

Methodology

5.22 The methods used to carry out the survey of the Site, to determine the ecological value and to prepare the chapter is outlined in this section.

Scope

5.23 The scope of this report is to describe the baseline ecological conditions within the Site and the potential effects that could arise from the proposed development. This report will determine the zone of influence of the development and if important ecological features could be significantly affected. Important ecological features include sites designated for nature conservation, protected habitats and species, as well as habitats and species of principal importance for conservation of biodiversity. An assessment of the effects of the proposed development on these features will be carried out and mitigation measures will be recommended where deemed necessary.

Zone of Influence

5.24 The 'zone of influence' for a project is the area over which ecological features may be subject to significant effects because of the proposed project and associated activities. This is likely to extend beyond the project site, for example where there are ecological or hydrological links beyond the site boundaries. The zone of influence will vary for different ecological features depending on their sensitivity to an environmental change (CIEEM, 2018).

5.25 The Zone of Influence for a project can be identified through a review of the nature of the proposed development, known impacts likely to arise because of the development type, distance from ecologically sensitive sites and the features of interest of sites designated for nature conservation. The desk study carried out for the proposed development includes identification of the potential zone of influence.

5.26 The potential Zone of Influence for a project such as the recommencement of a limestone quarry and processing plant, within a brownfield/existing quarry site is not generally considered likely to extend significantly beyond the Site, largely due to the scale of the project combined with the enclosed and localised nature of the excavation work and the proposed restoration (phased over time where possible). However, the zone of Influence may be increased for this project as there is the potential for impacts on surface water and ground water though aquifers which form an ecological connection to features outside this area, that in the absence of mitigation, may be significantly affected by the proposed development.

5.27 The potential zone of influence has therefore been set at 5 km, the distance beyond which, no hydrological or other effects are anticipated.

Baseline Data Collection

Desk Study

5.28 A desk study was carried out to collate the available existing ecological information on the Site. The Site and the surrounding area were viewed using existing available satellite imagery (Google + Bing 2020).

5.29 The National Parks and Wildlife Service (NPWS 2020) and National Biodiversity Data Centre (NBDC 2020) online resources were accessed for information on sites designated for nature conservation and on protected habitats and species. Only records for the past 15 years are considered within this report as older records are unlikely to still be relevant given their age and the changes in land management that has occurred in the intervening period. Environmental Protection Agency (EPA 2020) Maps was accessed for other environmental information, such as surface water features, relevant to preparation of this report.

5.30 Sligo County Council's website was accessed for information on relevant planning policy while the planning portal (Sligo County Council 2021) was accessed for information on other proposed or permitted developments within the Site and immediate surrounding area.

5.31 Birds of Conservation Concern in Ireland (BoCCI), published by BirdWatch Ireland and the RSPB NI, is a list of priority bird species for conservation action on the island of Ireland. The BoCCI lists birds which breed and/or winter in Ireland and classifies them into three separate lists; Red, Amber and Green; based on the conservation status of the bird and hence their conservation priority. Birds on the Red List are those of highest conservation concern, Amber List are of medium conservation concern and Green List are not considered threatened. The BirdWatch Ireland website (BoCCI 2020) was accessed for information on birds of conservation concern.

5.32 The conservation status of mammals within Ireland and Europe is evaluated using one or more of the following documents - Wildlife Acts (1976 - 2012); the Red List of Terrestrial Mammals (Marnell *et al.*, 2009); and the EU Habitats Directive 92/43/EEC.

5.33 The development design drawings and the project description provided within other chapters of the EIAR also informed the desk study. The chapters of the EIAR reviewed during the desk study include Chapter 7 Water, Chapter 8 Air, Chapter 10 Noise and Chapter 13 Landscape. The Natura Impact Statement prepared for the development was also reviewed during the desk study.

Consultation

5.34 Irish Raptor Survey Group (IRSG) was contacted on 19 September 2017 for records of raptors breeding within or in close proximity to the quarry and extension area. The IRSG responded by email on 19th September 2017. The records provided by the IRSG are discussed later in this report.

5.35 A response was received from the Inland Fisheries Ireland via email on 1st December 2020 (Aisling Donegan – Senior Fisheries Environment Officer). The response reiterated that Aghamore Stream flows into the Lough Gill SAC and so the following impacts relevant to this chapter should be assessed:

- Fish spawning and nursery areas
- Passage of migratory fish
- Biological diversity
- Ecosystem structure and functioning

5.36 The response also stressed that the IFI guidance document "Requirement for the Protection of fisheries habitat during construction and development work" (Inland Fisheries Ireland 2016) should be followed. They also emphasise that there must be no spread of invasive species as a result of the development.

Field Survey(s)

5.37 The fieldwork carried out to inform the preparation of this report is discussed in the following sections. It is worth noting that the initial field surveys were undertaken in 2016 by Steve Judge MCIEEM, the initial site walkover only included the Quarry Area.

5.38 A second site walkover was undertaken in 2018 by Elaine Dromey MCIEEM. The objective of the second site visit was to undertake a walkover survey to better understand the biodiversity of the Site and to determine its ecological value.

5.39 In 2020 a third walkover survey was undertaken by Nicola Faulks (MCIEEM) as the application boundary had changed, and the field survey needed to include the Processing Area to the east of the road and to include Aghamore Stream, from upstream of the Site down to Lough Gill where accessible. The site visit also included an updated survey of the Quarry Area, for completeness.

Walkover Survey

5.40 For the most recent survey, the Site was visited on 10th and 11th August 2020, the walkover survey was carried out by Nicola Faulks. The survey was carried out in dry weather conditions with a light F2[2] breeze. The temperature was ca. 22°C and conditions were generally sunny with cloud cover that varied throughout the days. The objective of the site visit was to walk the whole Site (Quarry and Processing Area) to describe and evaluate if any of the ecological features recorded during the 2016/17 surveys had changed.

5.41 Habitats were identified and classified using '*A Guide to Habitats in Ireland*' (Fossitt, 2000) 2020 visits. The dominant plant species present in each habitat type were recorded. Species nomenclature follows New Flora of the British Isles (Stace 2019) for scientific and English names of vascular plants.

5.42 Incidental sightings or evidence of birds, mammals or amphibians were noted. Trees or structures suitable for bat roosts within the Site and potential suitable bat foraging habitat were also noted and where found, additional surveys were undertaken to assess the bat assemblage and usage of the survey area (undertaken in 2018).

Bat Surveys

5.43 The first daytime bat roost assessment was undertaken in 2017. The habitats present within the Site were evaluated for potential roosting features (PRFs) such as trees with holes and cavities, cracks and splits in major limbs, loose bark, ivy cover and dense epicormic growth, were assessed from the ground and recorded where present. Trees with features suitable for roosting bats were categorised using the criteria set out in Bat Conservation Trust (BCT) Guidelines (Collins, 2016). The habitats present within the Site were also assessed for their potential value to commuting and foraging bat species.

5.44 In 2020, as the Processing Area was included in this assessment, and to more fully understand which species of bat are present in the area and how they may be using the Site, a daytime preliminary roost assessment for bats was undertaken of the Processing Area and adjacent habitat. The assessment again followed the methodology detailed in Collins (2006) and comprised an inspection of all accessible areas (trees, cliffs and buildings) to identify features likely to be used by bats.

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[2] Force 2 on the Beaufort Wind Scale https://www.met.ie/climate/wind.asp [Accessed 24 August 2020]

5.45 The suitability for the habitat to support foraging/commuting bats and connectivity to the wider area was also assessed. In order to provide additional information against which to assess the likely use of the habitats for foraging and commuting a static bat survey was also undertaken.

5.46 Two Anabat Express remote static bat recorders were placed out on the site (Figure 5-2). One was located within the Quarry Area and one in the Processing area. Both detectors were left in place over two nights 10th – 13th August 2020. The night of the 10th - 11th August had heavy rain, however the night of the 12th – 13th was dry warm and with no wind. The results of the remote recording was analysed using the Kaliedoscope Pro software, using automatic recognisers that use an algorithm and a reference library of calls to assign each call a species. The output from the Kaliedoscope Pro software was then manually checked while compiling the results, for quality control purposes.

Bird Survey

5.47 The breeding bird survey was undertaken in May and June 2018 and was timed to target breeding peregrine *Falco peregrinus* and kestrel *Falco tinnunculus* as previous records showed these species have previously breed at Aghamore quarry. The survey method used was followed the guidance set out in Hardy et al (2013).

5.48 The two visits were undertaken two weeks apart during the likely period of late incubation/small young (visit one - May) and presence of small to large unfledged young (visit two - June). During this period adult activity at the site would be expected to be high through provisioning, territorial behaviour and nest protection from predators and thus their detectability would be high.

5.49 An update survey to assess if raptors were breeding within the Quarry Area was undertaken in May 2021. The surveyor used a scope in order to identify if any nesting or likely breeding activity was being undertaken on the quarry cliffs at the time of survey.

Otter survey

5.50 During the 2020 site visit, an otter survey of the Aghamore Stream was undertaken. A non-invasive survey was undertaken in order to negate the need for a survey licence. The surveyor was able to walk the length of the Aghamore Stream (along the banks and in the channel shown on Figure 5.3) in order to search for signs of otter presence. Features which indicate presence include spraints, footprints, holts, slides, direct sightings and lie-ups. During the survey, if fresh evidence of otter had been found, the surveyor would have immediately withdrawn to prevent disturbance.

Aquatic Survey

5.51 A biological assessment of surface water quality was undertaken of Aghamore Stream, in September 2020 and again (at different location points) in November 2020. Both surveys involved sampling predefined sampling points, both upstream and downstream of the effluent discharge point for Aghamore quarry (Figure 5.3). The water quality assessment was undertaken using the benthic macroinvertebrates as bioindicators. A range of physical metrics were recorded at each sample point: average depth, average width, meso-habitat type and substrate characteristics. Chemical characteristics of the water were also measured: dissolved oxygen, temperature, conductivity and pH.

5.52 For the invertebrate sampling, two-minute kick samples and one minute stone wash samples were taken at each monitoring location. The sample nets were emptied and rinsed into a sorting tray for analysis. All macro-invertebrate specimens were isolated and identified to family or genus level in the field. Where individuals were not identifiable in the field, biological samples were taken and preserved in 70% alcohol solutions. These samples were brought to the laboratory for further analysis under a light microscope.

5.53 Identification of specimens was carried out to the level required for the EPA Q-Rating methodology (McGarrigle et al., 2002). Based on the relative abundance of each indicator group, a biotic index (Q Value) was determined based on the biological assessment procedure used by the Environmental Protection Agency (McGarrigle et al., 2002) and European Communities Environmental Objectives (Surface Waters) Regulations 2009 S.I. No. 272 of 2009. The reports are contained within Chapter 7: Water, Appendix 7.5.

Limitations

Desk Study

5.54 Desk study data is unlikely to be exhaustive, especially in respect of species, and is intended mainly to set a context for the study. It is therefore possible that important habitats or protected species not identified during the data search do in fact occur within the vicinity of the site. Interpretation of maps and aerial photography has been carried out using recent imagery, but it has not been possible to verify the accuracy of any statements relating to land use and habitat context outside of the field study area.

Field Survey(s)

5.55 There were no limitations encountered during the field survey. The survey was carried out in suitable weather conditions and during the optimal season for terrestrial habitat surveys (August 2020). All areas of the Site were generally accessible. Exceptions to this were the base of the Quarry Area which was full of water at the time of survey.

5.56 For the survey of Aghamore Stream, the survey was undertaken after a period of relatively dry weather, so footprints and spraint would have been visible above the waterline.

Assessment Approach

5.57 The ecological evaluation and impact assessment approach used in this report is based on Guidelines for Ecological Impact Assessment in the United Kingdom and Ireland ("CIEEM guidelines") (CIEEM, 2018).

Important Ecological Features

5.58 Ecological features can be important for a variety of reasons. Importance may relate, for example, to the quality or extent of the site or habitats therein; habitat and/ or species rarity; the extent to which such habitats and/ or species are threatened throughout their range, or to their rate of decline.

Determining Importance

5.59 The importance of an ecological feature should be considered within a defined geographical context. The following frame of reference has been used in this case, relying on known/ published accounts of distribution and rarity where available, and professional experience:

- International (European);
- National (Ireland);
- County (Sligo)
- Townland (Aghamore Near, Aghamore Far and Carrownamaddoo);
- Local (intermediate area between Site and Townland); and
- Site (the development area).

5.60 The above frame of reference is applied to the ecological features identified during the desk study and surveys to inform this report.

5.61 In assigning a level of value to a species, it is necessary to consider its distribution and status, including a consideration of trends based on available historical records. Examples of relevant lists and criteria include: species of European conservation importance (as listed on Annexes II, IV and V of the Habitats Directive or Annex 1 of the Birds Directive), species protected under the Wildlife Acts 1976 - 2018 and Birds of Conservation Concern (Colhoun & Cummins 2013).

5.62 The approach to impact assessment, as set out in CIEEM guidelines, only requires that ecological features (habitats, species, ecosystems and their functions/processes), that are considered to be important and potentially affected by the proposed development are carried forward to detailed assessment. It is not necessary to carry out detailed assessment of receptors that are sufficiently widespread, unthreatened and resilient to impacts from the proposed development and will remain viable and sustainable.

5.63 For the purposes of this report ecological features of Local importance or greater and/or subject to legal protection have been subject to detailed assessment. Effects on other ecological features are considered unlikely to be significant in legal or policy terms.

Impact Assessment

5.64 The impact assessment process involves the following steps:

- identifying and characterising potential impacts;
- incorporating measures to avoid and mitigate (reduce) these impacts;
- assessing the significance of any residual effects after mitigation;
- identifying appropriate compensation measures to offset significant residual effects (if required); and
- identifying opportunities for ecological enhancement.

5.65 When describing impacts, reference has been made to the following characteristics, as appropriate:

- Positive or negative;
- Extent;
- Magnitude;
- Duration;
- Timing;
- Frequency; and
- Reversibility.

5.66 The impact assessment process considers both direct and indirect impacts: direct ecological impacts are changes that are directly attributable to a defined action, e.g. the physical loss of habitat occupied by a species during the construction process. Indirect ecological impacts are attributable to an action, but which affect ecological resources through effects on an intermediary ecosystem, process or feature, e.g. the creation of roads which cause hydrological changes, which, in the absence of mitigation, could lead to the drying out of wet grassland.

5.67 Consideration of conservation status is important for evaluating the effects of impacts on individual habitats and species and assessing their significance:

- Habitats – conservation status is determined by the sum of the influences acting on the habitat that may affect its extent, structure and functions as well as its distribution and its typical species within a given geographical area.
- Species – conservation status is determined by the sum of influences acting on the species concerned that may affect its abundance and distribution within a given geographical area.

Significant Effects

5.68 The concept of ecological significance is addressed in paragraphs 5.24 through to 5.28 of CIEEM guidelines. Significance is a concept related to the weight that should be attached to effects when decisions are made. For the purpose of EcIA, a 'significant effect' is an effect that either supports or undermines biodiversity conservation objectives for 'important ecological features' or for biodiversity in general. Conservation objectives may be specific (e.g. for a designated site) or broad (e.g. national/local nature conservation policy) or more wide-ranging (enhancement of biodiversity). Effects can be considered significant at a wide range of scales from international to local and the scale of significance of an effect may or may not be the same as the geographic context in which the feature is considered important.

Cumulative Effects

5.69 Cumulative effects can result from individually insignificant but collectively significant actions taking place over a period of time or concentrated in a location. Cumulative effects can occur where a proposed development results in individually insignificant impacts that, when considered in-combination with impacts of other proposed or permitted plans and projects, can result in significant effects.

5.70 Other plans and projects that should be considered when establishing cumulative effects are:

- proposals for which consent has been applied but which are awaiting determination;
- projects which have been granted consent, but which have not yet been started or which have been started but are not yet completed (i.e. under construction);
- proposals which have been refused permission, but which are subject to appeal, and the appeal is undetermined;
- constructed developments whose full environmental effects are not yet felt and therefore cannot be accounted for in the baseline; or
- developments specifically referenced in a National Policy Statement, a National Plan or a Local Plan.

Avoidance, Mitigation, Compensation and Enhancement

5.71 When seeking mitigation or compensation solutions, efforts should be consistent with the geographical scale at which an effect is significant. For example, mitigation and compensation for effects on a species population significant at a county scale should ensure no net loss of the population at a county scale. The relative geographical scale at which the effect is significant will have a bearing on the required outcome which must be achieved.

5.72 Where potentially significant effects have been identified, the mitigation hierarchy has been applied, as recommended in the CIEEM Guidelines. The mitigation hierarchy sets out a sequential approach beginning with the avoidance of impacts where possible, the application of mitigation measures to minimise unavoidable impacts and then compensation for any remaining impacts. Once avoidance and mitigation measures have been applied residual effects are then identified along with any necessary compensation measures, and incorporation of opportunities for enhancement.

5.73 It is important to clearly differentiate between avoidance mitigation, compensation and enhancement and these terms are defined here as follows:

- Avoidance is used where an impact has been avoided, e.g. through changes in scheme design;
- Mitigation is used to refer to measures to reduce or remedy a specific negative impact in situ;
- Compensation describes measures taken to offset residual effects, i.e. where mitigation in situ is not possible; and
- Enhancement is the provision of new benefits for biodiversity that are additional to those provided as part of mitigation or compensation measures, although they can be complementary.

Baseline Ecological Conditions

5.74 This section of the chapter sets out the baseline ecological conditions at the Site using the findings of the desk study and surveys.

Designated Sites

5.75 The sites designated for nature conservation within 5 km of Aghamore Quarry are discussed in the following section. The 5 km radius search area was selected for the Natura Sites due to the hydrological links surface and groundwater, between the Site (Aghamore Stream and Lough Gill SAC, Ballysadare Bay SPA/SAC, Cummeen Strand SPA and Cummeen Strand/Drumcliff Bay). The sites designated for nature conservation found during this search are shown on **Figure 5-1**.

5.76 The quarry at Aghamore Near, Aghamore Far and Carrownamaddoo townlands is not within a site designated for nature conservation or subject to any nature conservation designations. (**Figure 5-1**).

Natura 2000 Sites

5.77 There are seven Natura 2000 sites within 5 km of the boundary of the application area. A summary description of each site is set out below. The information about each site has been downloaded from the NPWS Protected Sites in Ireland Page (NPWS 2020).

Lough Gill SAC (001976)

5.78 Lough Gill SAC, located at its closest point, 365 metres north east from the access track to the Processing Area, or 620 metres north east of the Quarry Area. Lough Gill SAC is described as an important example of a lake which appears to be naturally eutrophic. Quality generally good, though blooms of blue-green algae in recent years indicate some artificial enrichment. Significant areas of alluvial forest occur along the Garvoge River (*Osmunda - Salicetum atrocinerea* type) and at the mouth of the River Bonet (*Carici remotae - Fraxientum* type). Old oak woodland of varying quality is well scattered along the shoreline and on some of the islands and is an important example of this habitat for western Ireland.

5.79 At least six Red Data Book plant species have been recorded from site. Site has three species of lamprey and white clawed crayfish *Austropotamobius pallipes*. The lake and its associated rivers support an important population of Atlantic salmon *Salmo salar*. Otter *Lutra lutra* has a good population within the site. Of minor importance for birds though the site has a small breeding colony of common tern *Sterna hirundo*. A wide range of rare or scarce invertebrates are known from the site, as well as several Red Data Book mammal species, including pine marten *Martes martes*.

5.80 The Aghamore Stream, which flows through the Site, flows into the Lough Gill SAC, so a hydrological linkage exists between the Site and this SAC.

Union Wood SAC (000638)

5.81 This SAC is located 2.79 km to the south west of the site at its closest point. Located on the eastern bank of Ballysadare River, this site consists of fairly pure, open woodland dominated by sessile *oak Quercus petraea*, with some downy birch *Betula pubescens*. The soils of the area are acidic and the ground flora is typical of an acidic woodland. The woodland also supports a diverse fauna including pine marten *Martes martes* and red squirrel *Sciurus vulgaris*.

Ballysadare Bay SAC (000622)

5.82 This SAC is located 3.30 km southwest of the Site. This SAC contains extensive intertidal sand and mud flats, with an extent of approximately 1,500 ha. The mud provides an abundance of food for wildfowl, in the form of colonising plants such as Eelgrass *Zostera marina* and Tasselweed *Ruppia maritima*, as well as numerous species of invertebrates on which both wildfowl and waders feed. Well-developed salt marshes occur at several locations around the bay. There is also a large sand dune system at Strandhill which has been relatively undisturbed by grazers. The dune system is highly dynamic, with the tip of the peninsula actively growing and displaying a good, through limited, example of embryonic dunes.

Ballysadare Bay SPA (004129)

5.83 Located 3.30 km east from the site, Ballysadare Bay SPA and Cummeen Strand SPA form part of the complex of SPA sites in the wider Sligo Bay. The bay contains extensive intertidal sand and mudflats. The flats support good populations of macro-invertebrates which are important food items for wintering waterfowl. The site is of special conservation interest for light-bellied Brent goose, grey plover, dunlin, bar-tailed godwit and redshank.

Unshin River SAC (001898)

5.84 This river-based SAC is located 3.70 km south west of the Site at its closest point. The Unshin River runs from Lough Arrow north to Ballysadare Bay, Co. Sligo. The river is largely undrained and unaltered along much of its course. The marginal vegetation associated with the river is also included in the site, along with other semi-natural habitats adjacent to the river (included in order to enhance its protection). The Unshin River supports an excellent example of floating river vegetation. The diversity of aquatic macrophytes is exceptional, and to a certain extent the unusual combinations and richness of species can be accounted for by the good quality water being discharged from Lough Arrow upstream.

Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC (000627)

5.85 Located 4.41 km north of the Site, this large coastal SAC encompasses two large shallow bays, Drumcliff Bay and Sligo Harbour, and both Ardboline and Horse Island. The dominant habitats on the site are estuaries and intertidal sand and mud flats. Sligo Harbour receives the waters of the Garavogue River, which flows from Lough Gill, while Drumcliff Bay receives the Drumcliff River which flows from Glencar

Lough. At low tide extensive areas of intertidal flats are exposed in both of these sheltered estuarine bays.

5.86 This site is quite diverse, with a range of habitats including, fixed dues, marram dunes, orchid-rich calcareous grassland, juniper scrub and embryonic shifting dunes.

Cummeen Strand SPA

5.87 This site lies 4.80 km north of the Site and is defined by the shallow bay which stretches from Sligo Town, westwards to Coney Island. At low tide, extensive sand and mud flats are exposed. These support a diverse macro-invertebrate fauna which provides the main food supply for the wintering waterfowl. The site is of special conservation interest for the following species: light-bellied Brent goose, oystercatcher and redshank. Cummeen Strand also supports important concentrations of wintering waterfowl.

Natural Heritage Areas and Proposed Natural heritage Areas (pNHA)

5.88 The (p)NHA sites are listed below. Those with the same names as the Natura 2000 sties generally share similar extents/boundaries, habitats and species; therefore, have not been described again in detail.

- Lough Gill pNHA (001976)
- Slieveward Bog NHA (001902) This site is approximately 4.6 km south – west of the quarry at its closest point and is designated for peatlands and is vulnerable to land drainage schemes, overgrazing, afforestation and erosion.
- Ballysadare Bay pNHA (000622)
- Union Wood pNHA (000638)
- Ballygawley Lough pNHA (001909) 2.4 km south – west – a citation for this site could not be found but is assumed to be a natural eutrophic lake with *Magnopotamion* or *Hydracharition* type vegetation, and possibly associated bog woodland.
- Lough Dargan pNHA (001906) is approximately 3.9 km south of the quarry boundary at the closest point. A citation for this site could not be found, but it is assumed to be a natural eutrophic lake with *Magnopotamion* or *Hydracharition* type vegetation, and possibly associated bog woodland.
- Unshin River pNHA (001898)
- Cummeen Strand/Drumcliff Bay pNHA (000627)

Habitats

5.89 Figure 5-2 shows the habitats recorded during the ecological survey carried out on 10th and 11th August 2020. The habitats are discussed in detail below and their ecological importance assessed.

ED3 – Recolonising Bare ground

5.90 Within the Quarry Area and the Processing Area, some areas of bare ground have become colonised by a range of primary colonising species which can survive in either waterlogged or drought conditions. Commonly encountered species included procumbent pearlwort *Sagina procumbens*, bird's foot trefoil *Lotus corniculatus*, ribwort plantain *Plantago lanceolata*, colt's foot *Tussilago farfara*, autumn hawkbit *Leodonton Hispidus* and mouse-ear hawkbit *L. officinarum*. In some areas, such as TN3 and TN12, where revegetation is more than 70% on previously worked areas, commonly occurring limestone grassland species were also found including false oat grass *Arrhenatherum elatius*, fairy flax Linum catharticum, knap weed *Centaurea nigra*, wild carrot *Daucus carota*, oxeye daisy *Leucanthemum vulgare* and carline thistle *Carlina vulgaris*. If left undisturbed, it is likely that these areas would revert to a type of calcareous grassland.

5.91 The species recorded within the ED3 habitat are commonly occurring primary colonising species and are found in a range of habitat types, especially where recent earth movement has taken place or associated with calcareous grasslands. This habitat is relatively common and widespread throughout Ireland especially in quarries, alongside railway lines, and on derelict sites where demolition has taken place. This habitat is evaluated as important at a site level only and so has been scoped out of further consideration in this report.

ED4 – Active Quarry

5.92 Active Quarry is the dominant habitat type within the Quarry Area and can be broadly described as exposed rock faces, stockpiles and bare ground sparsely recolonising with ruderal species. The quarry void also contains standing water (TN 14). This area is largely unvegetated, though since the area has been undisturbed over the last few years, herbs have started to colonise the gravelly areas, with occasional yellow-wort *Blackstonia perfoliate,* common century *Centaurium erythraea*, Euphrasia *Euphrasia spp.* and creeping bent *Agrostis stolonifera* present in areas. Around the edges of the quarry void species such as gorse *Ulex europaeus* and bramble *Rubus fruticosus* agg. are encroaching and re-establishing on areas which were previously worked. Though in most areas, vegetation density was not considered sufficient to map these areas as ED3 – Recolonising Bare Ground.

5.93 The active quarry habitat would be evaluated as important at Site level. The active quarry will continue to operate as previous and is not expected to be significantly affected by the proposal. Active quarry is scoped out of this assessment.

FW1 - Eroding/Upland Rivers

5.94 Aghamore Stream runs south to north adjacent to the Processing Area. The stream is up to two metres wide, with low banks, ranging from none to 1 metre high. Where the stream crosses under the bridge at TN6 the stony stream bed can be seen under the water. Similarly, upstream of TN4 the stony stream bed can also be seen, though here it is often associated with a slow flow and small localised areas of marshy grassland. The riparian corridor which shades the stream for almost its entire surveyed length comprises semi mature trees (discussed later under broadleaved woodland). Only limited instream vegetation was noted, suggesting that this water course is subject to spate flows during periods of high rain fall.

5.95 The stream is not identified as a salmonid river under the European Communities (Quality of Salmonid Waters) Regulations 1988 (SI No.293). It is a typically common and widespread habitat but does provide an ecological corridor linking to the Lough Gill SAC, ~765 m downstream all be it a stream which passes through multiple culverts (Figure 5.3). The river is therefore assessed to be important at a Townland level.

GA1 – Improved Agricultural Grassland

5.96 Areas of improved agricultural grassland are within the Site (Quarry Area). These are mostly present as marginal areas from adjoining farmland. One section of active pasture is present in the south east of the Quarry Area (TN11). As is typical of this species poor habitat this area is dominated by rye grasses *Lolium perenne*. Improved agricultural grasslands are widespread throughout Ireland and within the surrounding landscape. The improved agricultural grassland would be evaluated as important at the Site level. Improved agricultural grassland is scoped out of this assessment.

GA1/GS1 - Improved Agricultural Grassland/Dry Calcareous Grassland

5.97 Two large areas which included a mixture of these two habitats occur on either side of the entry road to the Quarry Area, beyond the planted woodland. This habitat also occurs in areas bordering the existing quarry void e.g. at TN15. This lime rich grassland has a variety of ruderal species such as coltsfoot *Tussilago farafara*. Other species recorded include; red clover *Trifolium pratense,* mouse-eared hawkweed *Hieracium pilosella,* glaucous sedge *Carex flacca,* knapweed *Centaurea nigra,* oatgrass *Arrhenatherum* sp., fairy flax *Linum catharticum,* red fescue *Festuca rubra,* wild carrot *Daucus carota,* creeping bent, oxeye daisy *Leucanthemum vulgare,* wild strawberry *Fragaria vesca* and eyebright *Euphrasia* sp. In some ranker areas species such as soft rush *Juncus effuses,* nettle *Urtica dioica*, gorse and bramble become more common.

5.98 Rougher areas of this habitat are "springier" underfoot with grasses such as red fescue being dominant and cocks-foot *Dactylis glomerata* being frequent and glaucous sedge abundant. An example of this habitat is found south of the Quarry Area entry road. Other species in these rougher areas include coltsfoot, fairy flax, Yorkshire fog *Holcus lanatus*, creeping bent, ragwort *Senecio jacobea*, yellow-wort, bird's-foot trefoil *lotus corniculatus,* crested dog's-tail *Cynosurus cristatusl,* meadow vetchling *Lathyrus pratensis* and wild carrot (e.g. TN16). In these areas, alder *Alnus glutinosa* and willow *Salix sp.* are encroaching in places, as is bramble, which is why TN13 has been classified as scrub, even though it still has elements of calcareous grassland present.

5.99 Close to the Processing Area, adjacent to Aghamore stream, there are some areas of Wet Grassland - GS4, too small to map. TN5 denotes one of these areas which is almost trending into a small area of Marsh – GM1. This habitat which kept moist by the stream and is likely to be subject to temporary periodic flooding during high rainfall events. Species included water mint *Mentha aquatica*, yellow flag *Iris pseudoacorus*, nettle *Urtica doica* wild angelica *Angelica sylvestris*, Yorkshire fog *Holcus lanatus* and jointed rush *Juncus articulatus*.

5.100 The grassland within Aghamore Quarry would be evaluated as important at Site level. It is not expected to be significantly affected by the proposal. This habitat is scoped out of this assessment.

WD1 – Mixed Broadleaf Woodland

5.101 Two areas of young planted mixed broadleaf woodland are present on either side of the Quarry Area entrance. The canopy of these areas is primarily comprised of sycamore *Acer psuedoplatanus*, ash *Fraxinus excelsior*, alder *Alnus glutinosa* and birch *Betula pubescens*. Elder *Sambucus nigra* is also present.

5.102 There is no woodland within the Processing Area boundary, however, adjacent to the Processing Area there is a range of different types of woodland. There is a line of riparian woodland which runs either side of the stream, comprising a range of species including sycamore, hazel, alder willow (grey and goat) and osier.

5.103 At TN9 there is a very wet area of woodland which is too small to map but would likely qualify as WN6 Wet Wood. It comprises tree species alder *Alnus glutinosa,* birch *Betula pendula* and willow *Salix spp.*, with understory species represented by meadow sweet *Fillipendula ulmaria*, jointed rush *Juncus articulatus*, remote sedge *Carex remota*, cleavers *Galium aparine*, mint *Mentha aquatica* and small areas of iris *Iris peeudoacorus* where the tree canopy cover is less dense.

5.104 The woodland at TN7 appears to be quite a semi-mature/mature woodland with tall trees, including holly *Ilex aquifolium*, hazel *Corylus avellana*, oak *Quercus petraea*, ash *Fraxinus excelsior* and alder *Alnus glutinosa.* Some good woodland indicator understory plants such as wood geum *Geum urbanum, herb Robert Geranium robertinium, dog violet Viola spp (*probably canina), opposite leaved golden saxifrage *Chrysosplenium oppositifolium,* enchanter's nightshade *Circaea lutetiana* and thyme leaved speedwell *Veronica serpullifolia,* cuckoo-pint *Arum maculatum* and honeysuckle *Lonicera periclymenum* were also noted.

5.105 A second area of more mature woodland is located at TN2, where the woodland has an understory dominated by ferns, the dominant species here is considered likely to be lady fern *Athyrium filix-femina*. The canopy is formed by mature sycamore *Acer pseudoplatanus,* alder *Alnus glutinosa*, oak *Quercus spp.* and hazel *Corylus avellana.*

5.106 The woodland habitat at Aghamore Quarry would be evaluated as important at local level as it does not form extended habitat corridors, and only limited areas are mature and established, the majority being situated outside of the Processing and Quarry Areas. The woodland inside the Quarry Area is plantation woodland and more recently planted. This habitat will not be significantly affected by the proposed works; therefore this habitat is scoped out of this assessment.

WL1 – Hedgerows

5.107 Numerous hedgerows are present along the perimeter of the Quarry Area. Combined these have an approximate length of 890 m. There are some trees present within the hedgerows, but overall, they are typically low in species diversity. The hedgerow comprising a field boundary to the north of the Quarry Area is noted as being dense with hawthorn *Crataegus monogyna*, ivy *Hedera Hibernica*, elder, bramble and other woody species.

5.108 Other hedgerows share this typical species composition but are less well-structured having been severely cut and managed. Other species noted within the hedgerows bordering the Site include blackthorn *Prunus spinosa*, gorse, holly *Ilex aquifolium*, bramble, crab apple *Malus sylvestris* and sycamore.

5.109 The hedgerow habitat at the Site would be evaluated as important at Site level. There will be no reduction of hedgerows as part of this project. This habitat will not be significantly affected by this proposal. Hedgerow habitat is scoped out of this assessment.

WS1 – Scrub

5.110 Within the Quarry Area, some sections of hedgerow along the perimeter have gone unmanaged and has widened into scrub. Other areas, such as that denoted by TN13, have become disused since the previous period of quarrying activity and scrub has encroached over the area. These areas of scrub share a similar species composition with the hedgerows discussed above but are dominated by bramble and gorse.

5.111 The largest area that has been attributed as scrub is located in the south of the Processing Area (TN3). This area comprises mounds of hardened concrete returns from historical operations and areas where pockets of soil or gravel are present, scrub species have begun to grow. The category WS1 covers the areas where native species such as gorse, silver birch, bramble and abundant willow species grow. However, buddleja *Buddleja davidii* has begun to colonise the area too, with this species making up to 50% of the scrub species in some areas. Over time, this area is likely to trend towards becoming WS3 – Ornamental Non-native Scrub. Between the piles of concrete returns are flatter areas, these have been classified as ED3 – recolonising bare ground; again, over time, these areas are also likely to become WS1/WS3 -Scrub.

5.112 The scrub habitat at Aghamore would be evaluated as important at Site level. The proposed works will not significantly affect this habitat. Scrub habitat is scoped out of this assessment.

WL2 – Treeline

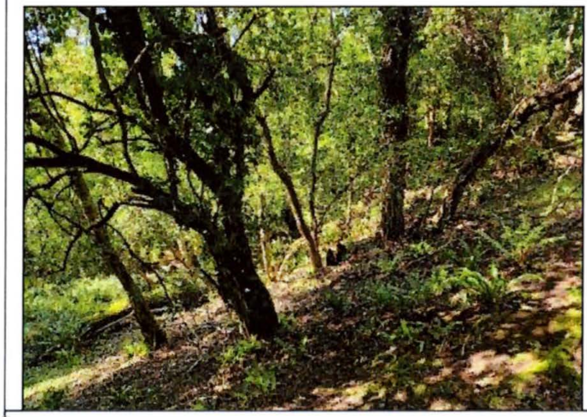
5.113 There are sections of treelines around the boundary of the south and west of the Quarry Area. The small section of treeline on the western border of the site consists of semi-mature ash *Fraxinus excelsior* and sycamore outside of the fence line that comprises the boundary. The longer treeline on the southern boundary contains semi-mature species dominated by sycamore and also occasional beech *Fagus sylvatica*. These sections of treelines are positioned within the hedgerows which are described above. There is approximately 265 m of treelines within the Site.

5.114 The trees present within the treelines are commonly occurring and widespread throughout Ireland and the surrounding areas. The treelines would be evaluated as important at the Site level. It is not proposed to reduce the length of treelines within the Site as part of this project. Treelines will not the significantly affected by the proposed works. Treelines can be scoped out of this assessment.

Photograph 5-1 The Quarry Area with sparse vegetation and water in the bottom.

Photograph 5-2 The stream adjacent to the Processing Area, this is the culvert at TN 6.

Photograph 5-3 Mature woodland at TN 7, adjacent to the Processing Area.



Photograph 5-4 Common spotted orchid in one of the grassier areas adjacent to the Quarry Area (TN 15).

Photograph 5-5 Revegetating bare ground to the south of the Processing Area with recolonization of vegetation.

Photograph 5-6 Bare ground within the Processing Area with limited recolonization of vegetation.

Faunal Species

Desk Study Results

5.115 The NBDC database was searched for records of rare and/or protected species from the 2 km grid squares G6931, G6392, G7031 and G7032 within which the Site is located. Only records for the past 15 years are considered within this report as older records are unlikely to still be relevant given their age and the changes in land management that has occurred in the intervening period. The records returned are presented in **Table 5-1** below.

5.116 The absence of recent (within 15 years) records of species from the NBDC database does not necessarily imply that a species does not occur within the search area, rather that it has not formally been recorded as present.

Table 5-1 Rare and/or Protected Species Previously Recorded in Grid Squares G6931, G 6932, G7031 and G7032

Species recorded	Grid Square	Date of last record	No. of records	Protected / Conservation Status
West European Hedgehog *Erinaceus europaeus*	G6932	22/03/2011	Wildlife Acts 1976 - 2012	NBDC Atlas of Mammals in Ireland 2010-2015
Eurasian badger *Meles meles*	G6931	20/10/2007	Wildlife Acts 1976 - 2012	NBDC Atlas of Mammals in Ireland 2010-2015
Red squirrel *Sciurus vulgaris*	G7032	07/12/2013	Wildlife Acts 1976 - 2012	NBDC Atlas of Mammals in Ireland 2010-2015
Soprano pipistrelle *Pipistrellus pygmaeus*	G7032	30/07/2007	Wildlife Acts 1976 – 2012 Habitats Directive: Annex IV	NBDC National Bat Database of Ireland

5.117 Table 5-1 provides records generated from NBDC which include protected species such as hedgehog, badger, red squirrel and soprano pipistrelle, all of which are protected under the Wildlife Acts 1976 – 2012, pine marten is protected under both the Wildlife Acts 1976 – 2012 and the Habitats Directive. Hedgehog, badger and pine marten are listed as of "least concern" in the most recent Red List for terrestrial mammals in Ireland, red squirrel is considered near threatened.

Amphibians

5.118 During the survey in 2020 frogs were noted in the artificial pond at TN4 Adjacent to the Processing Area. The flooded area within the base of the Quarry Area was not considered suitable for frog or smooth newt, as it has generally steep inaccessible sides, and is devoid of vegetation (used by smooth newt for egg laying). The size and likely fluctuating water levels of the quarry makes it sub-optimal for amphibians.

5.119 The proposed project Site itself does not contain any ponds suitable for breeding amphibians, so the proposed works are not likely to result in effect to the local amphibian population. Amphibians are therefore scoped out and not considered further in this report.

Birds

5.120 The IRSG was contacted with respect to records of breeding raptors within or in close proximity to the Site. The IRSG confirmed that peregrine falcon had nested in 2017 within the area[3] within which the quarry is located. The Site has regularly held breeding peregrine and kestrel in previous years and in addition supports a regular pair of nesting raven.

5.121 A raptor survey was carried out over two days on the Site (RFI report is located in Appendix 5-C). This survey determined that peregrine have not nested successfully at the Site during 2018, a single adult and subadult were observed during the survey perching within the quarry. The behaviour observed was highly indicative of non-breeding use of the Site. Kestrels were recorded on both days of survey and behaviour indicative of likely nesting were observed. These included prolonged sightings of courtship behaviour of at least one pair and in addition up to five subadults. Copulation and food provisioning was observed between the adult pair which are occupying a used ravens nest on the southern face of the quarry. On the second site survey, two weeks after the first visit, a kestrel pair was observed in the north-eastern corner of the quarry. This area also contained an overhang and obvious "whitewashed" perch area. This strongly indicated an occupied site.

5.122 Incidental observations during this survey included a pair of breeding ravens nesting on the southern quarry face. Two grey wagtails *Motacilla cinereal* displaying breeding behaviour, a single common sandpiper *Actitis hypoleucos* and two non-breeding choughs *Pyrrhocorax* were also observed.

5.123 Breeding grey wagtails are red listed within the Birds of Conversation Concern in Ireland (BoCCI) (Coulhoun & Cummins, 2013). Kestrel is amber listed as is common sandpiper and chough. Peregrine and raven are both green listed species.

5.124 An update breeding bird survey was undertaken on the 26 and 27th May 2021, which confirmed that there is a breeding pair of peregrine in the Quarry Area, south-eastern face. Three chicks were counted in the nest. The 2021 survey showed no signs of kestrel nesting in the quarry, but a pair were noted during the survey.

5.125 Grey wagtail and kestrel breeding within the Site would be evaluated as important at the Townland level.

Mammals

Bats

5.126 The initial desk study and daytime evaluation of habitat in respect of bats, undertaken in September 2017, found that Site is not close to any internationally or nationally designated sites for bats (the RFI bat report in Appendix 5-B provides more detail of this initial survey). In summary, the quarry void comprised largely unvegetated bare limestone faces and there are only small areas of immature woodland and scrub around the southern and western perimeter of the Quarry Area. The quarry habitats were evaluated as having negligible suitability for roosting and commuting and foraging bats.

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[3] Exact grid references are confidential and not provided within this report due to concerns about persecution. IRSG can be contacted directly to verify the location of the peregrine nest site.

5.127 The semi-mature plantation woodland at the entrance to the Quarry Area, was assessed not likely to provide any potential roost features and is evaluated as having negligible suitability. The plantation is considered to offer low suitability for foraging and commuting bats as it is poorly connected to suitable continuous habitat within the Quarry Area boundary and outwith the Site to the north and east.

5.128 In addition to the negligible – low suitability of the habitats within the Quarry Area for foraging and commuting bats there is also poor landscape connectivity to suitable roosting and foraging and commuting habitats in the wider countryside i.e. beyond the redline planning application boundary.

5.129 A second daytime evaluation of habitats in respect of bats was also undertaken in August 2020. The Quarry Area was found to comprise of quite a dense stone, with very limited crack lines. During the site walkover, using binoculars, no suitable bat roosting habitat was noted within the bare rock faces. In confirmation of the 2017 surveys, one of the trees within the Quarry Area appeared to provide potential bat roost features (cracks, woodpecker holes etc) as the trees are generally immature. With regards to foraging, the quarry itself will likely provide limited foraging habitat as it provides shelter, and the rock warmth (after a sunny day) which will attract insects. The tree lined entrance to the Quarry Area will provide limited sheltered foraging habitat for a range of bat species.

5.130 The Processing Area has a number of buildings on it, standing on made ground. These open areas, with sheet metal storage style buildings provide negligible suitable bat roosting habitat, and likely only foraging on calm nights over the open areas. The vegetated habitats, within the Processing Area will provide suitable foraging habitat for bats; especially on the edge habitats between grassland, scrub and woodland. With regards to roosting, only the more mature woodland (TN7), which is located outside of the Processing Area, was considered to contain trees that may provide potential roost features for bats. Some rot holes, broken limbs, lose bark were noted.

5.131 During the August 2020 site visit, two Anabat Express detectors were left in the field to record over night. One was placed in the Processing Area, close to TN6, the second detector was placed in the Quarry Area, at the base of a small cliff to the north of TN 13. The detectors were left out for two full nights, as during the first night of recording there was heavy rain. The second night was warm 12°C with no rain and wind of F2-3. The results are as follows:

5.132 The following species were recorded within the Site:

- *Myotis Daubentonii* – Daubenton's bat
- *Myotis Nattereri* – Natterer's bat
- *Nyctalus leisleri* – Leisler's bat
- *Pipistrellus pygmaeus* – Soprano pipistrelle
- *Pipistrellus pipistrellus* – Common pipistrelle
- *Pipistrellus nathusii* – Nathusius' pipistrelle
- *Plecotus auratus* – Brown long-eared bat

5.133 The seven species that have been identified are all resident bat species within Ireland. The majority of the species identified are widespread and common, however the Natterer's bat is one of the rarer species, and so too is the Nathusius pipistrelle. This is reflected in the records for these species.

5.134 The detector located in the Quarry Area recorded 145 bat pass files, 81 were attributed to soprano pipistrelle and 16 to common pipistrelle. Eleven bat passes were attributed to Daubenton's bat, and 14 to Leisler's bats. 23 bat passes appeared to have been made by brown long eared bats. No Natterers or Nathusius' bats were recorded at this location. The Processing Area recorded was placed close to the access track, surrounded by semi mature woodland associated with the stream. Here 223 bat pass files were recorded. Of these, 201 were made up of common and soprano pipistrelle. Ten bat passes were attributed to Daubenton's bat and ten to Leisler's bat. One potential Natterer's bat pass was recorded, and one potential Nathuisus' pipistrelle bat pass was recorded. The calls are termed as "potential records", as the parameters for bat calls can overlap, so it is often difficult to definitively identify some calls to species level, however on the balance of probability it is considered that these species were present, if only briefly.

5.135 The two bat recorders also picked up a range of bat social calls, suggesting that young bats were flying with their mothers at the time. In addition to this, calls were recorded for all species within an hour of sunset, suggesting that they are roosting in the area, though not necessarily within the Site. A number of potential bat roosts are present in the wider area, such as farmhouses, barns and large mature trees with rot holes.

5.136 The Site itself (Processing Area and Quarry Area) is considered to provide negligible bat roosting potential, due to lack of suitable potential bat roost features. The Site does provide foraging habitat for bats; though the foraging habitat within the Site is common and widespread throughout the region – hedgerows, field edges and tree lined roads. All bat species in Ireland are protected under the Annex IV of EU Habitats Directive, which is transposed into Irish law through the EC (Birds and Natural Habitats) Regulations 2011. All bat species are also protected under the Wildlife Acts 1976 - 2018. The Site is evaluated to be of local value for foraging bat species.

Badger

5.137 Badger has been historically recorded across the local area. During the 2016 and 2017 survey no signs of badger were noted within the Quarry Area. During the 2020 survey, tracks and a hole were noted. However, due to the prints and signs of recent kill that were found, it is considered most likely that the hole belonged to a fox. Fox scat was also noted around the quarry rim. No signs of badger dung, snuffle holes or prints were noted.

5.138 Badger *Meles meles* is legally protected under the Wildlife Acts 1976 – 2018. The Site does provide suitable habitat for both setts and foraging, though during the three site surveys (2016, 2017 and 2020) no, signs of badger presence have been noted within the Site. It is therefore considered that at the current time badger are not present within the Site. Therefore, they have been scoped out for further assessment.

Otter

5.139 During the 2020 survey, no signs of otter spraint, prints, holes or lie-ups were noted on the stream adjacent to the Processing Area. The stream flows into the Lough Gill SAC (700 metres downstream) which of which otter is a qualifying interest. However, between the Site and Lough Gill, the stream passes through a number of culverted sections, one of which is over 80 m long (Figure 5.3). It is considered that the length of these culverted sections is likely to deter otter from using this stream on a regular basis. The stream is narrow (2 m wide) and quite shallow so would not support permanent otter presence, due to lack of food source such as fish, though a limited source of common frog may be available.

5.140 Otter in Ireland are protected under the Annex II and IV of EU Habitats Directive, which is transposed into Irish law through the EC (Birds and Natural Habitats) Regulations 2011. Otter is also protected under the Wildlife Acts 1976 - 2018. The stream is considered not to support an otter population, due in part to accessibility but also lack of foraging provision; therefore, otter have been scoped out of this assessment.

Other Mammals

5.141 Pine marten was recorded during the raptor surveys carried out at the site. It was observed in an area close to an overhang in the northeast corner of the Quarry Area, which was deemed to be a likely kestrel nesting sight. A pine marten latrine was also recorded in this same area during the second site visit (June 2018). The population of pine martens is thought to be increasing in Ireland after a long period of decline. The species status is regarded as being of "least concern" Woodland and scrub habitats are favoured, such as those surrounding but outside of the Processing Area but use of mature gardens has also been observed. They are known to den in hallow trees, burrows, brash and buildings. Persecution, habitat loss and fragmentation are threats to this species.

5.142 Other mammals, or their tracks and signs, were not observed during the site visits in 2016, 2017 and 2020.

5.143 The populations of other mammals would be evaluated as important at the Site level. They are not considered likely to be significantly affected by the proposal and are therefore scoped out of this assessment.

Aquatic Surveys

5.144 The results of the September 2020 aquatic survey, undertaken at two sample points above and below the quarry effluent outflow pipe (Figure 5.3), found that the water in the stream was relatively moderate flowing, clean and with little instream vegetation and similar water chemistries. At both locations the substrate was classified as gravel, sand and cobbles. A range of benthic invertebrates were found at each location, from seven orders/groups, belonging to ten families.

5.145 The determined Q Values for both locations surveyed in September 2020 were classified as being 3 – 4 which is described as slightly polluted water. The assemblage of invertebrates found upstream was slightly more diverse, but of a lower abundance than that found downstream, but the variation was not sufficient to affect the Q values that were determined. Specimens of the genus *Gammarus,* were by far the most common organisms present, followed by molluscs and caddis flies.

5.146 Additional macroinvertebrate surveys were undertaken in November 2020, and included five survey points, from upstream of the Processing Area, to an accessible point, close to the confluence with Lough Gill (Figure 5.3). At all points the substrates within Aghamore stream were found to be relatively clean with cobbles and or coarse gravel available for invertebrates. Flow velocity was higher at the downstream sites, and oxygen levels were within normal ranges at all locations (>6.5-8mg/l).

5.147 The results of the November 2020 surveys found that the macroinvertebrate assemblage indicated a Q value of 3, moderately polluted water at all locations. The assemblage did not vary significantly between sampling locations. The number of taxa present, and their diversity is likely to be limited due to the time of year. Optimal time for survey is April – September; so, a November survey is likely to have depressed the results. That said, based on the September surveys (which used 2 similar survey point locations); it is considered likely that the Q value along the length of the surveyed river is 3-4 when seasonal variation is considered – slightly polluted water.

5.148 The Q value applied is the same upstream and downstream of the yard drainage and the quarry effluent discharge, therefore it can be inferred that the emissions currently occurring from the yard and quarry are not having a deleterious effect on the macroinvertebrate fauna in the Aghamore Stream.

5.149 The Aghamore Stream is not identified as a salmonid river under the European Communities (Quality of Salmonid Waters) Regulations 1988 (SI No.293). The stream, as shown on Figure 5.3 flows south to north, adjacent to the Processing Area, and on into Lough Gill.

5.150 Between the Processing Area and the outflow of Aghamore stream into Lough Gill (approximately 765 metres), the stream flows under and number of culverts and pipes. Each culvert and each pipe will change the flow regime of the water and is likely to act to hinder salmonoid movement (Figure 5.3).

Photograph 5 -7 The culvert under the bridge leading to the Processing Area (TN6)

5.151 Figure 5.3 shows that north of the Processing Area, the Aghamore stream passes under the road and into a culvert. This culvert is over 80 metres long and is totally dark, due to its length. Due to the length of this culvert and the fact that it is unlit, it is considered that it will act as a barrier to fish migration. Studies have shown that culverts and weirs do disrupt fish migration and movement, including trout and salmon (WTT 2021). Therefore, if salmonid fish present in Lough Gill are migrating, they would be unlikely to swim up in to the Aghamore stream to spawn, as too many barriers are present in the form of culverts and pipes.

Invasive Species

5.152 During the site survey a stand of Japanese knotweed *Fallopia japonica* was recorded to the south of the Processing Area, in two small stands (Figure 5.2 TN1). It was not recorded elsewhere on the site. Cotoneaster *Cotoneaster spp.* was also recorded outwith but adjacent to the Processing Area. This plant, especially if it is the species *Cotoneaster horizontalis,* can become quite invasive, especially on the walls of quarries. Neither species was recorded within the Site, however mitigation for these species will be included in the next section in order to prevent future (accidental) spread.

5.153 American mink Mustela vison and feral goat *Capra hircus* have been recorded within 1 km^2 grid square in which the site is located. There were no invasive species recorded within the Site during the field surveys. Invasive faunal species can be scoped out of further consideration within this report as they are not known from the Site.

Summary of Important Ecological Features

5.154 Table 5-2 summarises all important ecological features for which detailed assessment is required. The geographical scale of importance for the ecological features within the Site are summarised along with their legal status and a rationale, where appropriate, for not carrying forward any features for detailed assessment. None of the European Designated sites have been brought forward for further assessment as they have been subject to an Appropriate Assessment Screening and Natura Impact Statement Report (SLR 2021).

Table 5-2 Summary of Important Ecological Features Subject to Detailed Assessment

Ecological Feature		Scale of importance	Comments on Legal Status and/or Importance
Habitats	FW1 – Eroding/upland rivers	Townland	Referenced in several policies, objectives and goals of Kildare County Development plan.
Species	Birds	Townland	Wildlife Acts 1976 – 2018 confers protection on breeding birds. Referenced also in several policies, objectives and goals of Kildare County Development Plan relating to protected habitats and species. One red and one amber listed species found breeding within the Quarry Area
	Bats	Local	Wildlife Acts 1976 – 2018 and Annex IV of the Habitats Directive, confers protection on all Irish bat species and their roosts. Bats are directly and indirectly referenced in several policies and objectives of Sligo County Development plan.
	Pine marten	Local	Wildlife Acts 1976 – 2018 and Annex confers protection on pine marten. It is an offence, except under licence to capture or to kill a pine marten, or to destroy or disturb its breeding or resting place. From being nearly extinct in Ireland, its population levels have recovered, a recent survey suggesting that a population of about 4,000 animals now exists within the country.

Detailed Project Description

Operational Phase

5.155 The applicants are seeking planning permission for the following development:

- Recommencement of quarry operations within the previously permitted quarry extraction area (c. 10.9ha);
- Deepening of the previously permitted Quarry Area by 2 no. extractive benches from c. -21m OD to -50m OD;
- Recommencement of aggregate processing (crushing and screening) within the existing Processing Area, located to the east of the local road that bisects the site;
- The provision of a settlement lagoon (c. 2,830m^2);

- The provision of 2 no. wheelwashes;
- The Provision of a double stacked portacabin office;
- The Provision of a wastewater treatment system;
- Additional stockproof / trespass proof boundary fencing;
- All within an application area of c. 22.5 Ha.

5.156 The quarry operations will comprise extraction of limestone using conventional blasting techniques; processing (crushing and screening) of the fragmented rock to produce aggregates for use in the manufacture of value-added products, road construction and site development works.

5.157 Material extracted from the Quarry Area will initially be processed within the quarry void using mobile processing plant. Material will then be transported to the existing Processing Area located on the opposite side of the local road. The lorries which will transport the material between the Quarry Area and the Processing Area may pass through two no. wheel washes, one within the Quarry Area and one just before the weigh bridge in the Processing Area. Both wheel wash systems will be closed systems, so will not discharge as surface water to nearby watercourses.

5.158 Existing facilities at the site include the weighbridge & weighbridge office and a garage / workshop. These facilities are located within the Processing Area on the eastern part of the application site.

5.159 A settlement lagoon of c. 2,830m^3 will be created in advance of quarrying activities recommencing at the site to treat surface water pumped from the quarry floor before being discharged in to the Aghamore stream. During the construction of the lagoon, the pumping of a combination of rainwater and groundwater from the quarry floor directly to the Aghamore stream will continue as presently occurs. The settlement lagoon will have a water depth of 1.5m and a minimum freeboard of 0.5m. The settlement lagoon will be lined to prevent leakage. Interceptors will be installed close to areas of potential risk such as the fuel storage area and refuelling station to reduce the risk of a pollution incident occurring. The discharge point from the settlement lagoon will remain at the current location into Aghamore stream. The predicted inflow rate will remain within below the maximum discharge rate set out in the existing trade effluent discharge licence to Aghamore stream (40.5l/s).

Restoration and Aftercare Phase

5.160 A Landscape Mitigation and Restoration Plan is provided in Chapter 2 of the EIAR. Landscaping during operation and post – operation will include hedgerow and woodland gapping-up with native species where appropriate, and aftercare management to encourage dense, well-structured hedgerows and woodland throughout.

5.161 It is proposed that restoration of the Site would be carried out once extraction activities have ceased. The full details of the proposed restoration are included in the Landscape Mitigation and Restoration Plan provided in Chapter 2 of the EIAR.

5.162 The cliff faces in the quarry that are used by breeding raptors will be allowed to remain undisturbed at all times during the bird breeding season and following restoration of the site.

Assessment of Effects and Mitigation Measures

5.163 This section sets out the potential impacts and their effects on important ecological features. The information available from the desk study and fieldwork has been used to identify impacts and the significant effects including positive, negative, direct, indirect and cumulative effects. The following design principles and "designed-in" mitigation have informed the assessment of impacts.

- Within the design of the proposal good practice environmental and pollution control measures are employed with regard to current best practice guidance such as, but not limited to, the following:
    - EPA Environmental Management Guidelines (2006): Environmental Management in the Extractive Industry (Non-Scheduled Minerals);
    - Environmental Good Practice on-site Guide (CIRIA, 2015); and
    - DoEHLG (Department of the Environment, Heritage and Local Government) April 2004: Quarries and Ancillary Activities Guidelines for Planning Authorities.
- Landscaping measures are proposed within the design of the development. These are listed in full in **Chapter 13** of the EIAR and include features to minimise loss of biodiversity on-site. Such measures include the following:
    - Landscaping during and post-operation, will include hedgerow and woodland gapping-up with native species where appropriate, and aftercare management to encourage dense, well-structured hedgerows and woodland throughout.

5.164 Taking the above into account, the potential impacts of the proposed development are outlined in the following sections.

Do Nothing Impact

5.165 The existing quarry, as permitted, would be restored in line with the conditions associated with the existing permission. The Do-Nothing Impact would result in moderate significant positive change in the ecological interest of the Site should the quarry not recommence operations and restoration takes place.

Potential Impacts

Eroding/upland rivers - FW1

5.166 The recommencement of the extraction of limestone from the Quarry Area, and its transport over to the Processing Area, will not result in any direct loss, damage or fragmentation of the stream, or its riparian corridor. The Processing Area has also been designed to have a standoff of 25 metres from the stream, in order to reduce disturbance (noise and light) of the stream and associated riparian corridor.

5.167 Surface water run-off from the Processing Area will continue to percolate to ground. Chapter 7: Water studies have found that the processing area is located on a sand/gravel deposit of >10m deep, so this will aid with water percolation and should enable any suspended solids to be filtered by the ground.

5.168 As noted previously the floor of the Quarry Area is currently filled with water, this is because the floor of the quarry (at -21 m OD) sits below the level of the water table which likely sits between -11m and -16m OD. During the operational phase, the quarry will be deepened to -50 m OD. To undertake quarry works, water will need to be pumped out of the quarry floor, to allow dry working. The water will be pumped out at varying rates depending on surface water conditions (ground water inflows to the quarry at final floor level of -50m OD would be 12.2l/s). Storm water will be pumped into the settlement lagoon, prior to being discharged into Aghamore stream, so will contain only a very low level of particulate matter on being discharged in to Aghamore stream. The lagoon will allow for a discharge rate of 28.3l/s, based on the proposed surface area of 2,830m^2.

5.169 A channel survey was carried out along the Aghamore Stream as part of this assessment from the quarry discharge point to Lough Gill. It was estimated that the peak flow for Aghamore stream at the quarry discharge point is approximately 500-800l/s, a flow rate which would occur during high rain fall events. Chapter 7: Water, also states that in summer months Aghamore stream is likely to dry up, or at least be partially ephemeral. Based on this, the stream can be described as a spate stream, a watercourse which experiences a wide range of flow rates over the year. Because of this it is anticipated that the proposed discharge rate in to Aghamore stream from the settlement lagoon is unlikely to have any significant impact on the stream habitats. A constant discharge from the settlement lagoon may even be beneficial for the stream and it will provide a constant flow of water, even during dry summer periods when the stream may have otherwise dried up.

5.170 Within Chapter 7: Water, the impact assessment section also assesses the potential for surface water discharge to impact on water quality. The study found that levels of ammonia and orthophosphate discharged currently from the quarry sump, would cause a negligible change to the existing background water levels in Loch Gill, downstream of the site. It is also worth noting that the concentrations of faecal bacteria in the quarry discharge water are lower than background levels. This is anticipated to remain so, even during the operational phase of the Project.

Proposed Mitigation Measures

5.171 Besides the design mitigation (the settlement lagoon and hydrocarbon interceptors) Chapter 7: Water sets out a range of mitigation measures which indirectly will benefit biodiversity, such as ongoing monitoring of water quality; managing runoff and preventing spills.

Significance of Residual Effects

5.172 Following the implementation of design and onsite mitigation measures, as fully described in Chapter 7: Water, the residual effect on Aghamore stream would not be significant.

Birds

Potential Impacts

5.173 Peregrine falcon is known to regularly nest on the faces within the quarry void. The raptor survey carried out as part of this project, determined that successful breeding of peregrine falcon did not occur at the Site, within the Quarry Area in 2018. The update survey undertaken in May 2021 identified a single pair of peregrine nesting in the Quarry Area, with three chicks in the nest. In 2018, Kestrel was observed nesting within a worked-out section of the quarry but were not present in 2021. Raptors are evaluated as important at the townland level.

5.174 There is no proposal to alter areas of the worked-out quarry faces as the project is concerned with deepening the existing quarry floor only, with no lateral extension proposed. However, quarrying activities which have not occurred on this site in the last number of years, such as blasting, may indirectly impact breeding raptors through noise and vibration disturbance. The operation of the quarry, including deepening, may potentially give rise to negative effects on breeding raptors in the absence of mitigation.

5.175 A pair of grey wagtails, a red listed species, were observed showing breeding behaviour in the Site. Common sandpiper and chough, amber listed species, were also observed in low numbers but showed no breeding behaviour.

5.176 Grey wagtail is evaluated as important at the townland level while common sandpiper and chough are evaluated as important as the site level. Changes to the existing environment used by grey wagtails are not proposed. However, quarrying activities which have not occurred on this site since 2014, such as blasting, may indirectly impact this species breeding through noise and vibration disturbance. The operation of the quarry, including deepening, may potentially give rise to negative effects on breeding grey wagtail.

Proposed Mitigation Measures

5.177 During operation, the cliff faces / rocky ledges currently used by raptor species within exhausted / worked out areas of the quarry will be retained. The haul road will pass beneath the current Peregrine nesting ledge but will lie 30 metres beneath it. Where possible, this haul road should be constructed after the 2021 chicks have fledged, but prior to the 2022 nesting season. So, if a peregrine does nest there, it can habituate to the already active haul road; rather than haul road use suddenly beginning within the nesting period, which could cause nest abandonment.

5.178 Additional mitigation measures would involve the environmental manager and site supervisor/manager providing a toolbox talk on peregrine falcon for all Site staff, including all new staff joining, over the lifetime of the operation. The toolbox talk will set out clearly how to identify the species and the importance of reporting any sightings to the environmental manager and site supervisor/manager.

5.179 From 2022 onwards, during operation, a peregrine survey should be undertaken three times per year by an ornithologist. The surveys would be undertaken:

- Early March to mid-April to identify newly occupied sites;
- Late April to end of May to identify newly occupied sites and confirm occupancy or absence at previously known nest location; and
- Early June to mid-July to record the likely breeding success or failure, and/or to confirm absence at the previously known nest location.

5.180 If peregrine falcon is confirmed to be attempting to breed or is successfully breeding within the Quarry Area, a peregrine falcon management plan will be prepared to prevent disturbance until chicks have fledged. The plan will take in to account the working methodologies used in the quarry at the time, and the proposed blasting strategy during the nesting period. Measures to protect the nesting birds are likely to include the implementation of an appropriate buffer zone around the nest site and the restriction of certain activities within the buffer zone to prevent disturbance of the nesting pair. As the peregrine surveys will be undertaken annually, the peregrine falcon management plan can be updated accordingly. So in years where no nesting takes place, then activities within the Quarry Area would not be subject to regulation for peregrine presence.

5.181 The grey wagtail will also be included in a breeding bird survey of the Site prior to the recommencement of quarrying activities should the proposal be accepted. If this species is observed nesting and/or breeding on the Site, then site specific mitigation will be developed as part of the reporting of the survey which will reduce any potential negative effects on this species to an acceptable level.

5.182 The amber listed species observed during surveys, i.e. common sandpiper and chough, were seen within suitable habitat and flying over the Site respectively. These species will also be included within the breeding bird survey.

Significance of Residual Effects.

5.183 Following the implementation of species-specific mitigation measures where and if required, the residual effect on the bird assemblage within the Site would not be significant.

Bats (All Species)

Potential Impacts

5.184 The current proposals do not involve the removal of any hedgerows or trees. The Quarry Area was found not to provide suitable crevices or cracks for roosting bats. Therefore, no potential roosting habitat will be removed because of the quarrying and processing activities.

5.185 Bats are using the Site for foraging, therefore noise and light generated at night-time, may disturb foraging bats. In accordance with condition 14 (b) of the previous planning permission quarry operations will be carried out between 0800 – 1800 hrs Monday to Friday: and from 09.00 – 17.00 hrs Saturday. The quarry will not operate on Sundays or Bank Holidays, except in emergency situations. Therefore, predominantly during the bat active period (March to October) quarrying and processing activities, will be undertaken during hours of daylight when the bats are roosting, so should not affect bats foraging within the Site.

5.186 Sufficient lighting will be provided at the site to ensure safe operations during winter periods.

Proposed Mitigation Measures

5.187 Security lighting will comprise low level spot lighting and will be directed towards the vehicle loading area and operational area, for safety purposes.

5.188 A landscape and restoration plan forms part of this EIAR. The plan the restoration of the site to a natural habitat, on completion of all extraction works. The landscape/restoration proposals will consist of the following (refer to Chapter 2 of the EIAR). As part of this plan, hedgerow and woodland planting, using native species, in advance of operations, will be planted along the boundaries of the Quarry Area. As they mature, these boundary features will be of benefit to foraging and commuting bats.

Significance of Residual Effects

5.189 The residual effect will not be significant.

Pine marten

Potential Impacts

5.190 A single pine marten was observed on the rocky edges around the existing water filled quarry void in the northeast. A pine marten latrine was also recorded here in the same areas as the nesting kestrel. It is possible that the pine marten was predating on the nesting kestrel.

5.191 Changes to the existing environment used by pine marten is not proposed. The operational phase is not likely to give rise to any negative effects on pine marten.

Proposed Mitigation Measures

5.192 No mitigation is proposed in respect of pine marten; however, the proposed bolstering of the hedgerows and woodland on the site by planting native species in advance of operations, as outlined in Chapter 13 – Landscape, may result in a slight positive impact for this species.

Significance of Residual Effects

5.193 The residual effect will not be significant.

Monitoring

5.194 The year after restoration has been completed the Site should be visited during bird breeding season, preferably in the period May – June, to check that the raptors e.g. kestrel, continue to use the Site.

Cumulative Effects

5.195 Cumulative effects can result from individually insignificant but collectively significant actions taking place over a period of time or concentrated in a location. Cumulative effects can occur where a proposed development results in individually insignificant impacts that, when considered in-combination with impacts of other proposed or permitted plans and projects, can result in significant effects.

5.196 There is one active quarry operation located within 5 km of the Site, located at Ballysadare, approximately 4 km to the southwest of the Site. This quarry is with the 5 km zone of influence of the proposed works. The zone of influence of quarrying activities typically do not extend beyond 2 km, the 5 km using a precautionary approach and to incorporate ecological connectivity though surface water pathways or landscape features. As there is no connectivity between the Site and the Quarry at Ballysadare there is no pathway for significant effects to occur cumulatively when considered with the quarry at Aghamore.

5.197 A search of the Sligo County Council online planning search facility indicates that there are no other planned developments in the vicinity of the application site and in the adjoining townlands of Carrownamaddoo, Cuilbeg, Aghamore Near, Tullynagracken South, Drumaskibbole, Ballydawley, Castledargan, which were granted planning permission in the last five years[4] and have the potential to have any significant adverse cumulative impacts on the local environment. All of the proposed planning application involve extensions, new road improvement, works to Sligo substation etc.

5.198 It is noted that planning permission was granted for development consisting of the filling of lands with construction and demolition waste in Carrownamaddoo townland c. 450 metres from the application area (Plan File Ref. No. 18/49) subject to 7 no. conditions. This proposed development, granted on 29/05/2018 is considered small scale, short term in duration (5 years) and is located sufficient distance from the application area and therefore no cumulative impacts are considered.

5.199 There are no policies or objectives within Sligo County Development Plan that when considered with the quarry proposal could give rise to cumulative effects on the ecology of the Site and immediate environs.

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[4] Planning search conducted on 29th April 2021 on Sligo County Council website.

5.200 The planning applications within the Aghamore area (refer to Chapter 4 and Planning Report) are largely confined to single dwellings and small developments. When considered together with the quarry there is no pathway for cumulative effects to arise.

5.201 Cumulative effects are considered unlikely to occur as result of the quarry proposal when considered with other plans and projects.

Summary of Effects

Table 5-3 Summary of Potential Impacts, Proposed Mitigation and Residual Effects

Ecological Feature	Effect	Proposed Mitigation	Means of Delivering Mitigation	Residual Effects
FW1 – Eroding rivers	Significant at the Townland level	No additional mitigation required, as this has been designed into the project through the construction of a settlement lagoon and interceptors.	No action required	Not significant
Birds	Significant at the Townland Level	Removal of vegetation will be carried out outside the bird breeding season (1 March – 31 August inclusive) where possible. Annual surveys to be undertaken for raptors, specifically breeding peregrine falcon. If breeding activity is noted, then mitigation will be implemented through a peregrine falcon management plan.	Landscape plan and quarry operator	Not significant
Bats	Not Likely	No mitigation required outside of the proposed landscape plan as the design allows for the retention of woodland and no potential roost areas will be impacted.	Landscape plan	Not significant
Pine marten	Significant at the Site Level	No mitigation required, but the proposed landscape plan will benefit this species.	Landscape plan	Not Significant

Conclusions

5.202 The applicants are seeking permission to recommence quarry operations at Aghamore Quarry, which will involve deepening the quarry from -21m OD to -50m OD. The recommencement of operations will also include for the aggregate Processing Area to the east side of the local road, and Aghamore stream which bisects the two sites.

5.203 A range of biodiversity surveys have been undertaken on the site, the first was an initial field survey undertaken in 2016. This was followed by an update survey in 2018. The most recent survey was undertaken in 2020. In addition to the general walkover surveys to map habitats and identify potential risks, the site and Aghamore stream have been subject to targeted aquatic, bat, otter and bird surveys.

5.204 The Quarry Area and Processing Area do not lie within a designated site, the closest site is Lough Gill SAC which lies (at its closest point) 360m from the access track to the Processing Area. The Aghamore stream, which flows between the Quarry Area and the Processing Area, flows into Lough Gill. Of the habitats and species identified during the site surveys, none were considered to be of greater importance than townland. Features brought forward for further assessment due to their value or conservation status were: Aghamore stream and the bird assemblage within the stie – townland level; bat assemblage and pine marten - local level.

5.205 The impact assessment concluded that, during operation, when the quarry is deepened, the need to discharge water (ground and surface) to Aghamore stream will continue, and as currently will have no significant impact on the water quality of Aghamore stream, nor Lough Gill SAC beyond. A settlement lagoon will be installed in the Quarry Area which will further reduce the potential for a pollution incident to occur. For the Processing Area, a minimum 25 metre standoff between Aghamore stream and the Processing Area will be maintained, this means that the existing woodland will also be retained. Water from the Processing Area will be allowed to naturally percolate into the ground or the underlying aquifer (which comprises sand and gravel); so will not run off directly in to Aghamore stream.

5.206 Peregrine falcon has historically and is currently nesting in the quarry. In case of peregrine continuing to nest in the quarry in future years, mitigation will be put in place. This will take the form of ongoing annual monitoring, retaining suitable nesting habitat and developing specific mitigation based on annual monitoring results and the proposed quarry activities during the nesting period. Although no bat roosts were found within the Quarry Area or Processing Area, or considered likely to be present, design mitigation will be implemented to benefit foraging bats, which utilise Aghamore stream and surrounding woodland edges. Security lighting will be low level spot lighting and will be directed away from woodland edges.

5.207 Following the implementation of the recommended mitigation, it is assessed that there will be no residual biodiversity effects as a result of the proposed quarry and processing works.

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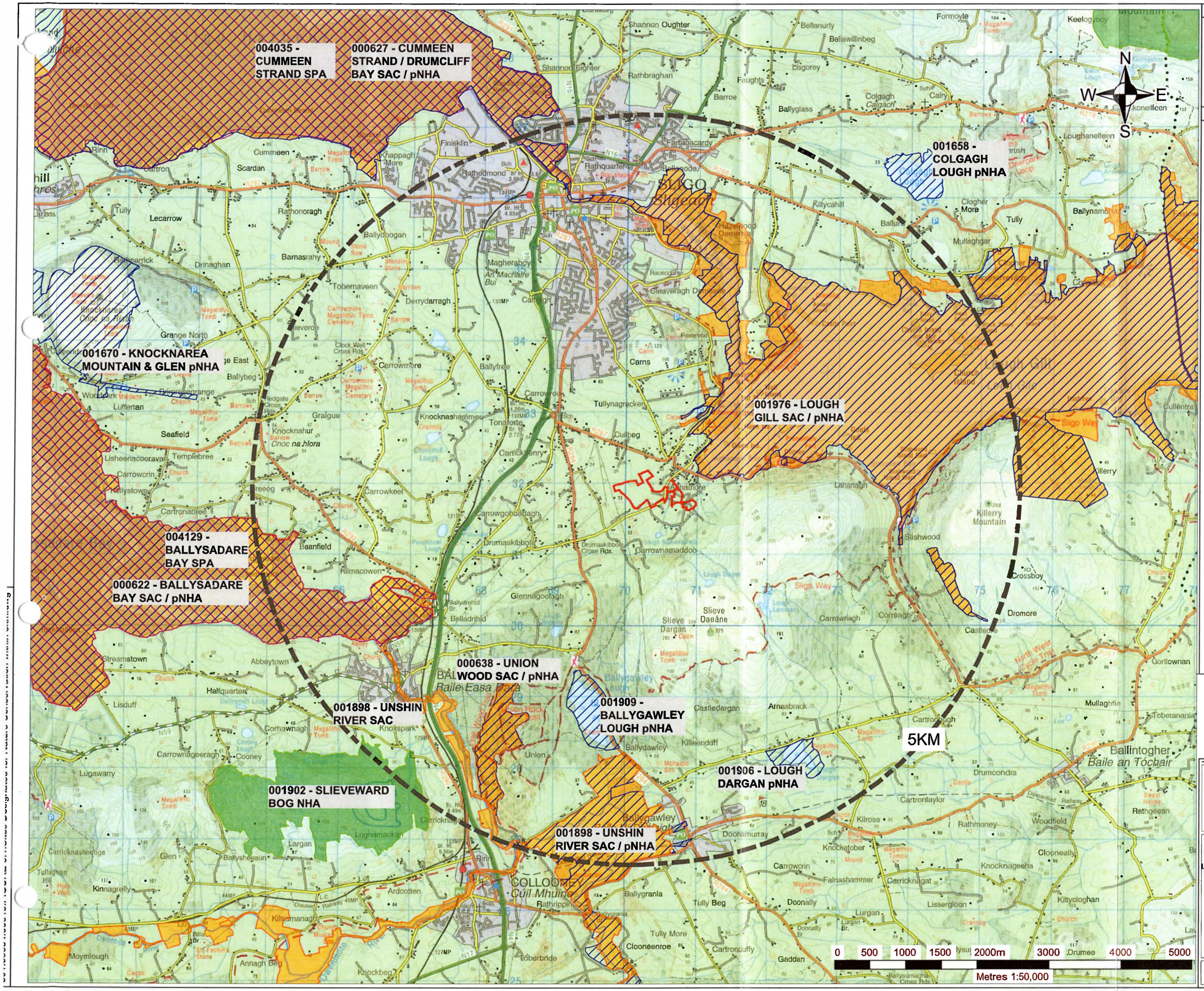
FIGURES



NOTES

1. EXTRACT FROM 1:50,000 O.S DISCOVERY MAP NO. 25
2. ORDNANCE SURVEY IRELAND LICENCE NO. CYAL50167032 (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND

LEGEND

- ▭ LOCATION OF PROJECT SITE
- ╌ 5KM OFFSET FROM APPLICATION SITE
- 🟧 SPECIAL AREA OF CONSERVATION (SAC)
- ▨ SPECIAL PROTECTION AREA (SPA)
- 🟩 NATURAL HERITAGE AREA (NHA)
- ▨ PROPOSED NATURAL HERITAGE AREA (pNHA)

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DESIGNATED SITES WITHIN 5 KM

FIGURE 5.1

Scale	Date
1:50,000 @ A3	MAY 2021

NOTES

1. ORDNANCE SURVEY IRELAND LICENCE NO. CYAL50167032 (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND
2. AERIAL PHOTOGRAPHY CARRIED OUT BY SLR CONSULTING SEPTEMBER 2020

LEGEND

☐	LAND OWNERSHIP
☐	APPLICATION AREA (c. 22.5 Ha.)

Key:
(Based on Fossitt J.A. (2000), *A Guide to Habitats in Ireland*, The Heritage Council, Kilkenny)

🟥	Active quarries and mines - ED4
🟪	Scrub - WS1
🟩	Dry Calcareous and Neutral Grassland / Improved Agricultural Grassland - GS1 / GA1
🟩	Improved Agricultural Grassland - GA1
▨	Hedgerows - WL1
▨	(Mixed) Broadleaved Woodland (Screen Planting) - WD1
🟧	Recolonising Bare Ground - ED3
▨	Building and Artificial Surfaces - BL3
7	Target Note Reference Number
B1	Bat Detector Location

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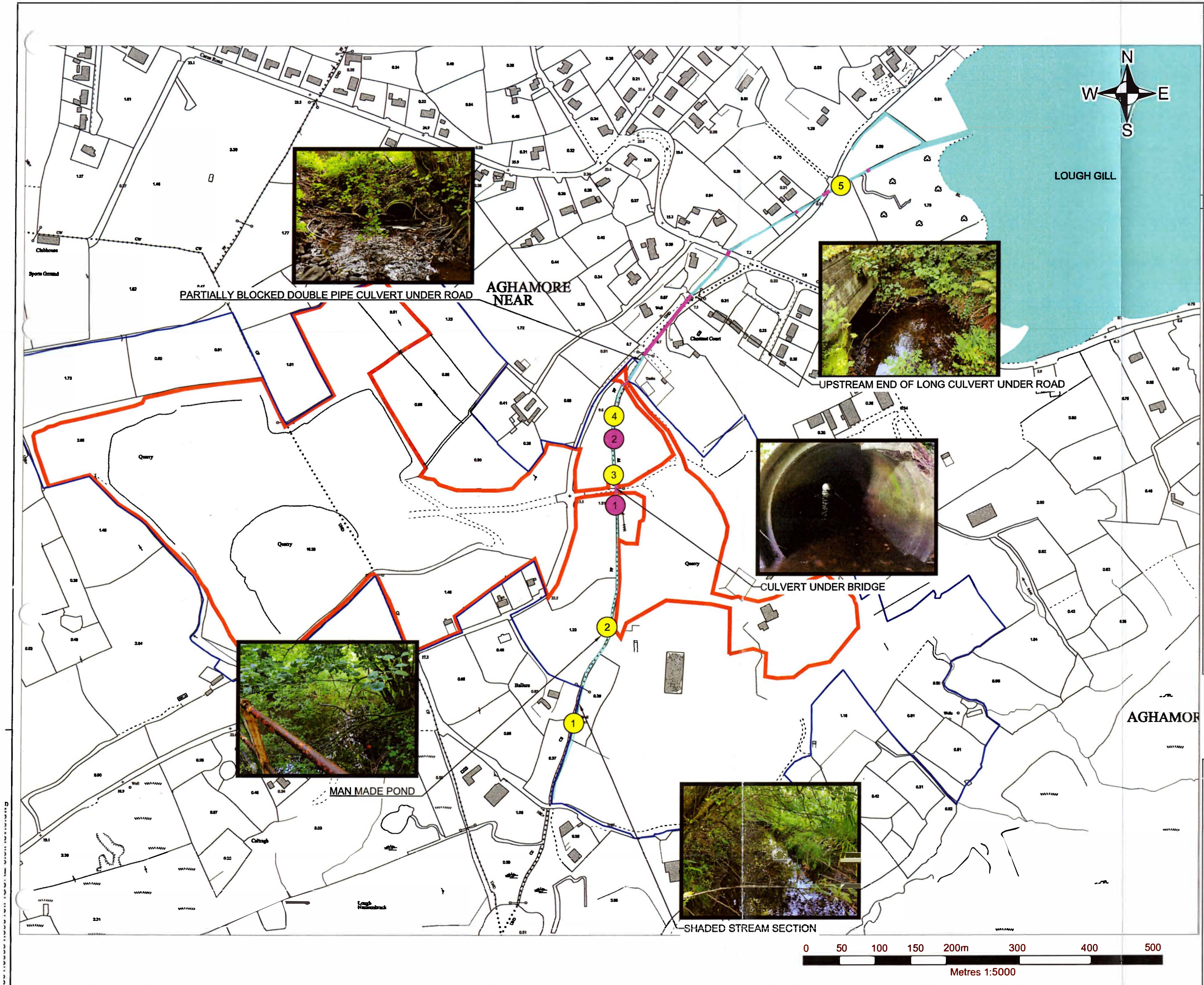
HABITATS MAP

FIGURE 5.2

Scale	Date
1:4,000 @ A3	MAY 2021



NOTES

1. ORDNANCE SURVEY IRELAND LICENCE NO. CYAL50167032 (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND
2. AERIAL PHOTOGRAPHY CARRIED OUT BY SLR CONSULTING SEPTEMBER 2020

LEGEND

▭	LAND OWNERSHIP
▭	APPLICATION AREA (c. 22.5 Ha.)
▭	CULVERT
▭	AGHAMORE STREAM
①	LOCATION OF BIOLOGICAL ASSESSMENTS (24th NOVEMBER 2020)
●	LOCATION OF BIOLOGICAL ASSESSMENTS (30th OCTOBER 2020)

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AGHAMORE STREAM

FIGURE 5.3

Scale 1:5,000 @ A3
Date MAY 2021

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6. Land, Soils & Geology

6. Land, Soils
& Geology

CHAPTER 6

LAND, SOILS AND GEOLOGY

CONTENTS

TABLES

FIGURES

INTRODUCTION

Background

6.1 This chapter of the Environmental Impact Assessment Report (EIAR) evaluates the regional and local geological conditions at the application site at Aghamore Near, Aghamore Far and Carrownamaddoo townlands to accompany a Planning Application to Sligo County Council by Lagan Materials Ltd.

6.2 The proposed application area covers an area of c.22.5 ha. and comprises the proposed recommencement of activities at the existing limestone quarry and adjacent processing area at Aghamore Near, Aghamore Far and Carrownamaddoo townlands, Co. Sligo.

6.3 A description of the site and proposed development is outlined in Chapters 1 & 2 of this EIAR.

Scope of Work / EIA Scoping

6.4 This Chapter describes the local land, soil and geology at and around the application site based on the available information for the area. This assessment is based on a detailed examination of the existing quarry and a review of geological investigation works carried out in the surrounding area.

Consultations / Consultees

6.5 The Irish Geological Heritage (IGH) section of the Geological Survey of Ireland has been consulted in relation to this site.

Contributors / Author(s)

6.6 The information presented in this chapter is based on a detailed examination of the existing quarry at Aghamore and the surrounding area and was prepared by EurGeol Dr John Kelly PGeo, MIMMM, MIQ. Dr Kelly is a Professional Geologist with over 27 years professional experience.

Limitations / Difficulties Encountered

6.7 The assessment of the land, soils and geology presented in this chapter is based on visual observations from site visits, published information and available ground investigation records.

6.8 No specific limitations or difficulties were encountered in the preparation of this chapter of the EIAR.

REGULATORY BACKGROUND

Legislation

EU Directives

6.9 The following European Union (EU) Directives relate to Land, Soils and geology at the site in this EIAR:

- Environmental Impact Assessment Directive (2011/92/EU);
- The management of waste from extractive industries (2006/21/EC); and
- Environmental Liability Directive (2004/35/EC).

6.10 The EU EIA Directive regulates the information impact assessment process and information in this EIAR. The management of Waste Directive and the Environmental Liability Directive regulates the activities at the site.

Irish Legislation

6.11 The following legislation relating to Land, Soils and geology at the site in this EIAR:

- No. 349 of 1989, European Communities (Environmental Impact Assessment) Regulations, and subsequent amendments (S.I. No. 84 of 1994, S.I. No. 352 of 1998, S.I. No.; 93 of 1999, S.I. No. 450 of 2000 and S.I. No. 538 of 2001);
- S.I. No. 473 of 2011, European Union (Environmental Impact Assessment and Habitats) Regulations 2011;
- S.I. No. 584 of 2011, European Union (Environmental Impact Assessment and Habitats) (No.2) Regulations 2011;
- The Planning and Development Acts, 2000 to 2009; and
- The Planning and Development (Amendment) Act 2010, S.I. 600 of 2001 Planning and Development Regulations and subsequent amendments including, S.I. No. 364 of 2005 and S.I. 685 of 2006.

6.12 The above legislation regulates the information contained in an EIAR and planning application for the proposed development.

Planning Policy and Development Control

6.13 The following Planning Policy and Development Control relating to land, soils and geology at the site in this EIAR is set out in the:

- Sligo County Development Plan 2017-2023.

6.14 The county development plan sets out conservation objectives in relation to soils, geology, geomorphology and geological heritage in Sligo.

Guidelines

6.15 The following guidelines relating to Land, Soils and Geology and have been used in the preparation of this EIAR:

- DoEHLG, 2010. Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities;
- Environmental Protection Agency, 2002. Guidelines on the information to be contained in Environmental Impact Statements;
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- National Roads Authority, 2008. Environmental Impact Assessment of National Road Schemes - A Practical Guide; and
- National Roads Authority, 2008. Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

6.16 The above guidelines are relevant to the preparation of a Land, Soils and Geology chapter of this EIAR.

Technical Standards

6.17 The following Technical Standard relating to Land, Soils and geology at the site in this EIAR:

- British Standards (2015). Code of Practice for Site Investigations BS5930:2015;
- British Standard (2001). Geotechnical investigation and testing – Identification and classification of soil BS EN ISO 14688-2:2004;
- British Standard (2003). Geotechnical investigation and testing – Identification and classification of rock BS EN ISO 14689-1:2003.

ADDITIONAL INFORMATION

6.18 As outlined in Chapter 1 a planning application was submitted to Sligo County Council (Plan File Ref. No. 18/345 / ABP Ref. 305821-19) in August 2018 for similar development to that proposed as part of this application. In October 2019 Sligo County Council granted planning permission for the development (subject to 23 no. conditions). 2 no. third party appeals of the decision by

Sligo County Council to grant permission for the proposed quarry development were made to An Bord Pleanala (ABP-305821-19). An Bord Pleanala refused permission for the proposed development on the 30th June 2020 for the 2 no. reasons – refer to Chapter 1 for further details.

6.19 In order to address the reasons for refusal, and further comments contained within the An Bord Pleanala Inspectors Report a number of additional surveys / site investigations, field work and assessments have been carried out.

6.20 This Chapter 6 of the EIAR has been updated as follows:

- Additional ground investigations have been undertaken at the application site, including boreholes and geophysical surveys;
- The assessment now includes the processing area on the Eastern side of the Local road.

RECEIVING ENVIRONMENT

Study Area

6.21 The study area for this Land, Soils and Geology section of the EIAR comprises the application area (c. 22.5 ha.) and surrounding lands.

Baseline Study Methodology

6.22 Existing information on the regional soils, superficial deposits and bedrock geology of the Aghamore area and its surrounds was collated and evaluated. Subsequent to this data compilation and review, site visits and inspections were undertaken to review the superficial deposits and bedrock geology at Aghamore Quarry and in the surrounding area.

Sources of Information

6.23 The following activities were undertaken as part of this geological assessment:

- Examination of GSI 1:100,000 geology map sheet 07 Geology of Sligo and Leitrim.
- Review of available geological information and literature.
- Review of previous rotary core borehole records and ground investigation reports.
- Site / quarry face inspections.
- Review of geophysical surveying investigations (APEX Geoservices report AGL17164_01, APEX Geophysics reports AGP19223_01 and AGP21007_01).
- Review of borehole logs from additional boreholes installed as part of the updated hydrogeological assessment for the proposed development (Boreholes MW12 to MW25, 2020).
- Review of previous geology and geotechnical assessments and aggregate testing results.

Regional Geology

Soil

6.24 Teagasc soil mapping, reproduced in **Figure 6-1**, indicates that the current extraction area and the aggregate processing area at the Aghamore site was originally underlain by renzinas and lithosols, with adjacent areas of lithosols and regosols and surface water gleys. Due to previous extraction, few areas of original, undisturbed soil remain across the application area.

Superficial Deposit Geology

6.25 Teagasc sub-soil (parent material) mapping, reproduced in **Figure 6-2**, shows that the lands that form part of the application are/were underlain by bedrock at, or close to, surface and glacial tills derived from metamorphic rocks. The eastern part of the application area (the processing area) is mapped by Teagasc as being composed of made ground or sands and gravels derived from Carboniferous limestones.

Bedrock Geology

6.26 The GSI 1:100,000 geology map Sheet 07 shows the existing extraction area to be developed within the Dartry Limestone Formation, refer to **Figure 6-3**.

Local Geology

Introduction

6.27 The quarry extraction area at the site is located to the south of the R287 road. The processing area is located to the east of a local road which separates the extraction area from the processing area.

Soil and Superficial Deposits

6.28 Soils and superficial deposits have been entirely stripped from the footprint of the current and previous extraction areas. A small amount of soils / subsoil material will be removed to construct the proposed settlement lagoon.

6.29 Previous drilling work in the unextracted areas indicates that the total thickness of soils and superficial deposits in this area varied from 3.0m to 6.0m. APEX Geophysics report AGP21007_01 indicates that the superficial deposits in the unextracted area (Area B) is between 0.0 – 2.0m thick, with small, localised pockets up to 5.0m in thickness. An area defined by APEX (Zone 1) defines an area of thick superficial deposits up to 15m in thickness.

Bedrock Geology

6.30 The bedrock geology at Aghamore Quarry is well understood from abundant quarry face exposures and rotary core drilling to the north, east and southeast of the existing extraction area.

6.31 The existing extraction area is developed within the Dartry Limestone Formation (see Table 6-1) located on the hangingwall (downthrown) side of a northwest downthrowing major fault, part of the Ox Mountains fault complex.

6.32 The information available indicates that the current and future extraction at the existing quarry is derived from strong, fresh, mid to dark-grey, fine-grained well bedded bioclastic cherty silicified and dolomitised limestones of the Dartry Limestone Formation.

6.33 Three sub-units have been identified within the Dartry Limestone at the site, as follows:

6.34 The lowermost unit is composed of dark grey, well-bedded poorly fossiliferous fine-grained cherty limestones. This unit lies below the quarry floor and is only known from drilling.

6.35 The middle unit is composed of dark grey, well-bedded (0.4m to 1.0m thick) fossiliferous cherty fine-grained limestone and dolomite with abundant calcite and dolomite infilled vugs.

6.36 The uppermost unit, only exposed in the northwest area of the quarry is composed of massive, pale-grey fine-grained (micrite) fossiliferous limestones.

6.37 Geophysical surveys by APEX (APEX Geoservices report AGL17164_01, APEX Geophysics reports AGP19223_01 and AGP21007_01) indicate that the bedrock under the existing quarry floor, in the lands immediately north of the existing quarry and to the west of the existing quarry are composed of clean, thin to medium bedded limestones. There are no indications of weathered zones or structural (fault, fissure) or karst features, with the exception of APEX Area B, which is interpreted as an area of clay-infilled fissures, that have no potential to be hydrologically active.

6.38 Due to the geological structure of the area and the proposed final depth of extraction, no geological units except the Dartry Limestone Formation will be extracted. The Dartry Limestone is underlain by the Glencar Limestone Formation, but the APEX geophysical surveying has not encountered values typical of he Glencar Limestone Formation, so it can be concluded that the Dartry Limestone / Glencar Limestone contact lies below the depth of the geophysical surveying.

Table 6-1
Lithological Sequence of Geological Units Present in the Existing Quarry Area (after MacDermot, 1996)

Formation	Estimated Thickness	Description
DARTRY LIMESTONE FORMATION	200m+	The dominant facies is a massive to thick-bedded, mostly very fine-grained and dark wackestone, locally rich in sponge spicules. Bedding is picked out by bands and nodules of irregular chert, sometimes forming 50% of the rock. There is pervasive dolomitization and silicification.
GLENCAR LIMESTONE FORMATION	UNKNOWN	Dark fine limestone & calcareous shale
OX MOUNTAINS FAULT COMPLEX		
OX MOUNTAIN METAMORPHIC COMPLEX SLISHWOOD DIVISION		Pelitic and semi-pelitic paragneiss, psammites, schists, gneisses and metabasites/serpentinite.

6.39 When operational, quarry aggregates produced at the site will be independently tested and geologically assessed on an annual basis to confirm that the aggregates are compliant with the requirements of the relevant aggregate quality standards and to ensure that the aggregates are of suitable quality and are fit for purpose including:

- NRA Series 500, 600 and 800 compliant aggregates.
- SR 21:2014 + A1:2016 Annex E. Guidance on the use of IS EN 13242:2002.
- SR 16:2016 Guidance on the use of IS EN 12620:2002 + A1:2008 - Aggregates For Concrete.
- SR 17:2004 Guidance on the use of IS EN 13043:2002 Aggregates for Bituminous Bound Aggregate Products.

Structure

6.40 The bedding thickness within the Dartry Limestone averages 1.0m and the rocks dip from 8° to 20° to the north or northwest.

6.41 One major fault has been identified at Aghamore, trending north-northwest and dipping steeply (80°) to 247° (north-northwest). The fault zone has been solutionally enlarged and is partially infilled with clays.

6.42 Analysis of joint sets exposed on quarry faces indicates that three main joint sets are present. Set one is sub-vertical and dips 76° to 344°, set two and three are almost vertical and dip 89° to 100° and 85° to 256° respectively.

6.43 All joints are typically tight with some having a calcite infill. Rock strength is strong to very strong and weathering is rarely present below the epikarst zone.

Geological Heritage

6.44 Review of available geological heritage literature (McAteer and Parkes 2004) does not list the application site as a Geological Heritage site.

6.45 Consultations were held with the Geological Heritage programme to ascertain if there was any geological heritage value of the rock exposures at Aghamore.

6.46 Arising from consultations, staff working on the IGH Programme have indicated that there may be some interest due to the good quality exposures of the Dartry Limestone and this would be considered when a review of the heritage audit is undertaken in the future. Consideration has been given to this in the proposed restoration plan for the quarry – refer to Figure 2.2.

Economic Geology

6.47 Crushed rock which is extracted from the application site is used to produce standards compliant aggregates which have a wide variety of construction and engineering end-uses including:-

- Structural backfills for specified engineering purposes and sub-concrete fills;
- Road sub-base, base and blacktop (tarmacadam) surfacing;
- General aggregate.

Karstification

6.48 The regional hydrogeological setting is detailed in Chapter 7 Water. This assessment of the presence of karst is based on site visits to examine the existing quarry faces, available public information from GSI, Teagasc etc., a review of the previous and recent APEX geophysical Surveys and the results from the 2020 drilling programme, detailed also in Chapter 7, Water.

6.49 Limestones with a high calcium carbonate ($CaCO_3$) content, are readily dissolved by weak acids such as carbonic acid in rainfall or humic acids derived from agricultural soils. The dissolution and enlargement of discontinuities in the limestone (such as joints, fractures, etc.) over geological time leads to the formation of rock dissolution landforms such as closed depressions (dolines), sinkholes, springs, turloughs and caves.

6.50 Strictly speaking, the term 'karst' is applied to areas where surface drainage has been disrupted by underground capture of surface streams by dissolution of the bedrock. A broader definition of the term however includes landscapes where distinctive karst landforms occur as a result of dissolution of the underlying bedrock.

6.51 Dissolution features in karst limestones, whether open or infilled with sediments present significant environmental challenges, particularly with respect to protection of groundwater quality and groundwater fed ecosystems. They also present unique engineering challenges, particularly with respect to slope stability, control of drainage or contamination of high-quality limestone resources.

6.52 A review of the GSI Karst Database (Quarter 2, 2016) indicates that there are no known karst related features in the vicinity of the application site.

6.53 A single spring has been recorded 800m northeast of the site – refer to Chapter 7 Hydrogeology.

6.54 The presence, nature and extent of any karstification at Aghamore Quarry has been separately assessed by inspection of existing quarry faces.

6.55 A clay-infilled solutionally enlarged fracture (fault) has been identified within the existing quarry void – refer to Figure 7.9 for location.

6.56 Examination of quarry faces and the results of the geophysical surveying by APEX indicate that the rockmass at Aghamore is composed of intact, unweathered limestones with no indication of significant karst features.

6.57 APEX Area B (defined in report AGP21007_01) is interpreted as being related to fossil karst, where pre-glacial karst features have been infilled with pre-glacial or glacial sediments and is now inactive.

6.58 Any potential karstic activity in the area is likely to be restricted to the contact between the Dartry Limestone and the underlying Glencar Limestone. This contact has not been located by the APEX surveying and clearly is located at a depth below the survey depth of the geophysical methods and will not be intersected by the proposed quarrying operations.

6.59 A review of the results of the 2020 additional boreholes indicates that all bedrock intervals intersected recorded Total Core Recoveries of 100%, confirming the absence of solution features or cavities in the areas drilled.

6.60 In summary, therefore, no active karst features are present within the existing quarry, geophysical surveying indicates an intact rock mass or the presence of minor inactive karst features and the 2020 drilling did not record any core loss indicating the presence of inactive or active karst in the areas drilled.

IMPACT ASSESSMENT

Evaluation Methodology

6.61 The evaluation of impacts of the of the proposed development is based on a methodology similar to that outlined in the 'Guidelines for the Assessment of Geology, Hydrology and Hydrogeology for National Road Schemes' published by the National Roads Authority (2009) and Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements published by the IGI (2013).

Evaluation of Impacts

Direct Impacts

6.62 The importance of existing land, soil and geology attributes identified at the application site is assessed in **Table 6-2** below:

Table 6-2
Importance of Geological Attributes in Vicinity of Application Site

Attribute	Status / Occurrence	Importance
Geohazards	None identified	Low
Geological Heritage	Excellent exposures of the bedrock sequence at Aghamore are present in the extraction area at Aghamore.	Medium
Economic Geology	The development involves extraction from an area within the existing quarry and deepening of the quarry within the existing quarry area.	Low
Agricultural Soil	The quarry is at its current maximum extent and no further agricultural soils will be removed.	Low

6.63 The magnitude of these impacts on the soil and geology attributes is assessed in **Table 6-3** overleaf:

Table 6-3
Significance of Impacts on Land, Soil and Geology

Attribute	Impact of Proposal on Land, Soil and Geology	Magnitude
Geohazards	n/a	n/a
Geological Heritage	No impact	None
Economic Geology	Direct impact on the existing in-situ bedrock within the proposed extraction area.	Small, negative
Agricultural Soil	Earlier restoration of landform and placement of topsoil / subsoil will restore part of the lands to basic agricultural use.	Small, positive

6.64 There will be no impact on geological heritage in the vicinity of the site.

Unplanned Events (i.e. Accidents)

6.65 It is highly unlikely that any unplanned events within the application site would result in a noticeable impact on the land, soils and geology.

6.66 Adhering to the HSA Safe Quarry Guidelines to the Safety Health and Welfare at Work (Quarries) Regulations 2008 should limit the potential for unplanned events in the form of instability in the quarry faces.

'Do-nothing Scenario' (esp. where deterioration will arise)

6.67 If the proposed recommencement and deepening of Aghamore Quarry is not permitted, the existing void would naturally recolonise with vegetation and water in the quarry void would rebound to its natural level.

MITIGATION MEASURES

6.68 There will be no lateral extension of the quarry and therefore no soil and subsoil is to be removed. The quarry area will be restored following completion of quarrying at the site, refer to Chapter 2 of this EIAR for details of the site restoration plan and on **Figures 2-3**.

6.69 A small area of soil / subsoil material will be removed to enable construction of the proposed settlement lagoon – refer to Figure 2.1. In order to limit the effects of erosion on any excavated soil material the following mitigation measures will be used on site during handling:

- Soil material will be placed in permanent or temporary locations at a safe angle of repose; and
- The re-handling of soil material will be minimised as much as possible in order to preserve the integrity of the soil material; this is also an economically prudent practice.

RESIDUAL IMPACT ASSESSMENT

6.70 Based on the impact assessment and existing mitigation measures described above, there will be no residual impact on land, soils or geology as a result of this proposed development.

REFERENCES

GSI, 2007, 1:100,000 Bedrock Geology of Ireland (Digital-Map).

Institute of Geologists of Ireland (2013) 'Guidelines for the preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements'.

MacDermot, C.V., Long, C.B. and Harney, S.J. 1996. A geological description of Sligo, Leitrim, and adjoining parts of Cavan, Fermanagh, Mayo and Roscommon, to accompany the Bedrock Geology 1:100,000 Scale Map Series, sheet 7, Sligo-Leitrim, with contributions by K. Claringbold, D. Daly, R. Meehan and G. Stanley. GSI, 99pp.

McAteer, C. and Parkes, M. 2004 The Geological Heritage of Sligo. Geological Survey of Ireland Publication.

Teagasc, 2004, Ireland Subsoil Parent Materials Map (digital version).

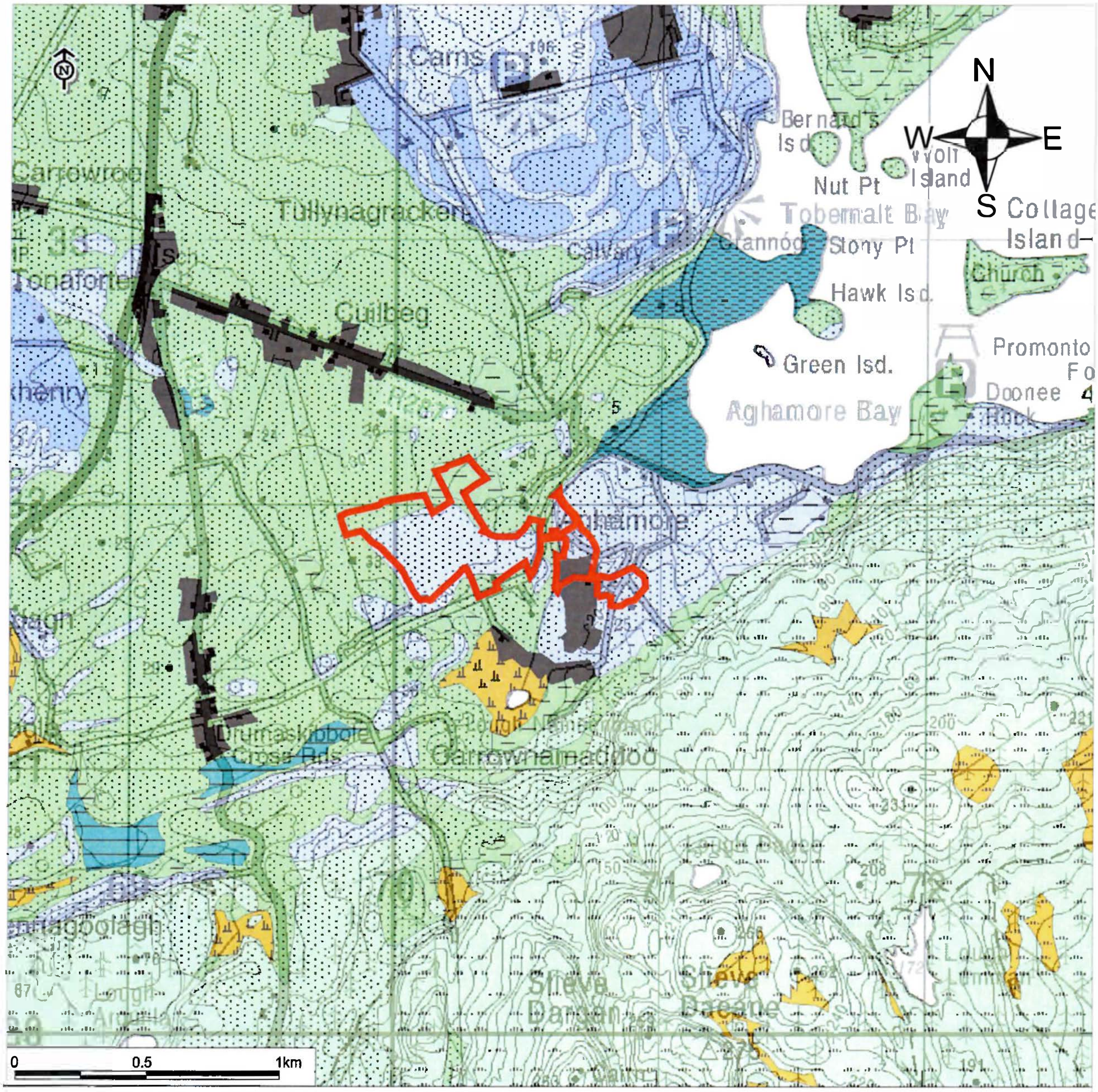
Teagasc, 2007, Ireland Soils Map (digital version).

FIGURES

Figure 6-1
Regional Soils Map

Figure 6-2
Regional Superficial Deposits Map

Figure 6-3
Regional Bedrock Geology Map



TEAGASC SOIL MAPPING

IFS SOIL TYPE

- 🟧 Blanket Peats
- 🟧 Cutaway and Cutover Peat
- 🟦 Lacustrine Sediments
- 🟦 Alluvium - Mineral
- 🟩 Acid Brown Earths and Brown Podzolics
- 🟦 Grey Brown Podzolics and Brown Earths
- ▨ Lithosols and Regosols
- ▨ Renzinas and Lithosols
- ▨ Surface Water Gleys derived from non-calcareous parent
- ▨ Surface Water Gleys derived from calcareous parent
- ▨ Peaty Podzols, Lithosols and Peats derived from non-calcareous parent
- ⬛ Made Ground

▭ PLANNING APPLICATION AREA

0 800m 2000

Metres 1:25,000

1. ORDNANCE SURVEY IRELAND LICENCE NO. CYAL50167032 (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND
2. EXTRACT FROM TEAGASC SOILS MAPPING

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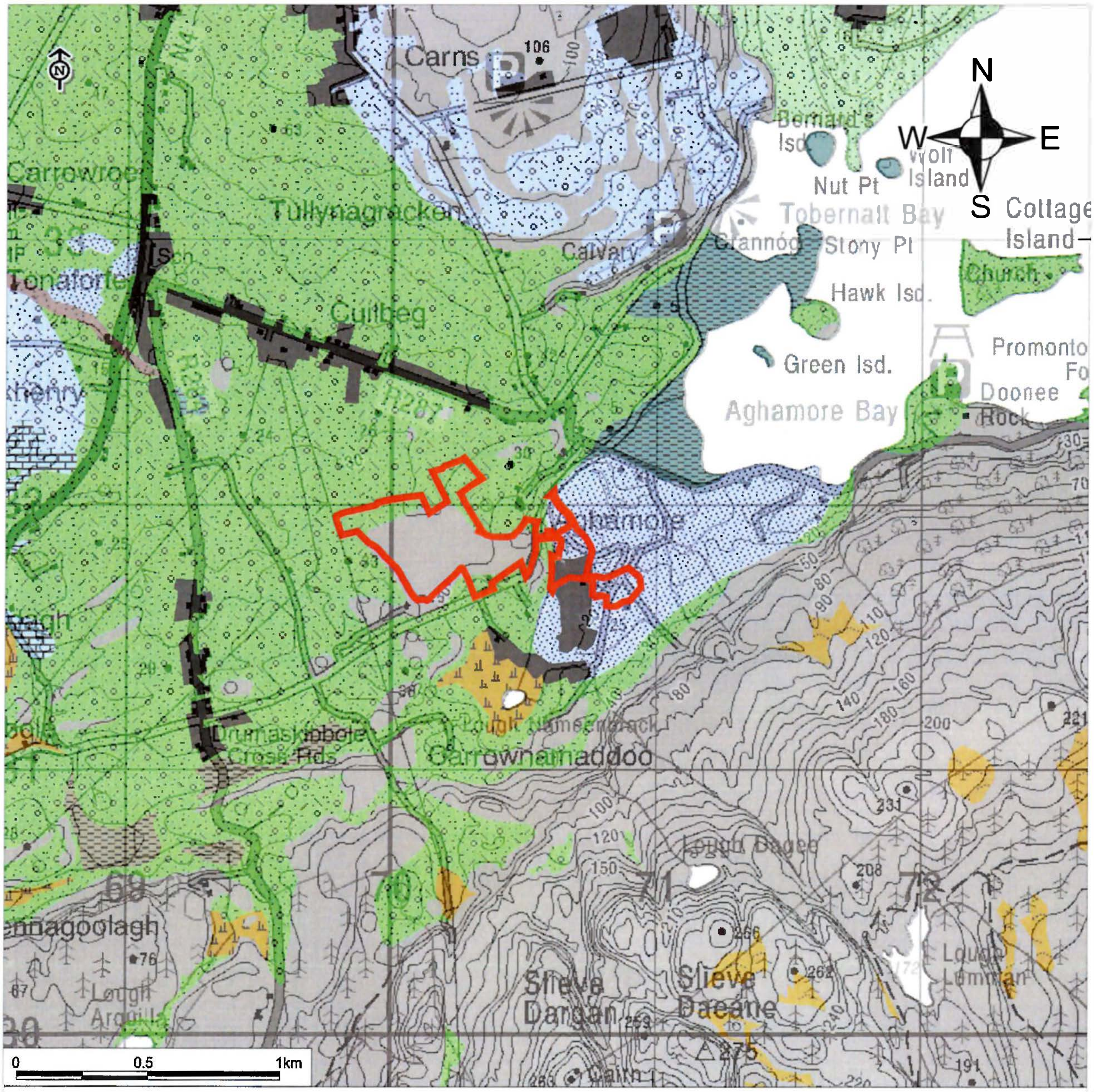
AGHAMORE NEAR, AGHAMOE FAR AND
CARROWNAMADDOO TOWNLANDS, CO. SLIGO

SOILS MAPPING

FIGURE 6.1

Scale	Date
1:25,000 @ A4	MAY 2021



Teagasc Subsoil Mapping
Parent Material Type

▨	Blanket Peat	▨	Till - Carboniferous Limestone
▨	Cutover Peat	🟩	Till - Metamorphics
▨	Alluvium	▨	Limestone Bedrock
▨	Lacustrine Sediments	▨	Outcrop & Subcrop
▨	Sand and Gravel - Carboniferous Limestones	■	Made Ground
▨	Till - Namurian Clasts		

▭ PLANNING APPLICATION AREA

1. ORDNANCE SURVEY IRELAND LICENCE NO. CYAL50167032 (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND
2. EXTRACT FROM TEAGASC SUBSOILS MAPPING

0 800m 2000
Metres 1:25,000

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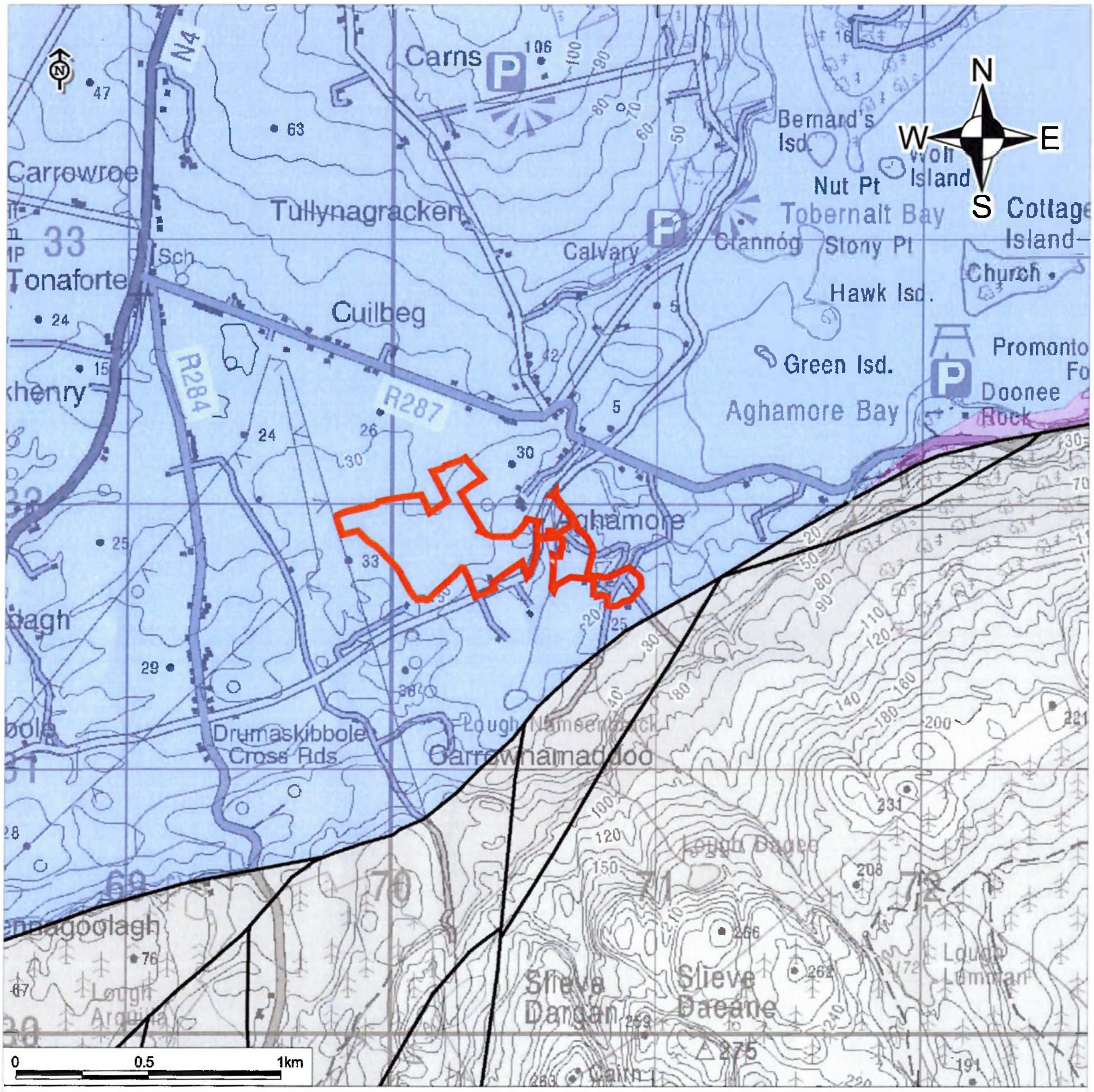
SUBSOILS MAPPING

FIGURE 6.2

Scale	Date
1:25,000 @ A4	MAY 2021



Aghamore Area
Bedrock Geology Units

🟦	Dartry Limestone Formation
🟪	Mudbank limestone
⬜	Ox Mountain Metamorphic Complex

▭ PLANNING APPLICATION AREA

0 800m 2000

Metres 1:25,000

1. ORDNANCE SURVEY IRELAND LICENCE NO. CYAL50167032 (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND
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BEDROCK GEOLOGY

FIGURE 6.3

Scale	Date
1:25,000 @ A4	MAY 2021

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Part of the Breedon Group

7. Water

CHAPTER 7

WATER

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INTRODUCTION

Background

7.1 Quarrying activity and the associate processing operations were established at Aghamore Near, Aghamore Far and Carrownamaddoo townlands in the 1950s, with permission for works in additional lands to the west, north and north-east of the original quarry granted in 1996 (Planning Ref. 96/172). Planning permission to further extend and deepen the quarry was granted in June 2003.

7.2 Dewatering of the site and discharge to the stream leading into Lough Gill have been occurring for more than 10 years. The site holds a current reviewed discharge licence (DL(W)151: 2020) and prior to the revision of the licence, there was a discharge licence for the site, albeit in the name of the previous owner of the site, CEMEX (ROI) Ltd.

7.3 The current floor level (c. -21mOD) of the quarry is below the water table requiring surface water and groundwater to be pumped from the quarry to a nearby stream which leads directly to Lough Gill c. 765m downstream.

7.4 The previous permitted floor level of the quarry was one bench below the existing floor level (i.e. -34.5mOD) and it is proposed to deepen the quarry by a further bench below this (i.e. to -50mOD), potentially increasing both the drawdown on the water table surrounding the quarry and the volume of water discharged to surface water. A comprehensive assessment of potential water-related impacts for the proposed development is therefore required.

7.5 Lagan propose to recommence operations at this site which were suspended temporarily since November 2014. During the suspension of activity, the environmental monitoring programme was continued for some of the time. A very comprehensive programme of work has since been completed as part of the detailed hydrogeological and hydrological studies undertaken to support this application.

7.6 Details of the site and a description of the proposed development are provided in Chapter 2. In summary:

> *The proposed development being applied for under this current planning application is shown on **Figure 2-1** and is similar to that previously granted under Sligo County Council Ref. No 02/271 and will consist of:*
>
> - *Recommencement of quarry operations within the previously permitted quarry extraction area (c. 10.9ha);*
> - *Deepening of the previously permitted quarry area by 2 No. extractive benches from c. -21mOD to -50mOD;*
> - *Recommencement of aggregate processing (crushing and screening) within the existing processing area, located to the east of the local road that bisects the site;*
> - *The provision of a settlement lagoon (c. 2,830m^2);*
> - *The provision of 2 No. wheelwashes;*

- *The Provision of a wastewater treatment system;*
- *The Provision of a double stacked portacabin office;*
- *Additional stockproof / trespass proof boundary fencing;*
- *All within an application area of 22.5 Ha.*

ADDITIONAL INFORMATION

7.7 As outlined in Chapter 1, a planning application was submitted to Sligo County Council (Plan File Ref. No. 18/345 / ABP Ref. 305821-19) in August 2018 for similar development to that proposed as part of this application. In October 2019 Sligo County Council granted planning permission for the development (subject to 23 no. conditions). 2 no. third party appeals of the decision by Sligo County Council to grant permission for the proposed development were made to An Bord Pleanala (ABP-305821-19). An Bord Pleanala refused permission for the proposed development on the 30th June 2020 for the 2 no. reasons – refer to Chapter 1 for further details.

7.8 In order to comprehensively address the reasons for refusal, and further comments contained within the An Bord Pleanala Inspectors Report, a number of additional surveys / site investigations, field work and assessments have been carried out.

7.9 This Chapter 7 of the EIAR has been updated as follows:

- A second site investigation and monitoring programme for surface water and groundwater was undertaken by TMS from August 2020 to March 2021 (Phase II). This investigation was undertaken to supplement the findings of the first site investigation and collect new information in relation to the processing area of the site.
- Five additional boreholes were drilled and installed as monitoring wells within the quarry along the access road (MW12, MW13, MW14) and on the northern boundary (MW18, MW19). Nine shallow boreholes were drilled and installed as monitoring wells within the processing area. The locations of the monitoring wells are indicated on **Figure 7.1**. Summary details of the monitoring wells and borehole logs are provided in **Appendix 7-4**.
- Four rounds of surface water sampling were carried out, with samples being collected from the same locations as in the first site investigation, plus upstream and downstream of the infilled area located upstream of the site at Lough Nameenbrack (i.e. reclaimed land surrounding Lough Nameenbrack). The surface water sampling locations are indicated on **Figure 7-2**. One round of groundwater sampling was carried out of all monitoring wells on site.
- Groundwater level and flow monitoring for the quarry was continued, with additional dataloggers installed in the new monitoring wells in the processing area.
- Two biological assessments of the Aghamore Stream were carried out by TMS in September and November 2020. The first biological assessment examined surface water quality upstream and downstream of the quarry discharge, the second assessment looked at surface water quality in the Aghamore Stream at five different locations. The TMS biological assessment reports are provided in **Appendix 7-5**.

- A geophysical survey of the quarry floor and land to the northeast of the quarry was carried out by APEX Geophysics in January 2021 to determine if any weathered or karst zones in bedrock were present. The APEX geophysical report is provided in **Appendix 7-6**.

Scope of Work / EIA Scoping

7.10 The objectives of this EIAR chapter are to:

- establish the baseline conditions for surface water/groundwater;
- develop a conceptual understanding of the quarry hydrology/hydrogeology;
- identify any potential impacts from the proposed development on the baseline conditions;
- assess the likelihood and significance of any potential impacts;
- propose mitigation measures (if required);
- identify any residual impacts after mitigation measures are implemented (if any).

7.11 In order to provide the information necessary to assess the potential impacts of the proposed development on the water environment, detailed site investigations and monitoring programmes for surface water and groundwater were undertaken by TMS from June 2017 to July 2018, and from August 2020 to March 2021. The scope of these site works was based on a review of the available information, the nature of the proposed development and the environmental sensitivity of the site.

7.12 Further details of the site investigations and monitoring programmes are provided in Paragraphs 7.47 to 7.61.

Consultations / Consultees

7.13 A pre-planning consultation document for the proposed development was prepared and issued to statutory and other consultees during the EIA scoping stage; responses from Irish Water, National Parks & Wildlife Service, Inland Fisheries Ireland and the Geological Survey of Ireland are of relevance to this chapter and are included in **Appendix 7-1**.

7.14 The Environmental Protection Agency (EPA) was consulted on surface water monitoring data for Lough Gill, undertaken by the EPA as part of the Water Framework Directive Monitoring Programme.

7.15 Sligo County Council (Environment Section) was consulted on surface water monitoring of the Aghamore Stream undertaken by Sligo County Council.

7.16 Sligo County Council (Water Services Section) was consulted on the mains water supply in the area surrounding the proposed development.

7.17 Irish Water, Sligo County Council, Leitrim County Council and An Bord Pleanála case records were consulted in relation to the Abstraction Orders, and information associated, for the Sligo Town and North Leitrim Public Water Supply abstractions at Foxes Den (Sligo) and Moneyduff (Leitrim).

Contributors / Author(s)

7.18 Fieldwork and the Water Chapter of the EIAR has been completed by Craig O'Connor of TMS Environment Ltd (TMS). Craig is a chartered geologist with 20 years' experience in surface water and groundwater assessments. Craig holds a BSc (Hons) in Geology from University College Cork and an MSc in Hydrogeology from University College London.

7.19 Following Irish Waters response to Scoping, the project team requested advice and information for Sligo's regional hydrological and hydrogeological regimes and Karst features from Suzanne Tynan of Tynan Environmental. Suzanne is a hydrogeologist and hydrologist with 18 years' experience in the area of hydrology and hydrogeology and 20 years' experience in the areas of environmental science and environmental geology. Suzanne holds a BSc in Geology and Botany from University College Dublin, an MSc in Environmental Science from Trinity College Dublin and an MSc in Hydrology and Water Resources Management from Imperial College London. Suzanne has studied the karst responses in the Sligo area for over 5 years. Her long-term characterisation of the karst responses in the vicinity of the Aghamore quarry was originally commissioned by Sligo County Council, who gave permission for Suzanne to share information for the benefit of an integrated assessment of the proposal under consideration. Suzanne's detailed report (2021) describing the regional hydrogeology and karst features of the Sligo peninsula is presented in **Appendix 7-2**.

7.20 Also, in response to the Irish Water response to scoping, Dr. Pamela Bartley of Hydro-G Hydrogeological & Hydrological Consulting was invited to assist in the impact assessment for the potential threat posed to the Public Water Supply Sources (PWSS's) abstracted each day from Lough Gill. Pamela is a water supply focussed civil engineer with 24 years' experience in groundwater sourced water supply, quarry assessments, surface water resource and assimilation capacity assessments and wastewater engineering. Pamela holds a Diploma in Water and Wastewater Technology from Sligo RTC, a BEng in Civil Engineering from Queens University Belfast, an MSc in Environmental Engineering and a Ph.D in groundwater impact characterisation from the Department of Civil Engineering, Trinity College Dublin. As a result of Pamela's involvement in appeal cases, she has become a specialist in assessing quarries in the context of planning, water and ecological Regulations. Separate to this project, Pamela is a panel hydrogeologist consultant to Irish Water. The evaluation of the potential impact on the PWSS abstractions is presented in **Appendix 7-2**. In addition, the final impact assessment section of this chapter is an integration of Craig O'Connor's and Pamela Bartley's work.

7.21 Dr. Pamela Bartley of Hydro-G Hydrogeological & Hydrological Consulting was also contracted by Lagan to carry out a peer review of the Water Chapter of the EIAR.

Limitations / Difficulties Encountered

7.22 The pre-existing monitoring record for surface water and groundwater was limited prior to this assessment, mainly consisting of information contained in the Environmental Impact Statement accompanying the 2002 planning application, and information submitted with the trade effluent discharge licence application in 2010, further information submitted in support of this application in 2011.

7.23 A comprehensive site investigation and monitoring programme for surface water and groundwater was necessary to provide the baseline information required to assess the potential impacts of the proposed development Some limitations were encountered during the investigation, but these were addressed, and satisfactory outcomes were achieved.

7.24 Some limitations were encountered when installing groundwater monitoring wells around the quarry area. Collapsing-rock conditions were encountered in two monitoring wells drilled to the east, limiting the depths of these wells. Thick clay overburden to the south of the quarry limited the installation of monitoring wells to the area close to the quarry. It was not possible to install groundwater monitoring wells to the west of the quarry as access was not available. Notwithstanding such limitations, satisfactory alternatives were identified, and a satisfactory network of wells was installed to allow completion of a comprehensive study.

7.25 The duration of the extended monitoring programme undertaken at the application site is over 3 years, during which time sufficient information has been gathered to assess the potential impacts of the proposed development on groundwater/surface water. The monitoring programme is continuing which will add to the database of information for the future management of discharges from this site.

REGULATORY BACKGROUND

7.26 The planning history of the site is detailed in a separate planning report submitted with the planning application.

7.27 The most recent planning permission (Planning Register No. PL 02/271) granted in respect of the quarry in June 2003 contained a number of water-related conditions. Condition No. 18 identifies a number of measures that are required, mainly to do with surface water treatment, discharge and monitoring at the quarry. PL 02/271 is now expired.

7.28 A trade effluent discharge licence (DL(W)139) was granted by Sligo County Council in November 2011, following an application and submission of further information by the previous owner of the site Cemex (ROI) Ltd. The trade effluent discharge licence superseded some of the original water related planning conditions in PL 02/271.

7.29 The site was purchased by Lagan from Cemex (ROI) Ltd. in November 2014, and at that time none of the water monitoring/treatment infrastructure proposed in the discharge licence application (October 2010) and further information submitted (September 2011) had been installed by Cemex.

7.30 Lagan formally notified Sligo County Council on 28th May 2015 that the site had been acquired from Cemex on 28th November 2014 and that the quarry closed from that date. Since the quarry was inactive and the only discharge from the quarry was clean groundwater/rainwater to prevent the quarry from flooding, it was proposed by Lagan to discontinue the environmental monitoring programme at the site until activities recommenced. It was proposed to give Sligo County Council 8 weeks' notice prior to commencement of activities at the site and the environmental monitoring programme would fully commence prior to activities re-starting at the site.

7.31 A new trade effluent discharge licence (DL(W)151) was granted by Sligo County Council in January 2020, following an application and submission of further information by Lagan – the documents submitted to Sligo County Council for the new discharge licence are included in **Appendix 7-3**. The new discharge licence replaces the previous discharge licence (DL(W)139).

Legislation

7.32 The Water Framework Directive (Directive 2000/60/EC) was adopted in 2000 as a single piece of legislation covering rivers, lakes, groundwater and transitional (estuarine) and coastal waters. Its objectives are to prevent further deterioration of and to protect, enhance and restore the status of all bodies of water with the aim of achieving at least good status by 2015, or later in some cases.

7.33 The Water Policy Regulations (S.I. No. 722 of 2003), Surface Waters Regulations (S.I. No. 272 of 2009, amended by S.I. No. 385 of 2015, S.I. No. 327/2012 and SI No. 77 Of 2019) and Groundwater Regulations (S.I. No. 9 of 2010, amended by S.I. No. 366 of 2016) are the principal instruments for determining the Water Framework Directive characterisation, monitoring and status assessment programmes.

7.34 The Surface Water Regulations set a wide range of environmental standards for Irish surface waters. The Groundwater Regulations establish environmental objectives for groundwater bodies and include groundwater quality standards and threshold values for the classification of groundwater and the protection of groundwater against pollution.

7.35 A non-exhaustive list of water legislation relevant to this assessment is listed below:

- Local Government (Water Pollution) Acts, 1977 (No.1 of 1997)
- Local Government (Water Pollution) (Amendment) Act, 1990 (No. 21 of 1990)
- European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003)
- European Communities Environmental Objectives (Surface Water) Regulations 2009 (S.I. No. 272 of 2009)
- European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010)
- European Communities (Drinking Water) Regulations 2014 (S.I. 122 of 2014)
- European Union Environmental Objectives (Surface Water) (Amendment) Regulations 2015 (S.I. No. 386 of 2015)
- European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (S.I. No. 366 of 2016).

Planning Policy and Development Control

7.36 The planning system is of central importance in protecting the water environment and meeting the objectives of the Water Framework Directive through the regulation of land-use and physical development.

7.37 Local Authorities develop forward planning policy (e.g. County Development Plans) and implement this policy through the development control process (i.e. the planning application system). The current County Development Plan for Sligo is effective from August 2017 (Sligo County Development Plan 2017-2023). Recent amendments to the Planning and Development Act (Planning and Development (Amendment) Act 2010) have required Local Authorities to introduce greater rigor into the planning system with respect to water management, including:

- a specific requirement that Local Authority forward planning policies support compliance with environmental standard required under the Surface Water and Groundwater Regulations
- a greater obligation to implement statutory planning guidance issued by Government (e.g. The Planning System and Flood Risk Management: Guidelines for Planning Authorities)
- greater integration between the planning system and protection/enhancement of ecological integrity and conservation objectives of Natura 2000 sites
- stricter control on quarries (Section 261A of the Amendment Act)
- the policies and objectives of all development plans must be aligned with the relevant River Basin Management Plan (implemented under the Water Framework Directive) and must include mandatory objectives for the promotion of compliance with WFD environmental standards for water.

7.38 Section 4.3.4 of the current County Development Plan for Sligo outlines the Council's approach to the development of quarries in Sligo. It states: '*The Council seeks to ensure that the extractive and concrete products industry operates in a manner that minimise the potential adverse impacts on the environment and local communities.*' It further states that: '*It is the policy of Sligo County Council to… ensure that extraction and associated processes are carried out in a sustainable manner, which minimises the impact on residential amenities, natural environment and water quality*'.

7.39 The development plan makes specific reference to a guidance document on quarries: '*In assessing development applications relating to existing or proposed quarries, the Council will take full account of the document 'Quarries and Ancillary Activities: Guidelines for Planning Authorities' (DoE, 2004).*' (listed in Section 7.35 below)

Guidelines

7.40 A non-exhaustive list of guidelines relevant to this assessment is listed below:

- EPA (2002) 'Guidelines on the information to be contained in Environmental Impact Statements'
- EPA (2003) 'Advice notes on current practice (in the preparation of Environmental Impact Statements)'
- Department of the Environment, Heritage and Local Government (2004) 'Quarries and Ancillary Activities, Guidelines for Planning Authorities'
- EPA (2006) 'Environmental Management in the Extractive Industry'
- IGI Guidelines (2013) 'Guidelines for the preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements'
- EPA (2015) 'Advice Notes for Preparing Environmental Impact Statements' (Draft)
- EPA (2017) 'Guidelines on the Information to be contained in Environmental Impact Assessment Reports' (Draft)
- WFD Pressures and Impacts Assessment Methodology, Guidance document No. GW5 (2004) 'Guidance on the assessment of the impact of groundwater abstractions'

Technical Standards

7.41 TMS holds Irish National Accreditation Board accreditation for surface water and groundwater sampling, complying with the following water sampling standards:

- I.S. EN ISO 5667-6:2016, 'Water quality – Sampling – Part 6: Guidance on sampling of rivers and streams (ISO 5667-6:2014)', National Standards Authority of Ireland
- ISO 5667-4:2016, 'Water quality – Sampling – Part 4: Guidance on sampling from lakes, natural and man-made', International Organization for Standardization
- ISO 5667-11:2009, 'Water quality – Sampling – Part 11: Guidance on sampling of groundwaters', International Organization for Standardization
- I.S. EN ISO 5667-3:2012, 'Water quality – Sampling – Part 3: Preservation and handling of water samples (ISO 5667-3:2012)', National Standards Authority of Ireland
- I.S. EN ISO 19458:2006, 'Water quality – Sampling for microbiological analysis', National Standards Authority of Ireland

Significant Risks

7.42 The potential for significant human health/environmental effects from activities connected to the proposed development is considered to be low because the site is regulated by the Conditions of the recently issued, 2020, reviewed Discharge Licence for the Site DL(W)151 (2020).

7.43 Potentially significant human health/environmental effects could result (in the worst case, with no monitoring or management) from accidental spillages on site, uncontrolled discharges to surface water and flooding. However, any potentially significant impacts identified as arising from the proposed development will be mitigated against with appropriate measures, which are clearly set out in DL(W)151, to ensure there are no significant human health/environmental effects from activities connected to the proposed development.

RECEIVING ENVIRONMENT

Study Area

7.44 The study area mainly comprises the previously permitted area of the existing quarry (shown in **Figure 2-1**), surrounding lands, processing area and the Aghamore Stream and Lough Gill (receiving waters).

7.45 The study area is highlighted on **Figure 7-4**.

7.46 EPA mapping for Status of the water features in the study area are as follows:

- Aghamore Stream (Garavouge_010) = Poor Status (attributed in the Bonet Sub catchment report available at https://catchments.ie/ as a January 2019 WFD Cycle 2 report entitled 'Catchment Sligo Bay & Drowse', Subcatchment Bonet_SC_030 (Code 35_10), which presents the known pressures and risks for the GARAVOGUE_010 as Forestry, Road Runoff and Wastewater. Sligo County Council, as the Local Authority, is fully aware of the quarry and robustly assessed its potential impacts in the procedure resulting in the recent grant of Discharge Licence DL (W)151 (2020) to the current operators and proposers of further workings at the site.
- Lough Gill SAC is 765m downstream of the quarry discharge point and mapped as Moderate Status and at Risk due to Forestry, Agriculture, Urban Wastewater, Domestic Wastewater, Invasive Species and extractive Industries (WFD Cycle 2 Sub catchment Report 'Catchment Sligo Bay & Drowse', Subcatchment Bonet_SC_030 (Code 35_10) January 2019). Given the importance of Lough Gill as a SAC and a Public Water Supply for Sligo and North Leitrim, the significance of this local attribute is noted.
- Cummeen Strand/Drumcliff Bay SAC and Cummeen Strand SPA form part of the Garavoge Estuary Transitional Waterbody (IE_WE_470_0100) which is 7km downstream of the quarry (downstream of Lough Gill) and mapped as Moderate Status (2013-2018) with the WFD risk currently under review – the significant pressures identified for the waterbody by the EPA are Anthropogenic pressures.
- Groundwater is a receptor. The area proposed for the deepening of the quarry void is mostly in the GSI mapped Carrowmore West Groundwater Body (IE_WE_G_0040) and the access roads and boundary screening berms are underlain by the GSI mapped Carrowmore East Groundwater Body (IE_WE_G_0042). Both mapped groundwater bodies are classified as Good Status 2013 to 2018 (EPA Envision map series https://gis.epa.ie/EPAMaps/Water). Of the total quarry void area on the west side of the local road, 110,000m^2 is mapped as being in the Carrowmore West Groundwater Body and the access road to the void and its associated screening berms occupy 50,000m^2, approximately, of the Carrowmore East Groundwater Body.
- Ballysadare Bay SAC and SPA forms part of the Ballysadare Estuary Transitional Waterbody (IE_WE_460_0300) is located 3.3km to the southwest and hydraulically downgradient of the quarry at its closest point and is mapped as Moderate Status (2013-2018) and at Risk due to Agricultural and Urban Wastewater pressures.

Baseline Study Methodology

7.47 The methodology used for the baseline study follows the guidelines and advice notes provided by the Environmental Protection Agency on Environmental Impact Assessments (May 2017), and the Institute of Geologists of Irelands guidelines for the preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (2013).

7.48 A combination of desk study and field study was used to establish the baseline conditions at the site. A wide range of water issues was considered under a number of headings including context, character, significance and sensitivities.

Context

7.49 Establishing baseline conditions is necessary to place the proposed development (and its likely impacts) within the context of the local/regional water environment. The description includes all relevant information about the existing water environment which could be impacted by the development, information such as surface water bodies, groundwater bodies, surface water and groundwater flow direction and relative magnitude of flow, private or public water abstraction points, areas at risk of flooding, known discharges to surface water or groundwater, habitat designations.

Character

7.50 A clear description of the character of the existing water regime is required to enable evaluation of any qualitative or quantitative impact. The description includes information such as groundwater levels and seasonal variation, groundwater flow direction, surface water and groundwater quality, extent of any flooding, aquifer characteristics and vulnerability, hydraulic characteristics, and flow regime, etc.

Significance

7.51 Any assessment of the significance of surface water and groundwater needs to evaluate beyond the boundary of the proposed development, as surface water and groundwater are part of a constantly moving hydrological cycle. The description of baseline conditions includes information such as water body status (surface water and groundwater) in relation to quality, water body status in relation to quantities, water use, the importance as a habitat/supporting a habitat, the local status in relation to flooding, etc.

Sensitivities

7.52 Changes in the natural surface water or groundwater regime, either qualitative (i.e. change in chemistry) or quantitative (e.g. dewatering) due to a development will depend on the sensitivity of the water environment and the scale and duration of the impact. The description of baseline conditions includes information on water quality, water levels, water volumes, water abstractions/discharges and future resource availability.

Sources of Information

7.53 The following sources of information have been consulted to establish the baseline hydrology and hydrogeology at and surrounding the site as part of the desk study:

- Groundwater Data Viewer, Geological Survey of Ireland website www.gsi.ie

- EPA Maps (WebGIS browser), Environmental Protection Agency website www.gis.epa.ie
- Catchment information, Environmental Protection Agency website www.catchments.ie
- 'Catchment Sligo Bay & Drowse', Subcatchment Bonet_SC_030 (Code 35_10) www.catchments.ie
- Surface water levels and flow, Environmental Protection Agency website www.epa.ie/hydronet
- National Flood Hazard Mapping, Office of Public Works website www.floodmaps.ie
- Preliminary Flood Risk Assessment Maps, The National Catchment Flood Risk Assessment and Management Programme, Office of Public Works website www.cfram.ie
- Flood Maps, Office of Public Works website www.floodinfo.ie
- Flood Estimation Methods, Web Portal of the Flood Studies Update Programme, Office of Public Works website www.opw.hydronet.com
- Office of Public Works (2018) 'Flood Risk Management Plan, Sligo Bay and Drowse'
- NPWS Map Viewer, National Parks & Wildlife Service website www.npws.ie
- OSI Map Viewer, Ordinance Survey of Ireland website www.maps.osi.ie/publicviewer
- Meteorological data, Met Eireann website www.met.ie
- Department of Housing, Planning and Local Government (2018) 'River Basin Management Plan for Ireland, 2018-2021'.
- Map of water mains, Sligo County Council (Water Services Section).
- EPA (2016), UGEE JRP Final Report 1: Baseline Characterisation of Groundwater, Surface Water and Aquatic Ecosystems.
- IFI (2012), Water Framework Directive Fish Stock Survey of Lough Gill, July 2011. Fiona L. Kelly, Lynda Connor, Emma Morrissey, Ciara Wogerbauer, Ronan Matson, Rory Feeney and Kieran Rocks. Inland Fisheries Ireland, Swords Business Campus, Swords, Co. Dublin.
- Thompson, E., Ryan, S. and Cotton, D.C.F (1998) 'Management Plan for the Lough Gill Catchment' for Sligo County Council. ISBN 0-948870-16-8.
- Environmental Impact Statement (2002) 'Quarry Deepening at Aghamore, Co. Sligo' Tom Philips and Associates
- Golder Associates report no. 10507150048/R02/A1 (2010) 'Discharge Licence Application Supporting Documents' 2010.
- Golder Associates report no. 10507150048.A0 (2011) 'Discharge Licence Application RFI' 2010.
- Previous Trade Effluent Discharge Licence DL(W)139 for the site, Sligo County Council.
- Abstraction Orders for the Foxes Den (Sligo WTP) and Moneyduff (Leitrim WTP).
- Tynan, S. (2018), Slides from the IEI NW Region Presentation: The 2015 Sligo Flood Event Winter 2015-2016 Flooding Co. Sligo. Characterisation and Potential Mitigation Measures. Suzanne Tynan, MSc. (Hydro), MSc. (Env Sci), PGeo. with the assistance of Sligo County Council, OPW and the residents and landowners at Carrowroe and Ballyfree.

- Information contained to support the successful grant of the current Discharge Licence Application (2019). SLR Consulting correspondence 'RE: Application for review of discharge licence Ref: DL(W)139 under Section 4 of the Local Government (Water Pollution) Act 1977, for Lagan Bitumen Ltd. at Aghamore Quarry, Aghamore Near and Carrownamaddoo townlands, Co. Sligo'. SLR ref. 190521.0501.00396.038.L.Rev0.Aghamore DL Cover Letter (7/8/2019)
- Technical detail presented in the Reply to the Request for Further Information to support the successful grant of the current Discharge Licence. 'RE: Request for Further Information in relation to review of discharge licence DL(W)139 for Aghamore Quarry Co. Sligo'. SLR Consulting correspondence ref. 191118.501.0396.038.R0.Aghamore DL FI.Rev1 (27/11/2019)
- Current Trade Effluent Discharge Licence DL(W)151, Sligo County Council (2020).

Field Survey / Monitoring / Inspection Works

7.54 Some off-site monitoring work was required in relation to the Aghamore Stream (sampling and channel survey) and Lough Gill (sampling), and monitoring wells installed outside the permitted area of the quarry in adjacent lands under the ownership of Lagan or with the permission of the landowner.

Initial Discharge Sampling

7.55 TMS collected a suite of monthly samples of the discharge from February to June 2016 (**Appendix 7-9**) prior to more detailed site investigation and monitoring.

Phase I Site Investigation

7.56 Site investigations comprising of drilling, geophysics and monitoring were completed over a 4-year period from July 2017 to March 2021.

7.57 The work was completed in phases.

7.58 There is also a body of baseline information from the previous owner's original application and operation of the site until the site was acquired by Lagan.

7.59 For the purposes of this application's Phase I, drilling commenced in 2017.

7.60 A monitoring programme for surface water and groundwater was then undertaken by TMS from June 2017 to July 2018. The scope of these site works was based on a review of the available information, the nature of the proposed development and the environmental sensitivity of the site. Nine boreholes were drilled and installed as monitoring wells to the north, east and south of the quarry (MW1-MW9). Two additional rotary cored boreholes were drilled as used as monitoring wells (MW10c, MW11). The locations of the monitoring wells are indicated on **Figure 7.1**. Summary details of the monitoring wells and borehole logs are provided in **Appendix 7-4**.

7.61 Dataloggers (Solinst Leveloggers) were installed in a number of monitoring wells to continuously record groundwater levels. Manual measurements were taken on site visits and used to verify datalogger levels.

7.62 Two electromagnetic flowmeters (Siemens SITRANS FM Mag8000) were installed on the two discharge lines running from the quarry sump pumps to the stream to monitor the volumes of water discharged off-site, their location is indicated on **Figure 7-2**. An ultrasonic-Doppler flowmeter (Unidata Starflow 6526H) was installed in the culvert upstream of where the quarry discharges to the Aghamore Stream to measure upstream flows.

7.63 A survey of the stream channel profile and culverts was carried out by DMC Survey in March 2018 from the quarry discharge point on the Aghamore Stream to Lough Gill 765m downstream.

7.64 Four rounds of surface water sampling were carried out, with samples being collected from the quarry discharge itself, upstream of the quarry discharge, downstream at two locations and from a headland in Aghamore Bay on Lough Gill. The surface water sampling locations are indicated on **Figure 7-2**. 2 No. rounds of groundwater sampling were carried out to characterise the background groundwater quality at the site.

7.65 Site visits were made on both wet and dry days to inspect quarry faces for inflows/seepages, evidence of karst features, bedrock fracture patterns, etc.

Additional Monitoring

7.66 Following the Phase I site investigation, additional monitoring continued from August 2018 to March 2019. Four additional rounds of surface water sampling and two rounds of groundwater sampling were carried out, as well as continued groundwater level and flow monitoring.

Phase II Site Investigation

7.67 A second site investigation and monitoring programme for surface water and groundwater were undertaken by TMS from August 2020 to March 2021 (Phase II). This investigation was to supplement the findings of the first site investigation and collect new information on the processing area of the site.

7.68 Five boreholes were drilled and installed as monitoring wells within the quarry along the access road (MW12, MW13, MW14) and on the northern boundary (MW18, MW19). Nine shallow boreholes were drilled and installed as monitoring wells within the processing area. The locations of the monitoring wells are indicated on **Figure 7.1**. Summary details of the monitoring wells and borehole logs are provided in **Appendix 7-4**.

7.69 Four rounds of surface water sampling were carried out, with samples being collected from the same locations as in the first site investigation, plus upstream and downstream of the infilled area located upstream of the site at Lough Nameenbrack (i.e. reclaimed land surrounding Lough Nameenbrack). The surface water sampling locations are indicated on **Figure 7-2**. One round of groundwater sampling was carried out of all monitoring wells on site.

7.70 Groundwater level and flow monitoring for the quarry was continued, with additional dataloggers installed in the new monitoring wells in the processing area.

7.71 Two biological assessments of the Aghamore Stream were carried out by TMS in September and November 2020. The first biological assessment examined surface water quality upstream and downstream of the quarry discharge, the second assessment looked at surface water quality in the Aghamore Stream at five different locations. The TMS biological assessment reports are provided in **Appendix 7-5**.

7.72 A geophysical survey of the quarry floor and land to the northeast of the quarry was carried out by APEX Geophysics in January 2021 to determine if any weathered or karst zones were present in the bedrock. The APEX geophysical report is provided in **Appendix 7-6**.

Hydrology

Rainfall & Evaporation

7.73 The nearest active weather station to the site is Markree Castle Automatic Weather Station (synoptic station), c. 6km to the south at a similar elevation to original ground levels at the application site of 34mOD. An historic weather station (Lough Gill, voluntary station, elevation 15mOD) was located c. 1.2km to the east of the site however this station ceased recording in July 2017.

7.74 The annual average rainfall at Markree for the 1981-2010 period is 1,260mm/year. Wind is not recorded at Markree therefore evaporation and evapotranspiration are not calculated for this station by Met Eireann.

7.75 The neareast two synoptic stations to the site are Knock Airport (c. 42km to the southwest) and Finner Camp (c. 32km to the northeast). Long term averages are unavailable for these stations however the average potential evapotranspiration and evaporation as calculated by the Penman-Monteith equation are 551mm/year and 784mm/year respectively for Finner Camp from 2018-2020, and 467mm/year and 684mm/year respectively for Knock Airport from 2018-2019. Taking the average of these records, the estimated potential evapotranspiration and evaporation for the site are 509mm/year and 734mm/year.

Drainage

7.76 The site is located at the top of a low hill at an elevation of c. 30mOD, with a gentle topographic slope away from the site to the north, west and south; the topographic gradient to the east is slightly steeper, into a wide shallow valley between the site and the Slieve Dargan/Slieve Daeáne Mountains, trending northeast-southwest.

7.77 The site lies in the Sligo Bay & Drowse Catchment, on the boundary of two sub-catchments: the Bonet Sub-Catchment to the east and the Carrowgobbadagh Sub-Catchment to the west. Drainage in the Bonet Sub-Catchment is towards Lough Gill, and drainage in the Carrowgobbadagh Sub-Catchment is towards the coast (Ballysadare Bay). The locations of these catchments are indicated in **Figure 7-3**.

7.78 There is only one river in the vicinity of the site. An unnamed stream, referred by the EPA as the Garravogue_010, and in this assessment as the 'Aghamore Stream', lies c. 300m to the east of the quarry void (**Figure 7-4**) and drains water from Lough Nameenbrack (c. 450m to the southeast of the quarry) to Lough Gill (c. 765m to the northeast of the quarry discharge point). There are several culverts downstream of the site along Aghamore Stream under local roads, details of the culverts and their locations are provided in **Figure 7-27** and **Figure 7-28**. One of these culverts extends to 80 metres in length.

7.79 Further to the east and southeast, a few small streams drain the uplands of the Slieve Dargan/Slieve Daeáne Mountains towards Lough Gill.

7.80 There are no active hydrometric stations in the immediate vicinity of the site. An historic gauging station (station no. 35045) maintained by Sligo County Council was located on the Aghamore Stream close to Lough Gill and consisted of a staff gauge with periodic spot flow measurements only between 1996 and 2004.

7.81 The most significant surface water body in the vicinity of the site is the Lough Gill SAC (Site Code 001976) and Public Water Supply Source to Sligo and Leitrim. There is an EPA hydrometric gauge on Lough Gill (EPA HydroNET Stn. 35073) and a record of water levels on the lake is available for the 1971 to 2021 period. Weir control of the lake's water level is an important part of the management of the lake for Irish Water's PWSSs. Lough Gill's EPA Stn. 35073 is1.2km, approximately, north of where the Aghamore Stream discharges into Lough Gill. Long-term records (**Figure 7-5**) show that lake water levels rarely rise above 4.4mOD at this station, however levels as high as 5.285mOD have been recorded. Ground levels in the land adjacent Lough Gill in Aghamore Far slope from c. 5mOD to <4mOD close to the lake, showing the potential for flooding in this area.

7.82 The capacity of Lough Gill (bathymetry) was presented by the EPA (2016) and the information is used in this assessment.

7.83 The information presented in the EPA Water Maps Envision map-based database (https://gis.epa.ie/EPAMaps/Water) was employed for evaluation of the site in the context of river and lake network information as well as the drainage directions, catchment and subcatchments, status and risk information for the surface water systems.

7.84 Given that this is a study for a proposal in a Karst aquifer setting, historic information for the EPA hydrometric station at the discharge record for the Tobernalt spring (EPA HydroNET Stn. 35046) was also considered in the assessment of drainage in the wider area. The Tobernalt spring discharges at a distance of 1km north east of the site at an elevation of 4.305 mOD. It is unlikely that the groundwater regime at the quarry site and Tobernalt spring are connected given that the understanding is that the Tobernalt spring receives flow from either the west or north rather than from the southerly location of the quarry. However, the evaluation of the available Tobernalt spring discharge record (2013 to 2021), relative to the current -21mOD floor elevation at the site was deemed useful in the development of an understanding of the region.

7.85 The work reported by Tynan (2021) for this assessment and in a previous presentation of the Sligo groundwater flooding assessments were also consulted for the purposes of developing an understanding of the integrated drainage system incorporating the surface water and the groundwater regimes. The drainage to karst features north and west of the site is described by Tynan (2021). The drainage systems are understood to react quickly to rainfall because the shallow epikarst dominates responses, from which we infer limited capacity of the bedrock to accept rainfall recharge at certain locations in the Sligo peninsula.

Flooding

7.86 The Office of Public Works (OPW) maintains records of past flooding events which were collated as part of the National Flood Hazard Mapping programme.

7.87 No flood events are recorded by the OPW in the vicinity of the quarry site, however the Aghamore Stream is indicated as prone to recurring flooding further downstream at the crossroads of the N287 and the small road leading to the quarry, c. 380m downstream of the quarry discharge. This is a common reaction when a bridge presents a constraint to flow. An area engineer's report from November 2005 indicated that the R287 road was prone to flooding at this location during heavy rain where Lough Gill water levels swell and prevent runoff to the lake. A flooding event on the R287 at this location was recorded in November 2009 where the road was recorded as passable.

7.88 The Preliminary Flood Risk Assessment maps for the area (No. 351 and No. 368 – see **Appendix 7-7**), produced by the OPW as part of the early work on the Floods Directive in 2011, suggest that the Aghamore Stream would be liable to flood a narrow zone along its channel from Lough Nameenbrack to Lough Gill following an extreme rainfall event, and Lough Gill would be liable to flood the low-lying lands adjacent the lake as far as the N287 road. Several isolated pockets of pluvial flooding are predicted to occur across the lands within 2km of the quarry.

7.89 There are two areas close to the quarry prone to groundwater flooding; Geological Survey of Ireland (GSI) historic groundwater flood mapping (**Figure 7-6**) shows a low-lying area c. 350m to the north of the quarry in the townlands of Cuilbeg/Aghamore Near that has a history of flooding, and another low-lying area c. 700m to the northwest of the quarry in the townland of Tullynagracken South with a history of flooding. These features are described by the GSI as possible turloughs. The GSI groundwater flooding map is primarily based on the winter 2015/2016 flood event, which in most areas represented the largest groundwater flood event on record. Tynan's work (reported here in **Appendix 7-2**) has included both these groundwater flood zones, as well as the discharges from the only swallow hole in the peninsula, to springs north and west of the quarry. Refer to Tynan (2021), **Appendix 7-2**) for more detail. Tynan's (2021) contribution to the project was integrated to develop the understanding of the potential for the site to contribute to the known groundwater flood triggers in the lands surrounding and downgradient of the site. Tynan's (2021) report to this assessment details the elevation range of the active epikarst as operating between 0mOD and 22 mOD. While Tynan (2021) acknowledges that there could be deeper karst systems underlying Lough Gill, work completed by APEX (2021) under the current floor of the Aghamore Quarry void from its current floor level of -21mOD to an investigation depth of -60mOD (i.e. 10m below the proposed future excavation depth of -50mOD) found no evidence of karst conduits or systems under the existing quarry floor.

Quarry Water Management

Quarry

7.90 As previously stated, the site's water management and consequent discharge has recently been reviewed and a new licence was issued by Sligo County Council [DL(W)151, 2020].

7.91 Conditions of the recent licence specify control measures for the management of waters arising at and discharged from the site.

7.92 Defensible and justifiable Emission Limit Values (ELVs) for the quantity and the quality of the discharge have been prescribed in DL(W)151 (2000) cognisant of the importance of the ultimate receiving water, which is Lough Gill SAC and PWSSs.

7.93 The Conditions of the DL(W)151 [2020] licence specify the controls on the water management systems at the site for oils, waste management, accidents, and emergency situations. The discharge licence application and the Response to Further Information (SLR, 2019) presents the technical detail that facilitated the successful grant of the reviewed licence by Sligo County Council in the regularisation of activity at the site.

7.94 The current water management within the quarry involves pumping a combination of rainwater and groundwater from the quarry floor directly to the Aghamore Stream. This is an interim measure agreed with Sligo County Council as there is no activity on site and no sources of potential water pollution remain within the quarry void (see Section 7.24).

7.95 Incidental rainwater and groundwater seepages entering the quarry drain across the quarry floor to a sump located in the southern corner. One electric 37kW submersible pump is currently operating in the sump. The pump operates on float switches and discharge directly to the Aghamore Stream via a 160mm uPVC pipeline. The discharge point at the Aghamore Stream is c. 330m east of the quarry void – refer to **Figure 7-2**.

7.96 The submersible pump pumps at a constant c. 32l/s, which is approximately equivalent to 2,765 m3/d in the context of DL (W)151's ELV of 3,500m3/d). However, that one pump is not able to keep the quarry floor dry during the wetter months (c. November to April/May). The quarry floor is allowed to flood during these months as there is no requirement to keep the quarry floor dry while the quarry is inactive (**Plates 7-1 and 7-2, Appendix 7-8**).

Processing Area

7.97 Rainfall across the processing area infiltrates the permeable subsoils (sands), which underlie this area of the site (**Plates 7-3 and 7-4, Appendix 7-8**).

7.98 There is currently no point discharge arising from the processing area of the site (located to the east of the public road) as this area of the site is also inactive. Any historical discharges arising from the processing area would have originated from the wash-water associated with concrete production activities. This plant has not operated since the site was purchased by the applicant from Cemex (ROI) Ltd. in 2014 and is now obsolete. The applicant does not intend to recommence the production of concrete products at the site.

7.99 There will be no point discharges arising from the processing area of the site at any point in the future. Consequently, there will be no requirement for the treatment and disposal of run-off and wastewater from the processing area of the site.

7.100 Any surface water run-off arising from the processing area will continue to naturally infiltrate to ground. These lands are underlain by sand and gravel material with a significant unsaturated zone.

Discharge to Surface Water

7.101 As previously stated, the site holds a new discharge licence, issued by Sligo County Council, in 2020 [DL(W)151, 2020].

7.102 Historically, the site's previous owners (Cemex) held a Trade Effluent Discharge Licence (TEDL) for the site, which was issued by Sligo County Council in December 2011 (DL(W)139) to enable discharge water from the quarry to the Aghamore Stream, subject to conditions. The site was in the ownership of Cemex at the time the licence was granted.

7.103 Analysis results for samples of discharged water pre-Lagan are contained in the licence application documents submitted to Sligo County Council in 2010/2011 (**Appendix 7-9**). These results show that there are historically, slightly, elevated concentrations of Biological Oxygen Demand (BOD) and Molybdate Reactive Phosphorus (MRP) above levels that would be desirable in a river, which lead to the proposed water treatment infrastructure in the licence application documents.

7.104 TMS collected a suite of monthly samples of the discharge from February to June 2016 (**Appendix 7-9**); the results mostly show compliance with all parameters of significance. However, there are occasional detections of BOD concentrations above the historic TEDL emission limit values. However, as there was no activity on site at the time, these elevated concentrations are considered to be related to background groundwater quality in the groundwater seeping into the quarry from surrounding agricultural lands. Recent sampling in 2018-2020 shows occasionally elevated BOD concentrations up to 10.32mg/l O_2 in groundwater samples from outside the quarry void (**Appendix 7-10**). This supports the conclusion of impact outside the area controlled by the operators. BOD concentrations of 10mg/l suggest mild agricultural impacts.

7.105 The most recent samples of the discharge collected from 2019-2021 as part of the monitoring for this assessment show most parameters below the specified Emission Limit Values for the site with occasional isolated exceedances of BOD, total ammonia and orthophosphate (**Appendix 7-9**). Again, the influence of agriculture, wastewater discharges and forestry are understood to contribute loadings to the site.

7.106 A programme of surface water monitoring is currently ongoing at the site, which includes sampling of the quarry discharge, sampling of the Aghamore Stream upstream and downstream of the discharge (**Figure 7-2**) and monitoring discharged flows and streamflows in the Aghamore Stream. The full environmental monitoring programme will resume on site prior to activities recommencing, as notified to Sligo County Council in 2015 (see Section 7.24).

Surface Water Quality

7.107 The most recent surface water sampling events span between January 2018 and March 2021 as part of the ongoing monitoring programme on site (**Appendix 7-11**).

7.108 Samples were collected from the quarry discharge, upstream and downstream of the quarry discharge, further downstream before the discharge point to Lough Gill and from a headland in Aghamore Bay on Lough Gill (ITM coordinates 571924, 832411). The sampling locations are presented in **Figure 7-2**.

7.109 Background water quality in the Aghamore Stream in these samples is generally quite good. However, there are some occasions of elevated faecal bacteria and traces of total ammonia and orthophosphate typical of runoff from an agricultural catchment. Aluminium was slightly elevated above the drinking water limit on one occasion only (26/8/2020) upstream of the site related to background water quality. All other parameters for background quality adhere to the requirements of the Surface Water Regulations' Environmental Quality Objectives and other relevant water quality standards. Total ammonia levels are mostly below these standards. Occasional instances of elevated BOD above the assessment criteria are recorded upstream of the quarry discharge and thus related to background quality.

7.110 The only parameters that exceed the Surface Water Environmental Quality Standards downstream of the discharge are single occurrences of slightly elevated mercury in November 2018 (0.2µg/l) and nickel (125µg/l) in January 2019. The slightly elevated mercury in November 2018 is also seen in the discharge (0.077µg/l), but neither parameter is elevated in samples further downstream at the bridge before Lough Gill, suggesting that the sampling location downstream of the discharge is within the mixing zone of the discharge and not far enough downstream (c. 30m) to represent fully mixed downstream concentrations. Traces of mercury and nickel are occasionally seen in groundwater surrounding the quarry, most likely as a result of either chemical fertilizers in the agricultural lands adjacent the quarry or atmospheric deposition from coal burning – there are no sources of mercury or nickel within the quarry itself.

7.111 Coliform bacteria (including *E.coli*) exceed the Drinking Water Parametric Values both upstream and downstream of the discharge and this is related to poor background bacterial quality in both the stream and in groundwater surrounding the quarry – there are no sources of coliform bacteria within the quarry. Levels of faecal bacteria and ammonia are higher in the upstream samples than the downstream samples which supports the hypothesis that agricultural activity is the dominant influence on water quality in this stream.

7.112 The effect of the quarry discharge is noted downstream of the discharge, with slightly raised conductivity, calcium and sulphate attributed to the residency in the flooded floor because of the inactivity at the site. BOD and orthophosphate levels are acceptable and adhere to the requirements of the Discharge Licence and the Surface Water Regulations. There is no change in water quality between the samples downstream of the discharge and before the stream enters Lough Gill, indicating no impact arising from the quarry and no further discharges downstream.

7.113 Regionally, the status of the Lough Gill lake waterbody is considered to be 'at risk' of not meeting the requirements of the WFD and accordingly Lough Gill is named as one of the 190 Areas of Action identified in the River Basin Management Plan 2018-2021 for better targeting of existing measures and the addition of supplementary measures to prevent deterioration and achieve the WFD objectives for the waterbody. The 'At Risk' status of Lough Gill is for reasons other than the quarry.

7.114 Two biological assessments of the Aghamore Stream were carried out by TMS in September and November 2020 (**Appendix 7-5**). The first biological assessment examined surface water quality upstream and downstream of the quarry discharge, and determined a Q-Value of 3-4 (slightly polluted) for both upstream and downstream of the discharge indicating that the discharge was not having a deleterious effect on the biological quality of the stream. The second assessment looked at surface water quality in the Aghamore Stream at 5 No. different locations and determined a Q-Value of 3 (moderately polluted) for all locations sampled. Note: these determined Q-Values are most likely artificially lower than if the survey was done during April-September due to the absence of the more ephemeral macroinvertebrates which are unlikely to be present in the winter months.

Hydrogeology

Geology

7.115 The geology of the site is discussed in detail in Chapter 6 and by Tynan (2021) in Appendix 7-2.

7.116 In summary, the upland area surrounding the quarry is underlain by thin glacial till deposits overlying bedrock; deep well draining mineral soils have developed over the till, with poorly drained gleys developing in some low-lying areas (**Figure 7-7** and **Figure 7-8**). Gravels occur within the overburden in the shallow valley to the east, between the quarry and the mountains, i.e. within the processing area. The depth to rock varies from c. 2.5-4m below ground level, a thin weathered zone occurs at the top of bedrock (**Plate 7-5, Appendix 7-8**). Bedrock is made up of well-bedded to massive dark grey micritic limestone of the Dartry Limestone Fm. (**Figure 7-9**). Chert bands and 'vuggy' cavities infilled with calcite crystals delineate bedding in the more massive beds (**Plates 7-6 to 7-9, Appendix 7-8**). Colonial corals occur within the limestone beds as isolated concentrations which are laterally discontinuous (**Plates 7-10 to 7-13, Appendix 7-8**).

7.117 Regionally, the site is located on the southern limb of a gentle syncline, whose limbs dip gently c. 5^{o} and whose axis trends northeast-southwest, bounded to the south by a major northeast-southwest trending fault separating the Carboniferous limestones from the Dalradian metamorphic rocks of the Ox Mountains inlier.

7.118 Permeability within the limestones is entirely related to fracturing, there is no primary permeability in the limestone matrix. The dominant structural element within the quarry which influences groundwater flow is the orientation of bedding planes. Examination of quarry faces shows that there is a consistent low dip (8^{o}-18^{o}) on bedding planes across the quarry to the northwest - this agrees with ground lineations seen in aerial photographs on adjacent lands outside the quarry (Figure 7-9). No evidence of the folding suggested by O'Neill Groundwater Engineering in the 2002 EIS was seen on examination of the quarry faces. Sub-vertical joints are present which link groundwater flow along bedding plane fractures in the vertical plane.

7.119 A single large sub-vertical fault is noted in the east of the quarry (**Plate 7-14, Appendix 7-8**) and in the southeast, most likely a continuation of the same fault. The fault zone is linear, trending northwest-southeast, and is clay filled, extending vertically from the top of bedrock to the quarry floor. A small clay-filled channel at the top of bedrock occurs close to the fault which may be related (**Figure 7-10**).

7.120 Site investigation across the processing area has shown >10m of sands/gravels (**Appendix 7-4**). Regional mapping by the GSI indicates these sands/gravels are fan deposits (Aghamore Fan) produced by the melting of ice at the end of the last glacial period.

Regional Hydrogeology

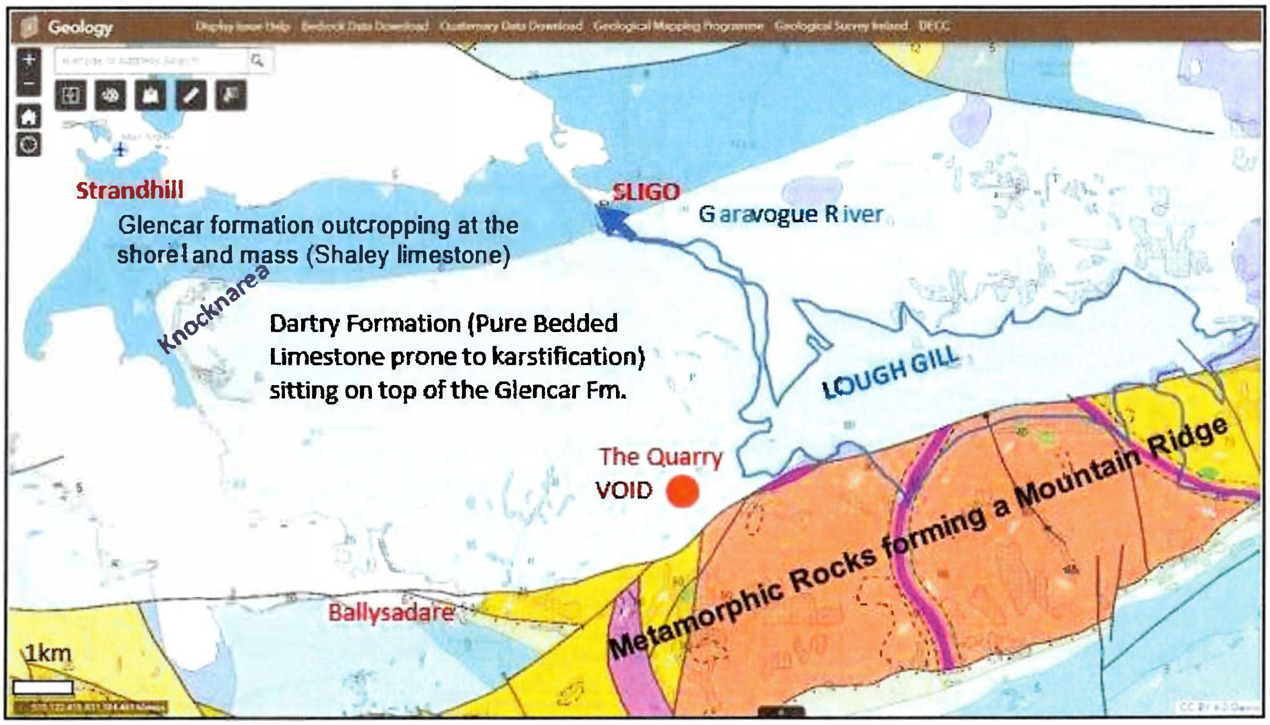
7.121 The regional hydrogeological setting of the site is discussed in detail by Tynan and Bartley (2021) in **Appendix 7-2**.

7.122 Bartley (**Appendix 7-2**) summarises as follows:

"The intensively studied Karst in the peninsula is highly active but relatively shallow compared to

the walls of the void and the floor of the quarry. The regional karst system in Sligo and around the quarry seems to be dominated by its epikarst. For purposes of clarity, epikarst means the weathered top layer of the limestone bedrock and it is in direct contact with the overlying subsoil cover of the landscape over rock. Epikarst is considered a critical link between rainfall and transport of water to the deep aquifer. In the Sligo peninsula the quarry is situated in the south east corner. The peninsula encompasses land from the site, around the western edge of Lough Gill, up northerly to Sligo town, heads west to Strandhill behind Knocknarea, down south to Ballysadare and its bay and back over east to the quarry, the land elevation is generally around 30 – 40m OD and it rises to heights at Knocknarea. Almost all of the quarry sits within the Darty Limestones, which is most probably underlain somewhere at depth with the muddier Glancar limestones. The quarry sits on the boundary of the limestones with the paragneisses of the Killery Mountain band to the South East of the site. Paragneiss is a metasedimentary rock with a gneissic texture; a gneiss is formed by the metamorphism of a sedimentary rock. The geology is better explained in the introduction of Tynan's (2021) report attached. However, simply, the regional structural geology is most easily understood with reference to a pictorial representation of the general GSI mapping for Bedrock for the region, as presented in Plate 7-1, in which I have marked the location of the quarry and Lough Gill. The reason the geology is important is because it controls the karst. You can see from Tynan's Figure 1 for the regional geology and karst that the surface water features are related to the boundaries of the different rock types."

PLATE 7-1 **Regional Geology (www.gsi.ie) with Annotations for the purposes of communication**



Karst

7.123 Regional mapping of karst features by the GSI has noted karst features (enclosed depressions/dolines, springs, swallow holes) in this bedrock formation further to the west of the site (**Figure 7-11**), however few features are recorded in the immediate vicinity of the quarry. Apex (2021) found no evidence of karst features beneath the floor of the quarry (survey depth to -60m OD).

7.124 The existing quarry provides a large cross-section of the bedrock formation down to a depth of -21mOD but shows little evidence of karst solution features. No karst conduits are present within the quarry. Evidence of solution weathering of fossils within the massive limestone beds has been noted (Section 7.90), however these cavities are not connected and do not form enhanced permeability within the rock. Examination of quarry faces and the results of the geophysical investigation (**Appendix 7-6**) show a thin (c. 5-10m) weathered zone at the top of bedrock (epikarst) across the quarry area.

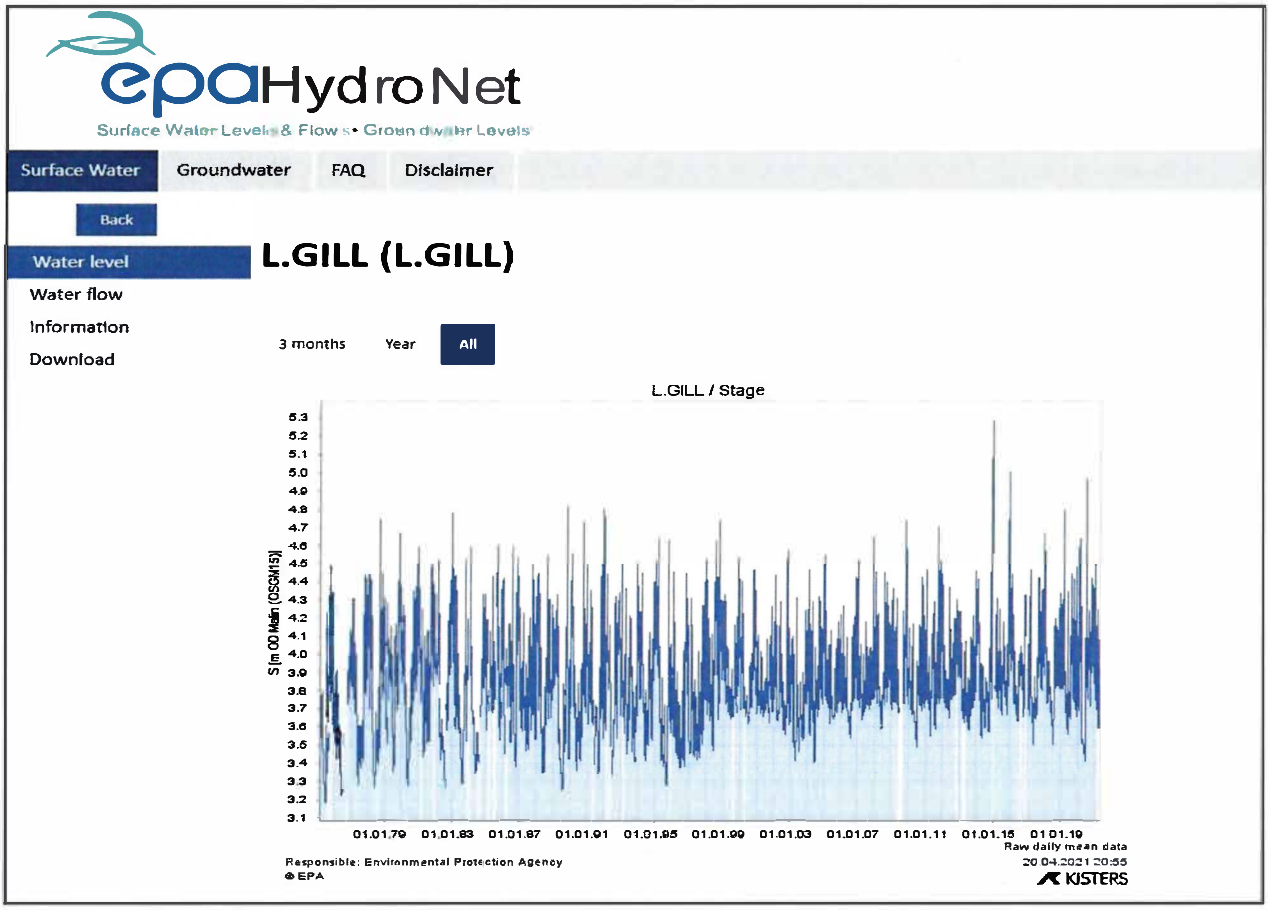
7.125 A desk survey of potential karst features in the vicinity of the quarry was undertaken as part of the Phase II investigation and very few features are identified (**Appendix 7-12**); the probable turloughs to the north and northwest of the quarry are the most significant features in the vicinity.

7.126 In response to Irish Waters request that the site evaluate the potential for karst in more detail, Tyan's work in the area was evaluated in detail. Bartley (**Appendix 7-2**) summarises as follows:

> *"With reference to the significance of the Karst, there is only one swallow hole system in the entire peninsula, located centrally in the Dartry formation (Refer to Tynan's Figure 1, 2021). Tynan refers to there being two adjacent swallow holes 'Ballyfree' and the GSI has this mapped as the 'Tonafortes Sink'. The mouth of this sink at the land surface has an elevation of 20mOD, approximately. Tynan's detailed studies of the rainfall response of the regional karst system includes, amongst much more fieldwork, continuous quantification of the volume of water flowing into Ballyfree (swallow holes) and relating it to concurrent rainfall and continuous monitoring of the spring discharges at Tobernaveen (15mOD, approximately) and Carrowbodogagh (5m OD approximately) [Diagram 1 and Figure 3 Tynan, 2021]. That underground flow goes in opposite directions from Ballyfree: to the NW and the SE and discharges from the Tobernaveen and Carrowbodogagh Springs, respectively. The discharge responses at the springs are rapid and therefore suggests that a relatively shallow, rainfall dominated, epikarst system plays a massive role in the hydrogeology of the area immediately west of the quarry. Tynan's Diagram 1 (2021, Appendix 7-2 to this Water Chapter) annotates the regional conceptual flow system with flow arrows for epikarst and deep karst flows. The 'deep' flows depicted, which Tynan refers to as conduit, are above the 0mOD elevation.*
>
> *It was therefore a long time ago that the original perimeter ground level at the quarry was brought from 30mOD, approximately, to its current floor elevation at -21mOD. It was a long time ago that excavations at the quarry at Aghamore had potential for interception with the known, well studied (Tynan 2017 – 2018), active, often conduit type, active epikarst zone from 20mOD at surface to 0mOD at discharges. The floor's void is now at -21mOD. It is therefore suggested that the time for*

big water strikes has long passed. Long ago is the time when impact would have been experienced if it were a thing. The EPA Hydrograph for 50 years of Lough Gill's water levels tell no story of any impact at any time (Plate 7-2)."

Plate 7-2 Lough Gill's Water Level Elevation (EPA HydroNET Stn. 35073): 1971 to 2021



Aquifer Classification

7.127 The Dartry Limestone Fm. is mapped regionally by the GSI as a Regionally Important Karstified Bedrock Aquifer, dominated by conduit flow (Rkc)(**Figure 7-12**).

7.128 The gravels in the shallow valley underlying the process area, to the east of the quarry void, are not classified by the GSI as an aquifer, due to the limited extent of the deposit (0.53km^2). Regionally Important Gravel Aquifers usually cover an area of >10km^2 and Locally Important Gravel Aquifers usually between 1-10km^2. Groundwater in the gravels is believed to be in hydraulic continuity with groundwater in the limestone bedrock and discharges to Lough Gill to the northeast.

7.129 As part of the implementation of the Water Framework Directive (WFD) in Ireland, Groundwater Bodies (GWBs) were delineated across the entire country. The GWB is the management unit under the WFD necessary for the subdivision of large geographic areas of aquifer in order for them to be effectively managed. Similar to the surface water catchments, the quarry straddles the boundary of two GWBs: the Carrowmore West GWB to the west, and the Carrowmore East GWB to the east (**Figure 7-13**). A detailed description of the GWBs is provided in **Appendix 7-13**.

Aquifer Characteristics

7.130 Yields from boreholes in regionally important bedrock aquifers are typically >400m^3/d (4.6l/s). Yield tests on the boreholes drilled as part of this assessment were orders of magnitude lower than this (3-49m^3/d), the only exception was MW3 which hit significant groundwater inflows in a collapsing fracture zone (c. 400m^3/d) which may/may not have been laterally continuous. The significant inflow was noted at an elevation of -24.5mOD and the collapsing fracture zone was encountered at an elevation of -33.5mOD where the borehole was terminated. MW3 is located c. 150m to the northeast of the quarry void (see **Figure 7-1**) within the zone of drawdown surrounding the quarry void.

7.131 Yields within the limestone bedrock (below the epikarst) tended to increase gradually with depth once below the level of the water table (**Appendix 7-14**), suggesting the permeability is not related to a single flow-zone but a diffuse flow through fractures.

7.132 Two rotary cored boreholes (MW10c and MW11) were drilled to recover rock core and measure the permeability of the limestone at different intervals with depth (packer tests). The core results show a consistently high fracturing with depth (average fracture index of 5 fractures per 1m of core) and packer tests suggest a consistently low permeability with depth (**Appendix 7-15**) which indicates the absence of individual high-flowing fractures within the cored boreholes and the predominance of diffuse fracture flow within the deeper limestone. The packer tests were carried out during coring; once a 9m interval had been cored the coring assembly was withdrawn and the interval sealed and tested using a single inflatable packer. Results show a median permeability of 1.66 x 10^{-6}m/s (0.143m/d) for MW10c and 8.85 x 10^{-7}m/s (0.076m/d) for MW11. These permeabilities are not suggestive of karst conduit groundwater flowpaths. The slow recovery of water levels in the monitoring wells following groundwater sampling (e.g. MW4, MW10c) also suggests low permeability. Therefore, although bedrock at the site is classified regionally as a regionally important aquifer, evidence from the site investigations undertaken indicate that locally in the Aghamore area the limestone is of low permeability with poor well yields.

7.133 Groundwater inflows into the quarry are delineated by calcium-carbonate deposits on the quarry faces (yellow-white staining). Inflows tend to be diffuse through a network of bedding and joint planes, with more seepage in some areas than others (fracture controlled).

7.134 Shallow groundwater inflows to the quarry from the epikarst zone (c. top 5-10m of bedrock) are noted in 3 No. locations in particular within the quarry: the northwest corner (**Plates 7-15 to 7-17, Appendix 7-8**), the northeast corner (**Plates 7-18 and 7-19, Appendix 7-8**) and the southwest corner (**Plate 7-20, Appendix 7-8**). These locations are indicated on **Figure 7-14**.

7.135 One groundwater inflow was noted on the quarry floor at the base of a quarry wall (**Plate 7-21, Appendix 7-8**); the inflow was elongate and is resultant from flow along bedding planes rising into the quarry void. It is not believed to be connected to the fault in the east of the quarry as it does not fall along the trend of the fault.

7.136 The drawn-down water table level behind the quarry face occurs within the bottom 5-10m of the existing quarry floor. Temporary seepages are noted higher than this in the quarry faces and this related to rainwater that has infiltrated through the overburden in the areas adjacent the quarry and is flowing along bedding planes above the saturated zone into the quarry (i.e. recharge). Observations during site visits note relatively strong seeps higher up in the quarry faces in the days following heavy rainfall; these seeps progressively 'switch off' in vertical order during prolonged dry spells and reflect shallow recharge and seepage from the epikarst. These observations concur with the region's groundwater flooding experiences studied and reported by Tynan (2021) (**Appendix 7-2**).

Water Balance

7.137 A water balance has been carried out to estimate the quantity of groundwater input to the quarry over a period of time of falling water levels in the quarry lake (**Appendix 7-16**). Total inputs of water to the quarry void (rainfall, runoff, epikarst inflow, deeper groundwater inflow) have been compared with total outputs (pumping, evaporation), plus changes in storage within the flooded floor of the void. The groundwater component was estimated by iteration to balance inputs/outputs.

7.138 The main inputs of water to the floor of the quarry are rainfall/runoff and drainage from the epikarst; the stormwater catchment and epikarst drainage catchment to the quarry is shown in **Figure 7-14**. The epikarst drainage catchment is estimated based on topography as the epikarst appears to mirror topography. This is clearly presented in Tynan's Cross- Section (Tynan 2021, **Appendix 7-2**).

7.139 The results of the water balance indicate that, for the period considered (26th January to 9th April 2021), the largest input of water to the quarry was from direct rainfall/runoff (71%), with indirect drainage via epikarst accounting for 19%, and deeper groundwater inflows making up only 10%. (Appendix 7-16).

Groundwater Vulnerability

7.140 The vulnerability of groundwater to potential contamination from surface activities is related to the ease with which water moves vertically down from the surface to either the water table (if within the bedrock) or top of rock (if overlying subsoils are saturated). Groundwater vulnerability is largely driven by the permeability and thickness of the subsoils overlying bedrock. Groundwater vulnerability has 4 categories: Extreme, High, Moderate and Low.

7.141 GSI regional mapping of groundwater vulnerability is indicated in **Figure 7-15**. The area of the quarry where rock has been exposed at the surface is categorised as extremely vulnerable (i.e. no protection from potential pollution), all other areas are categorised as highly vulnerable due to the thin cover of moderately permeable subsoils; site investigation results indicate cover of 2.5 to 4m.

Groundwater Recharge

7.142 A methodology for making initial estimates of groundwater recharge in Ireland was developed by the GSI on a regional scale by first calculating the effective rainfall (rainfall minus evapotranspiration) and then applying a recharge coefficient to indicate the proportion of the effective rainfall that recharges groundwater. The recharge coefficient is mainly determined by the permeability and thickness of the overlying superficial deposits (subsoils) as well as the ability of the underlying aquifer to accept the percolated water. Groundwater recharge mapping is therefore closely linked to vulnerability mapping.

7.143 The GSI groundwater recharge map for the area (**Figure 7-16**) would suggest an annual rate of recharge of 542mm/year for the upland surrounding the quarry, based on an effective rainfall of 903mm/year, a recharge coefficient of 60% and no recharge cap for the aquifer.

7.144 GSI mapping presents rainfall, effective rainfall and groundwater recharge values for the country. The GSI database for the quarry void site suggests as follows:

Table 7-1 Recharge Details (GSI)

Effective Rainfall	829.2
Recharge Coefficient (%)	85
Average Recharge (mm/yr)	705
Recharge Cap Apply	N
Subsoil description	Bedrock outcrop and subcrop
Groundwater Vulnerability	Extreme (X)
Groundwater Vulnerability description	Rock at or near Surface of Karst
Hydrogeological Setting Description	E Vul: Areas where rock is at ground surface or karst feature
Bedrock Aquifer Category	Rkc
Bedrock Aquifer Description	Regionally Important Aquifer - Karstified (conduit)
Rock Unit Group	Dinantian Pure Bedded Limestones

7.145 The GSI database for the area's surrounding the site as follows:

- To the immediate north and east of the site: groundwater recharge ranging from 474mm/yr to 498mm/yr;
- In the mountains to the south, which are classified as Poor Aquifer - Bedrock which is Generally Unproductive, Precambrian Quartzites, Gneisses & Schists, despite 805mm/yr rainfall mapped by the GSI, only 100mm is assigned to groundwater recharge. Therefore, 705mm is determined to be lost to evaporation, evapotranspiration and runoff from land and to watercourses.

- In the Glaciofluvial sands and gravels, whilst Effective Rainfall is mapped to amount to between 729mm/yr and 829 mm/yr, groundwater recharge is mapped to range from 671mm/yr to 701mm/yr.

7.146 Thus, the information available conveys the complexity of meteorological interaction with the various hydrogeological environments at and surrounding the site.

Groundwater Abstractions

7.147 The area surrounding the quarry is rural, with occasional farms and ribbon development of once-off houses along secondary roads. Sligo County Council has confirmed that the area is served by a mains water supply (**Figure 7-17**), with each of the public roads surrounding the quarry having its own water main; a well survey in the area was also completed. Most private houses in the area are built within the last 10-20 years and are connected to the mains water supply.

7.148 GSI well records are indicated on **Figure 7-18** and do not show any wells in the vicinity of the quarry, and there is no record of any groundwater sourced public supply or group scheme source protection area in the immediate vicinity of the quarry. As previously stated, it is Lough Gill surface water rather than groundwater that is the regional water supply source for Sligo (Foxes Den) and Leitrim (Moneyduff).

7.149 An updated survey of private wells within 1km of the quarry was carried out as part of the Phase II investigation and shows very few wells; the only private wells identified are indicated in **Figure 7-19**.

7.150 The closest well to the quarry was a disused farm well located on lands owned by a third party just south of the quarry site boundary, however the owner has confirmed that this well is now removed and his farm is served by the mains water supply.

7.151 Cemex (previous quarry operators) are reported to have installed a water supply well in the processing area. The well is not accessible, no information can be verified, it is reported it was used by Cemex for non-potable uses.

7.152 A pumphouse owned by Mr. Seamus McDaniel is located across the road from the entrance to the Top Coast Oil depot, c. 360m northeast from the quarry void. This pumphouse abstracts surface water from the Aghamore Stream via a pipe culvert, and therefore is not a groundwater abstraction.

7.153 The only other private wells identified in the area were a pumphouse c. 300m to the west of the quarry void owned by Mr. Noel Ward who confirmed that this well is not in use/inaccessible, and an old historic well-located c. 400m to the north of the quarry owned by the Mullane's who also confirmed that the well is not in use/inaccessible.

Groundwater Levels

7.154 Baseline groundwater level monitoring was provided in the 2002 EIS relating to the quarry, where groundwater levels were measured over a 4-month period in 5 No. shallow monitoring wells within the quarry area. These shallow monitoring wells have since been destroyed, however the 'Old Well' monitored in the most recent investigation is likely to be BH5 from the 2002 EIS work.

7.155 For the Phase I site investigation, groundwater levels were monitored in the 9 No. new deep monitoring wells (MW1-MW9) and also in the 2 No. rotary cored boreholes (MW10c and MW11) – refer to **Figure 7-1**. These monitoring wells were drilled to the level of the proposed deepening of the existing quarry (-50mOD) in order to investigate the depth of groundwater circulation which was previously unknown. Boreholes were completed as open-hole completions, therefore groundwater levels measured are an average of all groundwater inflows across the epikarst and deeper bedrock response zones.

7.156 In addition, one old shallow monitoring well was discovered during site visits which was included in the monitoring (this monitoring well is most likely BH5 from the 5 No. monitoring wells installed by O'Neill Groundwater Engineering in 2000).

7.157 Dataloggers (Levelogger Edges) were installed in eight boreholes to provide continuous groundwater level-monitoring and better characterise the hydrogeology in the bedrock. Groundwater levels were also measured manually by dipmeter on site visits. Difficulties were encountered making manual measurements of groundwater levels in a number of boreholes following heavy rain due to cascading water from a shallow level in the bedrock into the borehole (e.g. MW2, MW10c – epikarst drainage). Some boreholes were completed open-hole from the conductor casing to the bottom-of-hole, and therefore percolating rainwater could 'short-circuit' the normal percolation path and cascade into the open borehole.

7.158 For the Phase II site investigation, additional monitoring of groundwater levels was carried out in the shallow boreholes drilled on the northern quarry margin (MW18, MW19), as well as the new monitoring wells installed in the processing area.

7.159 A record of manually measured groundwater levels and continuously monitored levels is presented in **Appendix 7-17**. The information demonstrates that all wells react uniquely, which is expected of a karst system, and the water levels show rapid response to rainfall, which reflects the significance of the epikarst.

7.160 Groundwater levels in the immediate vicinity of the quarry are lowered due to the presence of the quarry. The current quarry floor level is below the water table therefore groundwater in the surrounding bedrock drains under gravity into the quarry void, lowering groundwater levels in the vicinity of the quarry ('drawdown'). The drawdown and distance of influence of the quarry on groundwater levels is discussed in detail in Section 7.224.

7.161 Groundwater levels around the quarry show a seasonal fluctuation of c. 4-8m, best seen in the levelogger records for MW6 and MW7. Groundwater levels in MW6 vary seasonally from c. -6mOD to 2mOD; groundwater levels in MW7 vary seasonally from c. -8mOD to -3mOD (Note these monitoring wells are within the zone of influence of the quarry and are subject to drawdown).

7.162 Percolating water cascading into the open boreholes following heavy rain is a regular feature in the monitoring record from the Leveloggers; this water has infiltrated the soils/subsoils and is slowly percolating down through the unsaturated zone in the bedrock. This would not normally occur (i.e. the borehole itself creates a short cut), therefore the raised groundwater levels following storm events are not representative of the piezometric level down deeper in the aquifer. This artificial 'sump' behaviour is more marked in the less permeable boreholes (MW2, MW10c) with rapid rises immediately following rainfall events. Damped oscillations in water levels are seen with rapid rises in some monitoring wells (e.g. MW4), this is due to the inertia of the long water column in the boreholes.

7.163 As part of the Phase II site investigation, 2 No. shallower monitoring wells were installed next to MW7 on the northern quarry margin, MW18 and MW19 – see **Figure 7-1**. MW7 was drilled to 80m, MW18 was drilled to 40m and MW19 was drilled to 20m. Monitoring of groundwater levels in these monitoring wells shows only a small downward vertical gradient below the water table (i.e. between MW18 and MW7), and the development of a temporary saturated zone in the epikarst during extended wet periods – see **Figure 7-20**.

7.164 Monitoring of groundwater levels during prolonged dry spells shows steps in long recessions, with changing recession slopes (e.g. MW1, MW10c) suggesting zones of slightly different permeability within the bedrock, most likely related to varying transmissivities of the bedding planes.

7.165 Evidence of individual fractures controlling rising or falling groundwater levels was seen in the monitoring record for MW2 and MW4; filling of fractures on a rising water table or draining of fractures on a falling water table suspends the water level for a time at the level of the fracture.

7.166 Small-scale regular fluctuations of groundwater levels in the order of 2-4cm were noted in some wells after barometric compensation (e.g. MW8); these fluctuations are not as a result of nearby groundwater pumping but are known as Earth Tides. Earth Tides are related to the position of the Moon and the slight changes in pull exerted by the Moon on the aquifer. The fluctuations are sinusoidal and cyclical, being stronger at New Moon and Full Moon.

7.167 Groundwater levels in the processing area are shallow, the exact depth to the water table varies depending on the ground elevation which varies across the area. Water strikes during the drilling of groundwater monitoring wells in the processing area were typically 6 metres below ground level. Groundwater was encountered between c. 1-5m below ground level depending on location during the monitoring period October 2020 to March 2021.

Groundwater Flow Direction

7.168 Regionally, groundwater flow would be expected to generally follow topography similar to the surface water catchments. Groundwater to the east of the quarry might be expected to discharge to Lough Gill, and groundwater to the west of the quarry might be expected to discharge towards the southwest and the coast (Ballysadare Bay) (**Figure 7-21**). However, local deflections do exist and topographical anomalies control groundwater discharge and directions in some parts of the catchment (Tynan, 2021, **Appendix 7-2** Figures 1, 2, 3).

7.169 A groundwater divide would have existed across the quarry site before the quarry was developed, this now would be shifted slightly to the west of the quarry due to the drawdown caused by pumping of groundwater from the quarry. The upland area surrounding the quarry would be considered a recharge area, and therefore a vertical component to groundwater flow would be expected due to the effects of elevation and recharge (**Figure 7-21**).

7.170 When groundwater levels measured during dry weather (without the influence of recharge in the boreholes) are plotted spatially, radial drawdown is apparent towards the quarry void (**Figure 7-22a**) which is clear from the monitoring data.

7.171 The groundwater flow direction across the processing area is generally towards the north and Lough Gill (**Figure 7-22b**); some natural minor discharges from the subsoils to the Aghamore Stream is expected from the sands and gravels.

Groundwater Quality

7.172 A total of five rounds of groundwater samples have been collected from the monitoring wells installed as part of the Phase I and Phase II site investigations. Samples were analysed for a wide range of parameters: field parameters, whole-sample parameters, major ionic content, minor constituents, trace metals, hydrocarbons and bacteria. The results are presented in **Appendix 7-10**.

7.173 When the major ions are plotted on a Piper Diagram (**Figure 7-23**), the relative proportions of the ions are shown to be very similar between the wells and between sampling rounds. This is typical of groundwater that is in connectivity. The groundwater is classified as a Calcium-Bicarbonate type groundwater, typical of shallow limestone aquifers.

7.174 No significantly elevated parameters were detected in the samples, other than faecal bacteria indicating recent faecal pollution. Elevated concentrations of faecal coliforms were detected at different times in MW5, MW6, MW7 and MW10c to the north of the quarry (agricultural grazing land), and in MW1, MW3 and MW11 to the east of the quarry (agricultural grazing land). Low levels of Total Ammonia and Orthophosphate above the laboratory detection limit but below water quality standards were detected sporadically in the samples, typical of rural land use. Total Ammonia exceeded the groundwater threshold value in only 2 samples (MW2, MW8), and Orthophosphate exceeded the groundwater threshold value in 1 sample (MW6).

7.175 With respect to compliance with the Groundwater Regulation Threshold Values, on most occasions, samples were compliant.

7.176 The new monitoring wells in the processing area were sampled on one occasion (October 2020) and elevated concentrations of Orthophosphate were detected in all wells in this round, with elevated Total Ammonia, Nitrite and coliform bacteria also detected. These samples were high in suspended sediment due to the silty sands the standpipes were installed in and it is likely the Orthophosphate results are artificially elevated due to interference of sediment in the samples with the laboratory analysis method. The elevated Total Ammonia, Nitrite and coliform bacteria are detected upgradient and downgradient of the processing area and are likely to be related to poor background groundwater quality; there are no sources of Total Ammonia, Nitrite or coliform bacteria within the application site.

7.177 Regionally, the Carrowmore East GWB is considered 'at risk' of not meeting the requirements of the WFD; the most significant pressure on the GWB is the impact of forestry on groundwater. The groundwater quality status in the GWB was 'Good' in the last assessment cycle (2013-2018).

Potential Sources of Groundwater Pollution

7.178 Land use immediately surrounding the quarry is predominantly agricultural (grazing), with a few small farms and ribbon development, which are likely to be served by on-site domestic wastewater systems, along local roads.

7.179 Given that groundwater is highly vulnerable to potential pollution due to the thin cover of moderately permeable subsoils, it is quite likely that the background groundwater quality entering the quarry is linked to agricultural activities (e.g. grazing animals, land-spreading, fertilizer application). The quality of groundwater observed from monitoring wells on site reflects the agricultural land use of the lands surrounding the quarry.

7.180 An oil storage facility (Top Coast Oil depot) is located to the north of the processing area on the adjacent property. This facility is hydraulically upgradient of the processing area and any potential source of groundwater pollution on that site is unlikely to affect groundwater within the application site.

7.181 An area of land surrounding Lough Nameenbrack was recently infilled and developed for industrial use by third parties, this infilled area has the potential to affect surface water and groundwater quality upstream/upgradient of the site. TMS has recently carried out surface water sampling of the Aghamore Stream upstream and downstream of this infilled area and no impact on surface water quality has been identified (**Appendix 7-11**). No impact on groundwater quality has been observed in the monitoring wells located at the southern end of the processing area (MW17, MW22, MW23 – see **Appendix 7-10**) therefore this infilled area is not of concern as a potential source of groundwater pollution.

7.182 A Certificate of Registration was granted by Sligo County Council to Mullane Plant Hire Ltd in 2018 for a soil and stone recovery operation adjacent to and immediately south of Lough Nameenbrack (COR No. COR-SO-18-001-01). The operation involves the infilling of a 1.3ha site with inert soil and stone (100,000 tonnes) over a five-year period (20,000 tonnes/year) for the benefit of agricultural land. Similar to above, no impact on surface water and groundwater has been noted upstream/upgradient of the application site in recent monitoring, therefore this operation is not of concern as a potential source of groundwater pollution.

Conceptual Model

7.183 The conceptual site models for the site and surrounding area is presented diagrammatically in **Figure 7-24a** and **Figure 7-24b**.

7.184 The existing quarry is below the water table and there is local drawdown draining groundwater into the quarry void. Outside the zone of influence of the quarry, groundwater to the west of the quarry discharges towards the southwest and the coast (Ballysadare Bay), groundwater to the east of the quarry discharges towards the northeast and Lough Gill.

7.185 During wet periods, a temporary saturated zone develops within the epikarst and this can drain laterally following the topographic gradient. During extended wet periods, the storage capacity of the epikarst is temporarily exceeded leading to ephemeral springs or seepages further down-slope and flooding of surface depressions in the lowlands (groundwater flooding).

7.186 The Aghamore Stream all but dries up in prolonged dry weather, indicating it is above the water table in summer; flow monitoring during the winter suggests a level of baseflow to this stream, with most baseflow likely to come from the adjacent sands and gravels deposits underlying the processing area.

Sensitive Receptors

7.187 Designated sites surrounding the quarry are shown in **Figure 7-25**.

7.188 The most sensitive potential receptor in the vicinity of the quarry is Lough Gill. Lough Gill is a designated Special Area for Conservation (SAC), it is a source of drinking water for Sligo town and its environs (Foxes Den Water Treatment Plant), Leitrim (Moneyduff) and it is also a popular lake for fishing.

7.189 Lough Gill was designated as a SAC due to the presence of four habitats listed on Annex I of the Habitats Directive (Natural Eutrophic Lake, Orchid-rich Calcareous Grassland, Old Oak Woodlands, Alluvial Forests), including two with priority status, as well as a number of listed species (White-clawed Crayfish, Sea Lamprey, Brook Lamprey, River Lamprey, Atlantic Salmon and Otter). The raw water for the Foxes Den treatment plant is abstracted from Lough Gill 3km southeast of Sligo town and pumped at a rate of c. 550m^3/hour to the main treatment works. The Foxes Den Water Treatment Plant (WTP) is designed to treat and supply up to 11,000m^3/d and the North Leitrim Moneyduff WTP is designed to treat and supply up to 3,600m^3/d (Mr. Des Joyce, Irish Water, *pers.comm.,* 2021).

7.190 There is a direct hydrological (surface water) connection between the site and Lough Gill SAC via the discharge from the quarry. This hydrological link is regulated by DL(W)151 and the conditions of that discharge licence specify measures to control the link and protect the target.

7.191 There is an indirect hydrological link (surface water) connection between the site and Cummeen Strand SPA, Cummeen Strand/Drumcliff Bay SAC which is located downstream of Lough Gill. Given that Lough Gill occurs upstream of Cummeen Strand, if the assessment of impact finds no impact on Lough Gill then Cummeen Strand would also not be impacted.

7.192 There is a direct hydrogeological (groundwater) connection between the site and Lough Gill, as groundwater from the eastern half of the site discharges to Lough Gill (see **Figure 7-21**).

7.193 There is also a direct hydrogeological (groundwater) connection between the site and Ballysadare Bay SAC to the west, as groundwater from the western half of the site discharges to Ballysadare Bay – however given the distance to Ballysadare Bay (c. 3.3km), the size of the catchment to Ballysadare Bay and the very small groundwater abstraction rate from the quarry, Ballysadare Bay SAC is not considered a potentially sensitive receptor for the proposed development.

7.194 The quantitative impact of abstracting small volumes of groundwater from the two groundwater bodies (GWBs) that the quarry straddles is considered to be negligible as these GWBs are not identified as being under pressure from abstractions. There are few local groundwater abstractions, and no known large-scale groundwater abstractions elsewhere in these two groundwater bodies that would put these groundwater bodies under pressure of over-abstraction.

7.195 The potential significance of the quarry abstraction on the water balance for the two GWBs concerned and surface water features has been assessed by Hydro-G in **Appendix 7-2**. In summary,

- the potential maximum, licensed, discharge from the quarry is calculated as c. 1,277,500m^3/yr;
- the recharge to the Carrowmore East GWB is calculated as c. 31,900,000 m^3/yr, the recharge to the Carrowmore West GWB is calculated as c. 20,350,000 m^3/yr, therefore the recharge to the entire underlying Regionally Important Karst Aquifer is c. 59,950,000 m3/yr;

- the calculations show that the volume of water discharging from the quarry (1,277,500m^3/yr) is a small proportion compared to the 32 million or 20 million m^3/yr going into the local GWBs or the 59.9 million m^3/yr entering the regional aquifer by rainfall recharge;
- the volume of water discharging from the quarry accounts for 6% of the recharge to the underlying Carrowmore West GWB, 4% of the recharge to the underlying Carrowmore East GWB, and 2% of the total recharge to the regional aquifer. WFD Guidance document GW5 (2004) indicates that where a groundwater abstraction constitutes 2-10% of the recharge to a river or large lake there is low potential for impact, therefore the quarry abstraction is unlikely to affect either the water balance of the two GWBs or surface water features in connectivity with those GWBs.

IMPACT ASSESSMENT

Assessment Methodology

7.196 The description and assessment of potential impacts and effects on the water environment follows current guidelines and advice notes provided by the EPA on Environmental Impact Assessment (2002 and 2003), as well as draft EPA guidelines (2017) and guidelines provided by the Institute of Geologists of Ireland (2013).

7.197 There is a difference in definition between 'impact' and 'effect', although in some guidance the terms are used interchangeably; in this chapter, impacts are defined as the changes resulting from the project, or an action associated with the project, and effects are defined as the consequences of impacts.

7.198 The impact assessment focuses on the likely, significant effects of the proposed development on the water environment. 'Likely' effects are those that are planned or reasonably foreseen to be inevitable consequences of the normal construction and operation of the development.

Framework for Description of Potential Impact

7.199 The statutory criteria for presenting the characteristics of potential effects requires consideration of the magnitude, spatial extent, nature, transboundary nature (if applicable), intensity, complexity, probability, expected onset, duration, frequency and reversibility, cumulation of the impact and possibility of effectively reducing the impact (Annex III (3) of Directive 2014/52/EU).

7.200 The criteria and associated terminology used for describing potential effects in this chapter follow those recommended in the draft EPA guidelines (2017), with the exception of 'significance' which follows the criteria/terminology in guidelines provided by the Institute of Geologists of Ireland (2013).

7.201 With respect to the EPA's (2017) structure for description of the Impact, the descriptive criteria Tables employed are presented in full in **Appendix 7-18**. The EPA Impact assessment structures the framework by full description of the type of Impact, which can be 'Positive, Neutral or Negative/Adverse' (Quality) and outlines other further qualifiers describing the Impact including 'Duration', 'Probability' and 'Extent'. Refer to **Table 7-1** to **Table 7-5, Appendix 7-18**.

Framework for Assessment of Potential Significance of Effect

7.202 The significance of potential impacts on geological, hydrogeological and hydrological sensitive receptors was estimated by implementing an assessment as per the Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, NRA (2008) and the Guidelines for the Preparation of Soils, Geology & Hydrogeology Chapters of Environmental Impact Statements, IGI (2013). Those assessment frameworks require input of the Project's groundwater and geological type attributes and measures to determine the magnitude of the impact on the attribute. The NRA's (2008) Framework Assessment Tables employed in this assessment are presented as **Table 7-6** to **Table 7-10, Appendix 7-18**.

Do-nothing Scenario

7.203 If planning permission was not approved for the proposed development, pumping of water from the quarry floor would cease and the quarry void would flood to approximately the level of the surrounding water table. There is no plant and equipment located within the quarry void and therefore there are no sources of potential contamination remaining. Similarly, there is no plant and equipment located within the processing area and therefore no sources of potential contamination.

7.204 The quarry void's waters are primarily recent rainfall and epikarst contributions to the exposed walls. Therefore, abandonment of the site and cessation of the licensed dewatering (2020) would have a temporary negative effect for the time taken for the void's water levels to rise from their current -20m OD, approximate, elevations to the level of the epikarst (0m OD to 20m OD) and re-establish the site's function in the regional hydrogeological regime.

7.205 The pumping of water from the void and consequent licensed (2020) discharge of water from the quarry to the Aghamore Stream maintains the regional hydrological and hydrogeological regime and augments the low flows in the stream, especially during dry weather. The slight positive impact of this augmented flow on aquatic life along the stream would be lost if activities at the quarry were to discontinue.

Description of the Likely Impacts

7.206 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 the existing quarry void and adjacent processing area, 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.

7.207 The Aghamore River receives the discharge from the site and also forms a boundary between the hard rock quarry working area to the west of the local road and the processing area to the east, which is underlain by sand and gravel deposits. The Aghamore River is therefore a receptor, which is labelled in the EPA River Basin teams as the GARAVOGUE_010 and it is classified as Poor Status (IE_WE_35G010200). The GARAVOGUE_010 is a river within the WFD Cycle 2 'Catchment Sligo Bay & Drowse', Subcatchment Bonet_SC_030 (Code 35_10) and the sub catchment report available at https://catchments.ie/ presents the known pressures and risks for the GARAVOGUE_010 as Forestry, Road Runoff and Wastewater. The EPA do not mention the quarry in their itemisation of risks and pressures in the catchment. This is unlikely to be an oversight because the Local Authority Water Programme team (LAWPRO) is essentially a Local Authority staff moved over to EPA catchment assessment assistance. Therefore, the Sligo County Council, as the Local Authority, is fully aware of the quarry and robustly assessed its potential impacts in the procedure resulting in the recent grant of Discharge Licence DL (W)151 (2020) to the current operators and proposers of further workings at the site.

7.208 Lough Gill SAC is a potential receptor. Lough Gill SAC is 765m downstream of the quarry discharge point. Given the importance of Lough Gill as a SAC and a Public Water Supply for Sligo and North Leitrim, the significance of this local attribute is noted.

7.209 Groundwater is a receptor. The area proposed for the deepening of the current void is mostly in the GSI mapped Carrowmore West Groundwater Body (IE_WE_G_0040) and the access roads and boundary screening berms are underlain by the GSI mapped Carrowmore east Groundwater Body (IE_WE_G_0042). Both mapped groundwater bodies are classified as Good Status 2013 to 2018 (EPA envision map series https://gis.epa.ie/EPAMaps/Water). Of the total quarry void area on the west side of the local road, 110,000m^2 is mapped as being in the Carrowmore West Groundwater Body and the access road to the void and its associated screening berms occupy 50,000m^2, approximately, of the Carrowmore East Groundwater Body.

Potential Impacts

7.210 The assessment of potential impacts from the proposed development is presented in **Table 7-2**, using the headings discussed under the Framework Methodologies' criteria for determination of impacts (EPA, 2013 & NRA, 2008 as presented in **Appendix 7-18**). The main anticipated impact associated with the proposed deepening of the quarry, in relation to hydrology and hydrogeology, relates to the potential contamination of groundwater from quarrying activities or impacts on quantitative status arising from dewatering and the subsequent risk posed to Lough Gill SAC as an ecological resource and a source of water supply, which is the ultimate receptor of intercepted waters arising at and discharged from the site.

7.211 In the year 2020, Sligo County Council granted the site a justifiable and defensible Discharge Licence DL(W) 151. In the 2019 to 2020 evaluation of the site, Sligo County Council assessed the potential for the site's discharge to be safely assimilated in the Aghamore Stream with no potential for impact on Lough Gill SAC. Information presented for the site and the assimilation capacity simulations justified the licensing for a potential maximum daily discharge volume of 3,500m^3/d and ELVs are specified to ensure protection of Lough Gill SAC. The ELVs granted to the site in the 2020 DL (W)152

Licence are justifiable in the context of ensuring compliance with the Groundwater Regulations (2010 to 2016), the Surface Water Regulations (2009 to 2019) and in the context of water quality monitoring results at the quarry.

Construction Stage Impacts Discussion

Proposed Development

7.212 The potential direct and indirect impacts to surface water and groundwater are discussed below. In the context of the proposed deepening of the existing quarry, the construction stage is taken to be the installation of a settlement lagoon of 2,830m^2 (see area calculations below and proposed location on **Figure 2-1**) in advance of quarrying activities recommencing at the site to treat surface water pumped from the quarry floor before being discharged to the Aghamore Stream, along with construction of the proposed berm in the processing area, the proposed wastewater treatment system, the proposed portacabin and 2 no. wheelwashes. Any soil and subsoil stripping required will be carried out using earth moving machinery. The topsoil and overburden will be stored in temporary overburden storage berms or be placed onto worked out areas as part of the progressive restoration scheme. During the construction stage, the pumping of a combination of rainwater and groundwater from the quarry floor directly to the Aghamore Stream will continue, as presently occurs.

7.213 The size of the settlement lagoon will depend on the pumping rate and calculations are presented in **Appendix 7-19**. The maximum discharge rate in the existing trade effluent discharge licence to the Aghamore Stream is 40.5l/s. Groundwater inflows into the quarry at the final floor level of -50mOD would be c. 12.2l/s (see **Appendix 7-20**), leaving a maximum headroom of 28.3l/s to pump storm water out of the quarry at its lowest floor level. For a discharge rate of 28.3l/s, a settlement lagoon with a surface area of 2,830m^2 is required (**Appendix 7-19**).

7.214 The settlement lagoon will have a water depth of 1.5m, a minimum freeboard of 0.5m and will be lined to prevent leakage. Interceptors will be installed close to areas of potential risk such as the fuel storage area and refuelling station.

7.215 The discharge point from the settlement lagoon will remain at the current location (see **Figure 7-2**).

Direct Impacts

7.216 There is the potential for generating suspended sediment in rainfall runoff during the construction stage of the settlement lagoon, berm, wastewater treatment system, portacabin and wheelwashes. There is also the potential for spills or leaks of fuels/oils from vehicles during the construction stage.

7.217 The Processing Area stands on a deposit of sands and gravels, therefore with regards to drainage, it is anticipated that surface water will continue to percolate into the ground, prior to flowing in to Aghamore stream or Lough Gill to the northeast via the underlying limestone bedrock. Therefore, any suspended particulates in the surface water would be naturally removed prior to water moving in to Aghamore stream or Lough Gill.

7.218 Whilst it is noted that the location of the settlement pond will be outside the quarry floor, any generated suspended sediment in runoff, or spilled fuels/oils from vehicles, could ultimately drain to the quarry sump and be pumped to the Aghamore Stream, which in turn drains to Lough Gill. Suspended sediment would most likely settle out over the quarry floor before reaching the sump. No other impacts on surface water or groundwater have been identified during the construction stage. The Discharge Licence for the site and SOPs for Lagan preclude impact at this stage.

7.219 A Construction Environmental Management Plan (CEMP) that outlines how potential adverse impacts on the water environment that may arise during the construction of the proposed settlement lagoon will be managed is provided in EIAR Appendix 2.2. Using the criteria outlined in **Table 7-1** to **Table 7-10, Appendix 7-18**, without mitigation, the potential effect of fine sediment is described as negative in quality, localised in extent, likely, temporary in duration, of rare frequency and irreversible. The importance of the surface water receptor (Lough Gill) is assessed as '**Extremely High**' (European site); the magnitude of impact is assessed as '**Small Adverse**'. The significance of the potential effect on the water environment is therefore assessed as '**Significant**'.

7.220 Without mitigation, the potential effect of spills or leaks of fuels/oils is described as negative in quality, localised in extent, unlikely, temporary in duration, of rare frequency and reversible. The importance of the surface water receptor (Lough Gill) is assessed as '**Extremely High**' (European site); the magnitude of impact is assessed as '**Small Adverse**'. The significance of the potential effect on the water environment is therefore assessed as '**Significant**'.

Indirect Impacts (if any)

7.221 No indirect construction stage impacts on the water environment have been identified.

Operational Stage Impacts

Proposed Development

7.222 The site layout for the processing area in the operational stage is provided in **Appendix 7-3**.

7.223 All storm water from the processing area to the east of the quarry will percolate to ground. There will be no stormwater discharge from this part of the site. There will be no point discharges from the processing area of the site at any point in the future. Consequently, there will be no requirement for the treatment and disposal of run-off and wastewater from the processing area of the site.

7.224 Within the Processing Area, there will be a standoff from Aghamore stream of a minimum 25m and all riparian and associated woodland will be retained. The Processing Area stands on a deposit of sands and gravels, therefore with regards to drainage, it is anticipated that surface water will continue to percolate into the ground, prior to flowing in to Aghamore stream or Lough Gill to the northeast via the underlying limestone bedrock. Therefore, any suspended particulates in the surface water would be naturally removed prior to water moving in to Aghamore stream or Lough Gill.

7.225 A supply well in the processing area will be used for water supply (see **Figure 7-1**); water from the well will be used for wheelwashes, dust suppression and non-potable use in the office canteen and toilets.

7.226 It is proposed to install a wheelwash system within the existing quarry and a second wheelwash will be installed before the weighbridge located within the processing area. The proposed wheelwashes will operate on closed loop systems meaning that there will be no discharges arising from them, and water will be recycled for re-use in the wheelwash system.

7.227 A new wastewater treatment unit is proposed to cater for the welfare facilities in the processing area. A site suitability assessment was carried out in February 2021 by Dr. Eugene Bolton of Trinity Green Environmental Consultants (**Appendix 7-24**) and a packaged treatment system (Oakstown BAF) with polishing filter was recommended. The proposed wastewater treatment system design specification is provided by O'Reilly Oakstown Environmental in **Appendix 7-24**.

7.228 The workshop located within the processing are is an enclosed and covered building and therefore does not require an oil interceptor. Bunded areas and spill trays are provided in the workshop to contain all oils and lubricants stored in the workshop.

7.229 There will be no bulk fuels held at the site. All mobile plant and equipment will be refuelled on an 'as required' basis by a local fuel supplier and HGV's serving the site will refuel at local service stations.

7.230 A hardstand area and hydrocarbon interceptor will be provided adjacent to the redundant fuel storage area to facilitate the refuelling of mobile plant. All treated runoff from the hydrocarbon separator will percolate naturally to the ground.

7.231 All oils / chemicals to be held at the site will be stored in the existing workshop / store, located within the processing area to the east of the quarry. The volume of oils / chemicals to be held at the site will be minimal and they will be stored within the existing bunded areas provided in the workshop. Any oils not stored within the bunded area, will be held on dedicated spill trays. Dedicated storage bins will also be provided in the workshop for oil filters and oily rags.

Direct Impacts

Increased Drawdown

7.232 Deepening of the quarry will increase drawdown on the water table surrounding the quarry. There is the potential for increased drawdown to impact on surface water bodies (Aghamore Stream and Lough Gill), private wells, groundwater flooding and the Groundwater Body's quantitative status under the Water Framework Directive.

7.233 An iterative method has been used to estimate the extent of drawdown at the lowest proposed quarry floor level (-50mOD) which is a combination of the Thiem-Dupuit Equation and the Rate-of-Recharge Method.

7.234 An initial indication of the radius of influence was calculated using the Sichardt equation (**Appendix 7-20**), indicating a radius of influence of approximately 350m at -50mOD. To further refine the expected radius of influence, the Thiem-Dupuit Equation is used for steady state unconfined conditions, and the rate-of-recharge method assumes all water pumped from the quarry comes from direct natural recharge in the area outside the quarry void (i.e. not including the quarry void area). The iterative method determines the distance out from the quarry face where recharge exactly balances the expected groundwater inflows. It is assumed in the calculations that there are no large flowing fractures present at depth. **Figure 7-26** shows the estimated radius of influence at the lowest quarry floor level of -50mOD, some 286m from the quarry face. The estimated radius of influence for the existing site and for the quarry floor level at -34.5mOD is also shown on **Figure 7-26**.

7.235 The estimated groundwater inflows for the current situation using this iterative method agree with field observations, adding confidence to the predicted radius of influence. During the extended dry spell in June 2018, the submersible pump was pumping at c. 36l/s (3,110m^3/d). Evaporation using estimates from Knock Airport was in the order of 220m^3/d over the entire flooded quarry floor area (c. 50,000m^2). The water level in the quarry was dropping by c. 0.4m/week, which would equate to a loss of 2,857m^3/d. Balancing the inflows and outflows, a total of 473m^3/d (5.5l/s) of groundwater must have been added to the quarry in that time.

7.236 The estimated radius of influence for the quarry with floor level at -50mOD of 286m does not extend as far as the Aghamore Stream, so no impact is predicted (i.e. reduction in baseflow). Lough Gill is further away from the site and will not be affected by drawdown from the quarry.

7.237 There are no private groundwater supply wells within the future estimated radius of influence of the quarry.

7.238 The increased drawdown will not affect groundwater flooding to the north and northwest of the site as these areas are flooded by outflows from the epikarst only; the proposed development is to deepen the existing quarry and no changes will be made to the surrounding epikarst, therefore increased drawdown will not affect these groundwater flooding areas.

7.239 The quantitative impact of abstracting small volumes of groundwater from the two groundwater bodies (GWBs) that the quarry straddles is considered to be negligible as these GWBs are not identified as being under pressure from abstractions. There are few local groundwater abstractions, and no known large-scale groundwater abstractions elsewhere in these two groundwater bodies that might put these groundwater bodies under pressure of over-abstraction.

7.240 Using the criteria outlined in **Table 7-1** to **Table 7-10, Appendix 7-18**, the potential operational phase impact of increased drawdown is assessed below.

7.241 Without mitigation, the potential effect of increased drawdown on Aghamore Stream is described as negative in quality, local in extent, likely, medium-term in duration, of constant frequency and reversible. The importance of the surface water receptor (Aghamore Stream) is assessed as '**Medium**' (Quality Class C); the magnitude of impact is assessed as '**Negligible**'. The significance of the potential effect on the Aghamore Stream is therefore assessed as '**Imperceptible**'.

7.242 Without mitigation, the potential effect of increased drawdown on Lough Gill is described as negative in quality, local in extent, likely, medium-term in duration, of constant frequency and reversible. The importance of the surface water receptor (Lough Gill) is assessed as '**Extremely High**' (European site); the magnitude of impact is assessed as '**Negligible**'. The significance of the potential effect on Lough Gill is therefore assessed as '**Imperceptible**'.

7.243 Without mitigation, the potential effect of increased drawdown on Groundwater Bodies is described as negative in quality, local in extent, likely, medium-term in duration, of constant frequency and reversible. The importance of the groundwater receptor (Carrowmore West GWB and Carrowmore East GWB) is assessed as '**High**' (Regionally Important Aquifer); the magnitude of impact is assessed as '**Negligible**'. The significance of the potential effect on the Groundwater Bodies is therefore assessed as '**Imperceptible**'.

Discharge to Surface Water

7.244 The quarry will continue to discharge to surface water (Aghamore Stream) in the operational stage. With increased discharge there is the potential for 1.) increased flood risk in the Aghamore Stream, and 2.) impact on surface water quality in Aghamore Stream and Lough Gill. These potential impacts are considered below.

7.245 There will be no point discharges arising from the processing area of the site at any point in the future. Consequently, there will be no requirement for the treatment and disposal of run-off and wastewater from the processing area of the site.

7.246 Any surface water run-off arising from the processing area will continue to naturally infiltrate to ground. These lands are underlain by sand and gravel material with a significant unsaturated zone – refer to Section 7.167.

Flooding

7.247 The increased discharge of water from the quarry has the potential to exacerbate the existing flood risk along the Aghamore Stream; the change is negligible and does not have a materially significant impact relative to the existing situation.

7.248 A channel survey was carried out along the Aghamore Stream as part of this assessment from the quarry discharge point to Lough Gill. A summary of the survey is provided in **Figure 7-27**. The Aghamore Stream channel has been culverted at several points - there are two culverts within the site boundary and five culverts in the c. 765m downstream between the site and Lough Gill (see **Figure 7-28**).

7.249 The stream was divided into a number of separate reaches between culverts (**Figure 7-28**), between which 40 No. cross-sectional profiles were measured (**Figure 7-29**) and a longitudinal profile constructed (**Figure 7-30**). Photographs of the stream channel and the cross-sectional profiles are presented in **Appendix 7-21**.

7.250 The maximum bank-full flows for each cross-section were calculated and the maximum pipe-full gravity flows in the culverts were calculated using the Manning Equation (**Appendix 7-22**). These were compared with the estimated peak flow in the stream in response to a storm with a 100-year return period calculated by the Rational Method, calibrating the runoff coefficient against monitored events in the existing monitoring record (events with unimodal distributions with durations close to the time of concentration for the catchment).

7.251 The peak flow for the Aghamore Stream at the quarry discharge point is estimated as c. 500-800l/s, which exceeds the maximum flow capacity of the culvert by the Top Coast Oil depot entrance. Anecdotal evidence would suggest this culvert floods onto the road every few years for a few days at a time. Estimation of peak flow for the catchment by the Flood Studies Update methodology yields a higher peak flow but these methods are not suitable for catchments under 5-10km^2. A new 5-parameter regression equation for flood estimation in small rural ungauged catchments developed by the OPW (FSU 4.2a) gives a similar result (c. 450l/s) to that calculated using the Rational Method.

7.252 On the basis of this assessment, 5 No. areas liable to flooding along the Aghamore Stream are identified (**Figure 7-31**). The most sensitive location is Location 3 (Culvert 4) where the restricted size of the pipe culvert may result in flooding of the adjacent road in extreme weather events. Any discharge of water from the quarry at such times would exacerbate such flooding downstream.

7.253 Without mitigation, the potential effect of discharge on flooding in the Aghamore Stream is described as negative in quality, local in extent, likely, medium-term in duration, of constant frequency and reversible. The importance of the surface water receptor (Aghamore Stream) is assessed as ‘**Medium**’ (Quality Class C); the magnitude of impact is assessed as ‘**Negligible**’. The significance of the potential effect on the Aghamore Stream is therefore assessed as ‘**Imperceptible**’.

Surface Water Quality

7.254 There is the potential that certain parameters in discharged water from the site could impact on water quality in the Aghamore Stream or Lough Gill.

7.255 Comparison of past discharge samples with the surface water quality limits indicates that Total Ammonia and Orthophosphate are the parameters of most interest in the discharged water (suspended solids will not be an issue in the future once the proposed settlement lagoon is constructed).

7.256 Faecal bacteria present in groundwater as a result of agricultural activities in the lands surrounding the quarry would make its way to Lough Gill quicker than normal by being discharged to the Aghamore Stream. Recent sampling of surface water between the discharge and Lough Gill (**Appendix 7-11**) shows that the concentrations of faecal bacteria in the discharge are lower than the background levels upstream, and downgradient faecal bacteria concentrations are lower than upstream due to the dilution effect of the discharge. Therefore, although some additional faecal bacteria are added to the stream from the discharge, the net effect of the discharge is to reduce the overall faecal bacteria concentrations in the stream going to Lough Gill.

7.257 The actual assimilative capacity available in the Aghamore Stream at times of low flow can be calculated using the estimated 95th percentile flow and background concentrations for individual parameters upstream of the discharge. For the general-case scenario, where background concentrations are taken as the mean of recent upstream monitoring data, the calculated assimilative capacity available is presented in **Appendix 7-23**.

7.258 To determine whether there is a negative impact on water quality in the stream, the concentrations downstream of the discharge have been estimated using a conservative mass balance. The mass balance uses the upstream flow (95th percentile flow) and background concentrations (mean of recent upstream monitoring data), as well as the discharge flow (maximum under existing trade effluent discharge licence) and concentrations (mean of recent discharge monitoring data), to estimate the fully mixed downstream concentrations. None of the calculated concentrations downstream of the discharge exceed the relevant water quality standards, therefore no negative impact on water quality in the stream is expected as a result of the discharge.

7.259 The results of additional surface water samples taken between August 2018 and March 2021 are presented in **Appendix 7-11**.

7.260 The only parameters that exceed the Surface Water Environmental Quality Standards downstream of the discharge are single occurrences of slightly elevated mercury in November 2018 (0.2µg/l) and nickel (125µg/l) in January 2019. The slightly elevated mercury in November 2018 is also seen in the discharge (0.077µg/l), but neither parameter is elevated in samples further downstream at the bridge before Lough Gill, suggesting that the sampling location downstream of the discharge is within the mixing zone of the discharge and not far enough downstream (c. 30m) to represent fully mixed downstream concentrations. Traces of mercury and nickel are occasionally seen in groundwater surrounding the quarry, most likely as a result of either chemical fertilizers in the agricultural lands adjacent the quarry or atmospheric deposition from coal burning – there are no sources of mercury or nickel within the quarry itself. Coliform bacteria (including *E.coli*) exceed the Drinking Water Parametric Values both upstream and downstream of the discharge and this is related to poor background bacterial quality in both the stream and in groundwater surrounding the quarry – there are no sources of coliform bacteria within the application site.

7.261 The percentage of the assimilative capacity available in the stream that is used up by the discharge is estimated in **Appendix 7-23**. This is based on a comparison of the 'headspace' available in the stream before and after the discharge (i.e. 'headspace' is the difference between the stream concentration and the maximum permissible concentration). For the general-case scenario, only low percentages of the available assimilative capacity are used by some parameters (maximum of 27% by orthophosphate). In some cases, additional assimilative capacity is made available (e.g. TSS and BOD) as the mean concentrations in the discharge are lower than the background concentrations upstream of the discharge.

7.262 In summary, the assimilative capacity of the Aghamore Stream has been assessed in relation to the discharge and no negative impact on water quality is expected. The only exceedances of the Surface Water Environmental Quality Standards in recent monitoring downstream of the discharge point were single occurrences of slightly elevated mercury in November 2018 and nickel in January 2019, and these are believed to be related to background groundwater quality surrounding the quarry and not any activity within the quarry site itself.

7.263 Without mitigation, the potential effect of the discharge water quality on surface water quality in the Aghamore Stream and Lough Gill is described as negative in quality, local in extent, unlikely, medium-term in duration, of constant frequency and irreversible. The importance of the surface water receptor (Lough Gill) is assessed as '**Extremely High**' (European site); the magnitude of impact is assessed as '**Negligible**'. The significance of the potential effect on Lough Gill is therefore assessed as '**Imperceptible**'.

Groundwater Quality

7.264 There is a potential risk of surface water contamination in the operational stage from blasting activities. The risk to groundwater quality from blasting is negligible as groundwater surrounding the quarry is drawn into the quarry and pumped out as discharge to surface water.

7.265 It is proposed to infiltrate surface water runoff within the processing area (see Section 7.292); surface water runoff would be expected to be uncontaminated (i.e. rainwater) and is therefore not considered a potential risk to groundwater quality or Lough Gill.

7.266 Without mitigation, the potential effect of blasting on surface water quality is described as negative in quality, local in extent, unlikely, medium-term in duration, of constant frequency and irreversible. The importance of the surface water receptor (Lough Gill) is assessed as '**Extremely High**' (European site); the magnitude of impact is assessed as '**Small Adverse**'. The significance of the potential effect on Lough Gill is therefore assessed as '**Significant**'.

Indirect Impacts (if any)

7.267 No indirect operational stage impacts on the water environment have been identified.

Post – Operational Stage Impacts

Direct Impacts

7.268 On cessation of activities, pumping of water from the quarry will cease and the quarry will be allowed to flood and become a natural habitat.

7.269 All chemicals, petroleum-based products, mechanical and electrical equipment will be removed from the site prior to its closure to eliminate potential sources of groundwater contamination. Site security will be maintained post-closure to discourage unauthorised dumping or any other potentially contaminating activities in the vicinity of the quarry.

7.270 No direct post-operational impacts on the water environment have been identified.

Indirect Impacts (if any)

7.271 No indirect post-operational stage impacts on the water environment have been identified.

Unplanned Events (i.e. Accidents)

7.272 Potential impacts on surface water or groundwater could occur (in the worst case, with no monitoring or management) from 1.) accidental spillages on site, 2.) uncontrolled discharges to surface water and 3.) flooding (on-site or off-site).

7.273 Spillages of fuels or chemicals during site activities could happen without proper control and supervision. Discharged water off-site could potentially breach water quality limits without monitoring. Pump failure in the quarry could result in the quarry floor flooding leading to the potential for groundwater pollution by plant and equipment; uncontrolled discharge of water to the Aghamore Stream could potentially lead to localised flooding off-site in the worst case.

7.274 Appropriate mitigation measures and monitoring have been proposed to ensure that there are no potential impacts on the water environment as a result of unplanned events at the site.

7.275 Sligo County Council, in the 2020 Discharge Licence DL (W) 151, adequately specified Condition 7 (Condition 7.1, 7.2 and 7.3) for the control of Accidental Spillages.

Cumulative / Synergistic Impacts (if any)

Infilled Area Upstream

7.276 There is the potential for cumulative impact on surface water quality in combination with recently reclaimed land located upstream of the site surrounding Lough Nameenbrack, as well as the inert waste recovery operation to the south of Lough Nameenbrack – see Sections 7.176 and 7.177.

7.277 4 No. rounds of surface water sampling were carried out in the Phase II site investigation, which included samples from upstream and downstream of the infilled area at Lough Nameenbrack. The sampling locations are indicated on **Figure 7-2**.

7.278 The results of these surface water samples show that water quality upstream of the infilled area is the same as downstream, indicating that the infill materials used in the reclamation are not having a deleterious effect on surface water quality in the Aghamore Stream. Therefore, the potential for cumulative impact in combination with the proposed development is considered negligible.

7.279 Without mitigation, the potential cumulative effect of the proposed development in combination with the infilled area upstream is described as negative in quality, local in extent, unlikely, permanent in duration, of constant frequency and irreversible. The importance of the surface water receptor (Lough Gill) is assessed as '**Extremely High**' (European site); the magnitude of impact is assessed as '**Negligible**'. The significance of the potential effect on Lough Gill is therefore assessed as '**Imperceptible**'.

Asphalt Plant

7.280 There is the potential for cumulative impact in combination with runoff from the existing asphalt plant area which lies outside the proposed development site boundary in the processing area.

7.281 There is currently no point discharge arising from the processing area of the site (located to the east of the public road) as this area of the site is also inactive.

7.282 It is not the applicant's intention to resume any point discharges from the processing area of the site at any point in the future. Consequently, there will be no requirement for the treatment and disposal of run-off and wastewater from the processing area of the site.

7.283 Any surface water run-off arising from the asphalt plant area will continue to naturally percolate to ground. These lands are underlain by sand and gravel material with a significant unsaturated zone – see Section 7.167.

Concrete Plant/Block Yard (Obsolete)

7.284 There is the potential for cumulative impact in combination with runoff from the area where the obsolete concrete plant and block yard are located which is outside the proposed development site boundary.

7.285 As stated above, there is currently no point discharge arising from the processing area of the site as this area of the site is also inactive. Any historical discharges arising from the processing area would have originated from the wash-water associated with concrete production activities. The concrete production plant has not operated since the site was purchased by the applicant from

Cemex (ROI) Ltd. in 2014 and is now obsolete. The applicant does not intend to recommence the production of concrete products at the site.

7.286 There will be no point discharges from the processing area of the site at any point in the future. Consequently, there will be no requirement for the treatment and disposal of run-off and wastewater from the processing area of the site.

7.287 Any surface water run-off arising from the concrete plant / block yard area will continue to naturally percolate to ground. These lands are underlain by sand and gravel material with a significant unsaturated zone – see Section 7.167.

7.288 Without mitigation, the potential cumulative effect of the proposed development in combination with the infilled area upstream is described as negative in quality, local in extent, likely, permanent in duration, of constant frequency and irreversible. The importance of the surface water receptor (Lough Gill) is assessed as '**Extremely High**' (European site); the magnitude of impact is assessed as '**Small Adverse**'. The significance of the potential effect on Lough Gill is therefore assessed as '**Significant**'.

7.289 No other potential cumulative/synergistic impacts have been identified.

Transboundary Impacts (If any)

7.290 No potential transboundary impacts have been identified.

Interaction with Other Impacts (if any)

7.291 No potential interaction with other impacts have been identified.

MITIGATION MEASURES

Construction Stage

7.292 There is the potential for generating suspended sediment in rainfall runoff during the construction stage of the settlement lagoon, berm, wastewater treatment system and portacabin, and the potential for accidental spills of fuels/oils from construction vehicles. No other impacts on surface water or groundwater have been identified for the construction stage.

7.293 A Construction Environmental Management Plan (CEMP) that outlines how potential adverse impacts on the water environment that may arise during the construction of the proposed settlement lagoon will be managed is provided in EIAR Appendix 2.2.

7.294 Good site practice in managing runoff and spill prevention will be necessary during construction. Runoff into the quarry void will be monitored and if sediment laden water enters the quarry floor and sump then the sump pump will be switched off until the sediment laden water has settled on the quarry floor to prevent direct discharge of untreated water to the Aghamore Stream.

7.295 Due to the extreme sensitivity of Lough Gill, all precautions will be taken to minimise the potential for accidental spills of fuels/oils from construction vehicles. Fuels and oils will not be stored within the quarry during construction and refuelling of construction vehicles will only be permitted outside the quarry at the dedicated refuelling hardstand area and associated interceptor. Spill kits will be maintained on site during construction to stop the migration of any accidental spillages, should they occur.

7.296 **Table 7-2**, **Table 7-3** and **Table 7-4** identified potential Impacts, Significance, Required Mitigation Measures and the potential Residual Impacts.

7.297 The proposed mitigation measures would reduce the significance of the potential impacts at construction stage from '**Significant'** to **'Imperceptible'** with the finding of **'No Residual Impacts'.**

Table 7-2 Potential Impact Assessment Table - Aghamore Quarry (following NRA 2008)

Activity	Attribute	Character of Potential Impact	Importance of Attribute (as defined by criteria assessment Table 7-6)	Magnitude of Potential Impact (as defined by criteria assessment Table 7-8)	Significance of Potential Impact (as defined by criteria assessment Table 7-10)
1. Fuel storage/usage on site	Groundwater Subsoils Bedrock Aghamore River (Garavogue_010) Lough Gill SAC & PWS Carrowmore West and East GWBs (IE_WE_G_0040 & IE_WE_G_0042) Ballysadare Bay SAC & SPA	Accidental spillage of contaminants during site operations may cause short to long-term, moderate to significant impacts to soils, groundwater and the surface water environment if not stored and used in an environmentally safe manner.	Extremely High	Moderate Adverse	Profound
2. Excavation works and vehicle movement on site		Excavation works will result the same vulnerability of groundwater at the site as is now experienced by the same area of open bedrock.	Extremely High	Moderate Adverse	Profound
3. Surface water Runoff		Road surface runoff or drainage systems have potential, if not correctly designed, to result in contamination of surface waters and groundwater. Accidental spillage could contaminate the aquifer by direct percolation or via the superficial water network.	Extremely High	Moderate Adverse	Profound
4. Increased dewatering		Lowering the quarry bench could lead to an increase of groundwater component in the sump. Interception of rainfall and groundwaters from one catchment and re-direction back to the adjacent catchment presents impact potential.	Extremely High	Large Adverse	Profound
5. Discharge from the Site		Direct discharge of waters arising at the site could contaminate the receiving waters, which is primarily the Aghamore River (Garavogue_010), or the groundwater body underlying the processing site (eastern area). The ultimate receptor that could be impacted is Lough Gill. Flooding and scour are also potential impacts.	Extremely High	Moderate Adverse	Profound

Table 7-3 Mitigation Measures Table - Aghamore Quarry (following NRA 2008)

Activity	Attribute	Character of Potential Impact	Mitigation	Residual Impact
1. Fuel storage/ usage on site	Groundwater Subsoils Bedrock Aghamore River (Garavogue_010), Lough Gill SAC & PWSS, Carrowmore West and East GWBs (IE_WE_G_0040 & IE_WE_G_0042) Ballysadare Bay SAC & SPA	Accidental spillage of contaminants during site operations may cause short to long-term, moderate to significant impacts to soils, groundwater and the surface water environment if not stored and used in an environmentally safe manner.	• The 9 specified 'Waste & Oil Management' Conditions of the 2020 Discharge Licence DL(W)151 will be enacted prior to re-commencement of activity at the site. In addition, Condition 7's three Measures regarding 'ACCIDENT PREVENTION & EMERGENCY PROCEDURES' shall be enacted including the onsite availability of containment booms and/or suitable absorbent material to contain and absorb any spillage. • Waste and fuel materials will be stored in designated bunded areas that are isolated from surface water drains or open waters (*e.g.* excavations). All materials will be considered as Hazardous Wastes, including waste oil, chemicals and preservatives, will be stored in sealed, labelled 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 (including all ancillary equipment such as vent pipes and refuelling hoses) will be stored within a secondary containment system (*e.g.* a bund for static tanks or a drip tray for mobile stores and drums). The bunds 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. 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. • In addition to Maintenance Agreements with the suppliers of infrastructure, regular monitoring and maintenance of interceptors, separators and silt traps will be undertaken by the staff of the quarry 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 will be undertaken to ensure no visual oil or fuel contamination is present. • Oil interceptors and separators shall be fitted, with the capacity to deal with the 2020 licensed discharge volume of 3,500m^3/d [DL(W)151].	Neutral

Activity	Attribute	Character of Potential Impact	Mitigation	Residual Impact
2. Excavation works and vehicle movement on site	Groundwater Bedrock Carrowmore West and East GWBs (IE_WE_G_0040 & IE_WE_G_0042) Ballysadare Bay SAC & SPA	Excavation works will result the same vulnerability of groundwater at the site as is now experienced by the same area of open bedrock.	• Procedures are in place for dealing with accidental spillages. The Discharge Licence [DL(W)151, 2020] for the site details all mitigation measures required for protection of the attributes. • No storage of unbunded fuel tanks or other site activities (*e.g.* fuel storage, refuelling, adding hydraulic oils, etc) will be permitted. • Excavations of rock will follow best management practices for maintenance of machinery. • Blasting of rock is governed by Industry Standards to ensure minimal loss of explosive constituents to the environment.	Neutral
3. Surface Water Runoff	Groundwater Aghamore River (Garavogue_010), Lough Gill SAC & PWSS, Carrowmore West and East GWBs (IE_WE_G_0040 & IE_WE_G_0042) Ballysadare Bay SAC & SPA	Road surface runoff or drainage systems have potential, if not correctly designed, to result in contamination of surface waters and groundwater. Accidental spillage could contaminate the aquifer by direct percolation or via the superficial water network.	• The Discharge Licence [DL(W)151, 2020] for the site details all mitigation measures required for protection of the attributes. • The settlement sump and the wider area of the floor of the quarry have volumetric capacity to accommodate all waters for the required residence time to settle and retain potential rainfall runoff generated solids and any vehicular contaminants associated with runoff. • The developers are an international company with SOPs clearly outlined to ensure no environmental degradation arising from their business activities.	Neutral
4. Increased Dewatering	Carrowmore West and East GWBs (IE_WE_G_0040 & IE_WE_G_0042). Lough Gill SAC & PWSS Ballysadare Bay SAC & SPA	Lowering the quarry bench could lead to an increase of groundwater component in the sump. Interception of rainfall and groundwaters from one catchment and re-direction back to the	The small loss to the Carrowmore west groundwater body is deemed insignificant in the context of the regional groundwater body recharge volume, when the WFD GW5 Characterisation Assessment procedure is adopted. The potential maximum 3,500m3/d licensed future discharge from the quarry and its underlying Carrowmore East GWB/CARROWGOBBADAGH_SC_010 Surface water catchment to the western Bonet_SC_030, ultimately adding more recharge to Lough Gill, can only be considered a positive in terms of providing a water balance mitigation for	Neutral

Activity	Attribute	Character of Potential Impact	Mitigation	Residual Impact
		adjacent catchment presents impact potential.	the 14,600 m3/d combined design abstraction rate for Irish Water's supply of Public Water from Lough Gill for Sligo and North Leitrim.	
5. Discharge from the Site	Groundwater Aghamore River (Garavogue_010), Lough Gill SAC & PWSS, Carrowmore West and East GWBs (IE_WE_G_0040 & IE_WE_G_0042) Ballysadare Bay SAC & SPA	Direct discharge of waters arising at the site could contaminate the receiving waters, which is primarily the Aghamore River (Garavogue_010), or the groundwater body underlying the processing site (eastern area). The ultimate receptor that could be impacted is Lough Gill. The discharge could cause scouring of the riverbed. Discharge volumes could cause flooding in the downstream surface water environments.	In advance of this planning application the site engaged with Sligo County Council and a new Discharge Licence for the site was issued. That Discharge Licence evaluation procedure demonstrated that the site could justifiably and defensibly discharge a daily maximum volume of 3,500m3/d and present no threat to the integrity of the receiving environments. The 2020 issued DL (W)151 presents ELVs and Mitigation measures required for the continued operation of the site. Site investigations and conclusions arising from this assessment suggest that the region's groundwater regime primarily operates in the shallow epikarst, in the 0m OD to 20m OD elevation range, and is forcibly driven by recent rainfall. Given that the site's floor is currently c. 20m below the regionally active epikarst zone and that the proposal to go to -50m OD has been thoroughly evaluated using intensive geophysical assessment across the entire floor of the void to -60m OD, with no evidence of deep conduits connecting the site to Lough Gill, it is considered that no further mitigation is necessary other than the current Discharge Licence Conditions. A Reno Mattress will be installed at the discharge point to prevent scour. With respect to potential for flooding, the application presents evaluation of the potential for flooding and associated appropriate mitigation measures.	Neutral

7.298 The 'Residual Effects' Conclusions for the site are presented as Table 7-4. In summary, NO Residual Effect is anticipated for any Impact arising for the continued operation of the site.

Table 7-4 Residual Effects Table - Aghamore Quarry (following NRA 2008)

Aghamore Quarry Residual Effect Evaluation	No.	Potential Impact	Potential Effect	Description of Effect						Mitigation Required?	Residual Effect
				Quality	Significance	Extent	Probability	Duration	Type		
Construction Phase	1	Generated suspended solids in runoff	surface water quality	Negative	Significant	Local	Likely	Temporary	Irreversible	Yes (Runoff into the quarry void will be monitored, if sediment laden water enters the quarry floor and sump then the sump pump will be switched off until the sediment laden water has settled on the quarry floor)	No
	2	Accidental leaks/spills of fuels or oils	Surface water quality	Negative	Significant	Local	Unlikely	Temporary	Irreversible	Yes (Fuels & oils will not be stored within quarry, refuelling of construction vehicles will only be permitted outside the quarry, spill kits will be maintained on site to stop the migration of any accidental spillages)	No
Operational Phase	1	Increased drawdown	a) Aghamore Stream	Negative	Imperceptible	Local	Likely	Medium-Term	Reversible	No	No
			b) Lough Gill	Negative	Imperceptible	Local	Likely	Medium-Term	Reversible	No	No
			c) Groundwater Bodies	Negative	Imperceptible	Local	Likely	Medium-Term	Reversible	No	No
	2	Discharge to surface water (quarry)	a) Flooding	Negative	Imperceptible	Local	Unlikely	Medium-Term	Reversible	No	No
			b) Surface water quality	Negative	Imperceptible	Local	Unlikely	Medium-Term	Irreversible	No (Reno mattress will be installed at the discharge point to prevent scour)	No
	3	Blasting	Groundwater quality	Negative	Significant	Local	Unlikely	Medium-Term	Irreversible	Yes (Development of site-specific blasting protocol)	No
	4	Accidental leaks/spills of fuels or oils	Surface water quality	Negative	Significant	Local	Unlikely	Temporary	Irreversible	Yes (bunding of petroleum-based products, regular plant inspections, no refuelling in quarry void, spill kits, interceptors, settlement lagoon)	No
	5	Infilled area upstream	Surface water quality	Negative	Imperceptible	Local	Unlikely	Permanent	Cumulative, Irreversible	No	No
	6	Discharge to surface water (processing yard)	Surface water quality	Negative	Significant	Local	Likely	Medium-Term	Cumulative, Irreversible	Yes (construction of berm to prevent runoff into Aghamore Stream)	No
Post-Operational Phase	1	None identified									

Operational Stage

7.299 To mitigate the potential impact of explosives on surface water quality during blasting operations site-specific protocol for blasting is provided in EIAR Appendix 2.3.

7.300 The type of explosive to be used at the quarry is Kemex 70. Kemex 70 is supplied by Irish Industrial Explosives (IIE) and is a waterproof, pumped emulsion product, which is designed for wet conditions. It is a site manufactured explosive whereby non-explosive materials are transported to site in a specifically designed pump truck. The materials are blended on-site and pumped directly into the blast holes by trained and experienced operators.

7.301 IIE provides blasting services to all of the applicant's quarry operations throughout Ireland. IIE operates an ISO9000 Quality Management System and its occupational health and safety management system is based on OHSAS 18001. IIE carries out all blasting activities in accordance with its Quarry Blasting Procedure, a copy of which is enclosed in EIAR Appendix 2.3. IIE's blasting procedure controls the loading of the explosive product into the drill holes and two points of initiation are used in each drill hole to ensure that initiation occurs, and the explosive product is fully consumed.

7.302 Discharge Licence DL(W)151 (2020) outlines Conditions 6.1 to 6.9 for the Operational Stage and Environmental Protection. Amongst other measures, all petroleum-based products (lubricating oils, waste oils, etc.) will be stored in labelled containers and in bunded areas to prevent pollution by accidental leaks as is Conditioned in the discharge licence.

7.303 All plant used on site will be inspected regularly for signs of leaks. Mobile plant/machinery will only be serviced on a hardstand refuelling area draining to an interceptor to prevent uncontrolled releases of pollutants to ground. No refuelling or servicing will be undertaken within the quarry void.

7.304 Spill kits will be maintained on site to stop the migration of any accidental spillages, should they occur.

7.305 Interceptors and separators are conditioned and will be installed, managed, maintained and inspected as Conditioned in the discharge licence.

7.306 A settlement lagoon will be installed to reduce suspended solids levels in the discharges conditioned in the discharge licence.

7.307 To mitigate the potential for erosion (scour) of the stream bed from the quarry discharge, a reno mattress will be installed at the discharge point to dissipate the energy of the discharge.

7.308 To mitigate the potential for exacerbating flooding at Culvert 4 downstream of the quarry discharge, where the restricted size of the pipe culvert may result in flooding of the adjacent road in extreme weather events, Lagan will ensure that there is no pumping during flooding events which eliminates the slight risk from flooding during extreme events.

7.309 To mitigate the potential for cumulative impact in combination with runoff from the area where the obsolete concrete production plant is located, a berm will be constructed across the open perimeter of the processing area where runoff from a collection sump overflows the Aghamore Stream. The berm will prevent any direct discharge to surface water from the processing area. Ponded runoff in the collection sump will be pumped to a soakaway nearby and allowed to infiltrate to groundwater. Any historical discharges arising from the processing area would have originated from the wash-water associated with concrete production activities. This plant has not operated since the site was purchased by the applicant from Cemex (ROI) Ltd. in 2014 and is now obsolete. The applicant does not intend to recommence the production of concrete products at the site.

7.310 These proposed mitigation measures would reduce the significance of the potential impacts at the operational stage from '**Significant**' to '**Imperceptible**'.

Post – Operational Stage

7.311 No direct post-operational impacts on the water environment have been identified.

RESIDUAL IMPACT ASSESSMENT

Construction Stage

7.312 If the proposed mitigation measures are fully implemented, no residual impacts are anticipated in the Construction Stage.

Operational Stage

7.313 If the proposed mitigation measures are fully implemented, no residual impacts are anticipated in the Operational Stage.

Post – Operational Stage

7.314 No residual impacts are anticipated in the Post-Operational stage.

Summary

7.315 **Table 7-4** presented the summary findings of the Residual Impact Assessment and the conclusion in each case is 'No Residual Impact'. Residual impacts on the hydrological or hydrogeological environment are not envisaged to result from the proposed quarry development in the vertical plane and the site's mitigation measures. Karst Limestone Aquifer's bedrock at depth has little primary porosity. Research commissioned by Sligo County Council and the OPW has demonstrated the highly active epikarst zone to be significant in the local hydrological and hydrogeological regime (Tynan, 2021, **Appendix 7-2**) and this has been proven by field measurement in the course of this work. Not much new groundwater will be encountered at the site because the conduit and epikarst rainfall transit zones are not at depth: they are at a higher elevation than the current floor level. The site has been dealing with its relatively small groundwater volume allotment for years and it has easily been managed and no impacts have been detected in either the Groundwater Bodies or the Lough Gill lake environment. The significant majority of the quarry's groundwater comes in by epikarst. Most of the water in the void comes in at a relatively high elevation between the perimeter land elevation of 30mOD, approximately, and the epikarst bottom boundary of 0mOD. The working area of the quarry is already at -21mOD and the licensed discharge from the void should comfortably be managed with no pressure placed on two appropriately specified 6" diameter pumps in the future.

MONITORING

7.316 All surface water monitoring required under the existing Trade Effluent Discharge Licence will be carried out once activities recommence on site. Flowmeters are already installed in the discharge pipes from the quarry sump and a flowmeter installed upstream of the quarry discharge to the Aghamore Stream.

7.317 Groundwater levels will be monitored in the existing monitoring wells as the quarry is developed to confirm the drawdown and estimated radius of influence. Monitoring of groundwater levels by datalogger with periodic site visits to download data will be carried out.

7.318 Groundwater quality monitoring will continue to be carried out on a biannual basis from a representative number of monitoring wells around the quarry.

7.319 Water levels at Culvert 4 (by the entrance of the Top Coast Oil depot) will be monitored during periods of high rainfall to assess the likelihood of flooding onto the adjacent road. As noted above, discharges will be discontinued during periods of elevated rainfall to eliminate the slight potential risk of flooding at this location.

Discussion & Conclusions

7.320 In the absence of specifically hydrogeologically directed Competent Authority Guidance on quarry dewatering appraisals, UK practical guidance as published by the UK Environment Agency (the public body equivalent of the Irish EPA) can be applied to collate and conclude all information collected and presented for the assessment of viability for the site to continue in vertical extractions of rock in this Karst Limestone & significant receptor environment.

7.321 The UK Environment Agency Guidance Document is cited as Boak, R. et al. (2007) Using Science to create a better place: Hydrogeological impact appraisal for dewatering abstractions. (Environment Agency, Science Report – SC40020/SR1).

7.322 The approach adopted by the UK Environment Agency (Boak, R. et. al., 2007) is succinctly described in the Guidance Document 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).

7.323 The EA conceptual HIA and the understanding of the site and its regional context is now applied to present a reasoned assessment of the potential for impact that might arise in response to the proposed development. The answers to each of the EA HIA steps can now be summarised as follows:

- ***Step 1:*** Establish the regional water resource status:
  - **ASSESSMENT OUTPUT =**
    1. Regionally Important Karst Conduit Aquifer, named the Carrowmore East and West Groundwater Body, each assigned Good Status (EPA 2013-2018, https://gis.epa.ie/EPAMaps/).
    2. Receiving Water Aghamore Stream = Poor Status attributed to forestry, wastewater and road drainage (EPA, 2019).

3. Downstream Receptor Lough Gill SAC and PWSS is Moderate Status (EPA, 2019), at Risk and an important PWSS for two counties.

- ***Step 2:*** Develop a conceptual model for the quarry void's abstraction and the surrounding area:
    - **ASSESSMENT OUTPUT =**
        - The Site's groundwater inflows are primarily by the shallow epikarst zone. Regionally, that epikarst zone is reported to be active in the 0mOD to 22mOD and rainfall is a dominant driver in the hydrogeological responses observed at the site and in the surrounding areas. No conduits were identified in geophysical investigation across the entire quarry floor void to an investigation depth of -60m OD (Apex, 2021). The application site is currently at an elevation of -21mOD and the proposal is to bring it to -50mOD. Current groundwater ingress is known.
        - The conceptual model, based on drilling and hydraulic response testing, is that there will be little new groundwater encountered.
        - The site's water balance in the context of the entire underlying Regional Aquifer and Lough Gill's land overflow recharge (NOT ACCOUNTING FOR RIVER INFLOWS THEMSELVES) is 2% and between 4% and 6% dependent on the underlying groundwater body considered. Those percentages are of no significance, when the WFD GW5 Assessment scheme is applied. This therefore adds to support the finding that the site poses no risk to Lough Gill SAC nor Ballysadare Bay SAC and SPA.
        - Given that the site's floor is currently located c. 20m below the regionally active epikarst zone and that the proposal to go to -50mOD has been thoroughly evaluated using intensive geophysical assessment across the entire floor of the void to -60mOD, with no evidence of deep conduits connecting the site to Lough Gill.

- ***Step 3:*** Identify all potential water features that are susceptible to flow impacts:
    - **ASSESSMENT OUTPUT =**
        - Aghamore Stream (Garavogue_010),
        - Lough Gill SAC & Public Water Supply Source (PWSS),
        - The most easterly boundaries of Ballysadare Bay SAC (Site Code 000622) and Ballysadare Bay SPA (Site Code 004129) are situated south west of the quarry at a distance of 3km, approximately, from the site's most western boundary.

  - Cummeen Strand SPA, Cummeen Strand/Drumcliff Bay SAC (Site Codes 004035 and 000627) are located 7km downstream of the quarry and downstream of Lough Gill.
  - Carrowmore West Groundwater Body (IE_WE_G_0040)
  - Carrowmore East Groundwater Body (IE_WE_G_0042).

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

  - **ASSESSMENT OUTPUT =**
    Project Information, Discharge Licence Information and Regional Water Balance calculations presented by Bartley (Appendix 7-2) suggests likely flow apportioning as follows:

    1. Aghamore Stream will receive all the site's pumped discharge under a 2020 issued licence DL(W)151 ELV for Volume of up to 3,500m^3/d.
    2. Lough Gill SAC & PWSS receives, amongst many river inputs in the catchment, flow from the Aghamore Stream at a distance of 765m downstream of the site's point of discharge. Regioanl Water Balance (Bartley, Appendix7-2) shows little low potential for impact. Ballysadare Bay SAC and SPA will receive a groundwater flow reduction of between 2 and 6%, approximately, depending on the scale of reference considered i.e. Regional Aquifer or Carrowmore West GWB. When considered over the entire Regionally Important Aquifer's rainfall recharge contribution area, the change in dynamic caused by the quarry's discharge heading to the Aghamore Stream rather than west towards the Bay is deemed insignificant in the context of WFD GW5 Guidance, which would this in the small risk category.
    3. The same conclusion is drawn for Cummeen Strand SPA, Cummeen Strand/Drumcliff Bay SAC (Site Codes 004035 and 000627) are located 7km downstream of the quarry and downstream of Lough Gill. Given that no impact is predicted for Lough Gill, no impact can be transferred to Cummeen Strand SPA, Cummeen Strand/Drumcliff Bay SAC (Site Codes 004035 and 000627).
    4. While the quarry site straddles two groundwater bodies and two surface water bodies, these are generally national scale mapping lines on GIS systems. Review of the catchment topography, regional and local highs and lows identified in Tynan's studies for the area (2021, **Appendix 7-2**) and the outcropping of rocks in the area suggests insignificance in the greater scheme of the site providing mitigation water balance for the design abstraction rate of 14,600m^3/d from the downstream Lough Gill surface water catchment for Public Water Supply to Sligo and Leitrim. (Refer to Bartley, 2021, **Appendix 7-2** for The Carrowmore East and West Groundwater Bodies and the Regional Water Balance Tables).

5. Regional Aquifer scale Water Balance calculations are tabulated by Bartley (2021, **Appendix 7-2**) and the resultant impact %'s are deemed insignificant in the context of GW5 Guidance.

- ***Step 5:*** Allow for the mitigating effects of any discharges, to arrive at net flow impacts:
    - **ASSESSMENT OUTPUT =**
        - No net flow impacts are envisaged for the following reasons:
            - In advance of this planning application the site engaged with Sligo County Council and a new Discharge Licence for the site was issued. That Discharge Licence evaluation procedure demonstrated that the site could justifiably and defensibly discharge a daily maximum volume of 3,500m3/d and present no threat to the integrity of the receiving environments. The 2020 issued DL (W)151 presents ELVs and Mitigation measures required for the continued operation of the site.
            - A Reno mattress will be installed at the discharge point to prevent scour.
            - With respect to potential for flooding, the application presents evaluation of the potential for flooding and associated appropriate mitigation measures.
            - Mitigation Effects and Residual Effects have been evaluated using EPA and NRA Guidance and the finding of "No Effects" Concluded after the application of the Mitigation Measures.

- ***Step 6:*** Assess the significance of the net flow impacts:
    - **ASSESSMENT OUTPUT =**
        - Negligible significance @ 2% of the Regional Aquifer's water balance, 4% of the Carrowmore East GWB, 6% of the Carrowmore West GWB & <1% of the Contribution of land surface runoff to Lough Gill SAC & PWS (Refer to Water Balance Tables in Bartley (2021, **Appendix 7-2**).

- ***Step 7:*** Define the search area for drawdown impacts:
    - **ASSESSMENT OUTPUT =**

    - ***Impact assessment determined that there are No Groundwater Source targets for impact.*** In any case, the groundwater flow mechanism is Karst Conduit flow with extremely low measured hydraulic conductivity in the matrix of the bedrock, as measured in site investigation boreholes. The conduit flow mechanism is therefore supported by field drilling and testing. This means that groundwater wells will source their water from discrete conduits. Site investigations suggest no conduits leading from the site or underlying the quarry floor.
    - ***Numerous drawdown calculation methods were applied in this evaluation and the radius of influence could be between 250 and 350m from the centre of the quarry.*** Given that there are no groundwater source targets and that the ultimate resource target is Lough Gill at 765m, a conclusion of no potential for impact arising from dewatering is concluded.
    - The Aghamore Stream is not a target at risk from the dewatering regime in the hard rock void of this quarry. The Aghamore stream is a rainfall driven stream coming from the mountains to the south east and the assimilation capacity simulations that supported the 2020 grant of Discharge Licence DL(W)151 showed that the discharge provided water quality improvement for the stream. The WFD sub catchment assessment for this stream identifies Forestry, road runoff and wastewater as risks to its integrity. Generally, correctly managed large scale regionally important quarries often provide a cleaner water to streams heavily impacted by forestry and agriculture.

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

  - **ASSESSMENT OUTPUT =**
    - Refer to comments above and Tables 7-2, 7-3, 7-4 above. No features will be affected by drawdown.

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

  - **ASSESSMENT OUTPUT =**
    - ***None predicted.***

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

  - **ASSESSMENT OUTPUT =**
    - ***Not relevant.***

- ***Step 11:*** Assess the significance of the net drawdown impacts:
  - **ASSESSMENT OUTPUT =**
    - ***Not applicable***

- ***Step 12:*** Assess the water quality impacts:
  - **ASSESSMENT OUTPUT =**
    - Assimilation capacity simulations sanctioned by Sligo County Council's 2020 grant of DL(W)151 suggest no deleterious impacts on water quality and some water quality improvements.

- ***Step 13:*** If necessary, redesign the mitigation measures to minimise the impacts:
  - **ASSESSMENT OUTPUT =**
    - Not necessary. The Mitigation Measures of Table 7-3 are appropriate.

- ***Step 14:*** Develop a monitoring strategy:
  - **ASSESSMENT OUTPUT =**
    - Monitoring specified in DL(W)151 and in the Monitoring Proposal set out in this application will ensure compliance with the Groundwater, Surface water and Birds and Habitats Regulations.

Lough Gill SAC Protection Measures

7.324 The main risk associated with the proposed extension in depth for a portion of the existing quarry at Aghamore, Co. Sligo, is the initially perceived potential adverse impact it could have on the Lough Gill SAC (Site Code 001976). The 2020 Discharge Licence provides a Protection Measure. The potential maximum 3,500m3/d licensed future discharge from the quarry to Lough Gill could be considered a positive in terms of providing a water balance mitigation for the 14,600 m3/d combined design abstraction rate for Irish Water's supply of Public Water from Lough Gill for Sligo and North Leitrim. T. Recharge characteristics and water balance calculations suggest that the site's potential interference in the wider groundwater catchment's water balance is insignificant. Groundwater enters the quarry primarily through epikarst high up in the already exposed face of the quarry void's walls. Rainfall plays a big part. Groundwater settles in the sump at the lowest level of the quarry and is pumped to under licence DL(W)151 (2020) to the Aghamore Stream. Monitoring results and ELVs specified in the Licence suggest no potential to negatively affect groundwater or surface water quality.

7.325 With the proposed expansion of the quarry, the quarry floor will be lowered. This could result in a small increase in the volume of water in the quarry: the same volume of rainfall runoff will fall on a similar area – it will just be ground at a lower elevation, with the same runoff co-efficient and volumes derived.

7.326 Extensive geophysics across the floor of the current void have examined the geology to the depth of -60m OD and no evidence was found of deep karst conduits or voids that could connect the site to Lough Gill. No potential for impact is envisaged.

Cummeen Strand SAC & SPA Protection Measures

7.327 Cummeen Strand SPA, Cummeen Strand/Drumcliff Bay SAC (Site Codes 004035 and 000627) are located 7km downstream of the quarry and downstream of Lough Gill.

7.328 As previously stated, there is an indirect hydrological (surface water) connection between the site and Cummeen Strand SPA, Cummeen Strand/Drumcliff Bay SAC which is located downstream of Lough Gill. Given that Lough Gill occurs upstream of Cummeen Strand and that the assessment of impact finds no impact on Lough Gill then Cummeen Strand would also not be impacted.

7.329 Given that discharge monitoring results from the quarry and ELVs specified in the 2020 Discharge Licence suggest no potential to negatively affect surface water quality entering Lough Gill, Cummeen Strand SPA, Cummeen Strand/Drumcliff Bay SAC is not considered a potentially sensitive receptor for the proposed development.

Ballysadare Bay SAC & SPA Protection Measures

7.330 The most easterly boundaries of Ballysadare Bay SAC (Site Code 000622) and Ballysadare Bay SPA (Site Code 004129) are situated south west of the quarry at a distance of 3km, approximately, from the site's most western boundary.

7.331 As previously stated, there is no direct hydrological connection with Ballysadare Bay SAC and SPA *via* surface runoff or stream networks. There is a direct underlying subsurface hydrogeological connection between the site and Ballysadare Bay SAC and SPA to the west, as groundwater from the western half of the site discharges to Ballysadare Bay. However, given the distance to Ballysadare Bay (c. 3.3km), the size of the catchment to Ballysadare Bay and the very small groundwater abstraction rate from the quarry, Ballysadare Bay SAC and SPA is not considered a potentially sensitive receptor for the proposed development. Water balance calculations for the Carromore East Groundwater Body, discharging from the site to Ballysadare Bay, suggest 'Low Potential for Impact' (Appendix 7-2).

Overall Conclusions

7.332 The site holds a defensible and justifiable discharge licence issued under review by Sligo County Council in 2020 [DL(W)151].

7.333 DL(W)151 establishes a management and operation system that will ensure discharge to the receiving waters and compliance with the Surface Water Regulations, Groundwater Regulations and Birds and Habitats Regulations.

7.334 The same management and operations will occur in the processing area. Evaluation of the sand and gravel subsoils and the groundwater regime at the processing area suggest no potential for interaction between the hard rock quarry void and the processing area. Mitigation measures will be in place for hydrocarbon management.

7.335 Geological and geophysical evaluations at the site proposed for further rock excavation suggest competent limestone beneath the current floor elevation of -21mOD to the investigation zone of -60mOD (Apex, 2021). The site investigations and evaluations therefore suggest that the proposal to deepen the quarry to -50mOD is viable.

7.336 The risk posed to Lough Gill SAC and PWSS is deemed negligible. Potential effects or interactions with the PWSSs abstractions for Sligo and North Leitrim have been robustly examined.

7.337 The risk posed to Ballysadare Bay SAC and SPA, and Cummeen Strand SAC and SPA, is deemed negligible.

7.338 The risk posed to the underlying Groundwater Bodies is deemed negligible.

7.339 The quarry void's perimeter land surface has an approximate elevation of 30mOD.

7.340 The regional karst system was well studied and reported to Sligo County Council independently of the assessment completed for the applicants. It is reported that there is an active and responsive, rainfall driven, epikarst system operating in the 0mOD to 20mOD elevation range.

7.341 Given that the quarry void's floor is currently at an elevation of -21mOD, the significant epikarst flow system's discharges are already encountered at the site, which currently discharges 3000m^3/d, approximately.

7.342 Water balance for the site itself suggests that the largest input of water to the quarry was from direct rainfall/runoff (71%), with indirect drainage via epikarst accounting for 19%, and deeper groundwater inflows making up only 10%.

7.343 It is therefore envisaged that as the void is progressed in depth, little more groundwater will be encountered. Apex geophysics analysis (2021) found no suggestion of groundwater flow paths beneath the area proposed for deepening.

FIGURES

Figure 7-16
Groundwater Recharge Map

Figure 7-17
Water Mains Map

Figure 7-18
Well Records Map

Figure 7-19
Private Wells within 1km of Quarry

Figure 7-20
Groundwater Levels at Northern Quarry Margin

Figure 7-21
Regional Groundwater Flow Map

Figure 7-22
Local Groundwater Flow Maps

Figure 7-23
Piper Plots of Groundwater Samples

Figure 7-24
Conceptual Site Models

Figure 7-25
Designated Sites

Figure 7-26
Radius of Influence Map

Figure 7-27
Summary of Channel Survey

Figure 7-28
Stream Channel Survey – Location of Reaches & Culverts

Figure 7-29
Stream Channel Survey – Location of Stream Cross-Sections

Figure 7-30
Stream Channel Survey – Longitudinal Profile of Aghamore Stream

Figure 7-31
Stream Channel Survey – Areas Liable to Flood

Fig. 7-1 Monitoring Well Location Map (Google Earth)

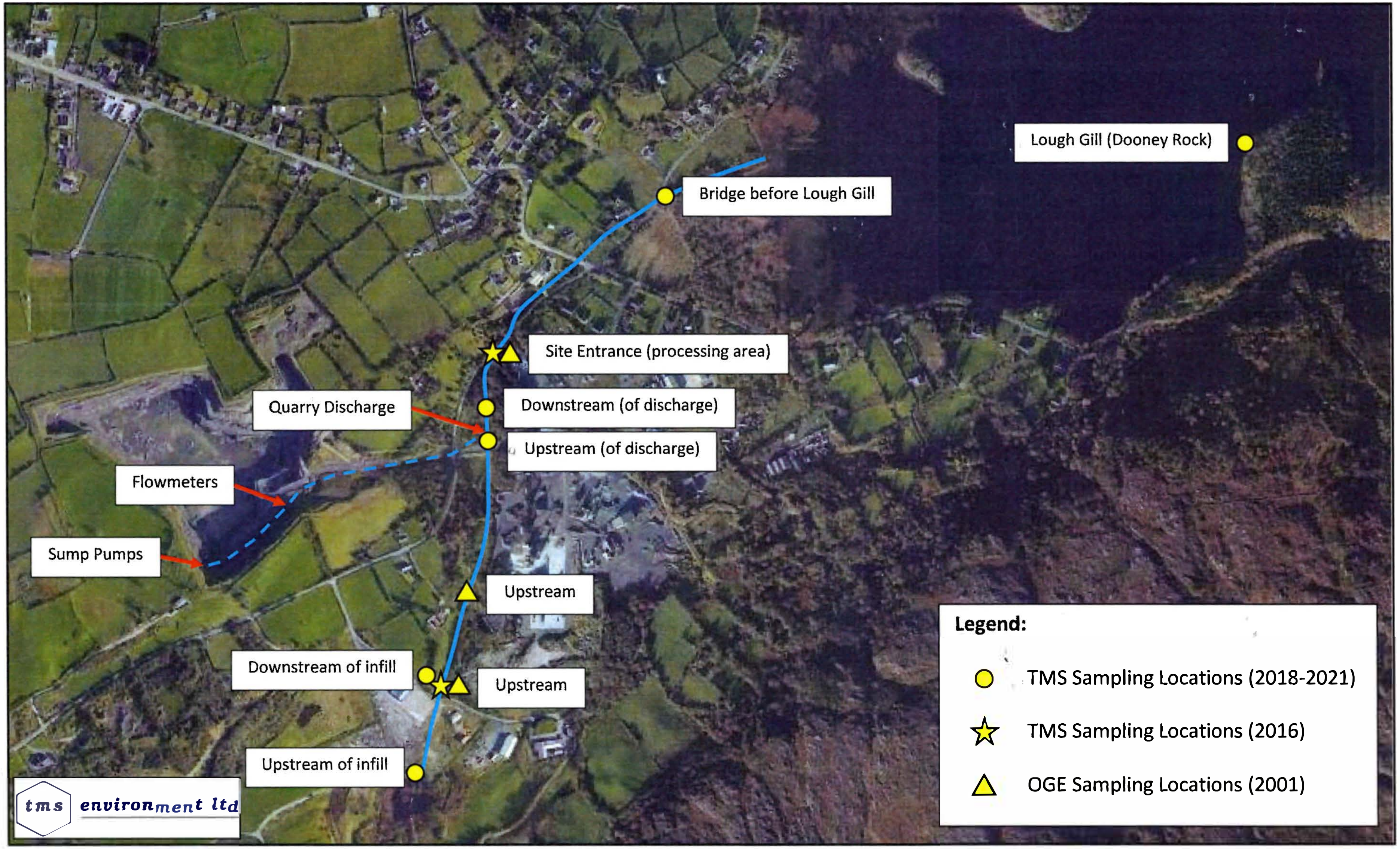


Fig. 7-2 Surface Water Sampling Locations Map (Bing Maps)

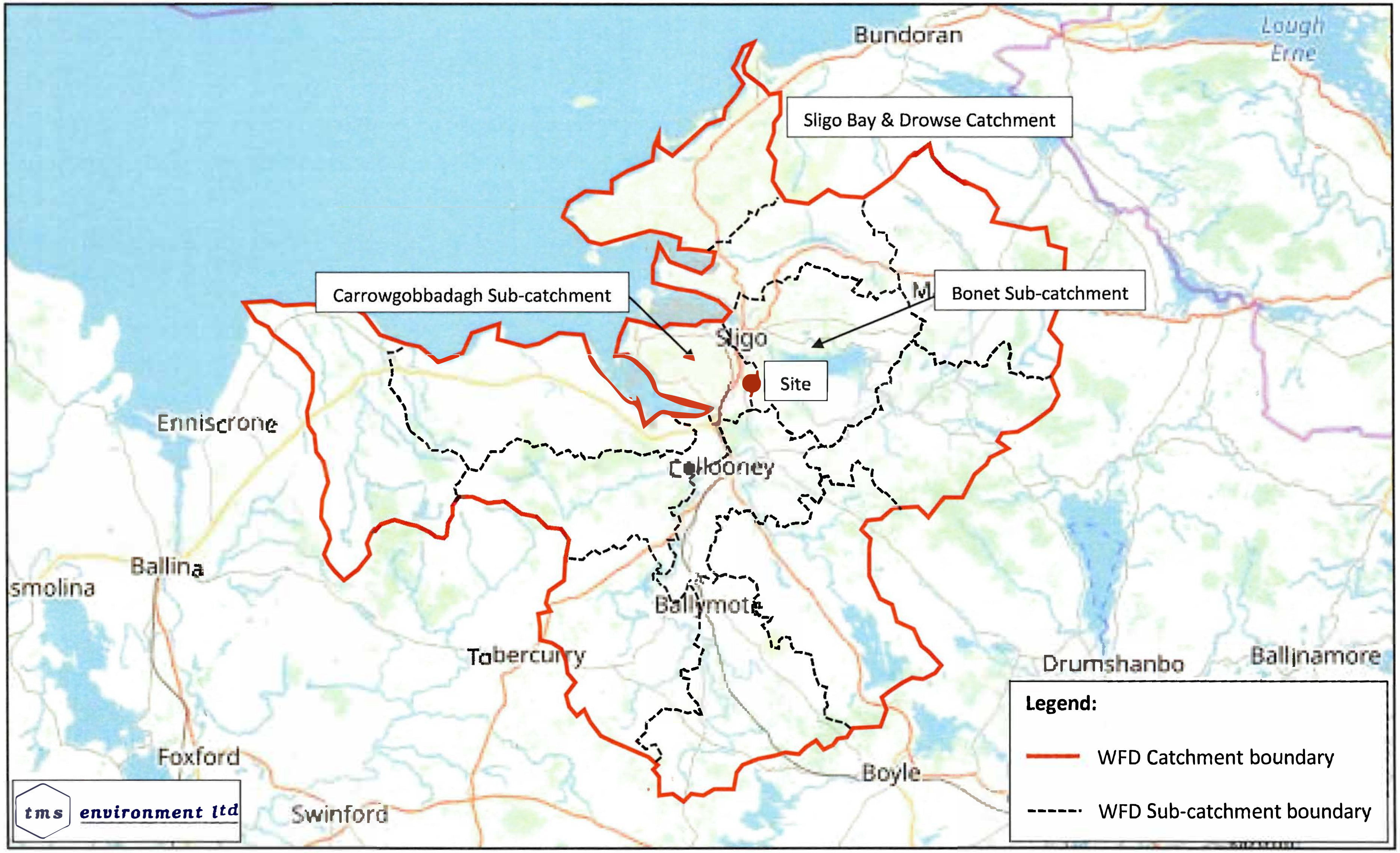


Fig. 7-3 Surface Water Catchment & Sub-Catchments Map

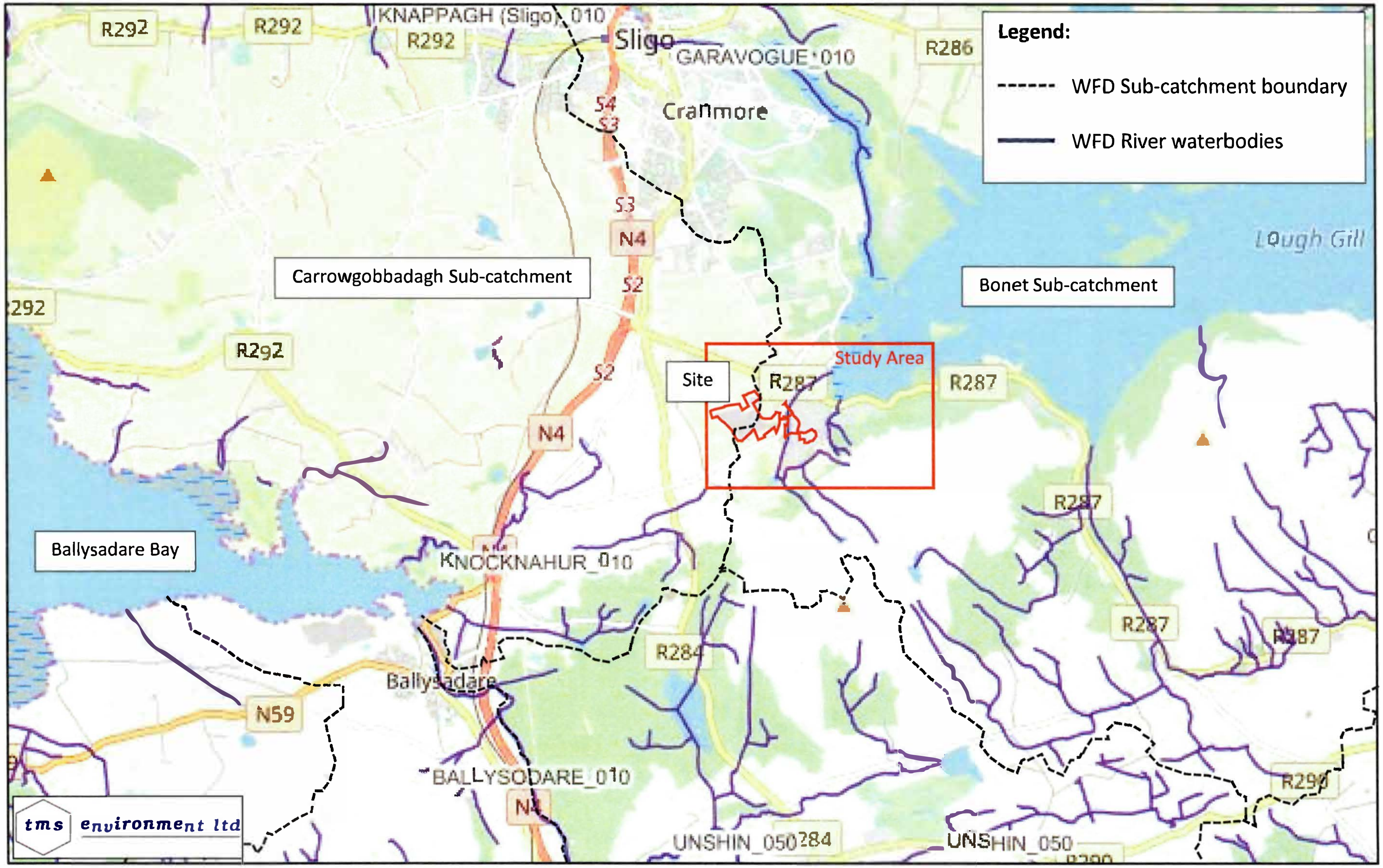
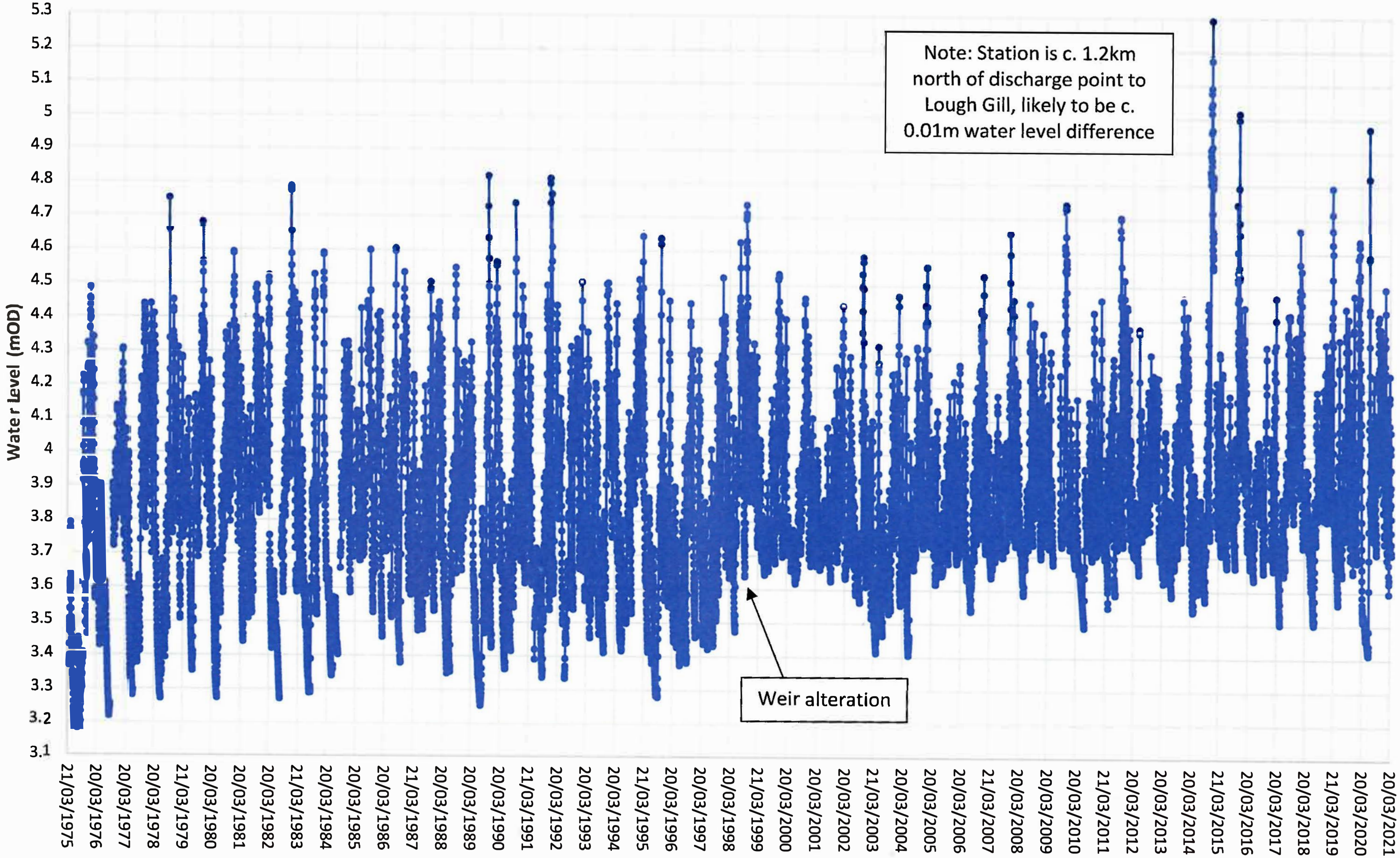


Fig. 7-4 Surface Waterbodies Map (EPA Water Maps website)

Fig. 7-5: Daily Mean Water Levels, Lough Gill (mOD)



Note: Station is c. 1.2km north of discharge point to Lough Gill, likely to be c. 0.01m water level difference

Weir alteration

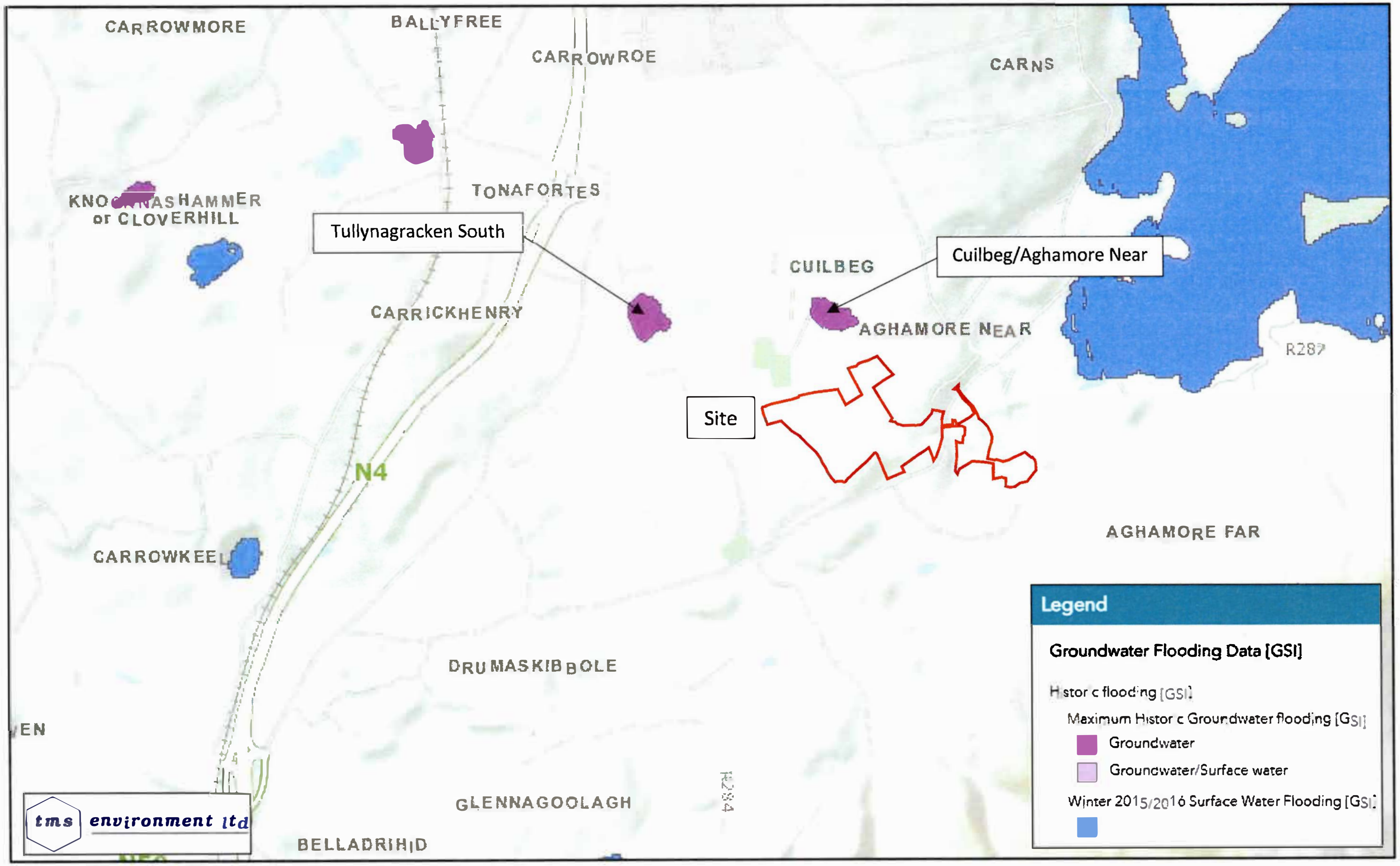
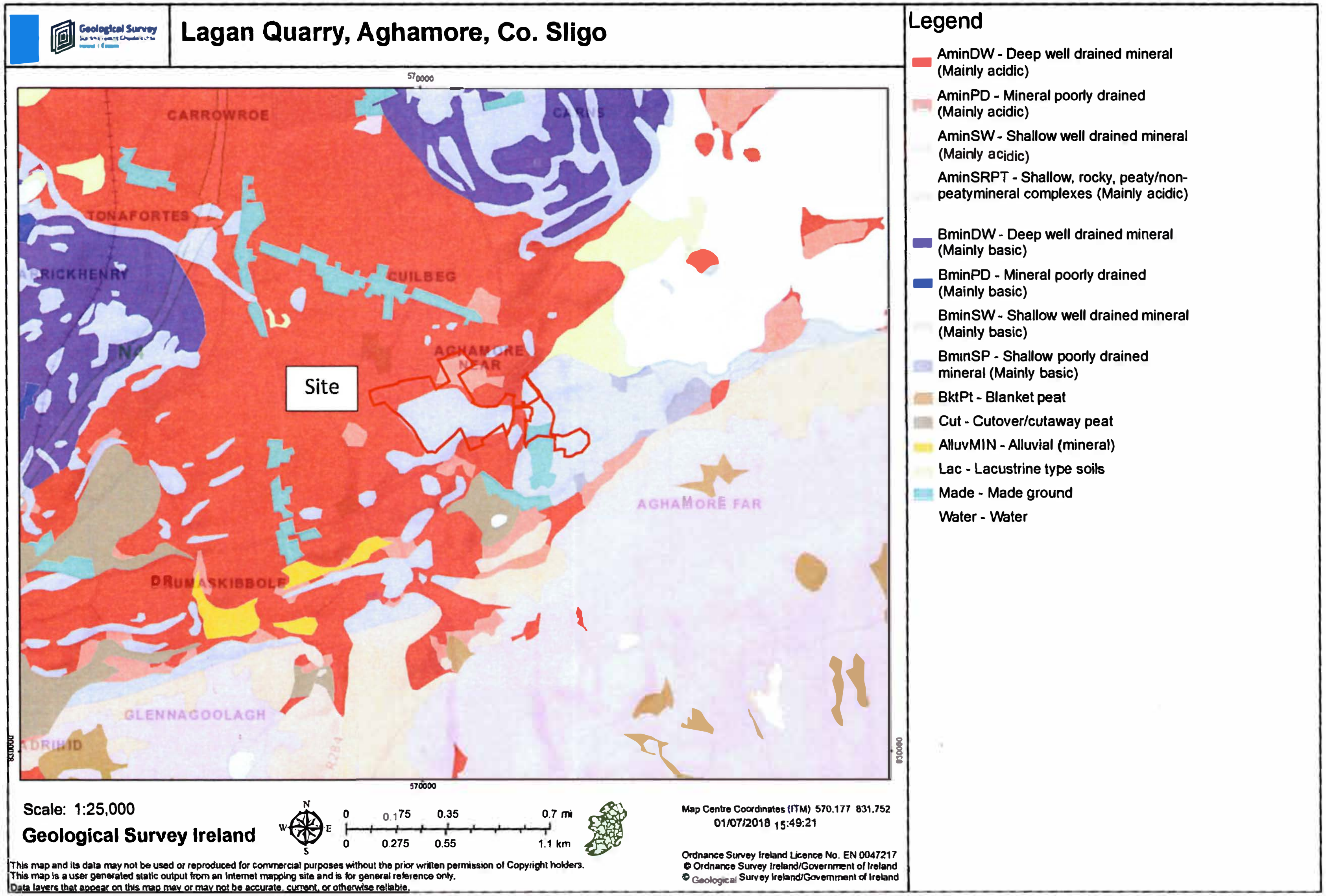


Fig. 7-6 Groundwater Flooding Map (GSI Groundwater Flooding Data Viewer)



Lagan Quarry, Aghamore, Co. Sligo

Legend

- 🟥 AminDW - Deep well drained mineral (Mainly acidic)
- AminPD - Mineral poorly drained (Mainly acidic)
- AminSW - Shallow well drained mineral (Mainly acidic)
- AminSRPT - Shallow, rocky, peaty/non-peatymineral complexes (Mainly acidic)
- 🟪 BminDW - Deep well drained mineral (Mainly basic)
- 🟦 BminPD - Mineral poorly drained (Mainly basic)
- BminSW - Shallow well drained mineral (Mainly basic)
- BminSP - Shallow poorly drained mineral (Mainly basic)
- 🟫 BktPt - Blanket peat
- Cut - Cutover/cutaway peat
- 🟨 AlluvMIN - Alluvial (mineral)
- Lac - Lacustrine type soils
- Made - Made ground
- Water - Water

Scale: 1:25,000

Geological Survey Ireland

Map Centre Coordinates (ITM) 570,177 831,752
01/07/2018 15:49:21

Fig. 7-7 Soils Map (GSI Groundwater Data Viewer)

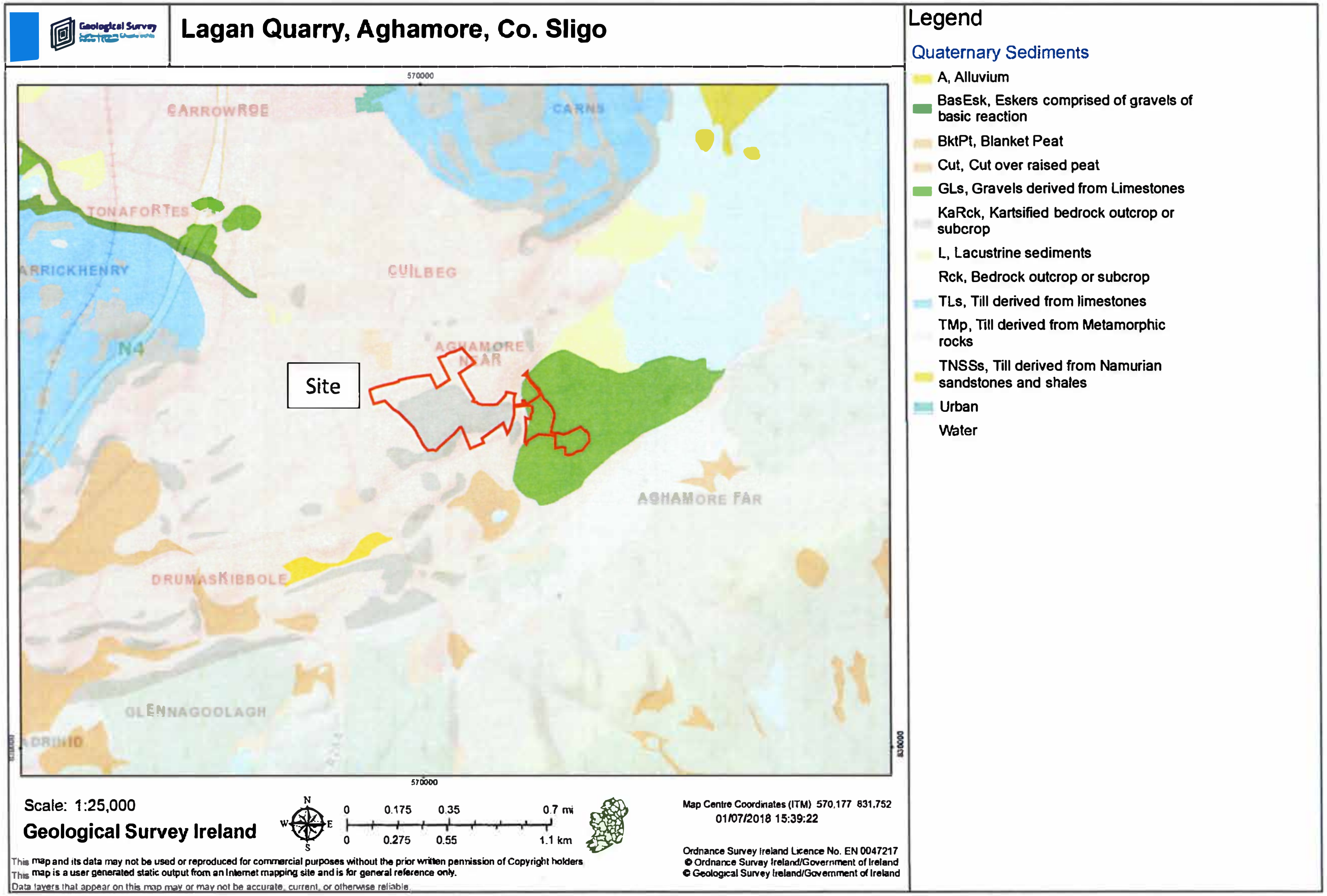


Fig. 7-8 Subsoils Map (GSI Groundwater Data Viewer)

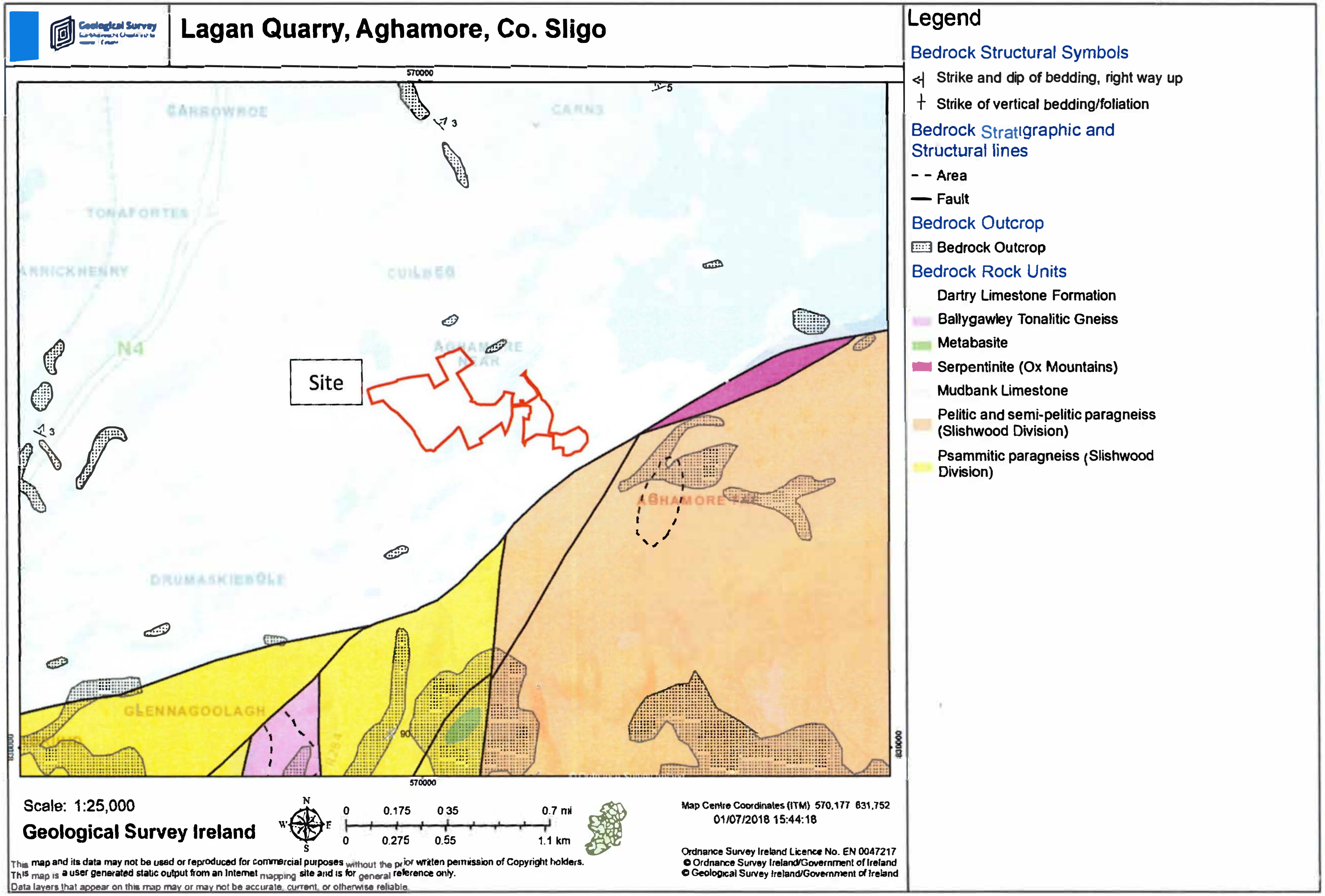
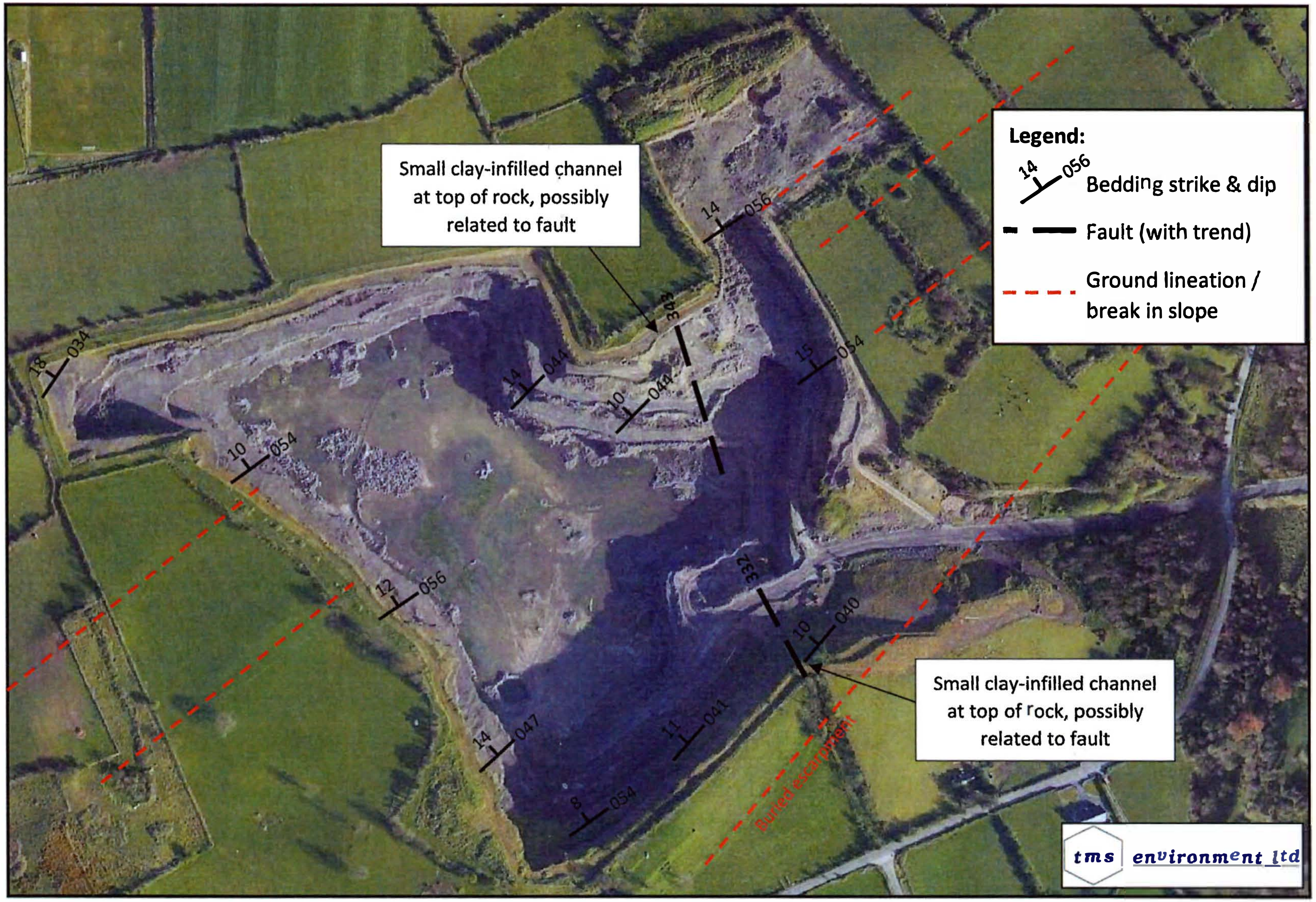


Fig. 7-9 Bedrock Map (GSI Groundwater Data Viewer)



Small clay-infilled channel at top of rock, possibly related to fault

Small clay-infilled channel at top of rock, possibly related to fault

Fig. 7-10 Bedrock Structure Map (Bing Maps)

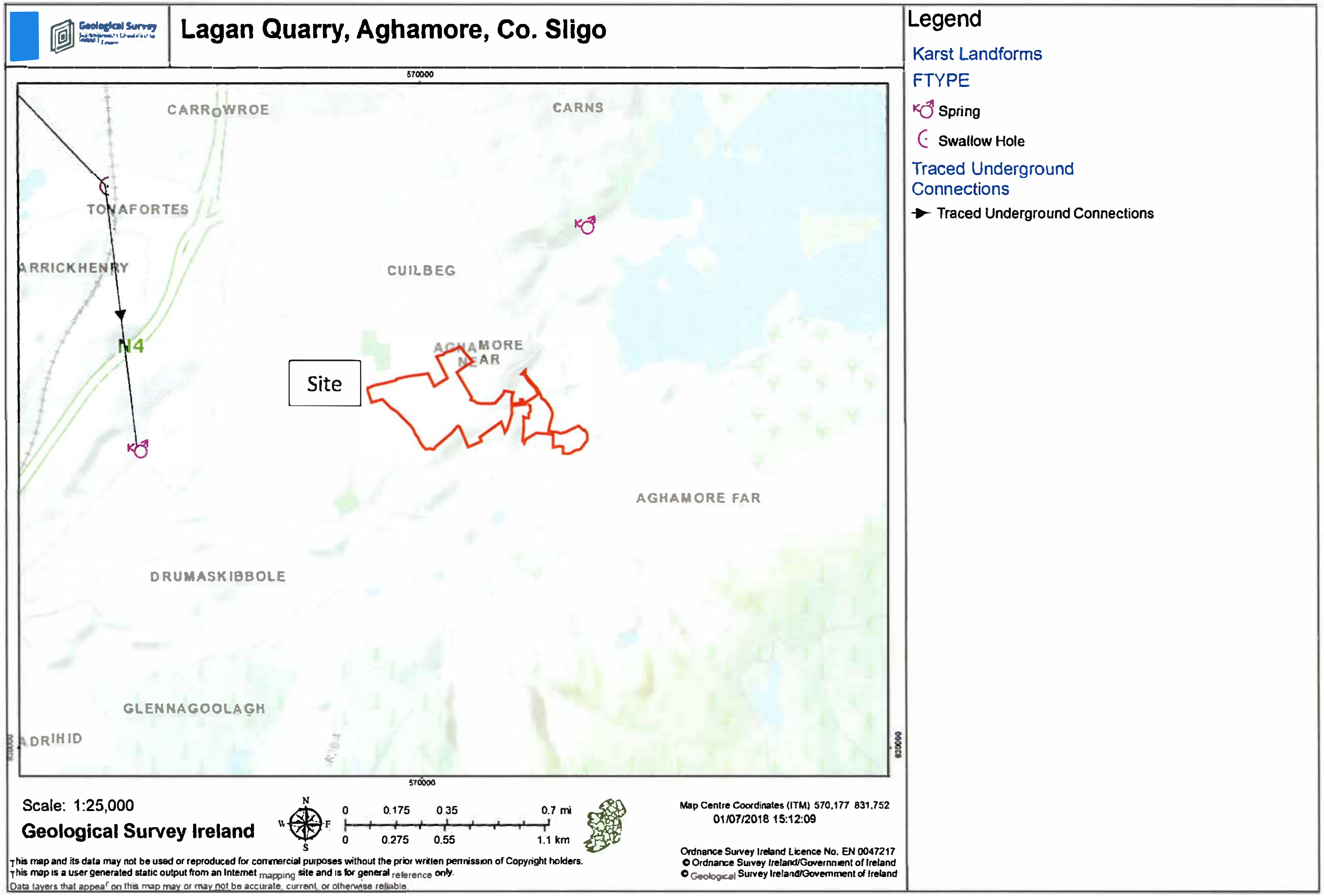


Fig. 7-11 Karst Features Map (GSI Groundwater Data Viewer)

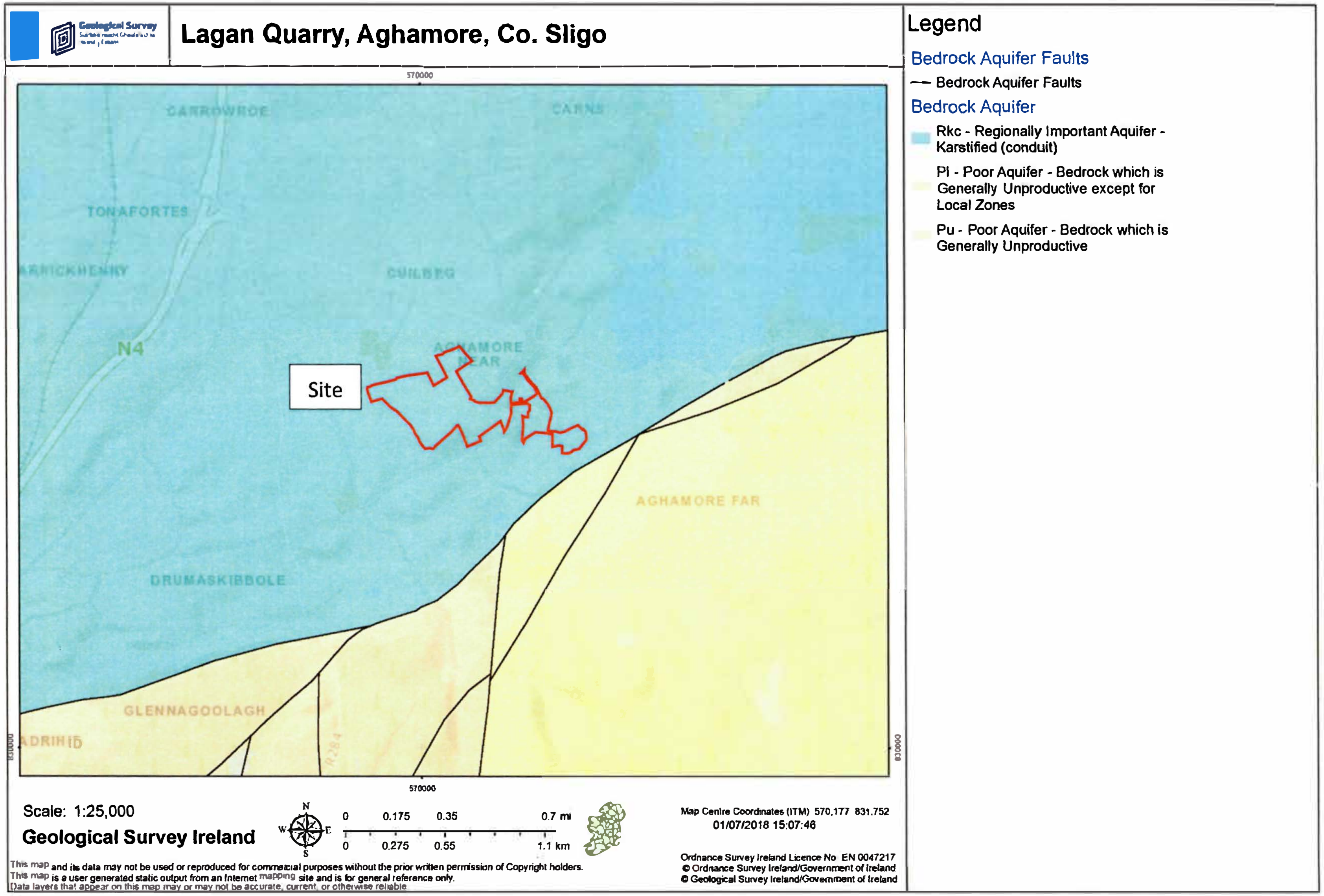


Fig. 7-12 Bedrock Aquifers Map (GSI Groundwater Data Viewer)

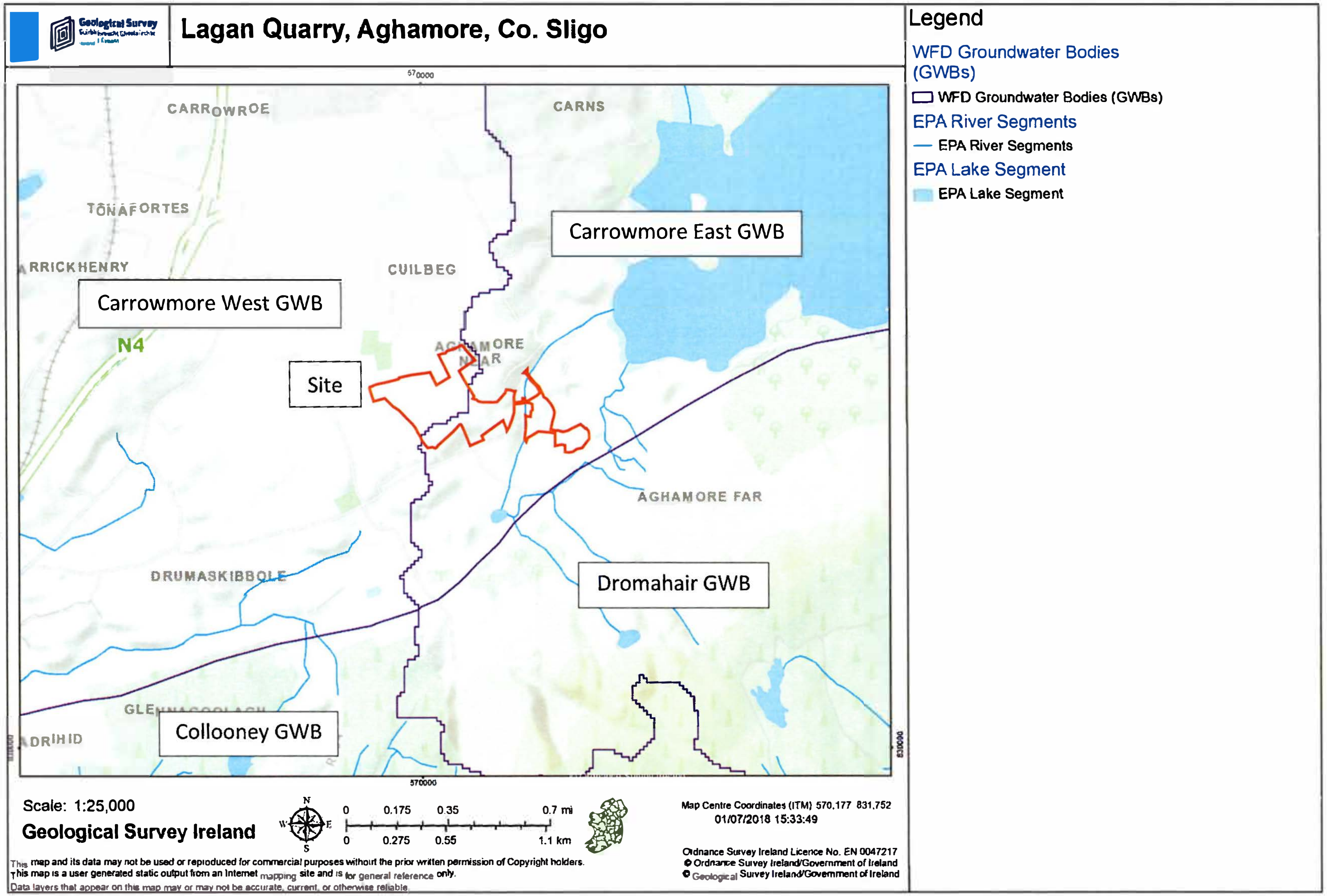


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Fig. 7-13 Groundwater Bodies Map (GSI Groundwater Data Viewer)

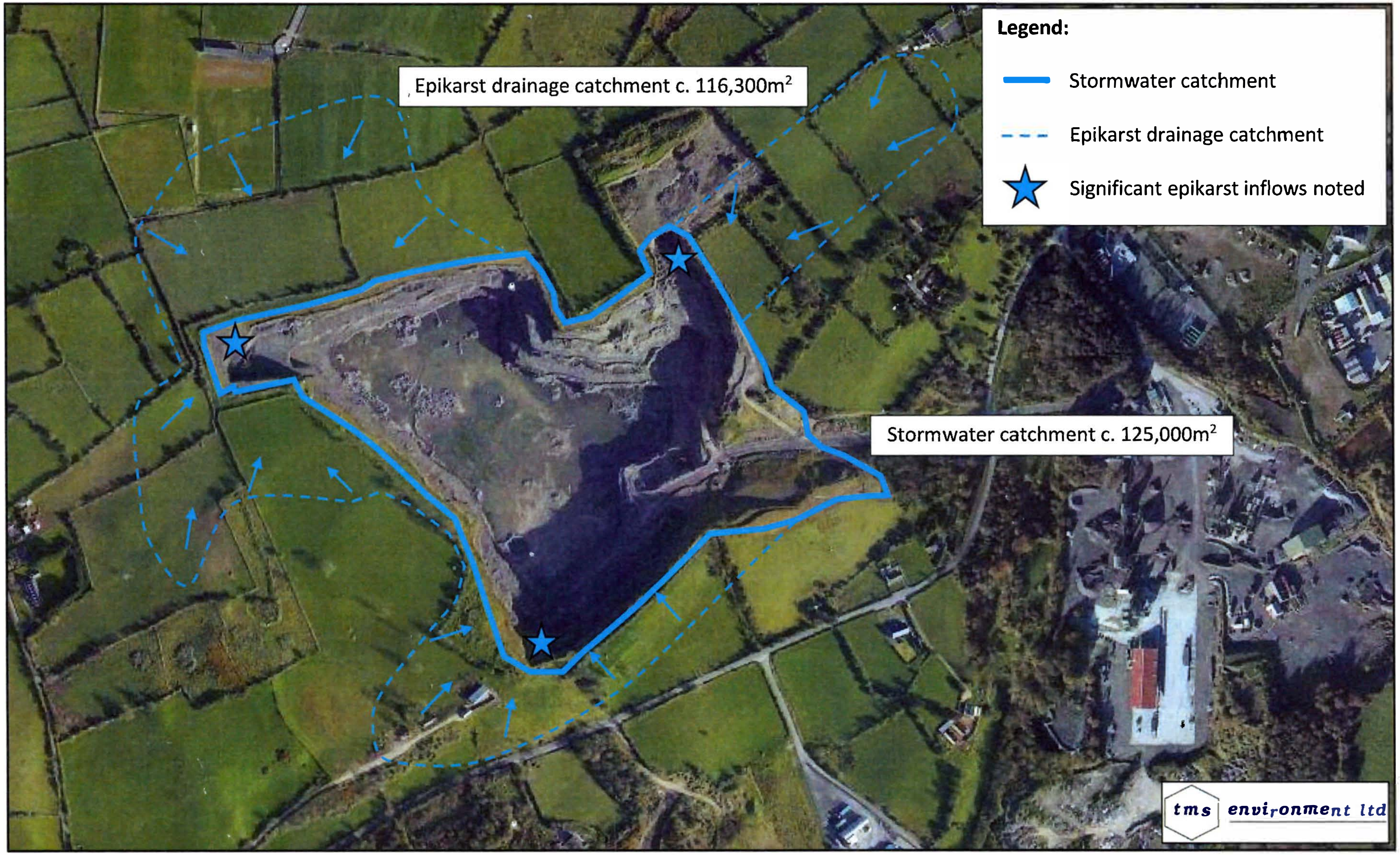


Fig. 7-14 Stormwater Catchment & Epikarst Drainage Catchment Map (Bing Maps)

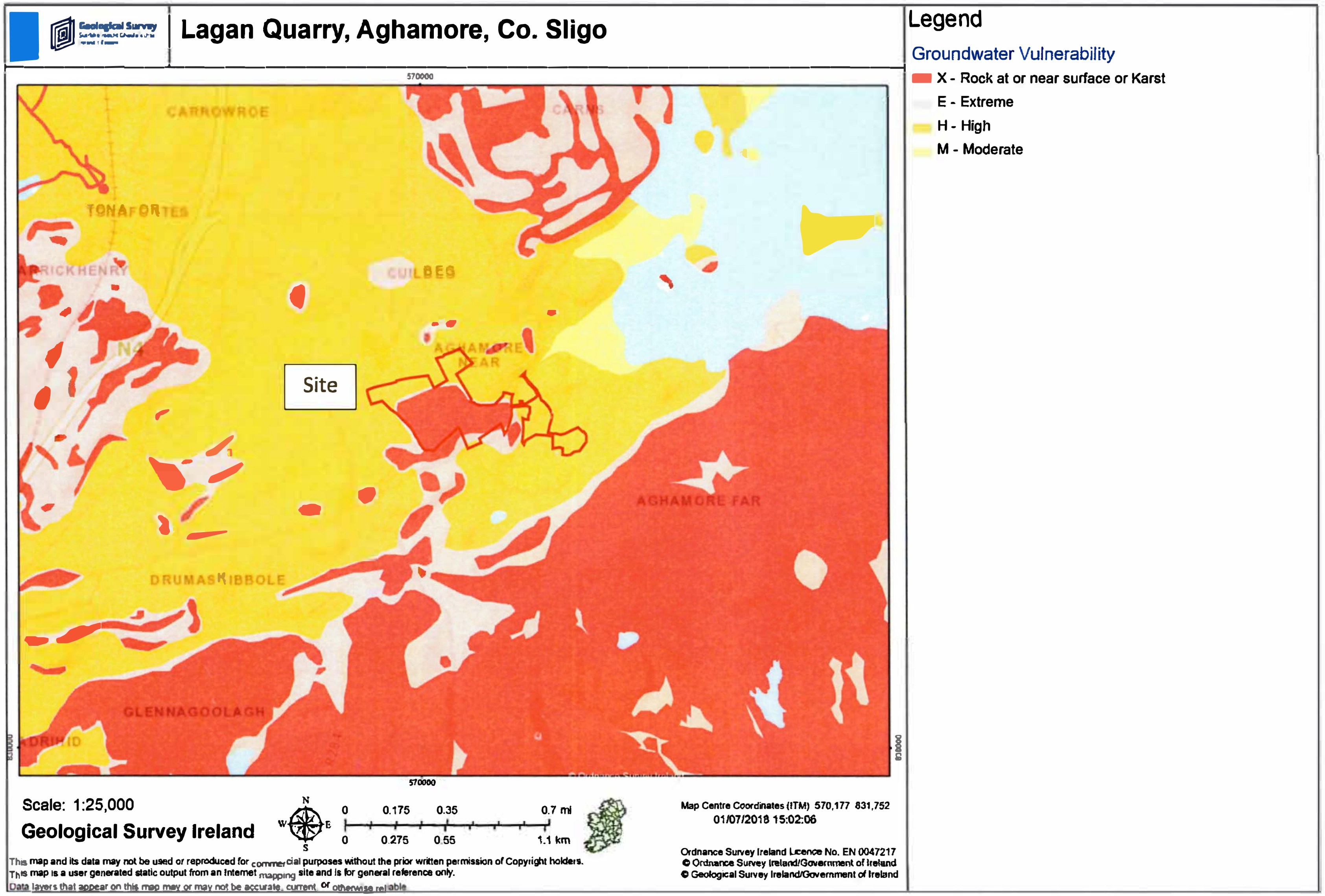


Fig. 7-15 Groundwater Vulnerability Map (GSI Groundwater Data Viewer)

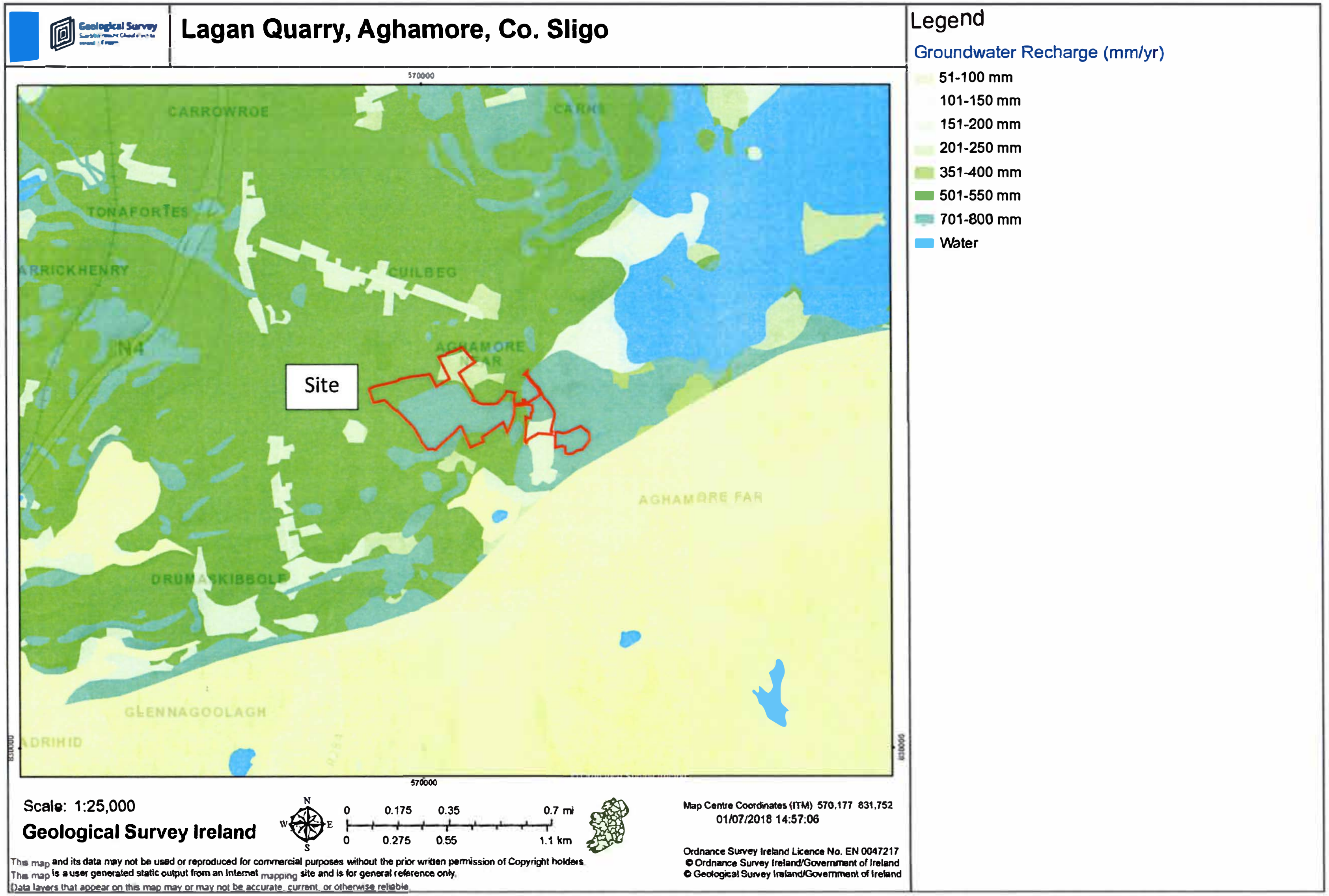


Fig. 7-16 Groundwater Recharge Map (GSI Groundwater Data Viewer)

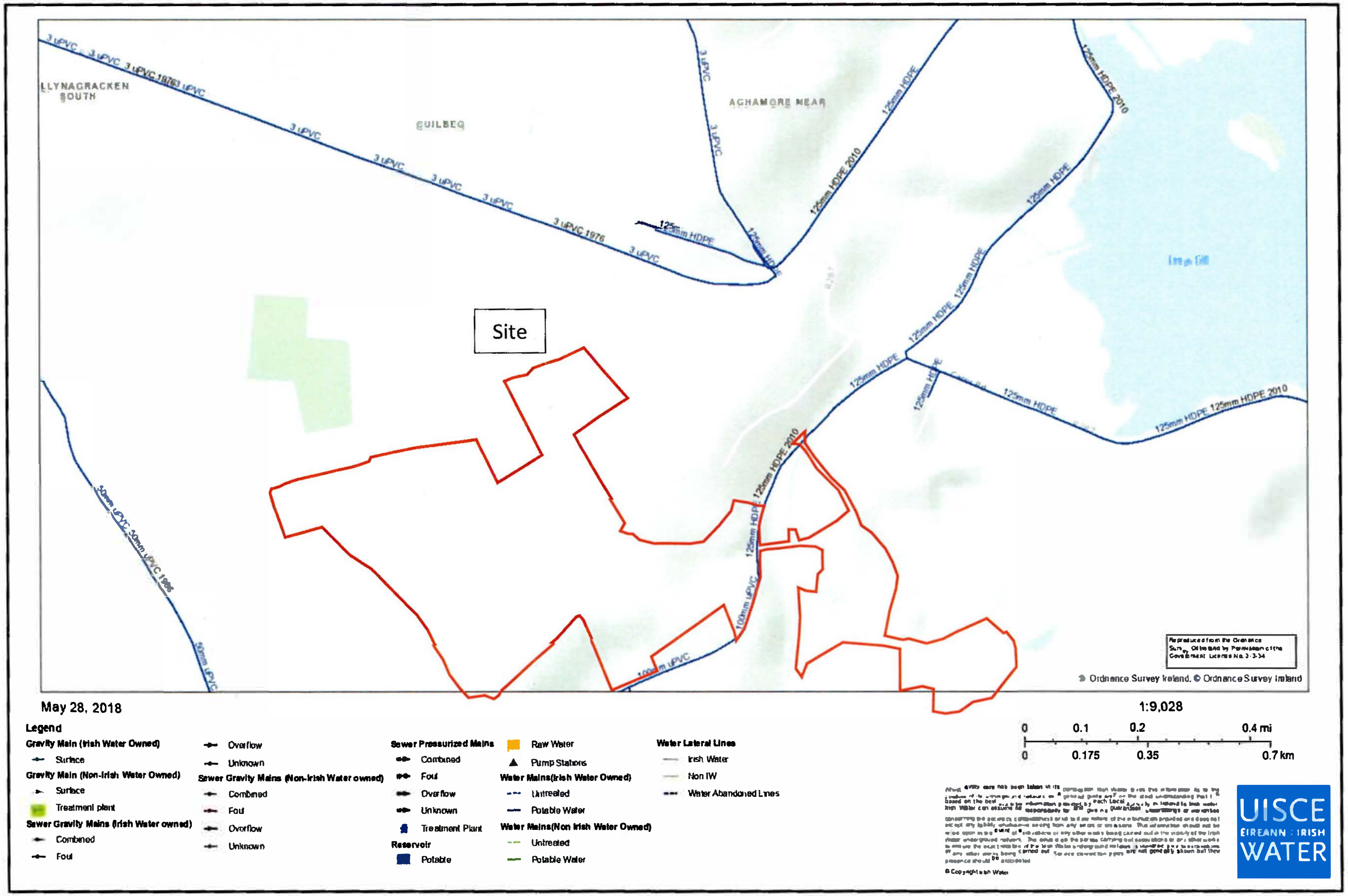


Fig. 7-17 Water Mains Map (Sligo County Council)

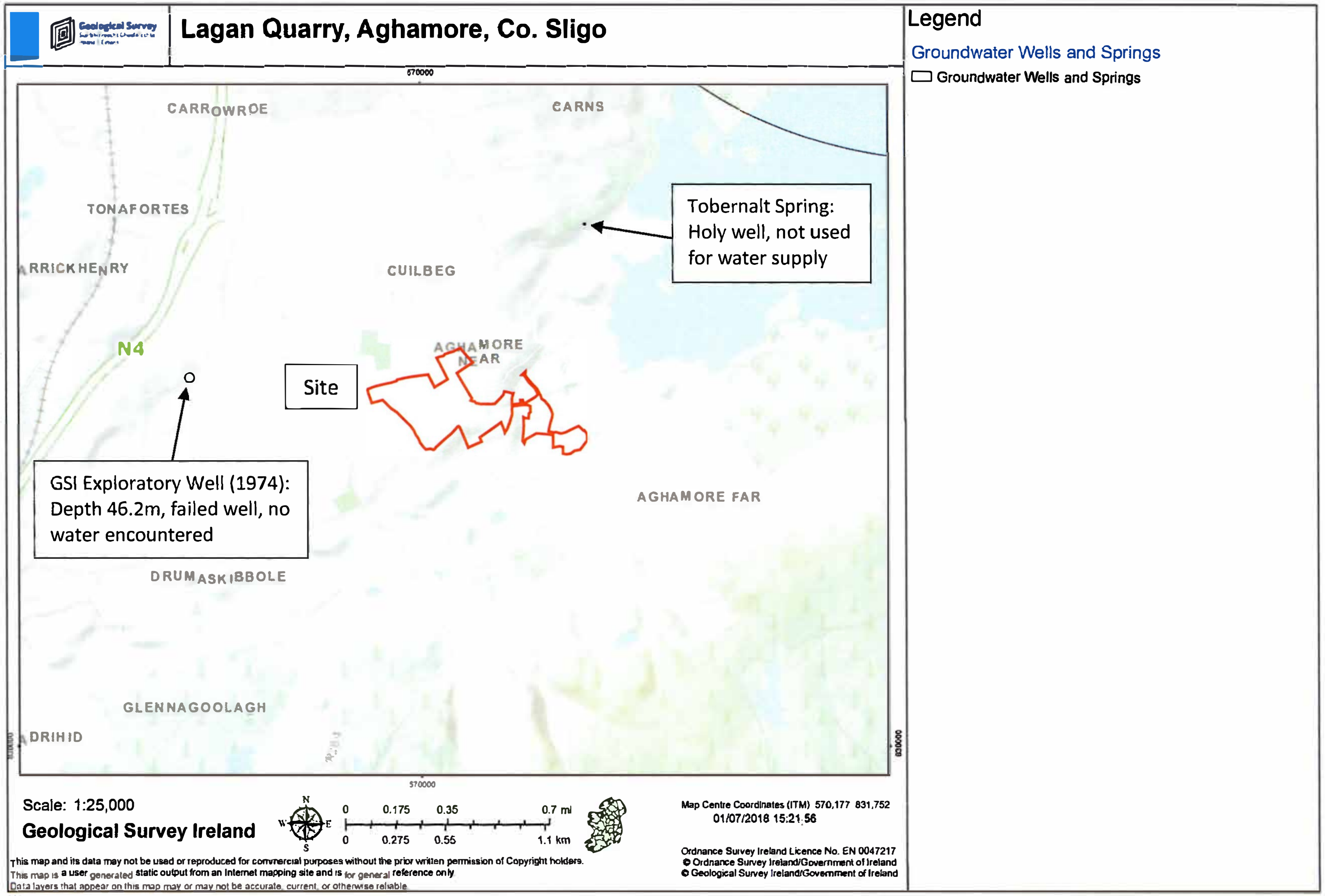
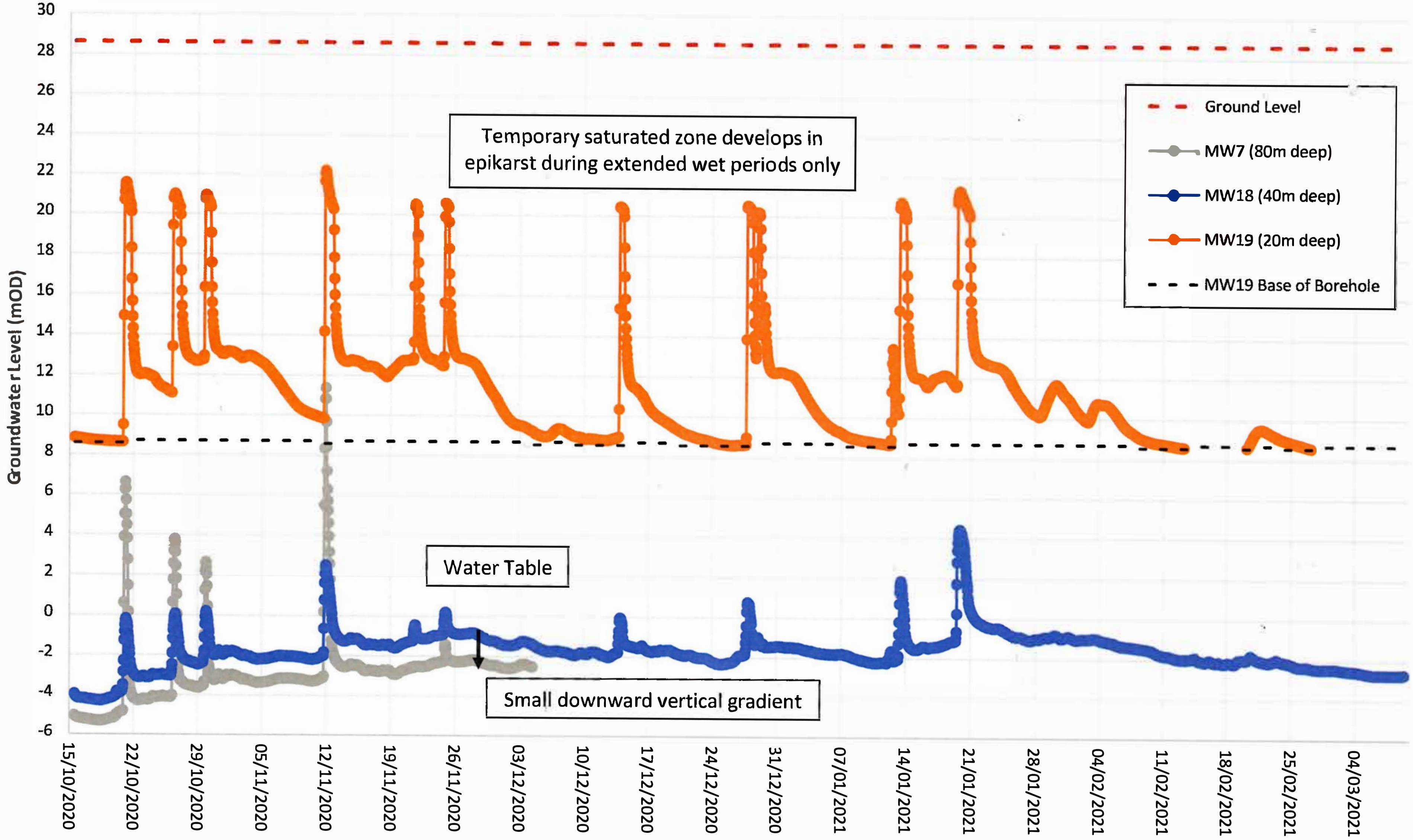


Fig. 7-18 Well Records Map (GSI Groundwater Data Viewer)

Fig. 7-19 Private Wells within 1km of Quarry (Bing Maps)

Fig. 7-20: Groundwater Levels at Northern Quarry Margin



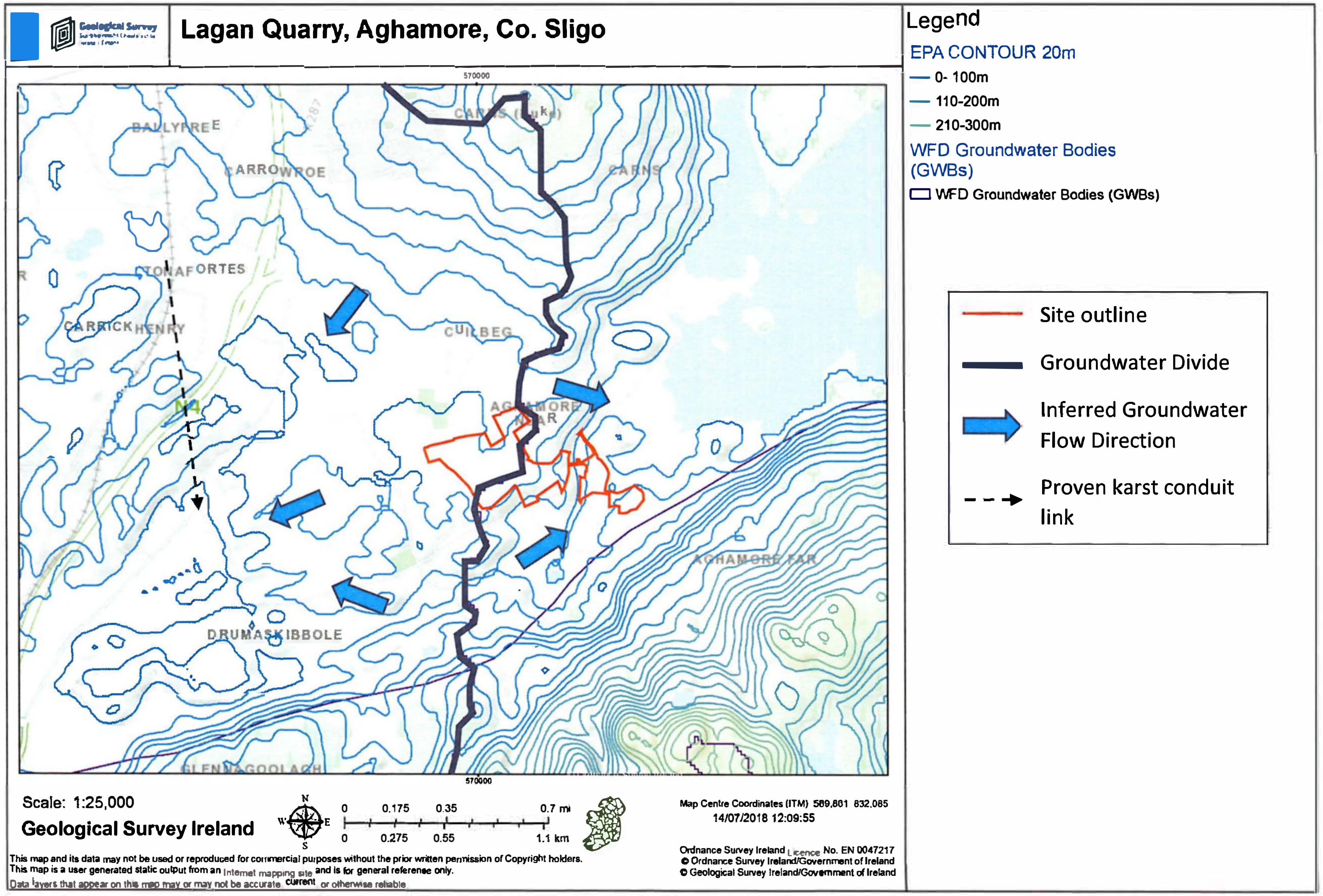
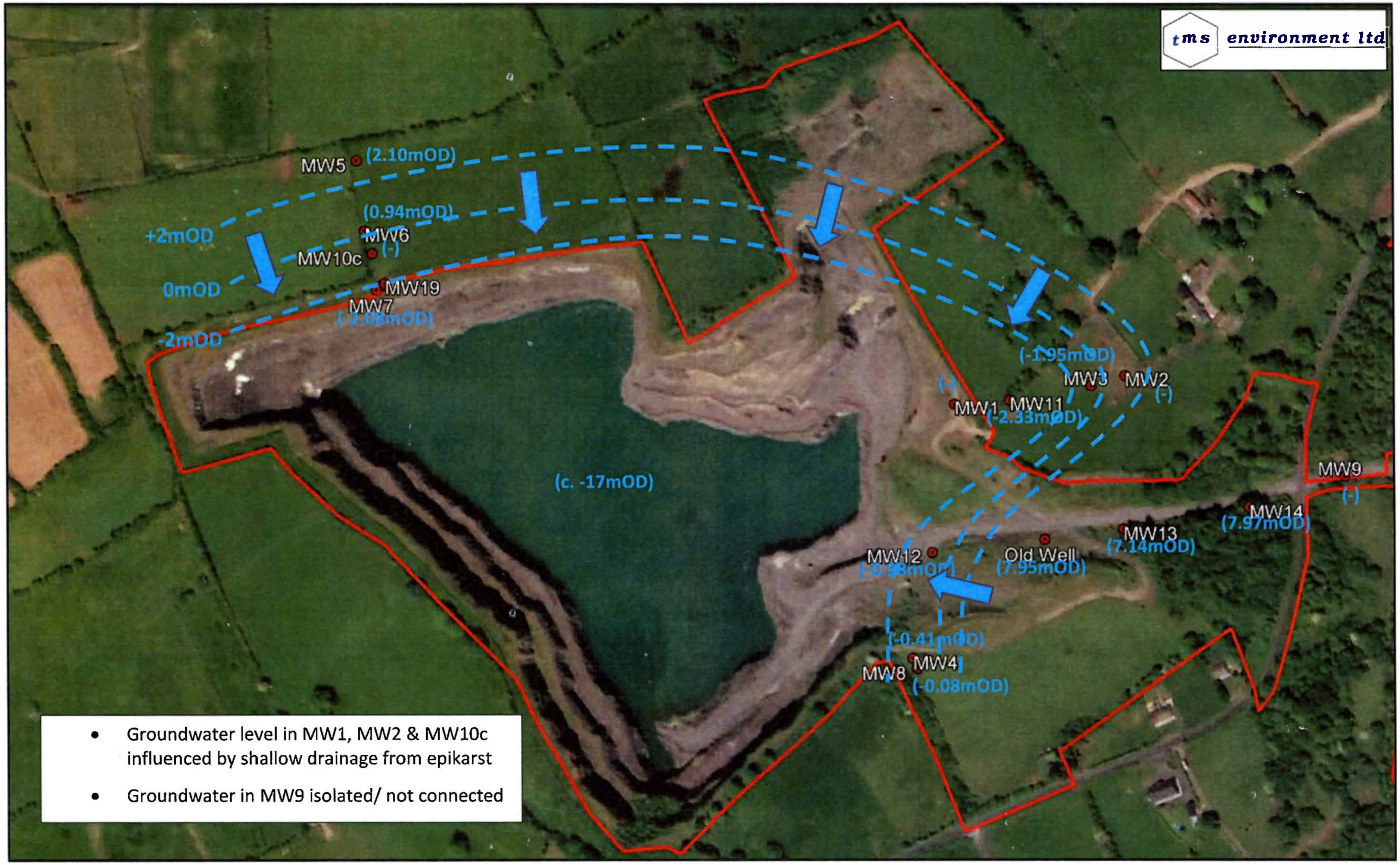
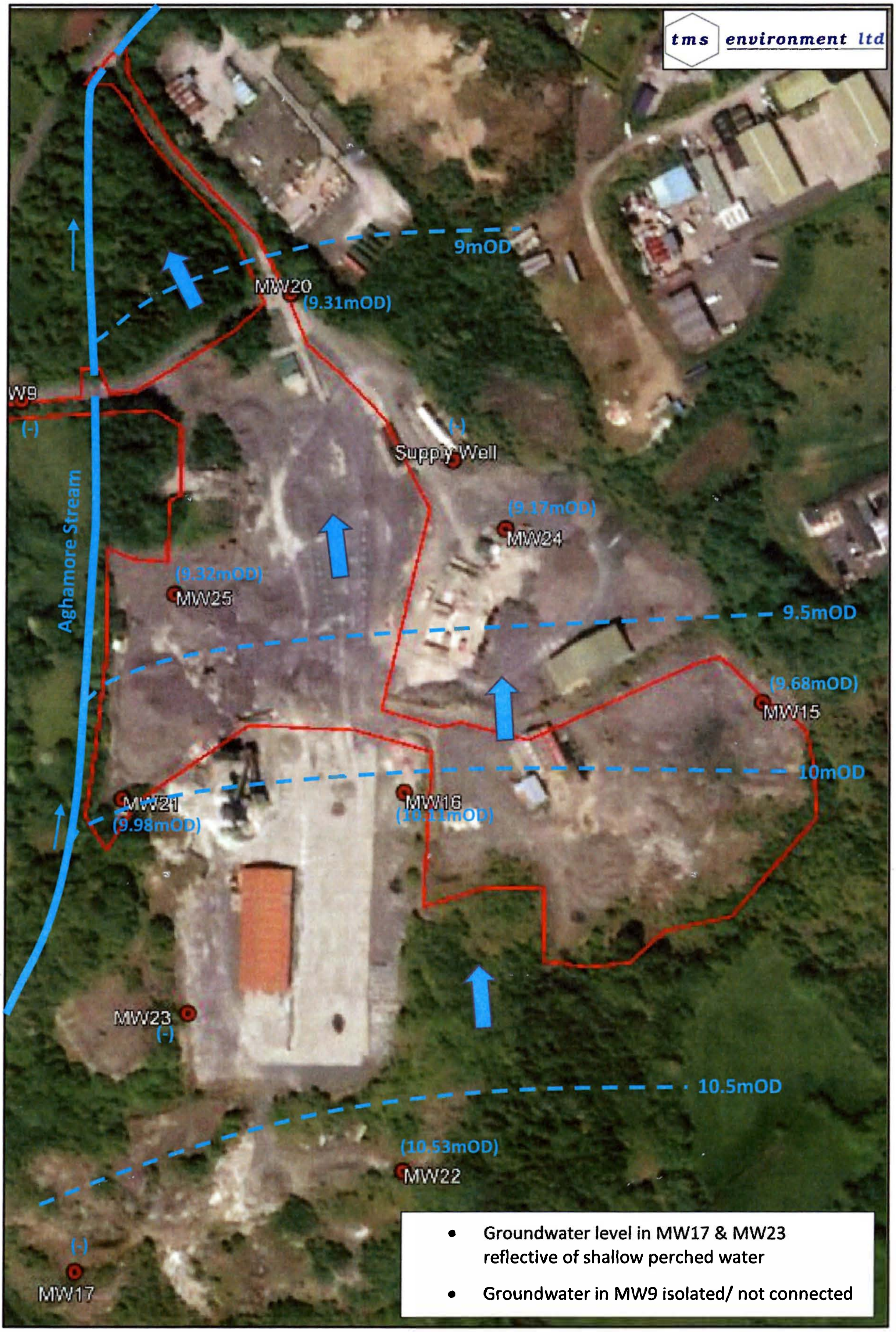


Fig. 7-21 Regional Groundwater Flow Map (GSI Groundwater Data Viewer contour map)



- Groundwater level in MW1, MW2 & MW10c influenced by shallow drainage from epikarst
- Groundwater in MW9 isolated/ not connected

Fig. 7-22a Local Groundwater Flow Map – Quarry (30/11/2020)



- Groundwater level in MW17 & MW23 reflective of shallow perched water
- Groundwater in MW9 isolated/ not connected

Fig. 7-22b Local Groundwater Flow Map – Processing Yard (30/11/2020)

APPENDIX 7-1 PRE-PLANNING CONSULTATION RESPONSES

UISCE
ÉIREANN : IRISH
WATER

Uisce Éireann
Bosca OP 6000
Baile Átha Cliath 1
Éire

Irish Water
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Dublin 1
Ireland

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www.water.ie

07/01/2020

Purpose of the document

The document details initial pre planning assessment of the proposed development by Lagan Bitumen for continued use, operation and deepening of the existing permitted quarry at Aghamore Near and, Carrownamaddoo Townlands, Co. Sligo.

Pre Planning Context

Irish Water have a responsibility to ensure that all its customers receive a safe and secure supply of drinking water. Irish Water demonstrates safe drinking water by compliance monitoring in accordance with the Drinking Water Regulations. However, to ensure drinking water is secure, Irish Water have adopted the Drinking Water Safety Plan approach put forward by the World Health Organisation and endorsed by the EPA in risk assessing and managing its source water.

Pre Planning Consultation

It is expected that all risks shall be mitigated to the IW lake source to ensure there is no net loss of water to the lake and the water quality is not impaired. The applicant, therefore, is required to clearly demonstrate there is no net loss of water to the lake and that the water quality is not impaired and that appropriate mitigations are in place to ensure protection of the drinking water source.

There are potential impacts to surface water and groundwater in the vicinity of the quarry which is located at/close to a river catchment boundary, a lake, a sizeable public water supply from the lake, and in a karst aquifer.

With respect to the hydrogeology there are a number of comments and queries provided below that may help determine risks to IW which need to be addressed ahead of any planning application. It might be advisable that the applicant makes enquiries to GSI in relation to the hydrogeology and karstification.

With respect to the water quality and treatability there are a number of comments and queries provided below that may help determine risks to IW which need to be addressed ahead of any planning application.

Clarifications required and comments to be addressed as part of any planning application

- There is a significant groundwater component to the quarry operation. Given that the quarry occurs on a mapped surface water catchment boundary it is not clear where the groundwater is coming from, as the EIAR suggests it is in a low permeability area.
- It is difficult to predict the future dewatering requirements. It is possible that the deepening could intersect major conduits.

Stiúrthóirí / Directors: Mike Quinn (Chairman), Eamon Gallen, Cathal Marley, Brendan Murphy, Michael G O'Sullivan
Oifig Chláraithe / Registered Office: Teach Colvill, 24-26 Sráid Thalbóid, Baile Átha Cliath 1, D01 NP86 / Colvill House, 24-26 Talbot Street, Dublin 1, D01 NP86
Is cuideachta ghníomhaíochta ainmnithe atá faoi theorainn scaireanna é Uisce Éireann / Irish Water is a designated activity company, limited by shares.
Uimhir Chláraithe in Éirinn / Registered in Ireland No.: 530363

- It is indicated in the EIAR that the Aghamore stream 'all but dries up' in dry weather. Is it ephemeral? Note that the EIAR also predicts that will be no reduced baseflow. This needs clarity. Is this the case below the quarry discharge location? It would be helpful to draw a schematic cross section of winter and summer groundwater levels (current/predicted) from west of the quarry through to the lake.
- Does the quarry discharge provide a net discharge back to the water environment? If the quarry drawdown has shifted a catchment boundary west, is there a net addition to the water environment to L. Gill?
- To what extent has the dewatering changed the river catchment boundaries and what is the cone of depression? The Zone of influence/ Cone of depression (EIAR, Fig 7.22) could be shown in relation to the regional flow system. The water levels in private wells should be shown as well as the water levels in the monitoring wells.
- What is the regional groundwater flow pattern? Fig. 7.18 (EIAR) suggests that the topographic contours were used to infer groundwater flow directions which is inappropriate in a karst setting. Apart from a few nearby water courses there is a general lack of surface water drainage. The EIAR suggests that this is/was a groundwater divide though this is an assumption based on WFD surface water catchment boundaries. The tracing in this aquifer underscores the variability in karst. Fig. 7-16 indicates wells, water levels from these and other wells may provide evidence on the water table.
- The information and assessment on the aquifer hydraulic properties seems to suggest that MW3 is not representative in terms of representing the aquifer as a whole. However, it is these 'exceptions' that point at the inherent hierarchical nature of the connected fractures, fissures and conduits. And there is a significant amount of groundwater being pumped, indicative of a transmissive karst aquifer. There are recorded karst features, dye tracing, and a cursory look at the 6 inch sheets suggests that there are possibly sinking streams in the vicinity of the application.
- The predicted radial influence assumes no fractures but MW3 is a significant fracture. To what extent does this and other aspects of the karst aquifer influence the assumptions around radial flow? The information points to the anisotropy.
- The information on the karstification is limited and citing the GSI Karst database should be accompanied with an acknowledgement that the database is not exhaustive. As indicated above there are possibly some sinking streams nearby.
- In relation to the karst, there has been some limited tracing done in the aquifer which demonstrates the velocities, the permeability, and how the groundwater flow direction is counter to what one might assume.
- The groundwater volume being pumped is recorded as 2.8Ml/d in the EPA register. The information around the groundwater being pumped and the overall stormwater/water management needs to be clearly described. It would be useful to include a simple water balance to cross check the area needed to provide the groundwater based on the groundwater recharge.
- It is indicated in the pre planning scoping document that there will be additional boreholes and sampling. The source in this instance is a lake waterbody and loadings are critical in that it is possible material will settle out of suspension for possible resuspension in much higher

concentrations during stratification. Water Treatment Plants are designed to treat raw water of a particular character that accounts for a range of contaminants present in source water. The information provided by the applicant indicate elevated concentrations of BOD and heavy metals associated with the activity. Contaminants from industry have the potential to alter the water quality of the lake and hence its treatability. The water quality character of the lake cannot be negatively impacted by the development proposal. Water quality character and dynamics of the lake must be considered by the applicant and addressed in any planning application.

Additional Pre Planning Considerations

The following aspects of Water Services would be in scope of any EIAR and should be fully addressed as part of any planning application;

- Any up-grading of water services infrastructure that would be required to accommodate the development.
- In relation to a development that would discharge trade effluent – any upstream treatment or attenuation of discharges required prior to discharging to an IW collection network
- In relation to the management of surface water; the potential impact of surface water discharges to combined sewer networks & potential measures to minimise/stop surface waters from combined sewers
- Any physical impact on IW assets – reservoir, drinking water source, treatment works, pipes, pumping stations, discharges outfalls etc. including any relocation of assets. IW does not permit development to impact on assets and/or drinking water sources nor any impairment of water quality of drinking water sources.
- Any potential impacts on the assimilative capacity of receiving waters in relation to IW discharge outfalls including changes in dispersion /circulation characterises
- 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 IW for public supply.
- Where a development proposes to connect to an IW 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.
- The develop/operator shall comply with the Water Framework Directive and River Basin Management Plan objectives to ensure that the development will not negatively impact on the water quality of source/receiving waters during both construction and operational phases
- The developer/operator shall meet the requirements of EIA Directive 2014/52/EU
- The developer/operator shall comply with the requirements of the Groundwater Directive, Article 6(1) of Directive 2000/60/EC
- In the interest of Public Health and Environmental Sustainability the developer/operator will comply with best practice Groundwater Protection Schemes set in the GSI Groundwater Protection Schemes.

All necessary mitigation measures in relation to any of the above to protect and maintain access to Irish Water infrastructure and water sources shall be undertaken and incorporated into the development proposal, as part of planning application, to ensure public water services and sources are protected and access is maintained

An Roinn Turasóireachta, Cultúir,
Ealaíon, Gaeltachta, Spóirt agus Meán
Department of Tourism, Culture,
Arts, Gaeltacht, Sport and Media

Your Ref: Lagan Materials Quarry
Our Ref: G Pre00196/2020 (Please quote in all related correspondence)

SLR Consulting Ireland
7 Dundrum Business Park
Windy Arbour
Dublin
D14 N2Y7

Via email: pkinghan@slrconsulting.com

Re: Re: Notification to the Minister for Culture, Heritage and the Gaeltacht under the Planning and Development Act, 2000, as amended.

Re: Limestone quarry (recommencement and deepening); Aghamore Near, Aghamore Far and Carrownamaddoo townlands, Co. Sligo

A chara

I refer to correspondence to the Department of Culture, Heritage and the Gaeltacht on 29th of September received in connection with the above.

Outlined below are heritage-related observations/recommendations co-ordinated by the Development Applications Unit under the stated heading.

Nature Conservation

The Department refers to the correspondence received on the 29th September 2020, in relation to your request for observations, on the preparation of the EIAR for the proposed continued use and deepening of an existing limestone quarry at Aghamore Near, Aghamore Far and Carrownamaddoo townlands, Co. Sligo, on behalf of Lagan Materials Ltd.

This submission is made in the context of this Department's role in relation to nature conservation. The observations have been divided into:

1. Matters relating to the EIAR;
2. Matters relating to Appropriate Assessment;
3. Comments relating to the sites in question;

These observations are intended to assist you in identifying potential conflicts that may arise in relation to European sites, other nature conservation sites, and biodiversity and environmental protection, in general, within and outside the study area. Data collected and

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Development Applications Unit
Oifigí an Rialtais
Government Offices
Bóthar an Bhaile Nua, Loch Garman, Contae Loch Garman, Y35 AP90
Newtown Road, Wexford, County Wexford, Y35 AP90

surveys carried out in future in connection with this proposed development may raise other issues that have not been considered here. Therefore observations are not exhaustive and are made without prejudice to any recommendation that may be made by this Department in the future.

The National Parks and Wildlife Service (NPWS) website has recently been updated and should be consulted with regard to the impact of planning and development on nature conservation. The following link gives extensive details on the standards and content NPWS expect from applications: https://www.npws.ie/development%20consultations. In addition, the www.npws.ie website should be consulted for data on protected species, maps of designated and proposed nature conservation sites and for a full descriptions of the sites. Additional specific data requests may be required for protected species and surveys which have been carried out by the NPWS.

Matters relating to the EIAR:

Baseline data

Other sources of habitat and species information beyond those already identified and the standard NPWS data request include (but are not be limited to): Article 12 and 17 reports under the Birds and Habitats Directives, the National Biodiversity Data Centre (www.biodiversityireland.ie), Inland Fisheries Ireland (www.fisheriesireland.ie), BirdWatch Ireland (www.birdwatchireland.ie), Irish Raptor Study Group, Golden Eagle Trust and Bat Conservation Ireland (www.batconservationIreland.org). In assessing the habitats within the proposed site reference (but are not limited to) should be made to Fossitt (2000)[1] and where habitats are considered to correspond to Annexed habitats in the EC Habitats Directive, the EC interpretation manual should be referenced including additional sources, for example with respect to Grasslands[2], Woodlands[3], and 91E0 Alluvial Woodlands[4].

Ecological survey

With regard to scoping for an EIAR for a proposed development, in order to assess impacts on biodiversity, fauna, flora and habitats; an ecological survey should be carried out of the proposed development site including the route of any associated feeder roads, drains, pipelines or cables etc. necessary for the construction and operational phases. Any improvement or reinforcement works required for access and transport anywhere along any

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[1] A Guide to Habitats in Ireland, Fossitt(2000)

[2] O'Neill, F. et al. (2013). The Irish semi-natural grasslands survey 2007-2012. Irish Wildlife Manuals, No. 78, NPWS

[3] Perrin, P. et al (2008). National survey of native woodlands 2003-2008. Volume II: Woodland Classification. NPWS.

[4] Daly, O.H., O'Neill, F.H. & Barron, S.J. (in prep.) The monitoring and assessment of four EU Habitats
Directive Annex I woodland habitats. Irish Wildlife Manuals, No. XX. National Parks and Wildlife Service,
Department of Housing, Local Government and Heritage, Dublin.

proposed access route(s) should be included in the EIAR and subjected to ecological impact assessment with the inclusion of mitigation measures, as appropriate.

Where ex-situ impacts are possible survey work may be required outside of the development sites. Such surveys should be carried out by suitably qualified persons at an appropriate time of the year depending on the species, habitat or technical investigation required. The EIAR should include the results of the surveys and detail the survey methodology and timing of such surveys.

It is expected by this Department that best practice will be adhered to with regard to survey methodology and if necessary non Irish methodology adapted for the Irish situation. In addition, survey data provided should be up to date.

The EIAR should cover the whole project, including construction, operation and, if applicable, restoration or decommissioning phases. Alternatives examined should also be included in the EIAR. Inland Fisheries Ireland should be consulted with regard to fish species if applicable. For information on Geological and Geomorphological sites, the Geological Survey of Ireland should be consulted.

Specific reference should be made to the National Biodiversity Action Plan. Any losses of biodiversity habitat associated with this proposed development (including access roads and drainage etc.) such as woodland, scrub, hedgerows and other habitats should be mitigated and compensated for. In addition, Annex 1 habitats which occur outside the Natura 2000 network are also important in terms of biodiversity conservation. The presence of any Annex I habitats outside the network should be given due consideration as part of the consideration of biodiversity matters generally for the proposed development. The loss of Annex 1 habitats outside SACs should be avoided wherever possible.

In order to assess impacts it may be necessary to obtain hydrological and/or geological data. Any impact on water table levels or groundwater flows may impact on wetland sites some distance away. The EIAR should also assess cumulative impacts with other plans or projects if applicable. Where negative impacts are identified suitable mitigation measures should be detailed as appropriate.

<u>Hedgerows and related habitats</u>

Hedgerows and uncultivated vegetation should be maintained where possible as they form wildlife corridors and provide areas for birds to nest in; hedgerow trees may provide roosting places for bats. Badger setts may be present. Hedgerows also provide a habitat for woodland flora. The EIAR should provide an estimate of the length of any hedgerow that will be lost. Where it is proposed that trees or hedgerows will be removed there should be an equal level of compensatory planting of native species in mitigation incorporated into the EIAR. Where possible, the removal of hedgerows, trees and uncultivated vegetation should take place outside of the nesting season (i.e. March 1st to August 31st).

Watercourses and wetlands

Wetlands (including Fens & bogs) and Watercourses are important areas for biodiversity. Hydrogeological connections should be assessed at an early stage and ground and surface water quality should be protected during construction and operation of the proposed development. Ground Water Dependent Terrestrial Ecosystems (GWDTE's) should be assessed in the study area. In addition, any watercourse or wetland impacted on should be surveyed for the presence of protected species and species listed on Annexes II and IV of the Habitats Directive.

For example, these species could include otters (*Lutra lutra*), which are protected under the Wildlife Acts and listed on Annexes II and IV of the Habitats Directive, salmon (*Salmo salar*) and Lamprey species listed on Annex II of the Habitats Directive, and White-clawed Crayfish (*Austropotamobius pallipes*) which are protected under the Wildlife Acts and listed on Annex II of the Habitats Directive, Frogs (*Rana temporaria*) and Newts (*Trituris vulgaris*) protected under the Wildlife Acts and Kingfishers (*Alcedo atthis*) protected under the Wildlife Acts and listed on Annex I of the Birds Directive (Council Directive 79/409 EEC). One of the main threats identified in the threat response plan for otter is habitat destruction[5]. A 10m riparian buffer on both banks of a waterway is considered to comprise part of the otter habitat. Therefore any proposed development should be located at least 10m away from a waterway.

Flood plains

Flood plains, if present, should be identified in the EIAR and left undeveloped to allow for the protection of these valuable habitats and provide areas for flood water retention (green infrastructure). If applicable the EIAR should take account of the guidelines for Planning Authorities entitled "The Planning System and Flood Risk Management" and published by the Department of the Environment, Heritage and Local Government In November 2009.

Bats

Bat roosts may be present in trees, buildings and bridges. Bat roosts can only be destroyed under licence under the Wildlife Acts and derogation under the Birds and Natural Habitats Regulations and such a licence may only be given if suitable mitigation measures are implemented. Any proposed migratory bat friendly lighting should be proven to be effective. Surveys for bat species should be included within the quarry and processing sites.

Alien invasive species

The EIAR should also address the issue of invasive alien plant and animal species such as Japanese Knotweed, and detail the methods required to ensure they are not accidentally Introduced or spread during survey and or construction. Information on alien Invasive species In Ireland can be found at http://invasives.biodiversityireland.ie/ and at http://invasivespeciesireland.com/ .

Bird surveys

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[5] see https://www.npws.ie/sites/default/files/publications/pdf/2009_Otter_TRP.pdf

Survey methodologies should follow best practice and if necessary be modified to reflect the Irish situation. When survey results are being presented in an EIAR it is important that best practice is followed and that the full survey methodology, including dates and times are detailed. Furthermore, it is expected that bird survey data should be presented in context and records should be supported by basic environmental data such as hourly estimates of visibility, glare arc's, cloud cover and precipitation during vantage point(VPs)and walk over survey periods. Results for species need to be referenced back to the overall populations and their dynamics; as in some cases even a small risk to a population of a species could be considered significant.

Impact assessment

The impact of the proposed development on the flora, fauna and habitats present should be assessed with particular regard to:

Natura 2000 sites, i.e.:

- Special Areas of Conservation (SAC) designated under the EC Habitats Directive (Council Directive 92/43/EEC)
- and Special Protection Areas (SPA) designated under the EC Birds Directive (Directive 2009/147 EC),

other designated sites, or sites proposed for designation such as,

- Natural Heritage Areas;
- proposed Natural Heritage Areas;
- Nature Reserves;
- Refuges for Fauna or Flora designated under the Wildlife Acts 1976 to 2012;
- species protected under the Wildlife Acts including protected flora;

'Protected species and natural habitats', as defined in the Environmental Liability Directive (2004/35/EC) and European Communities (Environmental Liability) Regulations, 2008 including

- Birds Directive - Annex I species and other regularly occurring migratory species, and their habitats (wherever they occur);
- Habitats Directive - Annex I habitats, Annex II species and their habitats;
- Annex IV species and their breeding sites and resting places (wherever they occur);
- important bird areas such as those identified by Birdlife International, features of the landscape which are of major importance for wild flora and fauna, such as those with a "stepping stone" and ecological corridors function, as referenced in Article 10 of the Habitats Directive;

- other habitats of ecological value in a national to local context (such as those identified as locally important biodiversity areas within Local Biodiversity Action Plans and County Development Plans);
- Red data book species;
- and biodiversity in general.

Complete project details, including Construction Management Plans (CMPs), need to be provided in order to allow an adequate EIAR and appropriate assessment to be undertaken, there should be no lacunae. Applicants need to be able to demonstrate that CMPs and other such plans are adequate and effective mitigation supported by scientific information and analysis and that they are feasible within the physical constraints of the site. The positions, locations and sizes of construction infrastructure and mitigation such as settlement ponds, disposal sites and construction compounds may significantly affect European and other designated sites, habitats and species in their own right and could have an effect for example on drainage, water quality, habitat loss, and disturbance. If these are undetermined at time of the assessment all potential effects of the development on the site are not being considered.

Construction Management Plans

Construction Management Plans should contain sufficient detail to avoid any post construction doubt with regard to the implementation of mitigation measures, timings and roles and responsibilities for same. There can be no doubts or lacunae regarding what is required for mitigation, pre-commencement surveys and or licencing requirements.

Construction work should not be allowed to impact on water quality and measures should be detailed in the EIAR to prevent sediment and/or fuel runoff from getting into watercourses which could adversely impact on aquatic species. See EIAR; Flood Plains for details with regard to flooding risk.

Inland Fisheries Ireland (IFI) should be consulted with regard to impacts on fish species and the applicant may find it useful to consult their publication entitled "Planning for watercourses in the urban environment" which can be downloaded from their website.

Cumulative and ex situ impacts

A rule of thumb often used is to include all European sites within a distance of 15km. It should be noted however that this will not always be appropriate. In some instances where there are hydrological connections a whole river catchment or a groundwater aquifer may need to be included. Similarly where bird flight paths are involved the impact may be on an SPA more than 15 km away.

Other relevant Local Authorities should be consulted to determine if there are any projects or plans which, in combination with this proposed development, could impact on any European sites.

Post construction monitoring

The applicant should not use any proposed post construction monitoring as mitigation to supplement inadequate information in the assessment. Please refer to Circular Letter PD 2/07 and NPWS 1/07 on this issue[6].

The EIAR process should identify any pre and post construction monitoring which should be carried out e.g. raptor monitoring, hydrological monitoring. Monitoring results should be made available to the NPWS or IFI as appropriate and copied to this Department and provided to the National Biodiversity Data Centre.

It is important to note again that unless post decision consultation with NPWS is specifically stated as a condition of planning, NPWS has no post consent role. However, regional staff are available for liaison regarding any associated licencing requirements and or new information arising for specific species of concern.

Note: any significant change to mitigation may require amendment and where a licence has expired; there will be a need for new licence applications for protected species.

Licenses

It should be noted that the European Habitats Regulations of 1997 have been revoked and that Part 6 of the European Communities (Birds and Natural Habitats) Regulations 2011, as amended (Regulation 51) is now the relevant part dealing with the protection of flora and fauna.

Species protected under sections 21, 22 and 23 of the Wildlife Acts should be considered in the EIAR and whether there are any impacts on other protected species or their resting or breeding places, such as on protected plants, badger setts or birds' nests. They will also need to be cognisant of Article 5 (d) of the Birds Directive. As outlined already and for that reason vegetation, including hedges and trees, should not be removed during the nesting season (i.e. March 1st to August 31st).

In order to apply for any such licenses or derogations as mentioned above the results of a survey should be submitted to the National Parks and Wildlife Service of this Department. Such surveys are to be carried out by appropriately qualified person/s at an appropriate time of the year. Details of survey methodology should also be provided. Should this survey work take place well before construction commences, it is recommended that an additional ecological survey of the development site should take place immediately prior to construction to ensure no significant change in the findings of the baseline ecological survey has occurred. If there has been any significant change, mitigation may require amendment and where a licence has expired, there will be a need for new licence applications for protected species.

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[6] https://www.npws.ie/development-consultations

Matters relating to AA:

Please note that in relation to European sites particular emphasis is placed in our observations on the adequacy of data, information and analyses available in the NIS, and on the implications of the proposed development for the conservation objectives and integrity of the European sites affected. This is because an appropriate assessment must contain complete, precise and definitive findings and conclusions with regard to the implications of a proposal for the conservation objectives and integrity of a European site(s).

In order to carry out the Appropriate Assessment screening, and/or prepare a Natura Impact Statement (NIS), information about the relevant European sites including their conservation objectives will need to be collected. Details of designated sites and species and conservation objectives can be found on http://www.npws.ie/. Site-specific, as opposed to generic, conservation objectives are now available for many sites. Each conservation objective for a qualifying interest (QI) is defined by a list of attributes and targets and is often supported by further documentation. Where these are not available for a site, an examination of the attributes that are used to define site-specific conservation objectives for the same QIs in other sites can be usefully used to ensure the full ecological implications of a proposal for a site's conservation objective and its Integrity are analysed and assessed. It is advised, as per the notes and guidelines in the site-specific conservation objectives that any reports quoting conservation objectives should give the version number and date, so that it can be ensured and established that the most up-to-date versions are used in the preparation of Natura Impact Statements and in undertaking appropriate assessments.

The Departmental guidance document on Appropriate Assessment is available on the NPWS web site at https://www.npws.ie/development-consultations and in the EU Commission guidance entitled "*Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC*"[7]

CJEU and Irish case law has clarified some issues and should also be consulted when considering the implications of the proposed development with regard to European sites.

Further to the above general comments please find below specific observations relating to the study area in question.

The Department would like to highlight the potential for impacts to wetland habitats and designated Natura 2000 sites which should be included in the assessments, not limited to, but including for example, Lough Gill Special Area of Conservation (SAC [site code 001976], adjacent to the study area for this project. The following recommendations are

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[7] http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/natura_2000_assess_en.pdf

required in order to assess whether the proposed project will negatively impact on the conservation objectives of Lough Gill SAC and any other Natura 2000 site.

The Department recommends that the assessments should include all the associated operations of both the quarry and processing site, for example, dewatering, tailing, sediment ponds and drainage and establish whether any of these operations are connected with the ecology of Lough Gill i.e. the surveys should not be confined to the proposed sites. Specifically, the additional investigations outlined in the Hydrogeological section of the EIAR scoping document are welcomed but should also include investigations outside of the proposed development site to establish if there is connectivity with Lough Gill.

The Department notes that while the hydrogeological investigations proposed will aid establishing the evidence of connectivity between the proposed site and Lough Gill, it is recommended that a concurrent investigation of the lake water levels is also carried out, to determine whether any of the Qualifying Interest (QI) habitats within the relevant SACs/SPAs receive groundwater flows from the proposed development site and that these are identified in the assessments. Evidence of the delineation of the catchments; connected springs and seepages are required for these assessments. Furthermore, the Department recommends that a water balance test should be conducted to establish whether significant amounts of groundwater will be removed from the quarry.

The Department advise that pre – consent ground investigations, data gathering infrastructure or testing that take place in a location that may affect an ecological feature (e.g. NHAs/ pNHA's and European sites SACs and SPAs), may require consent (i.e. are not exempted development) from the planning authority and/or the Ministers consent from NPWS/DHLGH.

The Department notes the previous EIAR survey evidence of peregrine falcon using the proposed quarry site. The Department recommends that a data request is submitted to NPWS for any records, including frequency of use, of peregrine falcon in the area and other birds of prey.

The EIAR should also include an assessment of the following habitats and species groups' specific to the proposed development site which include; semi natural grasslands, butterflies, and orchids. Consideration should be given in the EIAR relating to any proposed restoration plan in managing these habitats and species post operation of the proposed development.

General guidance and useful references;

1. *'Best Practice guidance for Habitat Survey and Mapping'* by George F Smith, Paul O'Donoghue, Katie O'Hora and Eamon Delaney, 2011. The Heritage Council.
2. The Departmental guidance document on Appropriate Assessment which is available on the NPWS web site at https://www.npws.ie/protected-sites/guidance-appropriate-assessment-planning-authorities

3. The EU Commission guidance entitled '*Assessment of plans and projects significantly affecting Natura 2000 sites, Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC*' which can be downloaded from http://ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm
4. The EU Commission notice - c(2018) "*Managing Natura 2000 sites The Provisions of Article 6 of the 'Habitats' Directive 92/43/EEC*". https://ec.europa.eu/environment/nature/natura2000/management/docs/art6/EN_art_6_guide_jun_2019.pdf
5. *'Interpretation Manual of European Union Habitats'*, version EUR 28, 2013. http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf

You are requested to send further communications to the Development Applications Unit (DAU) at **manager.dau@chg.gov.ie**, or to the following address:

The Manager
Development Applications Unit (DAU)
Government Offices
Newtown Road
Wexford
Y35 AP90

Is mise, le meas

Diarmuid Buttimer
Development Applications Unit

Preplanning consultation for Lagan quarry at Aghamore in Co. Sligo:

The quarry and processing area at Aghamore lie adjacent to the Aghamore Stream which flows into Lough Gill. This stream provides salmonid spawning and nursery habitat in its lower section. This stream also provides habitat for eel which is a critically endangered species. The lower section of the Aghamore stream forms part of the Lough Gill Special Area of Conservation which is designated for the protection of Atlantic salmon, white-clawed crayfish and lamprey species. This site is therefore directly hydrologically connected to the Special Area of Conservation. IFI request that the following comments are taken into consideration within the EIAR, NIS and planning application for this site:

There is a potential impact from this development on a number of elements of the aquatic habitat including damage to the aquatic and associated riparian habitat, pollution of waters, introduction of non-native species and interference with upstream and downstream movement of aquatic life. The assessment of these impacts should include the following:

- Water quality
- Surface water hydrology and Ground water hydrology
- Fish spawning and nursery areas
- Passage of migratory fish
- Areas of natural heritage importance including geological heritage sites
- Biological diversity
- Ecosystem structure and functioning
- Sport and commercial fishing and angling
- Amenity and recreational areas
- Sediment transport

IFI have concerns in relation to excavations below the site groundwater level and the potential for the pollution and contamination of groundwater. Information on the method of quarrying and the use of explosives should be provided.

Significant levels of dewatering may be required. The hydrological impacts of any proposed dewatering of the quarry and subsequent discharge to the Aghamore Stream must be assessed. This must include an assessment of the erosion and sediment regime within the channel and the impact on the salmonid spawning substrate downstream of this site. The impact of any proposed discharge may have on flooding of the adjacent local road or the R287 must be assessed. Flooding can wash pollutants such as sediment, hydrocarbons etc. into watercourses and put channels under pressure from drainage works and habitat damage.

Responsibility for the protection and/or improvement of ecological status of watercourses under the Water Framework Directive must also be taken into account. The Aghamore Stream has been designated poor ecological status in the River Basin Management Plan and this must be improved to good ecological status to comply with the directive. It must be demonstrated that there will be no negative impact, including hydrological or morphological, as a result of this development that will prevent or delay the achievement of this objective. Assimilative capacity calculations must be shown for any discharge to groundwater or surface waters. Details of the water discharge licence for the site should be provided.

The IFI guidance document "Requirements for the Protection of Fisheries Habitat during Construction and Development work" should be followed and is available at www.fisheriesireland.ie/Fisheries-management/fisheries-management.htm

In the case that a wheel wash is required, the wheel wash use a water recycling system with no direct discharge to the adjacent stream.

An assessment must be carried out of any on-site wastewater treatment system and details of this assessment provided.

The full planning history of the site should be clearly outlined.

Potential impacts of this development must be considered in combination and with existing land use practices and developments within the area.

There must be no spread of invasive species as a result of this development. A survey for the presence of invasive species must be carried out and if found on site a management plan must be drawn up. Biosecurity measures may also be required for equipment and machinery used on site. IFI provide a number of guidance documents on invasive species including a Bio-security Protocol which are available at: http://www.fisheriesireland.ie/Research/invasive-species.html

IFI requires further consultation on this development in due course and looks forward to hearing from you in this regard.

An Roinn Comhshaoil,
Aeráide agus Cumarsáide
Department of the Environment,
Climate and Communications

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

Peter Kinghan
SLR Consulting Ireland
7 Dundrum Business Park
Windy Arbour
Dublin D14 N2Y7

15 October 2020

Re: Pre-Planning – Proposed Deepening of an Existing Limestone Quarry at Aghamore Near, Aghamore Far and Carrownamaddoo Townlands, Co. Sligo

Your Ref: n/a
Our Ref: 20/239

Geological Survey Ireland is the national earth science agency and has datasets including Bedrock Geology, Quaternary Geology, Geological Heritage Sites, Mineral deposits, Groundwater Resources, Geohazards and the Irish Seabed. These comprise maps, reports and extensive databases that include mineral occurrences, bedrock/mineral exploration groundwater/site investigation boreholes, karst features, wells and springs. Please see our website for data availability and we recommend using these various data sets, when undergoing the EIAR, planning and scoping processes. Geological Survey Ireland should be referenced to as such and should any data or geological maps be used, they should be attributed correctly to Geological Survey Ireland.

Dear Peter,

With reference to your email dated 29 September 2020, concerning the proposed deepening of an existing limestone quarry at Aghamore Near, Aghamore Far and Carrownamaddoo townlands, Co. Sligo, Geological Survey Ireland (a division of the Department of Environment, Climate and Communications) would like to make the following comments.

Geoheritage

Geological Survey Ireland is in partnership with the National Parks and Wildlife Service (NPWS, Department of Culture, Heritage and Gaeltacht), to identify and select important geological and geomorphological sites throughout the country for designation as geological NHAs (Natural Heritage Areas). This is addressed by the Geoheritage Programme of Geological Survey Ireland, under 16 different geological themes, in which the minimum number of scientifically significant sites that best represent the theme are rigorously selected by a panel of theme experts.

County Geological Sites (CGS), as adopted under the National Heritage Plan are now included in County Development Plans and in the GIS of planning departments, to ensure the recognition and appropriate protection of geological heritage within the planning system. CGSs can be viewed online under the Geological Heritage tab on the online Map Viewer. The audit for Co. Sligo was completed in 2004 and full details of the report can be found here. **Our records show that there are no CGSs in the vicinity of the quarry.**

With the current plan, there are no envisaged impacts on the integrity of current CGSs by the proposed development. However, if the proposed development plan is altered, please contact Clare Glanville (Clare.Glanville@gsi.ie) for further information and possible mitigation measures if applicable.

Groundwater

Groundwater is important as a source of drinking water, and it supports river flows, lake levels and ecosystems. It contains natural substances dissolved from the soils and rocks that it flows through, and can also be contaminated by human actions on the land surface. As a clean, but vulnerable, resource, groundwater needs to be understood, managed and protected.

Through our Groundwater Programme, Geological Survey Ireland provides advice and maps to members of the public, consultancies and public bodies about groundwater quality, quantity and distribution. Geological Survey Ireland monitors groundwater nationwide by characterising aquifers, investigating karst landscapes and landforms and by helping to protect public and group scheme water supplies.

With regard to Flood Risk Management, there is a need to identify areas for integrated constructed wetlands. **We recommend using the GSI's National Aquifer, Vulnerability and Recharge maps on our Map viewer to this end. The quarry is underlain by a 'Regionally Important Aquifer – Karstified (conduit)'. The Groundwater Vulnerability map indicates the area covered is variable. We would therefore recommend use of the Groundwater Viewer to identify areas of High to Extreme Vulnerability and 'Rock at or near surface' which can be used to inform appropriate mitigation measures.**

Our **GWFlood** project is a groundwater flood monitoring and mapping programme aimed at addressing the knowledge gaps surrounding groundwater flooding in Ireland. The project is providing the data and analysis tools required by local and national authorities to make scientifically-informed decisions regarding groundwater flooding. **Although primarily focused on karst areas, this may provide information to benefit the proposed quarry deepening. We recommend using the Geological Survey Ireland's GWFlood tools found under our programme activities to this end**.

With regards to Climate Change, there is a need to improve the monitoring capacity of groundwater levels in Ireland so that the potential impacts of climate change can be monitored and assessed. In this context the GSI has established the GWClimate project in January 2020. GWClimate will 1) establish a long-term strategic groundwater level monitoring network and 2) develop modelling and analytical approaches for evaluating the impacts of Climate Change to Irish groundwater systems. **Further information can be found on the Groundwater flooding page of the Groundwater Programme.**

Geohazards

Geohazards can cause widespread damage to landscapes, wildlife, human property and human life. In Ireland, landslides are the most prevalent of these hazards. Geological Survey Ireland has information available on past landslides for viewing as a layer on our Map Viewer. Geological Survey Ireland also engages in national projects such as Landslide Susceptibility Mapping and GWFlood Groundwater Flooding. We recommend that geohazards be taken into consideration, especially when developing areas where these risks are prevalent, and we encourage the use of our data when doing so.

Guidelines

The following guidelines may also be of assistance:

- Department of Environment, Heritage and Local Government, 2004. Quarries and Ancillary Activities, Guidelines for Planning Authorities.
- Environmental Protection Agency, 2006. Environmental Management in the Extractive Industry: Non-Scheduled Minerals.
- Geological Survey of Ireland - Irish Concrete Federation, 2008. Geological Heritage Guidelines for the Extractive Industry.
- Institute of Geologists of Ireland, 2013. Guidelines for the Preparation of the Soils, Geology and Hydrogeology Chapters of Geology in Environmental Impact Statements.

Other Comments

Should development go ahead, all other factors considered, Geological Survey Ireland would much appreciate a copy of reports detailing any site investigations carried out. Should any significant bedrock cuttings be created, we would ask that they will be designed to remain visible as rock exposure rather than covered with soil and vegetated, in accordance with safety guidelines and engineering constraints. In areas where natural exposures are few, or deeply weathered, this measure would permit on-going improvement of geological knowledge of the subsurface and could be included as additional sites of the geoheritage dataset, if appropriate. Alternatively, we ask that a digital photographic record of significant new excavations could be provided. Potential visits from Geological Survey Ireland to personally document exposures could also be arranged.

The data would be added to Geological Survey Ireland's national database of site investigation boreholes, implemented to provide a better service to the civil engineering sector. Data can be sent to Beatriz Mozo, Land Mapping Unit, at Beatriz.Mozo@gsi.ie, 01-678 2795.

I hope that these comments are of assistance, and if we can be of any further help, please do not hesitate to contact me (Trish.Smullen@gsi.ie), or my colleague Clare Glanville (Clare.Glanville@gsi.ie).

Yours sincerely,

Trish Smullen
Geoheritage Programme
Geological Survey Ireland

APPENDIX 7-2 HYDRO-G TECHNICAL ADVICE NOTE

Hydro-G

50 Henry St.
Galway

H91 FA 4X

pamela@hydro-g.com

087 8072744

18th May 2021

Hydro-G Technical Advice Note

Including

Regional Hydrogeological Environment & Karst Information (Tynan, 2021)

&

Lough Gill PWSSs Potential Impact Assessment & the Proposed Continuance of Aghamore Quarry.

PREPARED IN RESPONSE TO

Irish Water's response Pre-Planning Consultation regarding Lagan (Breedon Group) Aghamore Quarry, Co. Sligo.

To whom it may concern

1.0 Introduction

Dr. Pamela Bartley (Hydro-G) and Suzanne Tynan (Tynan Environmental) worked on addressing Irish Water's points as they were presented in Irish Water's response to SLR's Pre-Planning consultation. Please refer to the Water Chapter's Appendix 7-1 for Irish Water's communication on the proposal.

The Regional Setting is now presented by Bartley & Tynan in this document. Their experiences in the examination of karst, the integrity of water supplies and karst flow systems in large limestone quarries close to SAC water bodies was communicated to the primary author of the overall assessment, Craig O Connor of TMS, and integrated into the EIAR's Water chapter .

The purpose of this communication is to inform the assessment of the hydrological and hydrogeological feasibility for continuation of development at the Lagan quarry at Aghamore, Co. Sligo. The site's actual address is Aghamore near, Aghamore Far and Carrownamaddoo townlands. For the sake of simplicity, the entire site will be referred to as the Aghamore quarry from her on in.

This Technical Advice Note focusses on the void and its waters, the hydrogeological characteristics of the regional setting, karst in the wider area and the potential for continued operation at the site to affect the security of Irish Water's abstractions from Lough Gill. The EIAR chapters consider both sides of the road for the entire area of the landholding of the quarry. This note addresses only the area going deeper in the application area.

2.0 Approach & Experts Involved

This technical advice note on Hydro-G's headed paper is Dr. Pamela Bartley's evaluation addressing Irish Water's points raised and the available information on Lough Gill and the regional karst system.

This technical note is based on integration of Tynan's research in the area with recent geophysical investigations at the site.

In this Hydro-G note, Irish Water's queries and statements are addressed by Dr. Pamela Bartley and therefore the analysis presented is her evaluation. However, that evaluation relies heavily on the specific and detailed work completed by Suzanne Tynan with respect to the Karst of the general area. Tynan prepared a report entitled "Regional Hydrogeological Context of Lagan's quarry at Aghamore Near, Aghamore Far and Carrownamaddoo townlands in Co. Sligo" (2021) for use in this evaluation and it is presented as Appendix A to this Hydro G Note. Tynan's (2021) report was informed by her work in the area for Sligo County Council and the OPW since 2015.

In addition to Tynan's (2021) contribution, the assessment was informed by the work of Apex Geophysics whom Lagan brough back to the site again in 2021 to complete more geophysical fieldwork to further explore the queries presented by Irish Water (Apex, January, 2021).

In addition, Dr. John Kelly, limestone and karst specialist geologist, who completed the geological assessments for the EIAR and Tynan consulted and integrated their experiences to inform the integrated assessment.

Pamela Bartley and Peter O Connor of Apex Geophysics consulted directly and explored the significance of the geophysics with specific reference to elevations, landscape position and bed levels at Lough Gill. Finally, the work of the additional hydrogeologists (Tynan and Bartley) and the additional geologists (Kelly and O Connor) was presented to Craig O Connor of TMS to finalise the assessment and presentation of over 4 years of fieldwork at the site. The Water chapter of the 2021 EIAR chapter was completed by Craig O'Connor with contributions by the four specialist subcontractors mentioned. The EIAR Water Chapter follows the legally guided structure for considering the proposed development, the physicalties of the hydrogeology and hydrology of the site itself and the interaction with the environment and assessment of potential impact. The work presented in this communication, penned by Dr. Pamela Bartley, and the report (Appendix A) prepared by Suzanne Tynan (2021) presents everything that is known, following 4 years of detailed fieldwork, about the karst features of the general area i.e. outside the quarry. Tynan's work presents the external environment for the purpose of placing the quarry in context. Dr. Pamela Bartley attempts to integrate all works in the language of water supply engineers from the perspective of her experience of both water supply and quarry development.

3.0 Statements of Expertise

Dr. Pamela Bartley's expertise is groundwater supply and large regionally important quarry assessments, often in SAC catchments. She is a water focussed civil engineer with 24 year's field-based practice experience in groundwater as a source of supply, quarries, surface water assessments and wastewater engineering. Pamela Bartley's company is

Bartley Hydrogeology ltd., registered to trade as Hydro-G. 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 as one of their panel Hydrogeologist service providers. Over the course of the last decade, she has acted for and advised Competent Authorities on hydrological and hydrogeological cases. 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 a Master's in Environmental Engineering followed by a hydrogeologically focussed Ph.D. within the school of Civil Engineering at Trinity College, Dublin. Her supervisor throughout was Professor Paul Johnston. Pamela's key work areas are large scale public supply boreholes, surface water and groundwater assessments, soil systems and soil hydrology, wastewater treatment and discharge assessments for groundwater and/or surface water, investigations for quarries with respect to Planning, Water & Ecological Regulations. She has been an invited guest speaker at the IAH national conference on numerous equations, An Bord Pleanála on numerous occasions, the Institute of Planning and the HSE's Environmental Health Officers national conference. She has delivered hydrogeologically focussed lectures to the public during national science week. She has demonstrated hydraulics laboratory sessions with undergraduates at Trinity College, Dublin. She has instructed and acted as a final interviewer examiner to FETAC students for their accreditation in Site Characterisation for On Site Systems. She has lectured at Waterford and Carlow Institutes of Technology full time for 3 years prior to establishment of her own company in 2007. Pamela has successfully completed the hydrology and hydrogeology assessments for many regionally important quarries in complex hydrogeological settings, most but not all in karst, including Bennettsbridge Limestone, Co. Kilkenny, McGrath's Limestone of Cong, Co. Mayo, Cassidy's of Buncrana, Co. Donegal, Harrington's of Turlough, Co. Mayo and Ardgaineen, Claregalway, Co. Galway and Mortimer's of Belclare, Tuam, Co. Galway. Pamela has assessed discharges from quarries on behalf of the National Competent Authority as well as on behalf of quarries themselves. She has authored the Water Chapters of many limestone quarry EIARs. Most water chapters of EIARS prompt Discharge Licence review. Amongst her successful discharge licence projects for karst limestone quarry sites similar to the Aghamore Quarry are:

- Bennettsbridge Limestone, Co Kilkenny who are licensed to discharge (ENV/W/78, 2017W395) a range of a mean daily discharge of 20,000 m3/d, which is justifiably, defensibly, and legally permitted to rise to 70,000m3/d, depending on the recharge season. The quarry is located 800m from the River Nore SAC. They discharge with no impact to the River Nore SAC. They have justified, defensible, permission to quarry below the bed level of the Nore SAC, and

- McGraths Cong, who are licensed to discharge 10,000m3/d (W/391_05_R1, 2019). Their pre-63 floor level is below sea level, but they prefer to work elsewhere in their site. They are nestled between two SAC Lakes and have a recently revised, legally defensible, justifiable discharge to the ephemeral Cong Canal, which borders their site. This is defensible because the quarry's discharge is also ephemeral i.e. rainfall driven. Their discharge is upgradient of Lough Corrib, which is a source of Public Water Supply for Galway City. No impact or damage has ever occurred.

Both of these sites are karst settings in SAC catchments. Both are large regionally important Limestone quarries, similar in scale and landscape setting to the Lagan Aghamore Quarry. Therefore, Dr. Pamela Bartley understands how to assess apply the correct wide scale methodology for assessment and has the experience for assessing the risk. There are other successfully operating sites that provide a wealth of experience, reassurance, and precedent with respect to this case.

Tynan Environmental carries out hydrological, hydrogeological and environmental consulting. It comprises the principal Suzanne Tynan, who works in partnership with other specialist scientists and engineers to provide a comprehensive range of services. Tynan Environmental holds public liability insurances and professional indemnity insurances of €2million for each and every claim in each period. Suzanne is qualified and IOSH certified to act as PSDP (Project Supervisor Design Phase) as defined by the Construction Regulations. Tynan Environmental is a registered Geological Survey of Ireland and Irish Water Supplier. Suzanne Tynan, principal of Tynan Environmental, is a hydrogeologist, hydrologist and environmental scientist with twenty-two years' experience in the area of hydrology and hydrogeology. Suzanne holds an MSc. in Hydrology and Water Resources Management (Department of Civil and Environmental Engineering, Imperial College, London), an MSc. in Environmental Science (School of Natural Sciences, Trinity College, Dublin) and a BSc, in Geology and Botany (School of Sciences, University College Dublin) and has held research fellowship and researcher positions at Trinity College Dublin. She has PGeo (Professional Geologist) chartered status from the Institute of Geologists of Ireland (IGI) and from the European Federation of Geologists (EurGeol). Suzanne is a board member of the Institute of Geologists of Ireland, a member of the working group which wrote the Institute of Geologists of Ireland (2013) Guidelines for the Preparation of Soils Geology and Hydrogeology Chapters of Environmental Impact Statements (and is currently involved in its update) and was a member of the Water Framework Directive Groundwater Working Group sub-group writing guidance on groundwater dependent ecosystems. Suzanne has been an invited guest speaker at Engineers Ireland Technical Lectures, IAH Annual Conference, CIEEM and lectured to the public at Engineers Week.

Suzanne has significant technical experience in assessment, mitigation, and management of the relationship between projects and the water environment. This includes experience in flood risk assessment and of hydro-ecology (the study of the interaction between water systems and dependent ecology) and design of mitigation measures for infrastructure located in or adjacent to water environments. Current and recent major hydrogeological/hydrological and flood risk assessments include two projects funded by OPW in support of characterisation and remediation of 2015 groundwater flooding in Co. Sligo, a combined groundwater surface-water flood risk modelling for a road and local authority housing development on behalf of Limerick County Council, assessment of the risk of fluvial and/or groundwater flooding at sites for a proposed school, a waste transfer station, quarries and land reclamation sites. These projects include the design of water management systems to reduce the risk of flooding from development storm water and groundwater discharges. Suzanne has carried out supporting hydrogeology/hydrology for Natura Impact Statements for numerous types of surface water and groundwater dependent Natura 2000 qualifying interest habitats, for developments including road drainage, quarries, marinas, gas pipeline, road, windfarm, and regional drainage projects. This work includes the design of a national methodology for screening the impacts of drainage maintenance schemes on groundwater dependent Natura 2000 sites on behalf of OPW. Work has also included the modelling of the impacts of climate change on flooding in the Thames Valley, at the British Geological Survey. Tynan Environmental's clients have included United Nations Development Programme, Office of Public Works, Local Authorities, Geological Survey of Ireland, Environmental Protection Agency, National Federation of Group Water Schemes, Irish Water, Planning and Ecological consultancies, Multinational and Irish Engineering consultancies, Quarry companies and Private developers. Suzanne has studied the karst systems and flooding in the Sligo peninsula since 2015.

4.0 Background to the Available Information Regarding Local Karst

The regional context of the karst system included in this report is derived primarily from unpublished hydrogeological and hydrological work carried out by Tynan Environmental, on behalf of Sligo Co. Co., for the purposes of flood risk assessment and mitigation. The work has been presented to the NW Region of the Institute of Engineers. The karst environment's reaction to cumulative storm event rainfall in combination with topographical controls dictate the area's flooding experiences.

With respect to the information available and shared for the purposes of the Aghamore quarry assessment, the following karst feature data are significant:

- groundwater level monitoring points in the Cuilbeg townland, 400m north of the northern boundary of the quarry.
- Groundwater level and discharge to the most southerly spring discharges from the peninsula's central 'Ballyfree' swallow hole. That spring system discharges at a distance of 1,500m to the west of the quarry's western boundary.
- 'Filan's field groundwater flood response 800m NW of the quarry boundary.

Sligo County Council and the OPW correctly identified that a karst and groundwater flooding specialist, which is Tynan, was the appropriate professional for the assessment of the road flooding responses to storm events in 2015-2017. This is because groundwater flooding is a significant part of, but not all, of the issue. The reason groundwater spills out to the land surface in extreme conditions is because the groundwater system is epikarst dominated, which means that a shallow broken rock system dominates responses. From this, I infer that the deeper rock cannot accept the rainfall and epikarst's load. The role of the epikarst will be expanded upon later. Sligo Co. Co. have given permission for use of Tynan's work for the purposes of setting the quarry in the regional context.

In advance of field visit to the site, Suzanne reviewed all available geological and water related works completed to date for the EIAR.

Dr. Pamela Bartley and Tyan visited the site in April 2021. At that time, they also completed a wider catchment tour of the mapped karst features such as Ballyfree Swallow Holes, the rising springs, exposures of the different bedrock outcrops, Tobernalt spring and Lough Gill, travelling then all the way round to the other side of Knocknarea and continuing to Ballysadare Bay. The obvious boundaries between the Glencar and Dartry Limestones and how they influence the surface systems, the significance of the karst features and their topographical setting and how that controls their responses to rainfall were observed in the area. Overall, the long-term Sligo County Council studies conclude a highly active karst system that operates at relatively shallow depths in the subsurface, when the depth of the quarry void is considered. The karst discharge system is extremely responsive and relatable to rainfall. The controlling role of the band of limestone around the bay and the fact that most springs and rivers rise in the vicinity of likely formation boundaries was highlighted. This information is best assessed by referring to Tynan's (2021) formal report contribution to this project and its associated Figures 1, 2 and 3 (Appendix A).

While I will address each one of Irish Water's points later, first I would like to generally address my impression that the main queries in everyone's mind and the overall question driving all Irish Water's points seems to be:

DOES FURTHER DEVELOPMENT AT THE QUARRY POSE A RISK TO:

A. LOUGH GILL'S QUANTITY OF WATER HELD?

&/or

B. THE QUALITY OF WATER IN LOUGH GILL?

Each of these questions are significant to the integrity of both the public water supply and ecological of the Lough Gill SAC site.

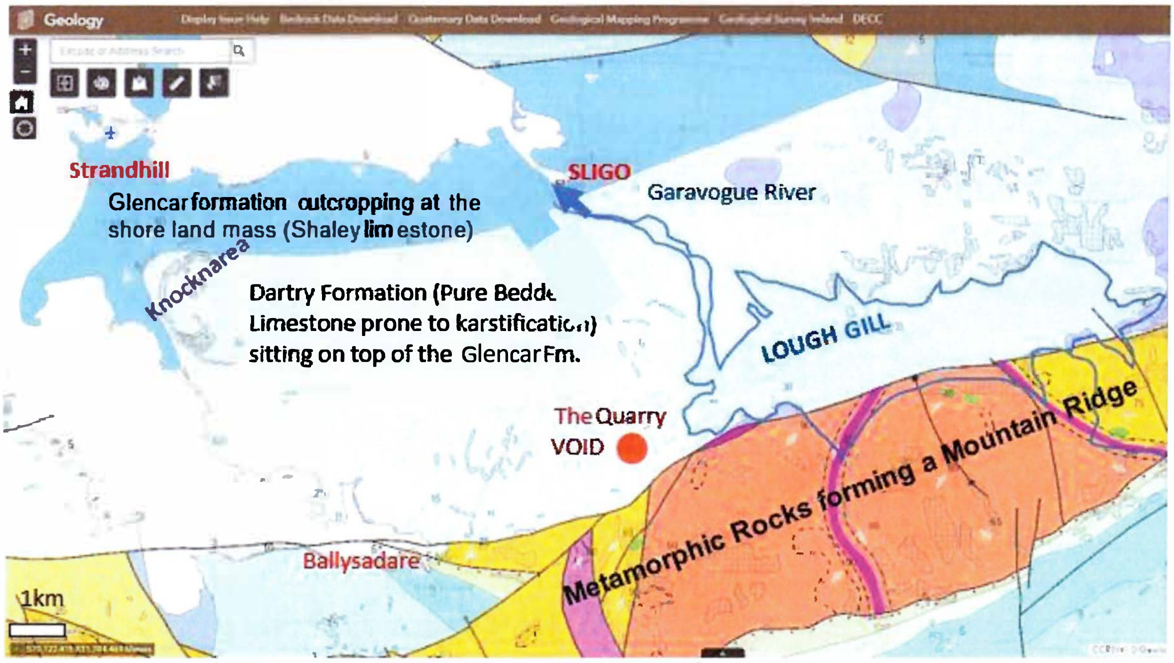
In my professional opinion, informed by more than 12 years intensive and detailed site intrusive assessments at karst limestone quarries, **the Aghamore quarry poses little or no threat to Lough Gill or the Public Water Supplies**. There are so many facts to support my assessment of the overall risk, including but not limited to the following 3 points:

1. What we now know about the regional karst system.
2. Elevations.
3. Scale.

Each of these three points can be expanded upon and discussed in detail below.

1. **What we now know in-depth about the regional Karst system:** The assessment of the quarry has had the benefit of detailed knowledge sharing with Tynan (2021). The intensively studied Karst in the peninsula is highly active but relatively shallow compared to the full depth extents of the walls of the void and the floor of the quarry. The regional karst system in Sligo and around the quarry seems to be dominated by its epikarst. For purposes of clarity, epikarst means the weathered top layer of the limestone bedrock and it is in direct contact with the overlying subsoil cover of the landscape over rock. Epikarst is considered a critical link between rainfall and transport of water to the deep aquifer. In the Sligo peninsula the quarry is situated in the south east corner. The peninsula encompasses land including the site, the western edge of Lough Gill, travelling northerly to Sligo town, heading west to Strandhill behind Knocknarea, down south to Ballysadare and its bay and back over east to the quarry. The land elevation is generally around 30 – 40m OD and it rises to heights at Knocknarea. The quarry sits within the Darty Limestones, which is most probably underlain somewhere at depth with the muddier Glancar limestones. The quarry sits on the boundary of the limestones with the paragneisses of the Killery Mountain band to the South East of the site. Paragneiss is a metasedimentary rock with a gneissic texture; a gneiss is formed by the metamorphism of a sedimentary rock. The geology is better explained in the introduction of Tynan's (2021) report attached. However, simply, the regional structural geology is most easily understood with reference to a pictorial representation of the general GSI mapping for Bedrock for the region, as presented in Plate A,which has been annotated by Hydro G to highlight the bedrock contacts, the location of the quarry and Lough Gill. The reason the geology is important is because it controls the karst. Tynan's report's Figure 1 (Appendix A) for the regional geology and karst simply demonstrated that the surface water stream risings are related to the occurrence boundaries of the different rock types.

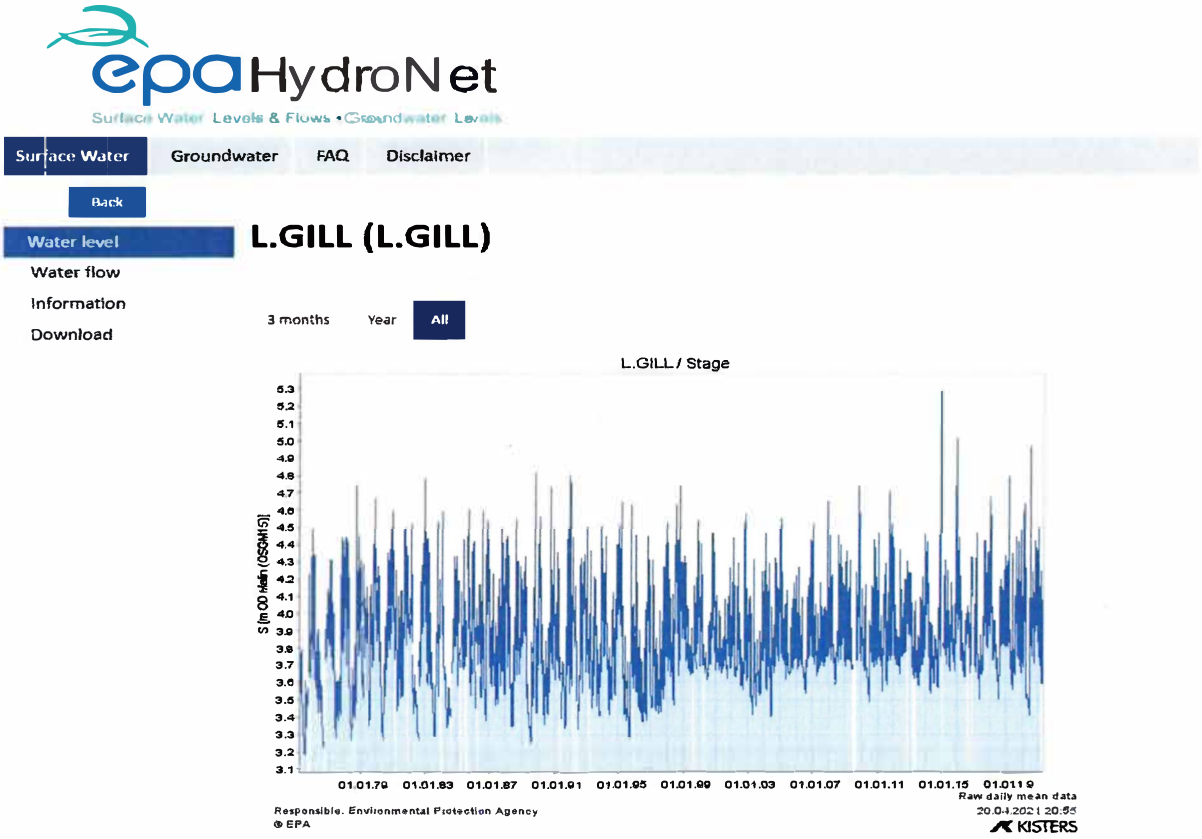
PLATE A Regional Geology (www.GSI) with Hydro-G Annotations for the purposes of communication.



Returning to the significance of the Karst, there is only one swallow hole system in the entire peninsula, located centrally in the Dartry formation (Refer to Tynan's Figure 1, 2021). Tynan refers to there being two adjacent swallow holes 'Ballyfree'' and the GSI has this mapped as the 'Tonafortes Sink'. The mouth of this sink at the land surface has an elevation of 20m OD, approximately. Tynan's detailed studies of the rainfall response of the regional karst system includes, amongst much more fieldwork, continuous quantification of the volume of water flowing into Ballyfree (swallow holes) and relating it to concurrent rainfall and continuous monitoring of the spring discharges at Tobernaveen (15m OD, approximately) and Carrowbodogagh (5m OD approximately) [Diagram 1 and Figure 3 Tynan, 2021]. That underground flow goes in opposite directions from Ballyfree: to the NW and the SE and discharges from the Tobernaveen and Carrowbodogagh Springs, respectively. The discharge responses at the springs are rapid and therefore suggests that a relatively shallow, rainfall dominated, epikarst system plays a massive role in the hydrogeology of the area immediately west of the quarry. Therefore, Hydro-G considers that the potential significance of groundwater strikes at deeper depths at the site present a relatively low risk component of the regional hydrogeological system.

Tynan's Diagram 1 (2021) annotates the regional conceptual flow system with flow arrows for epikarst and deep karst flows, the 'deep' flows depicted, which Tynan refers to as conduit, **are above the 0m OD elevation.** I offer that it was a long time ago that the original perimeter ground level at the quarry was brough from 30m OD, approximately, to its current floor elevation at -21m OD. It was a long time ago that excavations at the quarry at Aghamore had potential for interception with the known, well studied (Tynan 2017 – 1018), active, often conduit type, active epikarst zone from 20m OD at surface to 0m OD elevations of the epikarst discharge zones. The floor's void is now at -21m OD. I propose that the time for big water strikes has long passed. Long ago is the time when impact would have been experienced, if it were a thing. The EPA Hydrograph for 50 years of Lough Gill's water levels tell no story of any impact at any time (Plate B).

Plate B **Lough Gill's Water Level Elevation (EPA HydroNET Stn. 35073): 1971 to 2021.**

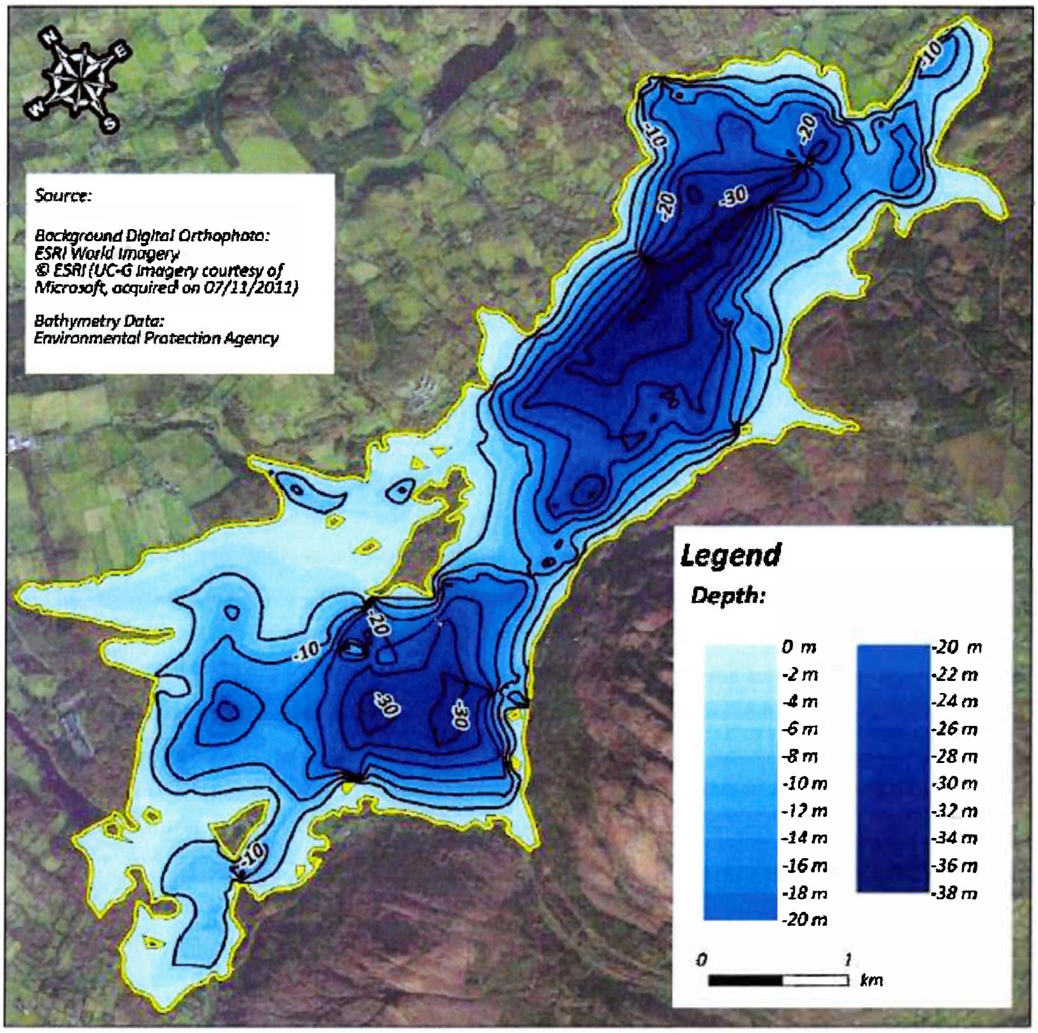


Tynan (2021) describes that the "swallow hole inflow - spring discharge setting and suggests that where the Dartry limestone is thin downward recharge is impeded by the presence of shaley beds and flows are therefore concentrated at the base of the Dartry limestone, with fissure/conduit development in this zone." Refer again to Plate A of this Technical Advice Note. When Tynan (2021) talks about impeded downward recharge and the presence of shaley beds, it is the point of contact between the shaley Glencar limestone under the Darty limestone that holds the significant potential for deep conduit development. Apex (2021) found no evidence of this contact in their survey level of -60m OD, which is below the proposed -50m floor depth. While Tynan (2021) refers to the possibility of deep karst under Lough Gill's bed, detailed survey across the flooded floor of the quarry to a depth of -60m OD (Apex Geophysics, 2021) found nothing to suggest any karst conduits in the rock proposed for excavation to -50m OD at the site. The Apex work (2021) surveyed the floor of the quarry using floating techniques on the entire flooded floor. Why is the floor now flooded? Because there have been periods of pump breakdowns and the site is not operational. The Water chapter of the EIAR considers this storage/discharge situation in their Water Balance evaluation. Apex's interpretation of their survey lines on the void's floor led them to offer that frequently the top 1-3 m of so of a quarry's floor's rock surface have slightly different characteristics (lower resistivity and lower seismic velocity) to the main deeper body of the rock. The normal explanation for low resistivity and velocity in rock is a weathered surface layer but in the case of quarry floors the weathered layer interpretation does not apply. The best explanation we have (and this has been confirmed by coring on the floor in some cases) is that the rock at the top of the floor has been fractured by blasting of the overlying bench and there is also an opening of fractures/joints due to stress relief/relaxation after removal of the overlying rock mass. These 'open joints' can therefore be described as blast induced fractures/relaxation joints. With regard to their impact on hydrogeology and due to their origin and nature they a) do not persist at depth into the rock mass and b) they do not extend outside the confines of the quarry floor. In geophysical terms and on this site, they form a thin transitional zone between the water column and the main rock mass (Peter O'Connor, Apex, *pers.comm.,* 2021).

Therefore, Hydro-G offers that the integration of information from distinct geological experts and their studies outside and inside the quarry suggests no potential for hydraulic connection nor drain from Lough Gill in the proposal presented regarding bringing the floor from the current -21m OD to -50m OD.

2. **Evaluation of elevations** reveals as follows:
    - **a.** The land edge perimeter to the quarry is 30m OD, approximately.
    - **b.** The floor is currently at an elevation of -21m OD and it is proposed to go to -50m OD.
    - **c.** The water level at Lough Gill is recorded by the EPA at established Station number 35073 and the graph for water levels over the 50-year monitoring period presents a water level that is rapidly responsive to rainfall, which fits in with the region's conceptual model of a rapidly responsive shallow epikarst driven system model. With reference to the EPA record for Lough Gill's water levels (Plate B), it is observed that the water level has lows in the order of 3.5m OD, generally, and peaks averaging around the 4.5m OD mark, in general. Let us say that the general average water level in Lough Gill is 4m OD. EPA's bathymetric survey of Lough Gill is presented in Plate C. The deepest part of the bed of the lake is mapped by the EPA as -30m deep but this is at a distance of 8km from the quarry and is in the NE corner of the lake more or less in Leitrim. Refer to Plate C. The part of Lough Gill closest to the quarry under evaluation is shallow and in the depth range of <5m, which is approximately -1m OD bed elevation for the bay of Lough Gill closest to the quarry.

PLATE C Lough Gill Bathymetry (EPA, 2016)


Source:
Background Digital Orthophoto: ESRI World Imagery
© ESRI (UC-G Imagery courtesy of Microsoft, acquired on 07/11/2011)
Bathymetry Data: Environmental Protection Agency

d. Continuing on the theme of the significance of elevations, GENERAL Information extracted by Pamela Bartley from Tynan's work on the significant karst features, suggests **approximate** elevations as follows:

- The central sinks @ Ballyfree = 20m OD land surface and flood levels can reach 22m OD.
- The spring discharges most significantly related to the inflows at Ballyfree sink = @ Carrowgodogah @ 3-4m OD, which is 1.5km west of the quarry's most western corner.
- The other spring discharging Ballyfree's inflow waters is unlikely to be significant as it is 4.5Km to the NW of the quarry and therefore upgradient in terms of flow. The elevation at Tobernaveen = 15m OD.
- Groundwater emergence on the land and flood levels at Filans field and Martin Reilly Motor were other significant karst features monitored by Tynan in her karst groundwater Sligo Flood Studies. Ground levels in this part of the catchment range from 10 to 20m OD and the groundwater flood levels range from 14.3 to 17.45m OD. (Institute of Engineer's NW Region Presentation, Tynan).

Hydro-G offers that the quarry void's most recent water level maximum reported level was -15.4m OD, approximately, in Late January 2021 (Apex, 2021). On the day of Tynan and Bartley's site visit in early April 2021 the water level had dropped 3.5m from its maximum observed level from -15.4m to -18.9m OD. So, the water level does drop in response to pumping. The abstraction rate is ~36 l/s, which is approximately equivalent to 3,110 m3/d. That is the maximum capacity of the one operational pump at the site now. This pump capacity has resulted in a 3.5m drop in water levels in 8 weeks between Apex's last field works and the day of Tynan and Bartley's site visit. Therefore, we know that the ingress of any groundwaters is significantly less than what is being pumped out, which is 2,900m3/d. I offer that 2,900m3/d is too low a volume to signify large operating deep karst conduit flows. Groundwater flows at numerous other parts in the catchment occur in the 0 to 20m OD (positive) rather than in the range of the – 15m to -18.9m OD (negative) water levels observed in the void. I would offer that the -21m elevation of the quarry floor and its void water's pool are significantly lower in elevation than the regionally active karst system. Observations in the quarry void suggest that the rainfall responsive dominant shallow epikarst that is close to surface and floods Filan's field (@ 800m NW), the car showrooms (@ 900m NW) and immediately north at the Cuilbeg townland Tynan monitoring (@400m N) suggest that it is rainfall driven rainfall integrating with epikarst that presents water in the void and that the quarry area is not the biggest player in the overall regional karst system around Lough Gill.

TAKE HOME POINTS FROM a, b, c and d above are that the excavated base floor of the quarry is @ -21m OD and Lough Gill's water level is 4m OD, on average, approximately, and the lake's bed level is -1m OD, approximately, in the vicinity of the quarry. Given that the groundwater inflow and outflows through the karst system operate between elevations of 0m OD and 22m OD (Tynan, April 2021), the fact that the floor is now 20m below the bed of Lough Gill's closest bay areas of Aghamore Bay and Tobernalt Bay, suggests that the likelihood of the quarry intercepting deep karst in the future proposed depths from -21m OD to -50m OD is highly unlikely. Apex Geophysics (2021) survey to -60m OD suggests solid limestone under the entire floor of the quarry.

There is anecdotal evidence by swimmers of springs emerging in the bed of Lough Gill, which they sense that cold water areas are evidence of. The elevation of Tobernalt spring, which is also an EPA HydroNET gauging station, is 4.3m OD. The current floor level is -21m OD and the proposal to bring the floor to -50m OD is deeper than any of the surrounding karst for which we have evidence. As previously stated, geophysics to an elevation of -60m OD presents no evidence of karst conduits under the void. It is only the void they propose to work. While the Apex 2021 investigations included 'Area B', the purpose of that was to further explore the borehole conditions in that area.

3. Scale:

a. The proposed area of the void is 10.9ha. =0.1km2, approximately.

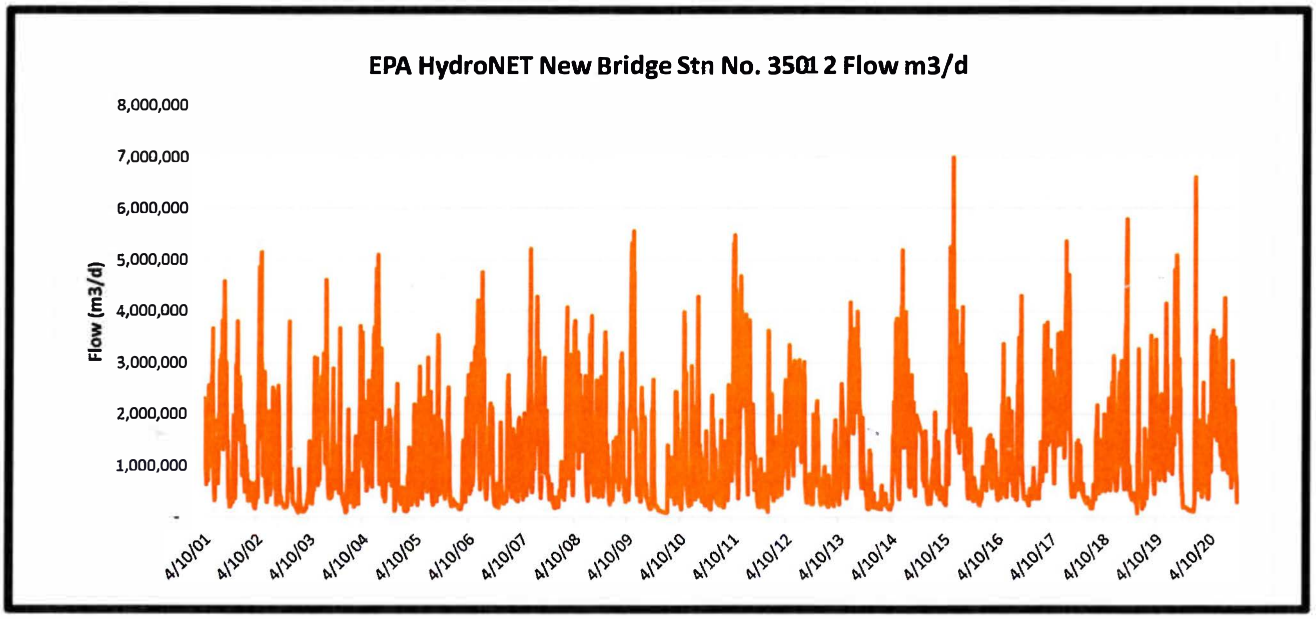
b. The area of Lough Gill is 14km2.

c. This suggests that the surface area of Lough Gill 128 times bigger than the surface area of the void of the quarry.

d. The land area contributing water to Lough Gill, i.e. the catchment, is reported to be 400km^2 (Thompson et al., 1998) but the EPA HydroNET Information suggests a catchment of 362.60 km^2 for the Lough Gill Station 35073. Let's take the lower value so as to be conservative.

e. The volume of water discharging from Lough Gill each day is recorded at EPA HydroNET station @ New Bridge (Station No. 35012 on the Garavogue downstream of Lough Gill). The daily mean dataset for m3/s has been converted to m3/d daily discharge volumes trend for the purposes of easy relation to the m3/d abstracted by Irish Water and the m3/d of the quarry's discharge. Daily discharge from Lough Gill, as recorded at the New Bridge hydro NET station is presented in Plate D.

Plate D Hydro-G's conversion of EPA HydroNET station's m3/s @ New Bridge (Station No. 35012 on the Garavogue downstream of Lough Gill) to equivalent m3/d.



With reference to Plate D, there is a wide range of discharge from Lough Gill over the seasons. The range observed is from 100,000 to 7,000,000 m3/d and that is the volume contributed to Lough Gill form the entire catchment around Lough Gill. Given that the future maximum envisaged and licensed discharge from the quarry will be 3,500m3/d, the scale issue is therefore clear. The maximum discharge volume from the quarry would most likely occur when the catchment contribution and flows are in the upper range shown in Plate D.

Hydro-G has taken the flow statistics from the EPA dataset for the discharge from Lough Gill at the New Bridge station on the Garavogue and these are presented in Table 1.

Table 1 Equivalent Flow Statistics for the flow volumes leaving Lough Gill on a daily basis.

EPA HydroNET New Bridge Stn No. 35012 Flow m3/d			**Quarry discharge licenced max ELV volume as a % of the Discharge from Lough Gill**
MAX	6,986,563	m3/d	0.05
AVERAGE	1,216,116	m3/d	0.29
95%tile	183,427	m3/d	1.91

With reference to Table 1,

- On an average day, there is just over 1million m3 of water leaving Lough Gill, compared to the 26,000m3/d planned future max abstraction for Irish water.
- The EPA 'Information' for the Station on the HydroNET system suggests that the 'Estimated 95%tile Flow = 2.123 m^3/s, which is equivalent to 183,427 m3/d.

- At the time of the maximum floods in 2015 there was nearly 7million m3/d of water flowing from Lough Gill.

- With reference to the graph in Plate D, most winters have flows of 4 to 5 million m3/d leaving Lough Gill through the Garavogue River. The usual max discharge times from a quarry are winter and high rainfall and that scenario. In winter, the quarry's licensed discharge input to Lough Gill would account for 0.05% of the water discharged from the lake.

- The relative scale of the volume of waters that could be discharged from the quarry, with reference to the daily licensed volume in the 2020 justified Discharge Licence [DL(W)20], is less 0.3% for the average condition and <2% for the 95%tile condition. The 95%tile condition is considered the worst case for modelling hydrology and under that 'worst case' flow condition, the quarries discharge is 2%. This is insignificant.

The overall assessment of this case, from the perspective of a planning professional, benefits with pictorial views of the situation. Tynan (2021) presented the NW SE cross section through the Ballyfree swallow holes and their discharge springs: at Tobernaveen (15m OD, approximately) and Carrowbodogagh (5m OD approximately) [Diagram 1 Tynan, 2021].

DIAGRAM 1 Tynan 2021

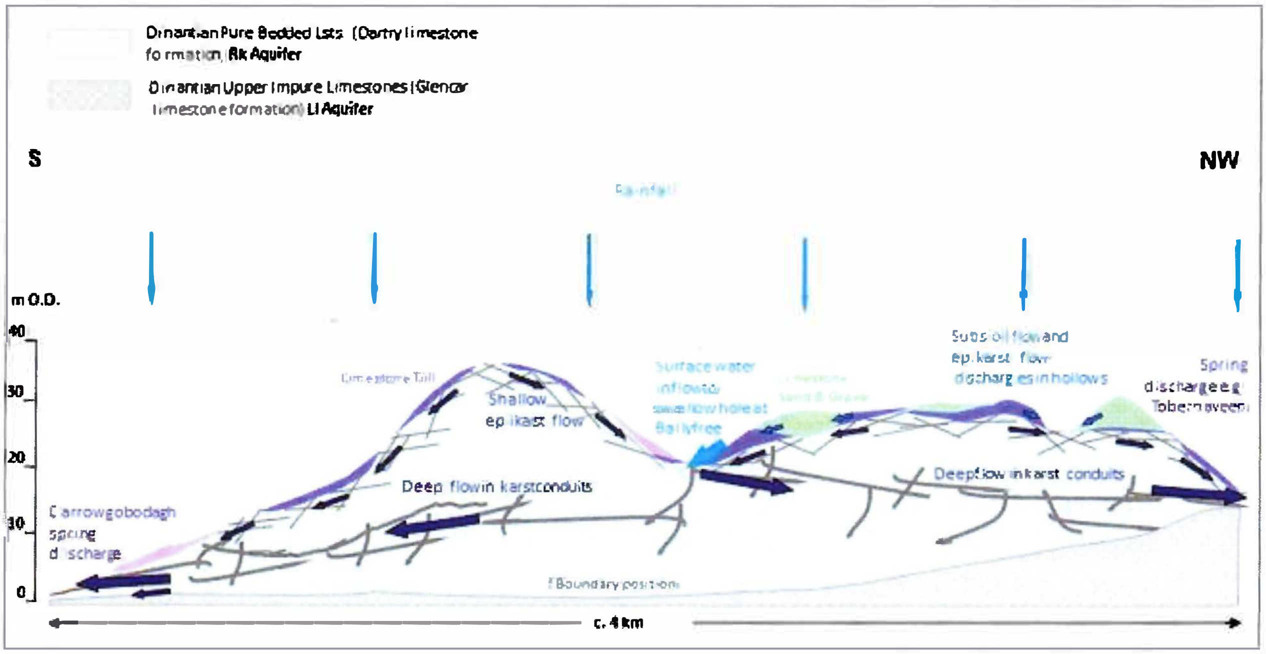


Diagram 1 Conceptual Model of Flows

With respect to addressing each of Irish Water's points raised individually, given that Dr. Pamela Bartley is a consultant panel hydrogeologist for the North West for Irish Water, she has a working relationship with Irish Water personnel in the area. Therefore, with specific reference to the letter issued by Irish Water, consultations commenced with Des Joyce, Regional Lead, Assets, Irish Water, Castlebar and following on from that Coran Kelly, Tobin's because he was the contract assessor for Irish Water's letter. Following on from further consultations with Anthony Mannix of Irish Water, Sligo County Council's environment Section and others, it was determined that the Irish Water communication was not intended to convey 'showstopper' concerns or reservations about the proposal to continue quarrying at the site. It is suggested that the Irish Water Letter dated 7/1/20 was written with the intention for general absorption in the water community amongst all Water Services, Environmental and Planning Departments that IW expect detailed consideration and discussion with respect to potential impacts and risk posed to every public water supply in their charge. In this case, the proximity of Lough Gill and the two public water abstraction points on it need to be considered. There is the abstraction for Sligo Town at Foxes Den WTP and the abstraction for Leitrim's Moneyduff across on the north east side of Lough Gill.

Generally, in basic terms there appears to be 2 risks:

(i) Flow out of Lough Gill into quarry and
(ii) Flow into Lough Gill from Quarry

With respect to the first identified risk, (i), if there was an interception of a conduit linking the lake and future deepening of the quarry, then in simplest terms the maximum volume that could be taken out of the lake is the maximum volume of the quarry void plus any volume that could reasonably flow out of the quarry, which will be limited by the perimeter and elevation of 30m OD, approximately. This volume is likely to have a low impact on the level of Lough Gill when you consider the volumetric capacity of such a large lake. Calculations of significance in this case are as follows:

a. The proposed quarry void for the application under consideration is calculated from the application details specifying as follows:

   i. "Recommencement of quarry operations within the previously permitted quarry extraction area (c. 10.9ha);

   ii. Deepening of the previously permitted quarry area by 2 no. extractive benches from c. -21m OD to -50m OD;"

   In order to calculate the future maximum quarry void, Hydro-G offers that even though the current surrounding land perimeter is 30m OD, the water level average in Lough Gill is 4m OD, APPROXIMATELY, and so this is the level we should consider for the equipotential level between the void and the lake. IF there were to be a deep, deep, conduit experienced to link the two, which is unlikely but we are at worst case evaluations here, the proposal is to bring the floor to -50m OD, suggesting a final void depth of (4m ODminus -50m = 54m depth of water over the proposed quarry area of 10.9 ha (10,900 m2) = 5,886,000 m3 quarry void as a maximum void space to be filled with water in the evaluation scenario of equipotential between Lough Gill and the void, which is probably closer to 5,500,000 m3 of lake water in the void space when one considers the land take by circling internal quarry roads and the associated set back from slopes between benches.

b. Based on the 14km2 plan area and average bathymetric depth data from the EPA (Plate B), it is likely that Lough Gill contains a volume of water in the order of 14,000,000 m^2 x 18m average depth = 252,000,000m3.

c. Comparing the available void volume to equilibrate with Lough Gill, the % is 2% of Lough Gill or a Water Level change of 0.4m, approximately, in Lough Gill. Given that there is weir control at the Water Abstraction at Foxes Den and that the lake water level is already experienced to vary from 3 to 5m OD, the controls already seem to be in place for mitigation of any risk posed (Plate A). No matter what, the catchment of Lough Gill is almost 400km2. Therefore, water rainfall runoff will continue to replenish it as it always has. The exchange with the void will be finite. If the quarry were to flood from the lake, that would be the end of it. The 2020 Discharge Licence for the site does not permit that level of dewatering. No quarry pumps could deal with it. It would rule out viable economic benefit to the operator.

With respect to the second identified risk, labelled (ii) above, the risk from quarry into lake again is similar to other potential threats from industries, farms in the entire catchment etc. and has already been mitigated by the **revised Discharge Licence for the site [DL(W)151] issued on the 24/1/20 by Sligo County Council.** The supporting documentation prepared for that discharge licence application, including the required assimilation capacity simulations in the August 2019 report and the November 2019 response to Further information, and resultant licence issued are presented in the Appendices of the Main Body of the Water Chapter. The discharge and mitigation measures have already recently been determined to provide the required protection to the quality of Lough Gill. The discharge point is 0.8km upstream of Lough Gill. Department guided assimilation capacity simulations suggest that for the BOD and Suspended Solids parameters the quality of water will be better downstream of the discharge relative to upstream: Conclusions of the August 2019 Assimilation Capacity report present as follows:

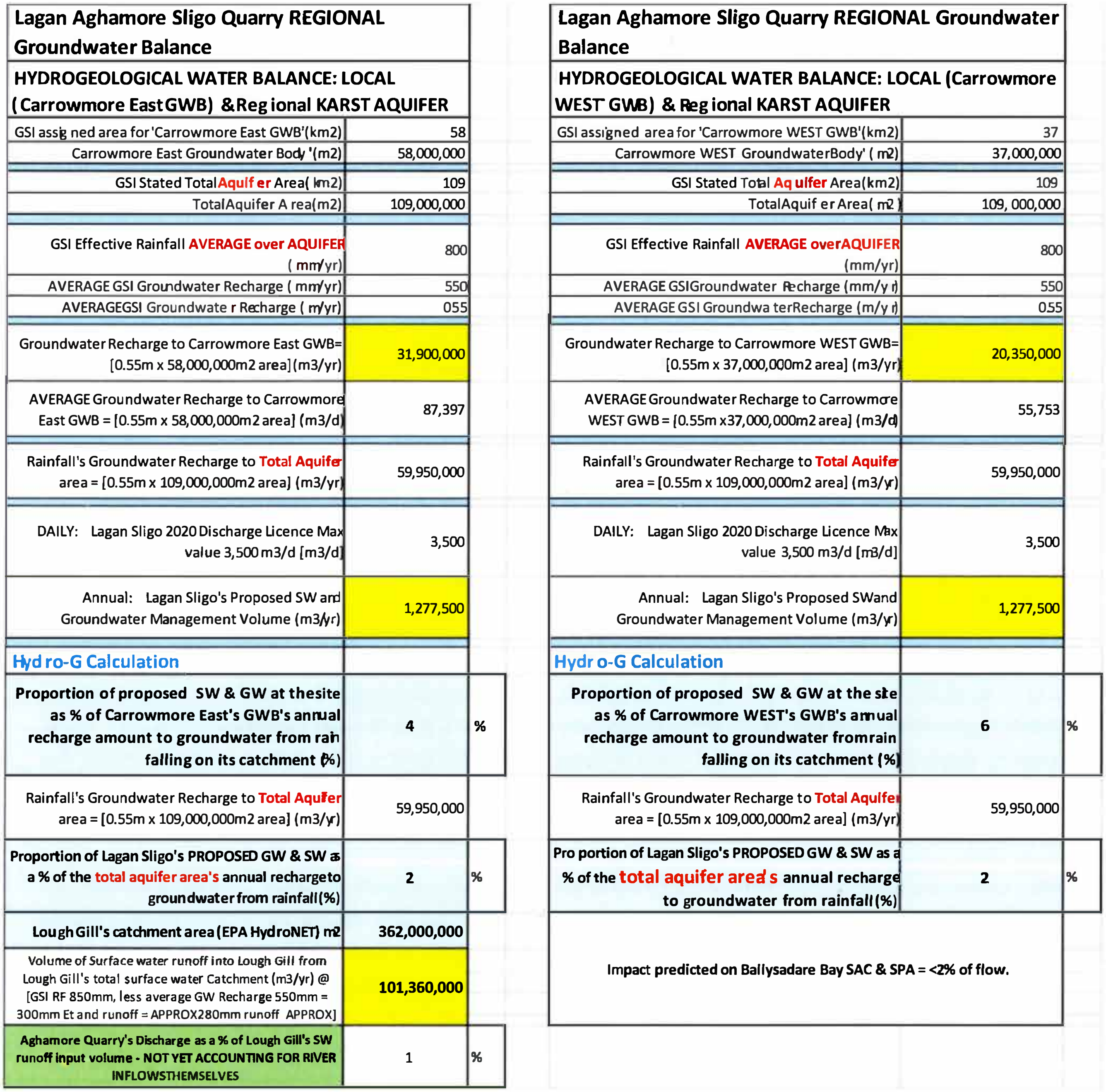
> *"For the general-case scenario, only low percentages of the available assimilative capacity are used by some parameters (maximum of 27% by orthophosphate). In some cases, additional assimilative capacity is made available (e.g. TSS and BOD) as the mean concentrations in the discharge are lower than the background concentrations upstream of the discharge."*

Hydro-G offers that the take home point here is that the discharge has been shown not to present a hydrochemical threat in terms of BOD, SS nor a nutrient threat to Lough Gill. There is no bacteriological source in a quarry's activities, only that brought in from local farmlands, which would have made their way to the Lake regardless of a quarry. Tynan has recorded times of travel in the order of hours in some parts of the karst system (Tynan, 2021). Therefore, the natural subsoil/bedrock system does not provide the usual 100-day time of travel protection, regardless of a quarry void in the corner part of the regional catchment.

Irish Water have completed assessments on Lough Gill as part of the National Water Strategy. Those assessments will be in the public forum soon but not yet. However, we all know that given the large volume and known massive capacity of Lough Gill, it is acknowledged that the quarry is unlikely to be a big player in the hydrology and hydrogeology of the entire catchment and the entire volume in the lake and that is the purpose of Bartley and Tynan's work contribution to O'Connor's Water Chapter. The entire project's documentation fits together to explain how all the water balance components interact with each other. For example, the question posed regarding the quarry sitting on a potential catchment divide – will the quarries water get sent into Lough Gill when in fact it may originally have been heading west? Again, it is the significance of the % that is important. The **WFD 'GUIDANCE ON THE ASSESSMENT OF THE IMPACT OF GROUNDWATER ABSTRACTIONS' GW5** can be used. I present that Guidance Document in Appendix B, for ease of reference). A quarry can be conceptualised as an abstraction in a catchment.

For example, general water balances for the site, the two underlying groundwater bodies and catchment have been calculated by Hydro-G and presented in Table 2. The Irish Water value of 2.8ML/d cited registered abstraction volume was not employed in the simulation evaluation, instead, the maximum future discharge volume licensed in the 2020 Discharge Licence DL(W)151 of 3,500m3/d was employed. This volume may or may not be groundwater and recent rainfall from the epikarst delivery is probably more of the issue. HOWEVER, this water balance is fit for the purpose of simple evaluation.

Table 2 Water Balance Data for both the Carrowmore East and West Groundwater Bodies



Lagan Aghamore Sligo Quarry REGIONAL Groundwater Balance		
HYDROGEOLOGICAL WATER BALANCE: LOCAL (Carrowmore East GWB) & Regional KARST AQUIFER		
GSI assigned area for 'Carrowmore East GWB'(km2)	58	
Carrowmore East Groundwater Body '(m2)	58,000,000	
GSI Stated Total Aquifer Area(km2)	109	
Total Aquifer Area(m2)	109,000,000	
GSI Effective Rainfall AVERAGE over AQUIFER (mm/yr)	800	
AVERAGE GSI Groundwater Recharge (mm/yr)	550	
AVERAGE GSI Groundwater Recharge (m/yr)	055	
Groundwater Recharge to Carrowmore East GWB= [0.55m x 58,000,000m2 area] (m3/yr)	31,900,000	
AVERAGE Groundwater Recharge to Carrowmore East GWB = [0.55m x 58,000,000m2 area] (m3/d)	87,397	
Rainfall's Groundwater Recharge to Total Aquifer area = [0.55m x 109,000,000m2 area] (m3/yr)	59,950,000	
DAILY: Lagan Sligo 2020 Discharge Licence Max value 3,500 m3/d [m3/d]	3,500	
Annual: Lagan Sligo's Proposed SW and Groundwater Management Volume (m3/yr)	1,277,500	
Hydro-G Calculation		
Proportion of proposed SW & GW at the site as % of Carrowmore East's GWB's annual recharge amount to groundwater from rain falling on its catchment (%)	**4**	**%**
Rainfall's Groundwater Recharge to Total Aquifer area = [0.55m x 109,000,000m2 area] (m3/yr)	59,950,000	
Proportion of Lagan Sligo's PROPOSED GW & SW as a % of the total aquifer area's annual recharge to groundwater from rainfall (%)	**2**	**%**
Lough Gill's catchment area (EPA HydroNET) m2	**362,000,000**	
Volume of Surface water runoff into Lough Gill from Lough Gill's total surface water Catchment (m3/yr) @ [GSI RF 850mm, less average GW Recharge 550mm = 300mm Et and runoff = APPROX280mm runoff APPROX]	**101,360,000**	
Aghamore Quarry's Discharge as a % of Lough Gill's SW runoff input volume - NOT YET ACCOUNTING FOR RIVER INFLOWS THEMSELVES	1	%

Lagan Aghamore Sligo Quarry REGIONAL Groundwater Balance		
HYDROGEOLOGICAL WATER BALANCE: LOCAL (Carrowmore WEST GWB) & Regional KARST AQUIFER		
GSI assigned area for 'Carrowmore WEST GWB'(km2)	37	
Carrowmore WEST GroundwaterBody' (m2)	37,000,000	
GSI Stated Total Aquifer Area(km2)	109	
Total Aquifer Area(m2)	109, 000,000	
GSI Effective Rainfall AVERAGE over AQUIFER (mm/yr)	800	
AVERAGE GSI Groundwater Recharge (mm/yr)	550	
AVERAGE GSI Groundwater Recharge (m/yr)	055	
Groundwater Recharge to Carrowmore WEST GWB= [0.55m x 37,000,000m2 area] (m3/yr)	20,350,000	
AVERAGE Groundwater Recharge to Carrowmore WEST GWB = [0.55m x37,000,000m2 area] (m3/d)	55,753	
Rainfall's Groundwater Recharge to Total Aquifer area = [0.55m x 109,000,000m2 area] (m3/yr)	59,950,000	
DAILY: Lagan Sligo 2020 Discharge Licence Max value 3,500 m3/d [m3/d]	3,500	
Annual: Lagan Sligo's Proposed SWand Groundwater Management Volume (m3/yr)	1,277,500	
Hydro-G Calculation		
Proportion of proposed SW & GW at the site as % of Carrowmore WEST's GWB's annual recharge amount to groundwater fromrain falling on its catchment (%)	**6**	**%**
Rainfall's Groundwater Recharge to Total Aquifer area = [0.55m x 109,000,000m2 area] (m3/yr)	59,950,000	
Proportion of Lagan Sligo's PROPOSED GW & SW as a % of the total aquifer area's annual recharge to groundwater from rainfall (%)	**2**	**%**
Impact predicted on Ballysadare Bay SAC & SPA = <2% of flow.		

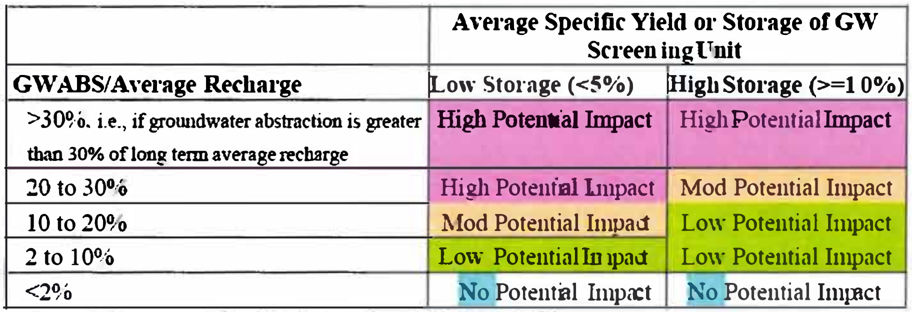
Based on the information presented in Table 2, we can see that:

- On an annual basis, the discharge from the quarry can be calculated to be 1,277,500m3/yr, approximately, and
- The calculated groundwater recharge to the underlying GWBs is 31,900,000 m3/yr for the Carrowmore East GWB and 20,350,000 m3/d for the Carrowmore West GWB, and

- The calculated groundwater recharge to the underlying entire aquifer is 59,950,000 m3/y.
- The point of the calculations is to show that of the waters arising at the quarry, the 1,277,500 m3/yr potential discharge is a small proportion compared to the 32 million or 20 million m3/yr going into the local GWBs or the 59.9 million m3/yr entering the regional aquifer by rainfall recharge.
- The proportions in percentages are presented in Table 2 for comparison with GW5 Groundwater Guidance on Abstractions and significance as outlined by national policy informing water framework Characterisations in Ireland (GW5, 2004). It is noted that the volume of quarry water that might require management in the future, accounts for as follows:
  - ➢ 6% of the underlying Carrowmore WEST GWBs rainfall recharge volume, and
  - ➢ 4% of the underlying Carrowmore EAST GWBs rainfall recharge volume, and
  - ➢ 2% total REGIONAL AQUIFER area's annual recharge to groundwater from rainfall, and
  - ➢ <1% of the rainfall runoff that might flow overland to Lough Gill.

The WFD Guidance document GW5 (2004) presents, on page 9 of 23, its Table 4 with which we can compare the percentages derived in Table 3 for the simple preliminary water balance for the Sligo quarry. GW5 is presented as an Appendix to this report, for ease of reference.

Table 4: Thresholds for rivers and large lakes



	Average Specific Yield or Storage of GW Screening Unit	
GWABS/Average Recharge	Low Storage (<5%)	High Storage (>=10%)
>30%. i.e., if groundwater abstraction is greater than 30% of long term average recharge	High Potential Impact	High Potential Impact
20 to 30%	High Potential Impact	Mod Potential Impact
10 to 20%	Mod Potential Impact	Low Potential Impact
2 to 10%	Low Potential Impact	Low Potential Impact
<2%	No Potential Impact	No Potential Impact

SOURCE: WFD Working Group (2004) GW5 GUIDANCE Document. Guidance on Abstractions.

Give that the preliminary results of Table 2 present 2-6% values, it is taken that we are in the "2 to 10%" bracket and therefore, 'Low Potential Impact' no matter whether it's a Low Storage or High Storage hydrogeological system. Karst or no karst, groundwater or surface water divides or no surface water divides, we are in minute percentage classes.

Of course, the Designation of the adjacent receptor Lough Gill is important. GW5 (2004) provides further guidance in direct text extracted from GW5, as follows:

> **"8.3 Thresholds for Sensitive Receptors**
>
> Assessing the impact of abstraction on sensitive receptors and setting thresholds is complicated for the following reasons:
>
> 1. Sensitive receptors have varying degrees of dependency on groundwater, thus making generalisations difficult.
> 2. The ecological significance of differing degrees of groundwater abstraction in the zone of contribution (ZOC) of receptors is seldom known, particularly at low levels of abstraction.
> 3. The connection between groundwater and receptors, such as GWTDEs, is usually not well understood, and is seldom investigated for individual receptors."

Hydro-G offers that the integration of the project's ecological information with the hydrology and hydrogeology information provided the opportunity to fine tune comment and assessment on this issue. Refer to the Ecological Section of the Main EIAR for the site.

In any evaluation of impact on the Lough Gill SAC, one must consider Irish Water's abstractions. Irish Water's NW Regional Office, Castlebar, supplied 'usage' information (*pers. Comm*. Des Joyce, January 2021) which can be summarised as follows with additional calculations by Hydro-G:

- Sligo PWS Abstraction (Foxes Den) WTP Design Capacity 2020 = 11,000m3/d
    - 2017 to 2020 usage averages 9,647 m3/d approximately.
    - WTP capacity will be upgraded to 18,000 m3/d.
    - **FUTURE EXPECTED ABSTRACTION of 18,000 m3/d = 6,570,000 m3/yr, approximately.**

- Leitrim PWS Abstraction (Moneyduff) WTP design capacity 2020 = 3,600 m3/d
    - 2017 to 2020 usage averages 3,547 m3/d approximately.
    - WTP capacity was upgraded to 8,000 m3/d.
    - **FUTURE EXPECTED ABSTRACTION of 8,000 m3/d Equates to 2,920,000 m3/yr, approximately.**

With respect to Irish Water's abstractions, a total can be calculated as Sligo's **6,570,000 m3/yr** m3/yr + Leitrim's **2,920,000** m3/yr based on maximum future potential volumes i.e. worst case scenario total volume to be taken by Irish Water from Lough Gill is 9,490,000 m3/yr.

Rounding things up for ease of evaluations,

- Irish Water, from two abstraction points, have plans to take 26,000 m3/d or just under 9.5 million m3/yr;

- Table 1 showed that the average volume discharged from Lough Gill to the Garavogue is 1,216,116 m3/d = 443,882,219 m3/yr or 445 million m3/yr, approximately, on average.

- The quarry is licensed to discharge 3,500m3/d [DL(w)151] = 1,277,500 m3/yr = 1 million m3/yr, approximately.

- Earlier the approximate volume of water standing in Lough Gill was estimated to be to be 252,000,000m3 or 252 million m3. Therefore, Irish Water's take of 26,000m3/d equates to approximately 0.01% of the standing water in Lough Gill.

- Might one conceptualise that the quarries discharge is providing some mitigation to Irish Water's abstraction with some small amount of a balancing opportunity that could be welcomed? Given that the assimilation capacities presented for the successful grant of the DL(W)151 Discharge Licence to Lagan for the site in 2020, which showed no potential impact on water quality, there appears to be little risk posed to Lough Gill.

Irish Water have asked the Lagan evaluation team to consider the fact that perhaps the surface water divide running through the quarry would mean that rainfall falling on the floor is being discharged towards Lough Gill rather than to the west and a different catchment that it might have naturally flowed to. In conversation with Suzanne Tynan, the position or other wise of that mapped surface water divide is debatable when one considers the regional highs of the Sligo Retail Park to the immediate north, the elevation of Carns (Duke) beside the retail park and the complexity of the karst system which she monitors at the GAA grounds immediately to the NW of the void. Given the shallow karst and topographical controls on how recent rainfall emerges to flood certain areas, the significance of the tiny portion of the void to which they refer is, in my opinion, inconsequential in the wider area and regional context. The Lough Gill Management Plan (Thompson et al, 1998) states that the dominant groundwater inflow to Lough Gill is from the north (Section 3.5 Hydrology, page 12, paragraph 2, Thompson et al., 1998). There is no information to suggest any change in this conclusion for the groundwater dynamic and Lough Gill in any WFD reports for the site (e.g. EPA (2019) WFD Cycle 2 Catchment Sligo Bay & Drowse Subcatchment Bonet_SC_030 14 Jan 2019., which includes Lough Gill).

This catchment divide issue and its significance is discussed further by Tynan in her communication to this project (Appendix A, April 2021). She concludes that the control on the system is not necessarily a divide that can be drawn in relation to topography. Rather, it is driven by the interaction between shallow karst, its exposures, or breakthroughs with topographical influences. Its not even very local topography but wider area topography that is at play. Tynan (2021) discusses the northern elevation areas and their role. Take home point = it's not really an issue for the quarry and its landscape position. If one considers the massive landmass east of that GSI mapped divide in the vicinity of the quarry and all the way over to Ballysadare @ 8.5km, the %'s of change in recharge dynamic on Ballysadare bay are not worth doing the maths on. It is insignificant.

In their opening comments, Irish Water Wrote in response to the SLR Pre-Planning Consultation:

> *"It is expected that all risks shall be mitigated to the IW lake source to ensure there is no net loss of water to the lake and the water quality is not impaired. The applicant, therefore, is required to clearly demonstrate there is no net loss of water to the lake and that the water quality is not impaired and that appropriate mitigations are in place to ensure protection of the drinking water source."*

- ➢ Hydro-G offers that the Catchment Management Plan for Sligo cites that most groundwater inflow to Lough Gill is from the north (Thompson et al., 1998).

- ➢ Calculations presented above regarding the void area of the quarry, the elevation of the surrounding area's karst system and of Lough Gill above the water level in the void, and that EVEN IF a connection established itself underground, all that would happen would be that water levels will symbiotically relate like pressure equipotential rather than the quarry being a source: the quarry will be a sink – the lake can afford to lose the void volume – it would cap at that. Irish Water has permission in two abstraction Orders to eventually take almost 9.5 million m3/yr of water to supply the public. No doubt they have done all the relevant assessments to justify this. There are two potential water balance aspects to conclude upon, as follows:

    1. Will the calculated 1million m3/yr likely future quarry dewatering volume negatively or positively affect Lough Gill's quantitative status?
       Hydro-G suggests that the addition of 1million m3/yr is a positive thing and is a mitigation for the lake's donation of 9.5 million m3/yr to public water drinking supply.

    2. The reverse flow scenario was addressed above in relation to connection back from Lough Gill to the quarry void through an intercepted conduit. Given the small proportion of water that Lough Gill could lose to the quarry void, the risk is deemed negligible.

- ➢ Hydro-G also suggests that the Total Organic Carbon of any Lake Water is much higher than any combination of waters arising in a quarry. It is generally accepted in the Water Industry that groundwater has a TOC concentration less than 3 or 4 mg/l and lake water could have a TOC > 5mg/l or more (I am leaving aside organic waste contamination of water sources here – that is another TOC story). Irish water must monitor the TOC concentrations of the water they treat for supply to the public because it controls the potential for THM formation, which is a suspected carcinogen. I have a lot of experience of TOC studies in lakes for Irish Water. If the planning authority were so minded to have a control measure in place for the monitoring of potential draw from the lake to the quarry void, a TOC monitoring requirement on the quarry's discharge waters would totally address this. IF the TOC were to rise above 5 mg/l, for example and subject to actual information on Lough Gill's TOC from Sligo County Council's Water Section or Irish Water, pumping could cease. Equilibration would be the only outcome and it has been demonstrated that this would not pose a threat to the integrity of the water supply.

Irish Water requested that *"water quality is not impaired and that appropriate mitigations are in place to ensure protection of the drinking water source"*

- Hydro-G suggests that this was addressed and proven in the assimilation capacities presented for the successful grant of the DL(W)151 Discharge Licence to Lagan for the site in 2020, which showed no potential impact on water quality. It is therefore concluded that little risk is posed to Lough Gill or the public water supplies fed from it.

Also in its opening page, Irish Water requested that the *"applicant makes enquiries to GSI in relation to the hydrogeology and karstification."*

- Dr. Pamela Bartley emailed and phoned Dr. Caoimhe Hickey, the karst specialist of the of the GSI. Karst mapping and knowledge in the area was discussed. The project manager for the EIAR followed up with an email. The GSI had little to contribute. After consultation amongst colleagues it was then determined that Suzanne Tynan has studied the karst in detail for Sligo County Council. As previously mentioned, Sligo County Council sanctioned her contributing to this project. Her report (Tynan, 2021) accompanies this response as Appendix A. In advance of finalisation of the report Tynan and Bartley spent a day at the quarry and on tour of the karst features in the peninsula. Therefore, this point is addressed.

Irish Water then provided a list headed as

"Clarifications required and comments to be addressed as part of any planning application".

Irish Water's list items are presented here in Blue, italic, text first, with a response from Hydro-G below, as follows:

- *"There is a significant groundwater component to the quarry operation. Given that the quarry occurs on a mapped surface water catchment boundary it is not clear where the groundwater is coming from, as the EIAR suggests it is in a low permeability area."*

  - Hydro-G offers that the current discharge volume and the likely future, licensed, discharge volume are not a significant volume when one considers that the 10.9ha void has a perimeter of 2km, or 2000m, of exposed shallow epikarst at its original land surface boundary. The volume of rain falling in the immediate boundary lands and the easy access migration to the void suggests that there is no significant groundwater component. McGrath's Limestone quarry in Cong, which sits in karst between two SAC lakes and is bounded by the Cong canal, experiences peak rainfall response inflows from the wider catchment up to 7,000m3/d in winter recharge periods. The annual variation is completely controlled by rainfall in the catchment.

- The EIAR Water chapter addresses this more fully. While the author of the Irish Water's clarification list has assumed it is groundwater, the work of Tynan has demonstrated the recent nature of it all (Tynan, 2021, Figure 3) and the dominance of the epikarst's response to rainfall. The EIAR Water Chapter further expands on the issue.

- *"It is difficult to predict the future dewatering requirements. It is possible that the deepening could intersect major conduits."*
  - Hydro-G offers that predicting future dewatering requirements is not that difficult given the wealth of experience and information to hand.
  - Hydro-G offers that our education, academically and later professionally, teaches us that the likelihood of water strike decreases as we go deeper.
  - One might and one might not hit conduits. Such is karst. However, we have the benefit now of Tynan's work (2021) and Apex's geophysics on the flooded floor to -60m OD with no suggestion at all regarding conduits (Apex, 2021). A conclusion of low risk is therefore applied.
  - Even if a conduit were hit, we have mathematically explored, in the introductory sections of this Technical Advice Note, the scenario of hitting a conduit and the consequent potential for reverse flow to the quarry. As previously outlined in depth, in summary, the quarry void would fill to the equal level of 4m OD that is Lough Gill. Water in the void could not rise from 4m OD to spill over the rim of the void at 30m OD. As demonstrated mathematically and in discussion above, the scale of the void and the scale of Lough Gill preclude there being a massive risk if one considers it from a hydraulics, pressure, levels perspective. There is a bigger risk to Lagan than to Lough Gill's ecology or its integrity as Irish Water's public water supplies. But that risk is finite *i.e.* end of site.
  - The detail of the Water Chapter (2021) and the detail of the Discharge Licence application documentation provides more information (Main Body EIAR Water Chapter Appendices).

- *"It is indicated in the EIAR that the Aghamore stream 'all but dries up' in dry weather. Is it ephemeral? Note that the EIAR also predicts that will be no reduced baseflow. This needs clarity. Is this the case below the quarry discharge location? It would be helpful to draw a schematic cross section of winter and summer groundwater levels (current/predicted) from west of the quarry through to the lake."*
  - The Aghamore stream flows off the Ox Mountains and down to the lake. Its flow is rainfall controlled. It would appear that it's a good job that it may not carry much water from the catchment in the summer because nutrient enrichment impacts are observed in the waters upstream of the quarry. The Aghamore stream's water quality is improved by the quarry discharge [SLR Discharge Licence Assimilation Capacity

Simulation Report and FI response, 2019, for the 2020 granted Discharge Licence DL(w)151]. It would appear that the quarry discharge is a positive for catchment management.

- Practitioners understand that most quarry discharge waters occur in response to high rainfall seasons and so the Aghamore stream's potential ephemeral nature may be the same as the quarry's discharge in time. Currently there is a legacy issue of waters in the void as a result of no activity at the site in recent times.

- Again, the detail of the Water Chapter (2021) and the detail of the Discharge Licence application documentation provides more information on this.

- *"Does the quarry discharge provide a net discharge back to the water environment? If the quarry drawdown has shifted a catchment boundary west, is there a net addition to the water environment to L. Gill?"*

  - Tynan's (2021) experience in the catchment and her report accompanying Hydro-G's response, here, suggests that the regions catchment boundaries are controlled by both topography to the north and local topographical changes that control the shallow karst system. Nationally recognised karst specialists acknowledge that rainfall seasons probably control boundaries more than a small excavation of rock relative to the almost 400km2 catchment around Lough Gill.

  - Regarding the possibility of a 'net addition', mathematics presented above comparing Irish Water's take from Lough Gill relative to the volume in the lake, the contribution from the quarry and the actual discharge from Lough Gill itself to the Garavogue and the sea each day demonstrate that in the GW5 Framework, the %'s involved are deemed 'Low Potential Impact'. Further, the discharge licence process between the site and Sligo County Council (2019 application to 2020 Grant) suggests that the qualitative potential for impact is also low to nonexistent.

- *"To what extent has the dewatering changed the river catchment boundaries and what is the cone of depression? The Zone of influence/ Cone of depression (EIAR, Fig 7.22) could be shown in relation to the regional flow system. The water levels in private wells should be shown as well as the water levels in the monitoring wells."*

  - Hydro-G offers that they should know better than to request Cone of Depression in this environment. The most skilled and diligent field hydrogeologist in the country, Mr. David Ball, has invested so many hours at our professional presentation sessions at the IAH negating the application of 'Zone of Contribution/Cone of Depression in karst. Their next point even refutes application of this type of academic application in Karst. The private well monitoring would be a valid point IF the area had a multitude of wells. The area is supplied by mains water. There are one or two wells. The EIAR chapter addresses this.

- *"What is the regional groundwater flow pattern? Fig. 7.18 (EIAR) suggests that the topographic contours were used to infer groundwater flow directions which is inappropriate in a karst setting. Apart from a few nearby water courses there is a general lack of surface water drainage. The EIAR suggests that this is/was a groundwater divide though this is an assumption based on WFD surface water catchment boundaries. The tracing in this aquifer underscores the variability in karst. Fig. 7-16 indicates wells, water levels from these and other wells may provide evidence on the water table."*

  - Tynan (2021) presents her understanding of the Regional Groundwater pattern. Her work over the last five years in the area trumps WFD boundaries derived generically using the same rules for the entire country. Mr. Pat Duggan of the Department of the Environment advised us at the beginning of the WFD reporting, over a decade ago, to revert to site specific information, when available, in all cases. Please refer to Tynan's contribution in the attachment to this response.

  - Earlier in this response I also discuss the divide and its relative significance, which I deem to be small.

- *"The information and assessment on the aquifer hydraulic properties seems to suggest that MW3 is not representative in terms of representing the aquifer as a whole. However, it is these 'exceptions' that point at the inherent hierarchical nature of the connected fractures, fissures and conduits. And there is a significant amount of groundwater being pumped, indicative of a transmissive karst aquifer. There are recorded karst features, dye tracing, and a cursory look at the 6-inch sheets suggests that there are possibly sinking streams in the vicinity of the application".*

  - Apex Geophysics (2021) explored that area to provide more information on the potential karst influences. The EIAR chapter discusses this. In summary, there appears to be no cause for concern.

  - Tynan (2021) on behalf of this team, has described in detail the karst features and discusses the significance of the tracers.

  - I again offer that the volume of water being pumped from the void @ -21m OD (i.e. 50m below ground level) is not significant when one considers 2000m linear extent of of exposed epikarst in the walls of the void in a region that Tynan (2021) has detailed as having a highly responsive rainfall driven epikarst zone from 20m OD to 0m OD.

- *"The predicted radial influence assumes no fractures but MW3 is a significant fracture. To what extent does this and other aspects of the karst aquifer influence the assumptions around radial flow? The information points to the anisotropy".*

  - Hydro-G offers that of course the aquifer is going to be anisotropic ('**physical property which has a different value when measured in different directions.**') because it is Ireland. This is the experience of every single working day as a filed hydrogeologist.

  - There are large regionally important limestone quarries in karst limestone environments all over the country. The anisotropy that a national scale assessor of karst considers is rarely a big player in the scale of each quarry's void in the rock. While it is an interesting trainspotting hydrogeology question, I don't think it is of relevance to the issue at hand for Irish Water, which is the integrity of the public water supplies to Sligo and North Leitrim. The Apex Geophysics (2021), Tynan's (2021) contribution and the water balance calculations above support the assessment of no potential for impact, which the Water Chapter presents (2021).

- *"The information on the karstification is limited and citing the GSI Karst database should be accompanied with an acknowledgement that the database is not exhaustive. As indicated above there are possibly some sinking streams nearby."*
    - As mentioned above, Dr. Pamela Bartley emailed and phoned Dr. Caoimhe Hickey, the karst specialist of the of the GSI. We discussed the karst mapping and knowledge in the area. The project manager followed up with an email. It was then suggested that Tynan has studied the karst in great detail for Sligo County Council. As previously mentioned, Sligo County Council sanctioned her contributing to this project. Her report (Tynan, 2021) accompanies this response. Therefore, we have addressed this and have presented in detail discussion above. The sinking streams issue is addressed in Tynan's Figure 1 and the explanations in her text regarding contacts with the Dartry limestone and the underlying Glencar Limestone that outcrops around the northern and western shores of the peninsula. The significance of upthrust between the site of the quarry and the neighbouring Ox Mountains is also clearly explained int eh accompanying Tynan report (2021). Based on Dr. John Kelly's evaluation of the underlying and surrounding geology of the site (EIAR chapter Solis and Geology, 2021) and the Apex (2021) field work, we are satisfied that the project has now contributed a wealth of karst information available to inform the 'non exhaustive' GSI database. Dr. Kelly and Tynan's contributions are considered amongst the most informed and experienced karst professionals.

- *"In relation to the karst, there has been some limited tracing done in the aquifer which demonstrates the velocities, the permeability, and how the groundwater flow direction is counter to what one might assume."*
    - Refer to Tynan's (2021) report and the Water Chapter. After detailed tour of the entire peninsula with Tynan in April 2021 it is obvious as to how the groundwater system is controlled and driven.

- *"The groundwater volume being pumped is recorded as 2.8Ml/d in the EPA register. The information around the groundwater being pumped and the overall stormwater/water management needs to be clearly described. It would be useful to include a simple water balance to cross check the area needed to provide the groundwater based on the groundwater recharge."*
    - Again, I reiterate that 2.8ML/d or 2,800m3/d is not a massive volume for a 10.9ha plan area of a void that has a 2000m open perimeter in a shallow epikarst rainfall driven system.
    - The Discharge Licence application documentation (2019) provided a robust description of the stormwater and water management system. The information submitted was approved by Sligo County Council in 2020 as satisfactory and protective to the receiving environment.

- The 2021 EIAR again reiterates the detail of the stormwater and management system.
- Please refer to the 2021 EIAR chapter and the relationship between storage and discharge and rainfall in the void's waters.
- Please refer to the documentation presented in with the Main Body of the EIAR in relation to the information submitted for the discharge licence application and the response to further information).

- *"It is indicated in the pre planning scoping document that there will be additional boreholes and sampling. The source in this instance is a lake waterbody and loadings are critical in that it is possible material will settle out of suspension for possible resuspension in much higher concentrations during stratification. Water Treatment Plants are designed to treat raw water of a particular character that accounts for a range of contaminants present in source water. The information provided by the applicant indicate elevated concentrations of BOD and heavy metals associated with the activity. Contaminants from industry have the potential to alter the water quality of the lake and hence its treatability. The water quality character of the lake cannot be negatively impacted by the development proposal. Water quality character and dynamics of the lake must be considered by the applicant and addressed in any planning application".*

  - Hydro-G offers that there are so many strands to the above paragraph.

  - Of course, 'The water quality character of the lake cannot be negatively impacted by the development proposal'. Firstly, water pollution is not permitted under any instance and The Water Pollution Act remains our overarching piece of Legislation. Therefore, one would not be adding BOD or heavy metals to any discharge and the quarry has treatment trains in place so as to deal with that. This is part of the Water Management Plan for the Site and the Conditions of the recently granted DL(W)151.

  - It is our general experience that many regionally important corporate quarries discharge a water that can act to improve the water quality downstream. The information presented in the Discharge Licence application certainly demonstrated that the discharge would create additional headroom for some parameters.

  - With respect to Water Quality, given the wholescale sanctioning of livestock grazing, slatted sheds and other agricultural activity all over Ireland in combination with the legacy of onsite wastewater treatment systems, I am sure that the WTPs have been designed to deal with the entire catchment's waters. No matter, we cannot add a BOD or metals load. The discharge licence DL(W)151 precludes it.

  - The issue of stratification is something that continues to present a challenge to all water scientists. Of course, the WFD Sub Catchment Teams will have used the available survey information for Lough Gill and how it behaves to inputs. Most of the recent focus on stratification and more importantly, inversion, relate to phosphorus dynamics. Quarries do not use or add phosphorus to surface water bodies. Agriculture and municipal wastewater treatment plants present that threat, not quarries. However, there is an Institute of Technology in Sligo and they have most likely invested many a project on Lough Gill. Specifically, Dr. Frances Lucey is renowned for her work on invasive species of freshwater systems and with 102 publications and 50 co-authors, it is likely that many Ph.D. students have produced papers on Lough Gill. The stratification and dynamics of the lake are more likely thrown by the invasive zebra mussel problem in Lough Gill.

- Another information source will be Fisheries Ireland of IFI. Their 2012 report is available on the web and it provides useful information even though it is almost 10 years old:

  "The IFI (2012) introduces as follows

  1.1 Introduction
  Lough Gill is mainly situated in Co. Sligo, with part of the north-eastern end of the lake extending into Co. Leitrim (Plate 1.1 and Fig. 1.1). It is located within the Garavogue catchment, between Dromahair in Co. Leitrim and Sligo town, and drains into the River Garavogue. Lough Gill is a large lake, with a surface area of 1,401ha and a maximum depth of 31m. It is approximately ten kilometers in length and four kilometers wide at its widest point. It is surrounded by wooded hills and contains around 20 small islands (Plate 1.1). The lake falls into typology class 8 (as designated by the EPA for the Water Framework Directive), i.e. deep (mean depth >4m), greater than 50ha and moderate alkalinity (20-100mg/l CaCO3). The site has been designated as a Special Area of Conservation for a number of reasons, including species listed on Annex II of the Habitats Directive, e.g. sea, river and brook lamprey, white-clawed crayfish, Atlantic salmon and otter (NPWS, 2005). The lake is the main domestic water supply for Sligo town.

  Many environmental and ecological studies have been carried out on Lough Gill over the past sixty years (Cotton, 1994). In 1953 samples of planktonic algae were taken from 26 Irish lakes in order to assess their trophic status. A sample analysed from Lough Gill indicated that the lake was eutrophic (Round and Brook, 1959). The first water quality survey of Irish lakes in 1973 and 1974 included Lough Gill and the authors considered that the lake was naturally eutrophic at that time. They determined this from slightly raised orthophosphate levels, from the composition of the phytoplankton community and from reports that algal blooms had occurred in the lake for the two years prior to their study (Flanagan and Toner, 1975). Water quality in the lake has deteriorated due to a number of reasons, one of these was the dumping of chicken slurry in the upstream Bonet catchment (Cotton, 1994). Blooms of blue-green bacteria were a noticeable feature of the lake in the autumn months of the 1980s.

Overall, with respect to Lough Gill, it is not just Irish Water but the SAC implications that need addressing. Therefore, the link between ecology and the Water Section is crucial. The Water and Ecology Chapters deal with the relationships, its current status and the pollution threats.

Obviously, all the work completed in the WFD Sub Catchment Characterisation Reports will be integrated (e.g. EPA 2019). The issue of resolving the assigned 'Moderate Status' of Lough Gill under the WFD and the NPWS citing Lough Gill as naturally oligotrophic is most likely being addressed in the detail of the EIAR.

As previously stated, Irish Water will soon be releasing information regarding assessment of National Water Resources in the National Water Plan. Information on Lough Gill as Resource MIGHT be available after that, I am sure Irish Water have assessed its capacity, quality etc. The planning applications or Abstraction Orders for the recent or imminent upgrades on their WTPs treating water from Lough Gill will provide information on the treatment processes and from these we can infer the quality issues they are dealing with. However, the burden placed on the quarry's team with respect to the 'Target/Receptor' assessment can be lessened by the clear definition of a robust **Water Management Plan** for the Site in which retention, treatment and discharge management are clearly outlined. If the conventional hydrogeological 'Source> Pathway > Target' assessment framework is applied, one would hope that detailed attention to the 'Source' (waters arising at the Quarry) would negate from overly needing to characterise the 'Target'. The 'Pathway' is what Craig is trying to pin down and the extra drilling and Geophysics is a part of that. However, the outer ends of the Framework (i.e. Source and Target) are crucial parts of the discussions needed.

Dr. Pamela Bartley consulted with Mr. Anthony Skeffington who is a regional lead for Irish Water for Sligo and Leitrim.

In consultation with Anthony, he recommended strongly that the Water Abstraction Orders for Lough Gill would provide a wealth of information. The Abstraction Orders were obtained and employed in the assessment. They do not actually contain that much information. However, the information supplied by Irish Water regarding recent usage and planned future abstractions and upgrades sufficed for the assessment.

The final page of Irish Water's response to the pre planning consultation was as follows:

> ***"Additional Pre Planning Considerations***
>
> *The following aspects of Water Services would be in scope of any EIAR and should be fully addressed as part of any planning application;*
>
> - *Any up-grading of water services infrastructure that would be required to accommodate the development.*
> - *In relation to a development that would discharge trade effluent – any upstream treatment or attenuation of discharges required prior to discharging to an IW collection network*
> - *In relation to the management of surface water; the potential impact of surface water discharges to combined sewer networks & potential measures to minimise/stop surface waters from combined sewers*
> - *Any physical impact on IW assets – reservoir, drinking water source, treatment works, pipes, pumping stations, discharges outfalls etc. including any relocation of assets. IW does not permit development to impact on assets and/or drinking water sources nor any impairment of water quality of drinking water sources.*
> - *Any potential impacts on the assimilative capacity of receiving waters in relation to IW discharge outfalls including changes in dispersion /circulation characteristics*
> - *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 IW for public supply.*
> - *Where a development proposes to connect to an IW 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.*
> - *The develop/operator shall comply with the Water Framework Directive and River Basin Management Plan objectives to ensure that the development will not negatively impact on the water quality of source/receiving waters during both construction and operational phases*
> - *The developer/operator shall meet the requirements of EIA Directive 2014/52/EU*
> - *The developer/operator shall comply with the requirements of the Groundwater Directive, Article 6(1) of Directive 2000/60/EC*
> - *In the interest of Public Health and Environmental Sustainability the developer/operator will comply with best practice Groundwater Protection Schemes set in the GSI Groundwater Protection Schemes.*
>
> *All necessary mitigation measures in relation to any of the above to protect and maintain access to Irish Water infrastructure and water sources shall be undertaken and incorporated into the development proposal, as part of planning application, to ensure public water services and sources are protected and access is maintained."*

Hydro-G offers that each of those 11 bullet points can be answered with consideration of the following 6 points:

1. The site will be self sufficient in its treatment of its own sewage arising from its employees and the system will comply with EPA (2021).

2. The site will be self sufficient in its own water supply.

3. No connections or interaction with Irish Water Services infrastructure is required.

4. The assimilation capacity has been appropriately assessed and the Discharge Licence issued in 2020 was justified and considered all protection measures required for both the public water supply and the status of Lough Gill, ecological and otherwise.

5. It goes without saying that the planning authorities will ensure that permission is not given to any development that cannot demonstrate compliance with all European and nationally enacted legislation.

6. With respect to the Water Framework Directive and River Basin Management Plan objectives, the development will not negatively impact on the water quality of source/receiving waters during both construction and operational phases. The quarry is acknowledged in the 1998 Management Plan for Lough Gill (Thompson *et al.*, 1998) and in the EPA (2019) WFD Cycle 2 Catchment Sligo Bay & Drowse Subcatchment Bonet_SC_030 Report. At no time has the quarry been highlighted as a problem in this catchment. Rather, as is quite common in many catchments, agriculture, which, as an industry in Ireland, is never as rigorously assessed as a quarry proposal, is the listed main pressure in the WFD Subcatchment report for the catchment.

Deliberately, I have left one of the opening statements of the Irish Water's preplanning response (Appendix 7-1) to the end of my communication. Irish Water raised the issue of 'Drinking Water Safety Plans' and their adoption of such in efforts surrounding security of supply, in risk assessing and managing its source water. Irish Water themselves offer as follows:

> *"Drinking Water Safety Plans (DWSP) seek to protect human health by managing risks to water quality taking a whole catchment approach to manage risks from source through to the tap. The plans assess the risks of contamination of water sources and propose mitigation measures to minimise these risks. They then propose appropriate treatment processes and preventative measures for contamination risks in the water distribution system. Both the World Health 28 | Irish Water Water Services Strategic Plan Organisation (WHO) and the EPA strongly endorse the Drinking Water Safety Plan approach to managing drinking water supplies effectively in the interests of public health. Irish Water will prepare DWSPs for all water supply zones (WSZs). All DWSPs will use an approach which is in accordance with the WHO guidelines and will ensure that protection and controls are put in place to meet health-based standards. DWSPs will also consider the longer term impacts of climate change on the water sources. We will categorise each WSZ on the basis of risk, focusing on those with the greatest risk of water quality failure. We have created data capture and management systems to assess risk and support DWSP development. We expect that these pro-active plans will take over from the reactive 'Remedial Action Lists' used successfully by the EPA up to now as the key drivers of investment in and operational management of our water supplies. We will engage with stakeholders in the development and implementation of measures aimed at delivering effective improvements in the quality of raw water within each catchment supporting good quality raw water sources. This approach will contribute towards sustainability and environmental gains, and potentially have a positive impact on both the cost of treating water and sustainability of yields from the catchment. The categorisation of the water supply sources nationally using DWSP's will support the phased implementation of the National Water Resources Plan and inform where water sources should be abandoned or combined and also where treatment must be upgraded and centralised to meet water quality standards. All WSZs will have DWSPs*

completed and implemented by the end of 2021."

SOURCE: *Chapter 4 Objective: Ensure a Safe and Reliable Water Supply of their 'Water Services Strategic Plan' (available at https://www.water.ie/docs/WSSP-Water.pdf which is not dated, but this is common with Irish Water).*

It is suggested that, similar to the Appropriate Assessment process in which it is convention that only the Competent Authority that can actually legally 'do' the Appropriate Assessment, Irish Water must complete the Drinking Water Safety Plan for Lough Gill and integrate the continuance of quarrying at the Aghamore site as part of their assessment.

It is respectfully offered that the proposers for the quarry have employed a wide panel of independent experts to present all information required to enable Irish Water include in their Drinking Water Safety Plan for the abstractions from Lough Gill at Foxes Den, for Sligo, and Moneyduff, for north Leitrim. The recently issued, justified and defensible, 2020 Discharge Licence DL(W)151 for the site and its supporting technical documentation provides all the required information on hydrochemical and ecological impact to Lough Gill, which has been assessed and accepted as nil.

In addition, the information now presented for the karst catchment immediately upgradient of the quarry (Tynan, 2021) and all the work completed for the site and its surroundings in the 2021 EIAR Water chapter (Craig O'Connor, TMS) and Dr. John Kelly (2021 Lands, Soils & Geology EIAR Chapter) in combination with Peter O'Connor's geophysical reports (Apex 2017 -2021) adds vastly to the national resource of information. We note that Irish Water has recently recruited, to their asset management team, an expert in catchment assessments and Drinking Water Safety Plans, Dr. Connie O'Driscoll. I have joint authored a peer publication with Dr. O'Driscoll on how karst systems can affect the security of water supply (O'Driscoll et al., 2020). I understand the information required and I assess that the quarry poses no threat to the security of water abstracted from Lough Gill by Irish Water for supply to the public in either Sligo or Leitrim.

Yours Sincerely

Pamela Bartley

Dr. Pamela Bartley B.Eng, M.Sc., Ph.D

Note, The Management Plan for Lough Gill (Thompson *et al.,* 1998) is referred to extensively because it was sent by Sligo County Council's Environment Section in response to consultations with them for the proposal under consideration.

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Tyan (2021) *pers comm.* Day long catchment tour and discussion with graphs and hydrographs and sections of interest for the regional karst systems of county Sligo.

Tyan (2021) Regional Hydrogeological Context of Lagan's Quarry at Aghamore Near, Aghamore far and Carrownamaddoo townlands, Co. Sligo. Prepared for client Hydro-G, 50 Henry Street, Galway.

List of Appendices

Appendix A Tynan (2021) Regional Hydrogeological Context of Lagan's quarry at Aghamore Near, Aghamore Far and Carrownamaddoo townlands in Co. Sligo. Report prepared for Hydro G. April 2021.

Appendix B GW5 GUIDANCE Document. Guidance on Abstractions.

APPENDIX A TYNAN (2021)

Regional Hydrogeological Context of Lagan's quarry at Aghamore Near, Aghamore Far and Carrownamaddoo townlands in Co. Sligo.

Project:	Lagan Materials Ltd. quarry at Aghamore Near, Aghamore Far and Carrownamaddoo townlands in Co. Sligo.
Client:	Hydro-G, 50 Henry Street, Galway
Date:	23/04/'21
Author:	Suzanne Tynan BSc. MSc.(Env Sci) MSc.(Hydro) PGeo. EurGeol.
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Work Items:	All
Author(s):	Suzanne Tynan
Signed:	Suzanne Tynan Suzanne Tynan BSc., MSc (Env. Sci), MSc(Hydro), EurGeol, PGeo. Principal Tynan Environmental

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1 INTRODUCTION

1.1 Assessment Brief

Tynan Environmental is contracted to Hydro-G to provide regional karst hydrogeological context for the Lagan Materials Ltd. quarry at an existing limestone quarry located at Aghamore Near, Aghamore Far and Carrownamaddoo townlands in Co. Sligo. The regional context understanding included in this report is derived primarily from unpublished hydrogeological and hydrological work carried out by Tynan Environmental on behalf of Sligo Co. Co., for the purposes of flood risk assessment and mitigation. That works focussed on the townlands of Carrowroe and Ballyfree, Co. Sligo. Sligo Co. Co. have given permission for use of this work for the purposes outlined above.

1.2 Statement of Authority

Suzanne Tynan, principal of Tynan Environmental, is a hydrogeologist and hydrologist with eighteen years' experience in the area of hydrology and hydrogeology and twenty in the areas of environmental science and environmental geology. Suzanne holds an MSc. in Hydrology and Water Resources Management (Department of Civil and Environmental Engineering, Imperial College, London), an MSc. in Environmental Science (School of Natural Sciences, Trinity College, Dublin) and a BSc, in Geology and Botany (School of Sciences, University College Dublin) and has held research fellowship and research assistant positions at Trinity College Dublin. She has PGeo (Professional Geologist) chartered status from the Institute of Geologists of Ireland (IGI) and from the European Federation of Geologists. Suzanne has significant technical and project management experience in the area of assessment, mitigation and management of the impacts of projects on the water environment. This includes significant experience in the area of flood characterisation, flood risk assessment, hydro-ecology (the study of the interaction between water systems and dependant ecology) and design of mitigation measures for infrastructure located in or adjacent to water environments.

1.3 External Contributors

SLR Consulting Ltd. (2018) Land, Soils and Geology Section of EIAR and conversation with Dr. John Kelly, report author.

APEX Geophysics Ltd (2019-2021). Reports on the Geophysical Investigations at Aghamore Near, Co. Sligo for Lagan Asphalt.

This report and figures contain Irish Public Sector Data (Geological Survey Ireland and Met Eireann) licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

2 DATA AND METHODS

2.1 Field Works

Field works were carried out as follows. All field works are recorded by photographic records and observations made of weather, hydrological and hydrogeological conditions on the day.

Table 1 Field Works

Works	Date
- Visit to Lagan Materials Ltd. quarry at Aghamore Near with Pamela Bartley, Hydro-G	9/4/2021

3 SUMMARY OF CONCEPTUAL MODEL

3.1 Bedrock and Subsoil Composition and Geometry

A regional conceptual model is proposed for the area bounded by the sea at Sligo and Ballysadare bays (north, west and south west), Lough Gill and it's outflow to Sligo bay via the Garavogue river (east and north east) and the Ox Mountains-Pettigoe Fault (south).

Bedrock geology within the area of the regional conceptual model, comprises a localised shallow dipping synclinal basin of Dinantian pure bedded limestones (Dartry Formation, comprising fine grained, cherty, pure bedded limestones) overlying Dinantian upper impure limestone (Glencar Formation, comprising dark fine limestone and calcareous shale). The basin occurs on the north western, down block side of the Ox Mountains-Pettigoe Fault (OMPF) and the Precambrian quartzites, gneisses and schists, which form a topographic ridge on the south side of the fault. The axis of the syncline runs north-east, south-west. Recorded bedrock dips are mostly shallow (3-6^{O}) and towards the axis of the syncline. Steeper bedrock dips towards the north west (25-30^{O}) occur in the vicinity of the OMP fault, as result of drag in this area (MacDermot *et al*, 1996). See **Figure 1** Regional Geology and Hydrogeology. Faulting is recorded at the Aghamore Near quarry site (SLR Ltd., 2018), which is located at c. 600 m north west of the OMP fault. This is not unexpected close to a major regional fault.

The Dartry formation pure bedded limestone is therefore bounded, below, to the north and to the west by the Glencar shaley limestones and to the south by the OMP fault and very low permeability Precambrian rocks. The Dartry formation is susceptible to karstification and is classified as a Regionally karstified (Rk) aquifer. On Knocknarea mountain in the west, the remaining (upstanding) Darty limestones are 220 m thick, above the well-defined contact with the Glencar limestones. At Cairns Hill in the north they are >110 m thick. Elsewhere in the lowland area they are significantly thinner. These rocks wedge out towards their boundary with the underlying upper impure limestones to the north west and west, along which a series of springs are likely to define the true contact in areas where the geology is currently inferred. A thick shale bed (3 m) is reported at 13 m b.g.l. in a GSI borehole (GSI1433SE) c. 0.8 km south of Carrowroe church, which may represent the transition to the underlying Glencar formation. This would indicate that the depth of pure bedded limestones in this area is limited. Approximately 500 m south of this borehole at Carrowbodogagh, two large springs discharge from the base of an escarpment of Dartry limestone at 3-4 m O.D. an area of flat ground. It is considered likely that relatively lower permeability of shale bed(s) underlying the Dartry in this area act as a barrier to downward groundwater flow, resulting in concentration of groundwater flow within the overlying karstified limestones.

Subsoils in the study area result from several phases of glacial activity. See **Figure 2** Quaternary Subsoils and Features. Significant erosion has occurred, leaving upstanding mountain features such as Knocknarea and Cairns Hill. Topographic hollows occur in the landscape and rock is exposed or covered in very thin soil/subsoils on the two mountains and in a swathe south east and east of Knocknarea to the OMP fault. The absence of cover has implications for the development of surface karst (epikarst) and therefore rates of groundwater recharge. Sub-glacial tills dominate the rest of the study area and form drumlins in the north east. Ice meltwater landforms occur predominantly across the area between Tobernaveen and Carrowroe. These comprise meltwater channels, hummocky sands and gravels and esker ridges (Teagasc/EPA, 2014 and Geological Survey of Ireland databases). Glacial action and patterns of meltwater deposits have resulted in enclosed basins in this area, with impeded surface water drainage.

3.2 Groundwater and Surface Water Inflows and Outflows

Two swallow holes have been identified at Ballyfree, which have inflow rates indicative of connection to karst conduits. See **Figure 1** Regional Geology and Hydrogeology, for location. Enclosed topographic depressions, which will, where subsoils are thin or permeable, result in concentrated recharge, occur in other locations, including at and surrounding the flooding location at Carrowroe. The relative paucity of point karst recharge features may indicate that recharge of any conduit karst flow paths is primarily via connectivity with overlying epikarst. Diffuse recharge rates across the pure bedded limestone area vary from 60% up to 85% (Geological Survey of Ireland, groundwater databases). Areas of exposed bedrock are most likely to have significant development of epikarst and proportionally higher groundwater recharge.

In the west and north west, a number of large springs, including that at Tobernaveen, discharge where karst flow paths reach the edge of the pure bedded limestone (Dartry formation) at its contact with the likely extent of the upper impure limestone (Glencar Formation). Springs at Carrowbodogagh, in the south, discharge from the base of a pure bedded limestone escarpment at c. 1.4 km from the Aghamore Near quarry site, probably also at, or close to the contact between the Dartry and underlying Glencar limestones. Tobernalt spring, c. 1 km north east of the Aghamore Near quarry site discharges from the Dartry limestone at a distance of c. 200 m from Lough Gill. All of these springs have broadly continuous flows and are the source of permanent (short) watercourses.

Groundwater flows have been traced from Ballyfree swallow holes south eastwards to the Carrowbodogagh springs and north westwards to Tobernaveen (Higgins, 1985). A significant proportion of the inflows at Ballyfree are known to comprise surface water type drainage from an enlarged, artificially drained surface water catchment, including limited spring flow contributions to small lakes within the catchment. Timing and pattern of spring outflows at Carrowgobodagh are related to inflows at Ballyfree, and are indicative of fast, conduit type flows, being of the order of several hours over a distance of 1.5 km, during high flows. Discharge flows from Tobernaveen spring are related to inflows at the Ballyfree swallow holes, above a threshold inflow at Ballyfree. This high flow discharge is indicative of conduit type flows. Combined spring flows at Carrowgobodagh have been estimated at 0.45 m^3/s in 2019, although these are not likely to be maximum possible flows. Chance (2005), measured winter flows at Tobernaveen of 0.12 m^3/s. Spring discharges continue after inflow at Ballyfree has ceased indicating the presence of other contributions, from aquifer storage and/or connected epikarst. **Figure 3** illustrates the responses of the spring discharges to rainfall and swallow hole inflow at Ballyfree during spring-summer 2018. This swallow hole inflow - spring discharge setting suggests that where the Dartry limestone is thin, downward recharge is impeded by the presence of shaley beds and flows are therefore concentrated at the base of the Dartry limestone, with fissure/conduit development in this zone. Maximum flow estimated at EPA station Tobernalt station 2013-2020 is 0.27 m^3/s. These spring flow rates are all indicative of conduit type karst flows. These springs discharge at a range of heights between 20 and 3 m O.D.

Smaller, frequently ephemeral, springs and seepages occur where shallow groundwater discharges from bedrock and from subsoils, where and when the groundwater level intersects the topography in enclosed topographic depressions. These discharges contribute small and ephemeral flows to enclosed depressions, wetlands and lakes. Spring contributions to topographically enclosed lakes are known to occur at Clover hill and Carrowmore Loughs.

Ephemeral waterbodies, fed by spring and epikarst type discharge from the Dartry limestone occur during winter in Carrowroe and Cuilbeg townlands. These are located 800 m and 400 m east and north east respectively from the Aghamore Near quarry site. Maximum net epikarst inflows estimated at Carrowroe in 2020 are of the order of 0.15 m^3/s. The pattern of the flows and of flood levels recorded in 2015 at and around these sites is indicative of epikarst type flows. Epikarst inflows in these two areas occur at heights ranging from ground levels of 14.5 m O.D. to 23 m O.D., indicating an epikarst zone of a minimum of 10 m thickness in this area.

The location of connectivity between epikarst and conduit flows is difficult to estimate. Water level monitoring in the Carrowroe church area shows no tidal influence, indicating a lack of connectivity with tidally influenced deep groundwater, in the immediate area. The magnitude of spring flows, known or assumed to be discharging from conduit type pathways, however, indicates that significant connectivity between epikarst recharge and conduit flows paths supplying them must exist.

Surface watercourses on the Dartry limestone occur downstream of discharges from major springs or as artificial drainage channels which intermittently convey water from topographically enclosed areas.

3.3 Groundwater Flow Directions

Regional groundwater gradients, derived by Higgins (1985) and estimated from surface expressions of groundwater in 2017, indicate that the dominant regional hydraulic control on groundwater flow direction is the coastal discharge boundary, towards which groundwater flows from the west and centre of the pure bedded limestones area. Lough Gill, and its discharge via the Garavogue river, form the eastern hydraulic boundary control.

Groundwater flows have been traced from Ballyfree swallow holes south eastwards to the Carrowgobodagh springs and north westwards to Tobernaveen (Higgins, 1985). These flows are responding to a combination of regional hydraulic gradient and constrained discrete flow paths.

A regional groundwater divide, which exercises hydraulic control on karst conduit flow directions, must occur between Ballyfree and Lough Gill. It is not clear where this is located. It is possible that the divide is at Ballyfree. There is no information as to whether an attempt was made to trace from Ballyfree towards Tobernalt at Lough Gill by Higgins (1985). There is a topographic divide running from Cairns Hill to Slieve Dangan, which the quarry site is located on or immediately to the east of, before excavation occurred. There is no evidence as to whether this topographic divide coincides with the regional hydraulic divide driving karst conduit flow direction. Epikarst flows are reasonably assumed to be along groundwater gradients which reflect topographic gradients. In Carrowroe and Cuilbeg and as far east as Aghamore, epikarst flow gradient is considered to be driven by the presence of the topographic high of Cairns Hill to the north. There may be some localised epikarst flow towards the Aghamore quarry from the south. In summary, epikarst flow directions in the area of the Aghamore quarry are assumed to be controlled by topography. Conduit/fissure flow direction is controlled by regional hydraulic controls, such as the sea boundary and Lough Gill, although flow is constrained within discrete flows pathways, who's individual direction is not necessarily consistent with the regional flow gradient.

Diagram 1, below comprises a conceptual cross-section of flows in the centre of the conceptual model area north west and south of Ballyfree. See **Figure 1** for the location of the cross-section.

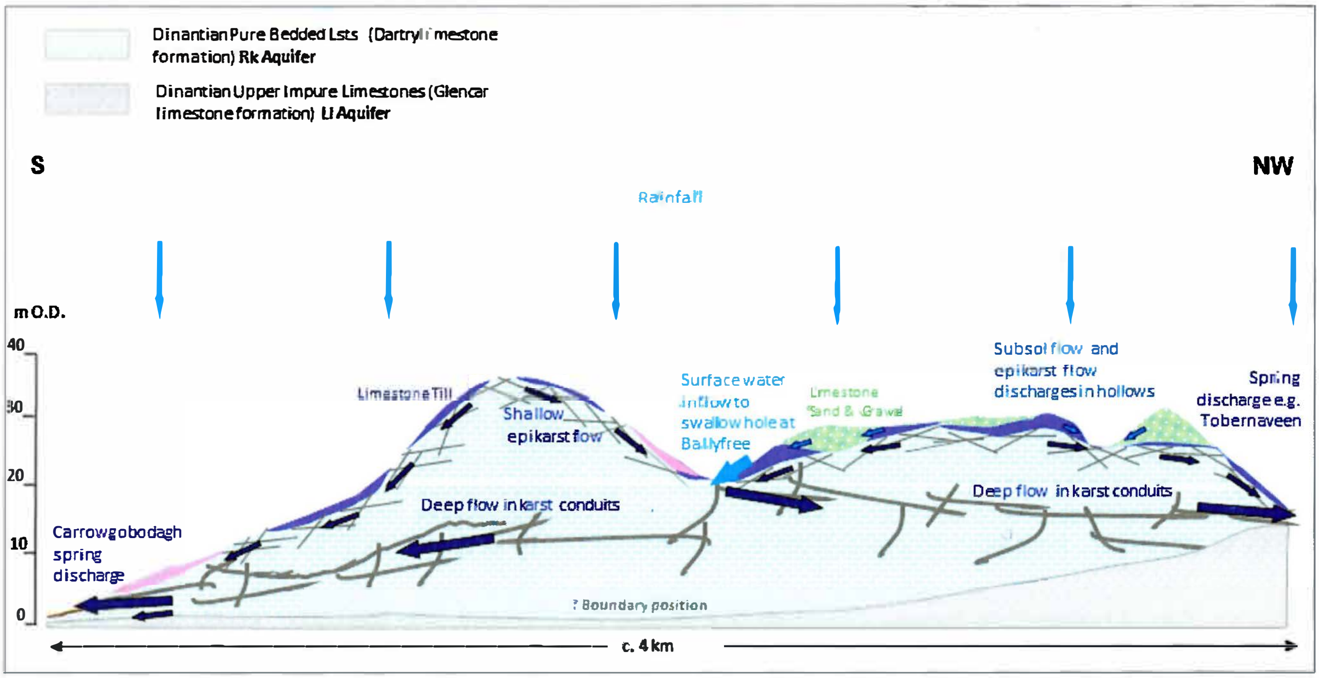

Diagram 1 Conceptual Model of Flows

4 HYDROGEOLOGY OF AGHAMORE QUARRY SITE CONTEXTUALISED

Epikarst is visible within the quarry, with localised inflows occurring in the top 15-20 m b.g.l. of the quarry face. This is estimated from photographs to be at heights from c. 30 m O.D. to 15 - 10 m O.D., which is consistent with other epikarst in the locality.

The existence of the quarry void causes local dewatering of epikarst on the upgradient side and cross gradient sides, by significantly increasing the hydraulic gradient towards the void. The maximum depth of epikarst has probably already been excavated and so the upgradient and cross-gradient extent of this effect is already at its maximum, assuming an increase in quarry depth only (not laterally).

Conduit flows occur locally, emerging above ground level to spring discharge heights of c. 3 m O.D., for example at Tobernalt, 1 km to the north west. Apex (2019 and 2021) record the presence of a lower resistivity zone at and below 10 m O.D., at c. 50 m north of the northmost side of the current excavation. Apex propose this as a possible a change in rock lithology or the presence of karstified limestone with increased clay and/or water infill. Interpretation of this as karstification is consistent with karstification encountered locally.

Possible karst features are visible on the north western quarry face just at the current (9/4/21) water level of -18.9m O.D.. These can't be verified given their inaccessible position.

Possible locations for development of discrete deep conduit flows are where flow is concentrated above the boundary with the shaley beds of the Glencar limestone formation, and at the discharge level between groundwater and the major hydraulic boundaries. Whichever is highest is the most likely to be relevant to this application.

Lough Gill has a maximum depth of approximately - 26 m O.D. (EPA, 2016). This maximum lake depth is likely to be the absolute maximum depth for the development of any zone of enhanced fissuring or conduit flows, associated with regional flows to the lake from the west side. The geophysics interpretation report (Apex, 2021) indicates the presence of fresh limestone to – 60 m O.D. within the quarry void. Assuming this interpretation, any concentration of flows associated with the boundary with shales is below - 60 m O.D..

Geological mapping (SLR Ltd., 2018) confirms that the quarry site is located on the north and north western dipping limb of the syncline. The quarry is located within 600 m of the mapped Ox Mountains Pettigoe Fault, which extends north eastwards beneath Lough Gill approximately 1 km west of the quarry site. One major fault has been identified by SLR (2018), trending north-northwest and dipping steeply (80°) to 247° (north-northwest). The fault zone has been solutionally enlarged and is partially infilled with clays (SLR, 2018). The presence or absence of connectivity of the quarry fault with the OMP fault is not known, nor is pathway connectivity with the lake. Lough Gill average water level is 3.85 m O.D. (daily mean 1975-2021, EPA station 35073), which is significantly above the quarry void water level recorded on 9/4/21 of -18.9 m O.D. Water level between the lake and the quarry void have not equalised.

5 CONCLUSIONS

5.1 The regional hydrogeological setting comprises a shallow syncline of Carboniferous bedrock in a down faulted block on the north western side of the Ox Mountains Pettigoe fault and metamorphic bedrock. The Carboniferous rocks comprise pure bedded Dartry Limestone formation rocks, overlying shaley limestone Glencar formation rocks. The pure bedded Dartry limestones are therefore bounded to the west, south and below, by less permeable bedrock. Karstification is constrained within these pure bedded Dartry limestones. The quarry sits in the Dartry Limestones.

5.2 The regional hydraulic boundaries comprise the sea boundary to the north, west and south west, the low permeability metamorphic rocks, to the south, and Lough Gill and the Garavogue river to the east.

5.3 Epikarst flow pathways have been identified from monitoring to the west of, and in exposure at, the Aghamore quarry. The active epikarst system depth range observed is 20m O.D. down to 0m O.D. Epikarst flow gradients and directions are reasonably assumed to be controlled by topographic gradients.

5.4 Conduit flow pathways have been identified from swallow holes at Ballyfree to multiple spring discharge points, by tracing, and from monitored flow responses and rates. Flow rates recorded at Tobernalt spring on the edge of Lough Gill are indicative of conduit type flow paths. Flow directions from a swallow holes input at the centre of the area at Ballyfree are towards both the north west and south. These conduit systems occur down to a level of zero m O.D. Conduit flow could occur below zero m O.D., in the east of the area, where the Dartry limestone occurs at these depths. Conduit pathways are very unlikely to be developed below the base of Lough Gill at c.-26 m O.D., which forms the eastern regional hydraulic boundary. Overall direction of conduit flows are driven by regional discharge boundaries, albeit within discrete, constrained pathways, which do not necessarily follow the same individual orientations. The exact location of the regional flow boundary, from which flows are eastwards towards Lough Gill, is not known.

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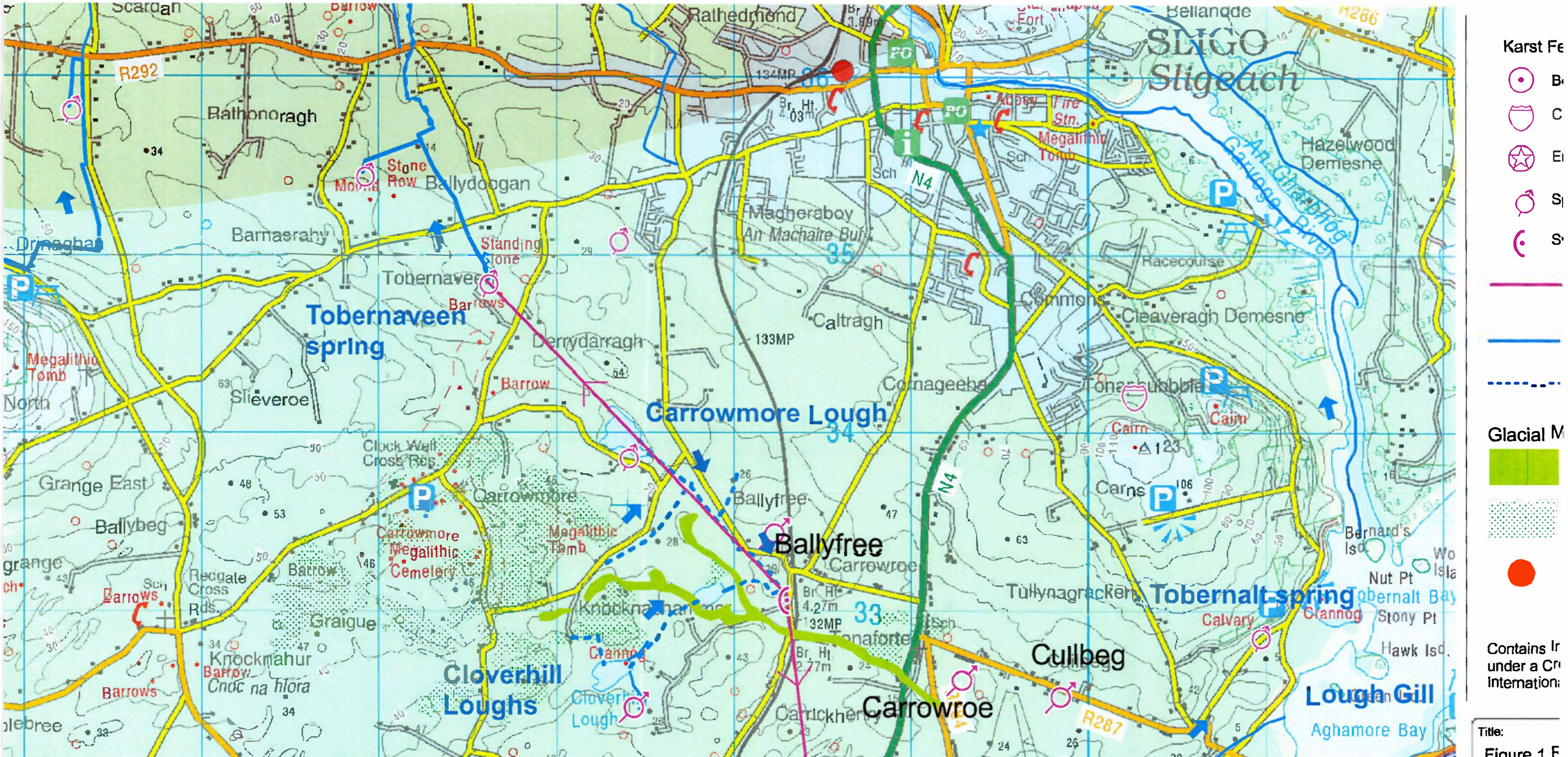
FIGURES



Title:
Figure 1 F

Drawing No: 1

Project:
Proposed
Quarry, A

Stage:

Client:
Hydro-G

Scale: 1:30,

surveyed
ST

LEGEND:

Groundwater Bedrock Units

- Dinantian Pure Bedded Lsts (Dartry fmn)
- Dinantian Upper Impure Lsts (Glencar fmn)
- Granites & other Igneous Intrusive rocks
- Precambrian Quartzites, Gneisses & Schists

Bedrock faults

Karst Feature Types

- ⊙ Borehole
- Cave
- Enclosed depression
- Spring
- Swallow hole

Traced groundwater connections (and line of X-section)

Surface watercourses & flow directions

Drainage channels to Ballyfree

Glacial Meltwater Landforms

- 🟩 Esker
- ▨ Hummocky sand and gravel

● Lagan Materials Ltd. Quarry location

Title: Figure 1 Regional Geology and Hydrogeology

Drawing No: 159_1

Project: Proposed Extension of Lagan Materials Ltd. Quarry, Aghamore, Co. Sligo

Stage:

Client: Hydro-G Ltd.

Scale: 1:30,000 @ A3

surveyed	drawn	checked	date
ST	ST	ST	22/04/2021

Revisions:

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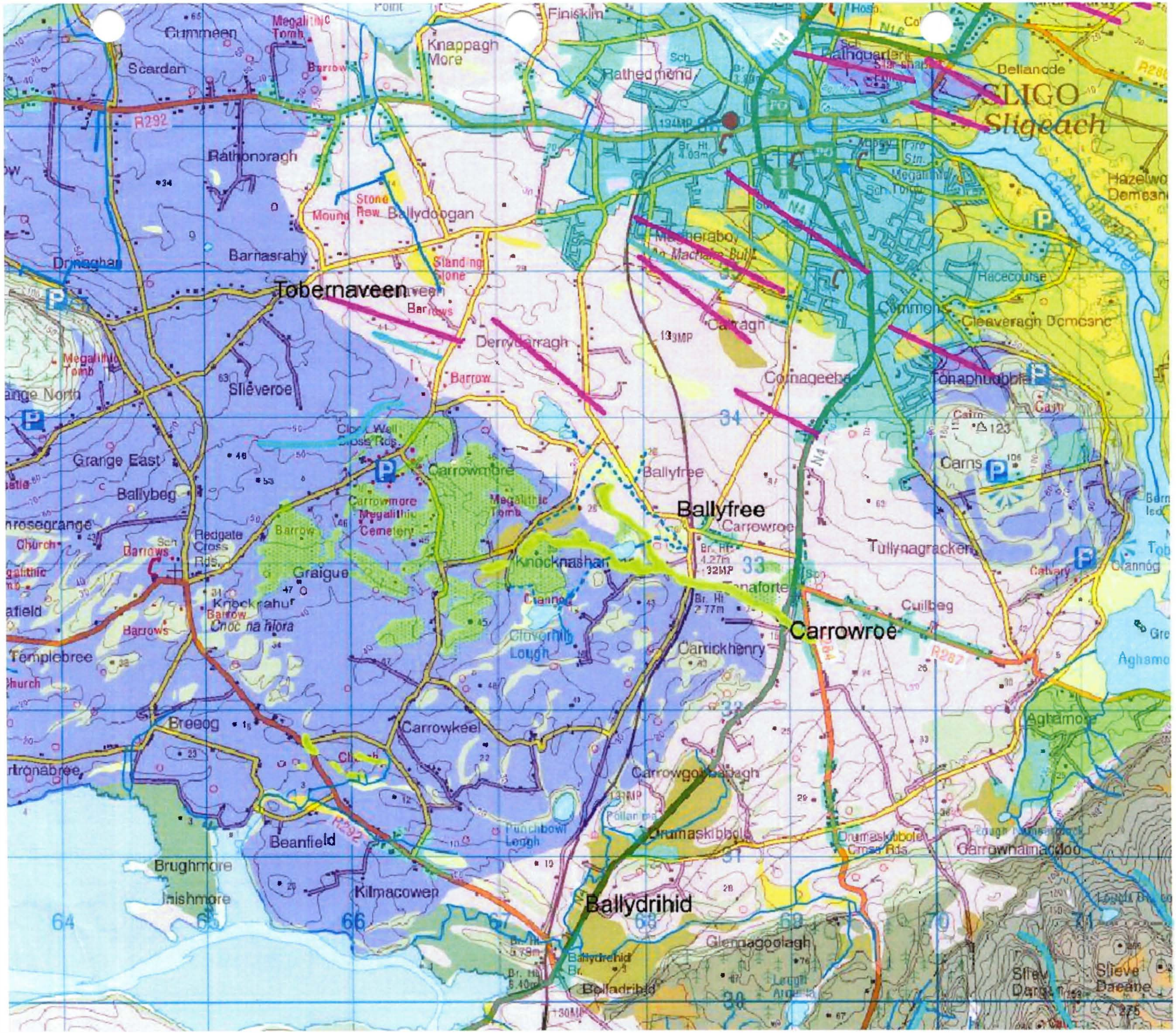


LEGEND:

Glacial meltwater landforms

- Meltwater channel
- Hummocky sand and gravel
- 🟩 Esker ridge

Sub-glacial landforms

- Drumlins

Subsoils

- 🟨 Alluvium
- 🟫 Cutover Peat
- 🟩 Limestone Sands and Gravels
- 🟪 Karst Rock
- 🟨 Lacustrine Sediments
- 🟦 Made Ground
- ■ Rock Exposed
- 🟦 Limestone Till
- 🟪 Metamorphic Till
- 🟨 Shales & Sandstones Till (Namurian)

- Surface watercourses
- Drainage channels

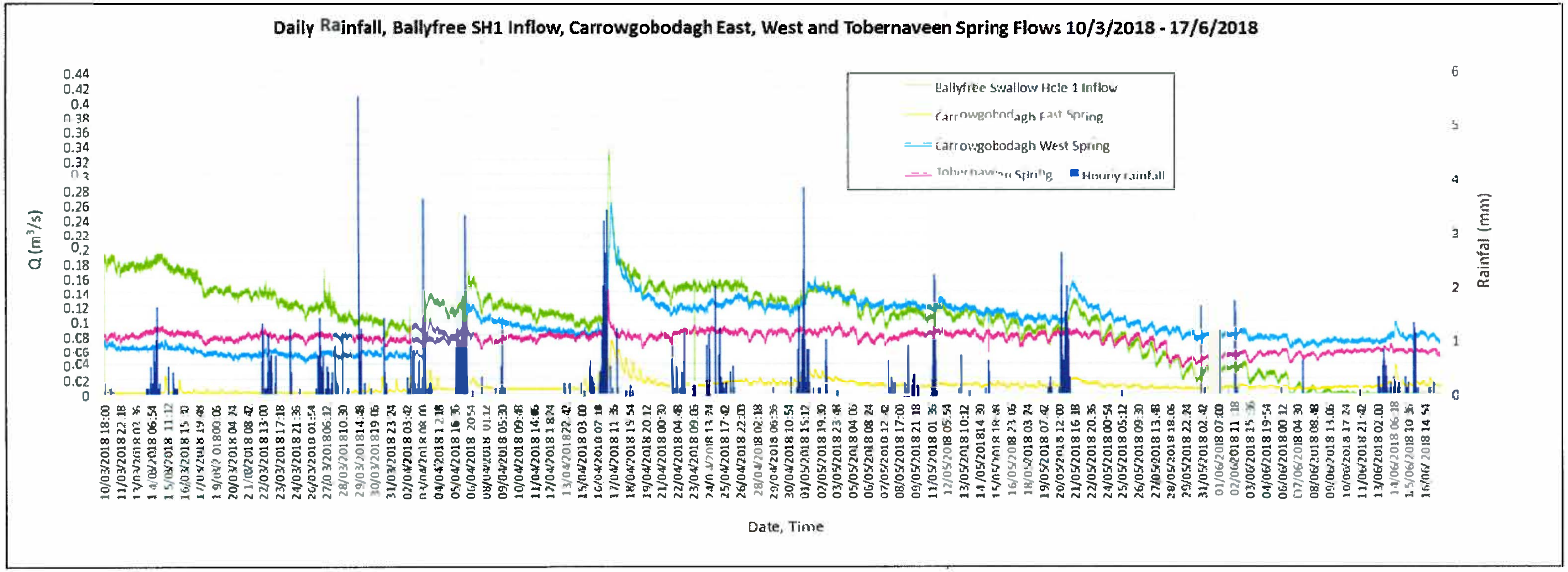
Title:	Figure 2 Quaternary Subsoils & Features
Drawing No:	159_1
Project:	Proposed Extension of Lagan Materials Ltd. Quarry, Aghamore, Co. Sligo
Stage	
Client:	Hydro-G
Scale	1:25,000 @ A3

surveyed	drawn	checked	
ST	ST	ST	22/4/21

Revisions

TYNAN ENVIRONMENTAL

Figure 3



Daily Rainfall, Ballyfree SH1 Inflow, Carrowgobodagh East, West and Tobernaveen Spring Flows 10/3/2018 - 17/6/2018

APPENDIX B GW5

WFD Pressures and Impacts Assessment Methodology

GUIDANCE ON THE ASSESSMENT OF THE IMPACT OF GROUNDWATER ABSTRACTIONS

Paper by the Working Group on Groundwater

Guidance document no. GW5

This is a guidance paper on the application of a **Groundwater Abstraction Risk Assessment Methodology**. It documents the principles to be adopted by River Basin Districts and authorities responsible for implementing the Water Framework Directive in Ireland.

REVISION CONTROL TABLE

Status	Approved by National Technical Co-ordination Group	WFD Requirement	Relevant EU Reporting Sheets	Date
Final	March 2005	Pressures and Impacts	GWPI 5	28 April 2004

Contents

Tables

Figure

WFD Pressures and Impacts Assessment Methodology
Guidance on the Assessment of the Impact of Groundwater Abstractions

1. Purpose of this paper

The paper sets out guidance on assessing the impacts of groundwater abstractions on bodies of groundwater and on groundwater dependent terrestrial ecosystems (GWDTEs), as part of 'initial characterisation'. It has been developed as part of a suite of guidance reports for the implementation of the WFD in Ireland as it relates to groundwater. The guidelines were drafted by the Working Group on Groundwater (see Section 9). The guidance assumes that the reader has a good working knowledge of groundwater and recharge, and consequently the text is not intended to be descriptive.

2. Background

The approach taken:

- uses risk-based analysis and the 'source-pathway-receptor' framework;
- uses the RBD GIS as the means of deriving results;
- requires a national approach to ensure consistency, but will not be overly prescriptive, to allow for varying datasets.

The general risk-based approach, as applied to groundwater abstractions, is summarised in Appendix 1.

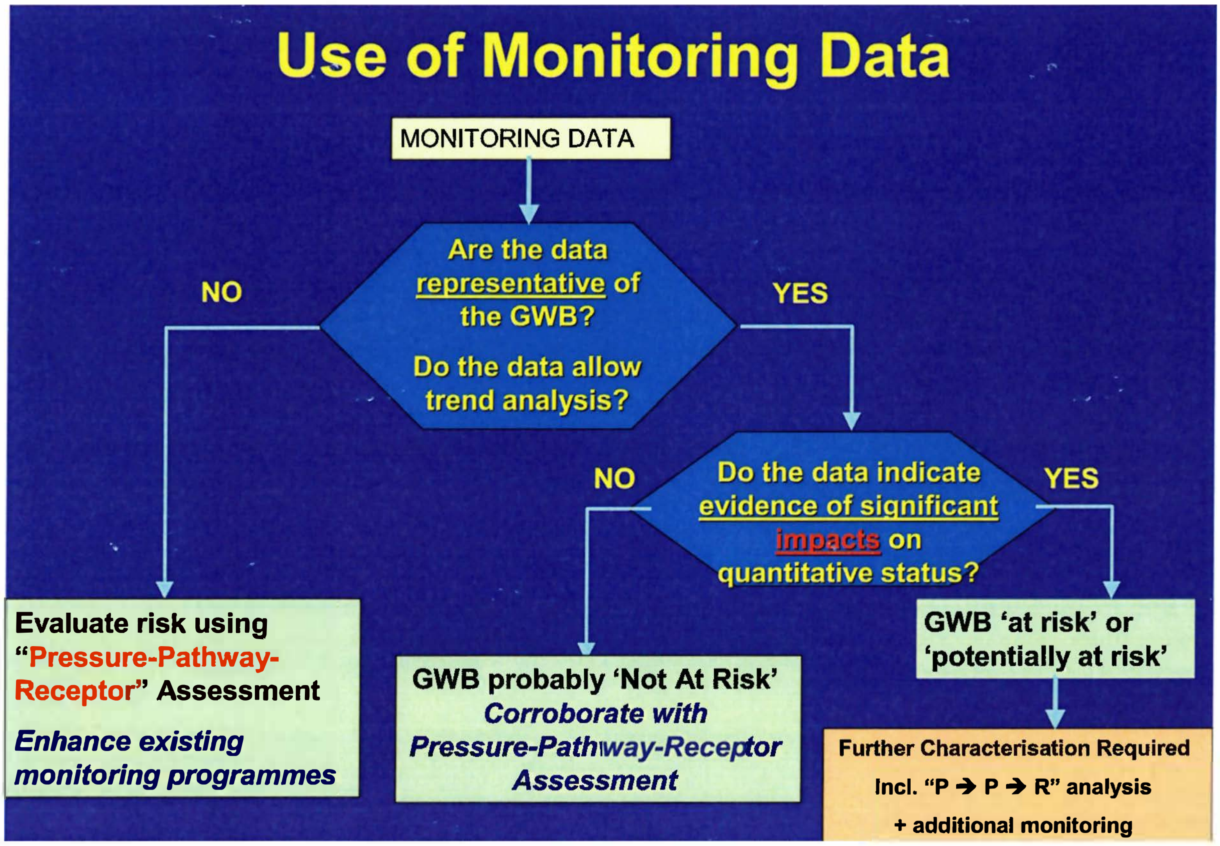
The UK Technical Advisory Group (UK TAG) has produced 'Guidance on the Assessment of Abstraction and Recharge Pressures on Bodies of Groundwater' (2004). This guidance has general applicability to Ireland and is therefore included in this paper as Appendix 2. It covers general issues, which are not repeated in this paper. However, there are some differences in language and approach, and the methodology outlined here specifically suits the Irish situation, and therefore has precedence where necessary.

3. Terminology

Infiltration	The proportion of precipitation which infiltrates into the soil zone.
Effective Rainfall (ER)	The proportion of rainfall that is potentially available for recharge and/or runoff, i.e. precipitation minus actual evapotranspiration.
Interflow	Water that moves laterally within the soil and/or unsaturated zone and may later reach the ground surface, rather than travelling down to a groundwater body.
Recharge	The proportion of precipitation that reaches the water table. There are two main types of recharge: diffuse (or direct) and point (or indirect).
Diffuse recharge	Recharge due to vertical infiltration of precipitation where it falls on the ground.
Point Recharge	Recharge which starts as runoff and then infiltrates at a point. This is particularly important in karst areas, due to the presence of sinking streams.
Recharge coefficient	The proportion of ER that becomes recharge, expressed as a fraction or percentage of effective rainfall.
Rejected recharge	Recharge that cannot be accepted by a high transmissivity aquifer due to a high water table.

4. Known Impacts

An evaluation of existing monitoring data and information will enable some impacts to be recorded and mapped. The general use of monitoring data is illustrated in Figure 1.



Use of Monitoring Data

MONITORING DATA

Are the data representative of the GWB?

Do the data allow trend analysis?

NO

YES

Do the data indicate evidence of significant impacts on quantitative status?

NO

YES

Evaluate risk using "Pressure-Pathway-Receptor" Assessment

Enhance existing monitoring programmes

GWB probably 'Not At Risk'

Corroborate with Pressure-Pathway-Receptor Assessment

GWB 'at risk' or 'potentially at risk'

Further Characterisation Required

Incl. "P → P → R" analysis

\+ additional monitoring

Figure 1 Flow chart indicating the use of monitoring data

While sufficient data may seldom be available, the following impacts may be observed in certain areas:

- Over-abstracted aquifers;
- Significant reduction in flow in known surface watercourses;
- Known damage to wetlands or GWTDEs;
- Known saline intrusion.

5. Pressure Magnitude

A receptor (e.g. a river or a GWDTE) may be affected by groundwater abstraction from a GWB. Hence, the pressure magnitude is defined by the total volume of groundwater abstracted from a GWB. The impact is manifested by a diminution of groundwater flow to receptors, and/or by reduced groundwater levels in the GWB.

5.1 Nature of Pressures

There are a number of human activities that act as the drivers for groundwater abstraction. Primarily, these are:

- Public and Group drinking water supplies
- Industrial use of water
- Dewatering, e.g. of mines, quarries, or for construction projects
- Drainage

5.2 Quantification of major abstractions

Abstractions below 10m^3/d are not taken into consideration.

For abstractions >10m^3/d, the RBD consultants collected data from various sources (there is no comprehensive register of abstractions). The primary data sources are the Local Authorities, large mines and quarries, and water consuming industries. The RBD consultants also utilised available local knowledge of significant abstractions which fall outside the data sources above.

All abstractions are assigned to the relevant GWB and the volume of each individual abstraction is summed to give the total for the GWB.

5.2.1 Springs and infiltration galleries

Careful attention is paid to water supplies from springs. Pumping of the overflow from springs will not lower the water levels in the groundwater body. However, it may impact on downstream groundwater dependent rivers and lakes.

Water supply from infiltration galleries is included in the pressure magnitude, as they reduce the water level in the aquifer and hence are a pressure on the GWB.

5.2.2 Arterial drainage

Arterial Drainage is considered a pressure to GWDTE receptors. The proximity of the GWDTE to the arterial drainage is used as a surrogate for actual volume of groundwater abstracted. Further details are given in risk assessment sheet GWDTERA1 in Guidance Document GW 8.

5.3 Sources of potential error in abstraction quantification

Care is required that the abstraction is allocated to the correct GWB. The following complications can lead to errors:

- *Inaccurate Abstraction Point Grid Reference* – If an abstraction lies near to a GWB boundary, even a small inaccuracy could cause error. It is essential that such abstractions are considered on a case by case basis.
- *Confined GWBs* – Although not common in Ireland, in some instances an abstraction point penetrates through the uppermost bedrock to abstract from an aquifer confined below it. The consultant should contact the GSI for advice in such instances.
- *Sand and Gravel Aquifers* – It is probable that abstraction points which plot within a Gravel GWB are actually abstracting from the bedrock GWB beneath the gravel deposit.
- *Large Abstractions* – for some very large abstractions it is possible that the cone of depression extends into another GWB. GWB boundaries are defined by topography and aquifer classifications. Where the boundary is defined by topography, if the hydraulic gradient is low and/or the abstraction is large, it is possible that the groundwater divide has moved and is no longer coincident with the topographic boundary. Where the GWB boundary is defined by aquifer classifications it is possible that the boundary does not constitute a "no flow boundary" and hence it is possible for water to pass from one aquifer into another. If the cone of depression does extend significantly outside the GWB boundary the GWB boundaries must be changed. The RBD consultant should contact the GSI for guidance in this instance.

6. Recharge Estimation

6.1 General Approach

The recommended methodology for initial characterisation is as follows:

1. Estimate effective rainfall (ER);
2. Multiply ER by a recharge coefficient to give the recharge amount;

3. In areas underlain by poorly productive aquifers, apply a maximum recharge figure (or recharge 'cap'). This takes account of the limited capacity of such aquifers to accept recharge.
4. Where point recharge is present, use information on the local situation to estimate its significance and the likely catchment area of the point.
5. If possible, corroborate results with an assessment of baseflow from local rivers

Where further characterisation is required, a more comprehensive assessment of recharge will be necessary, which will require more detailed analysis of ER and baseflow.

6.2 Effective Rainfall (ER)

- The data layers needed for calculating ER are rainfall (R) and potential evapotranspiration (PE).
- Use the (digital) national average annual rainfall map (based on 1961-90 averages or 1971-2000, if available). During further characterisation, monthly rainfall data may be required.
- Use 30 year average PE map from Met Éireann (not yet available digitally). During further characterisation where the GWB is deemed to be 'at risk', the soil moisture balance will need to be calculated using the Penman-Monteith/FAO method. (The SNIFFER (Entec UK, 2003) calculation spreadsheet may be helpful.)
- Actual evapotranspiration (AE) should be estimated by multiplying PE by 0.95, to allow for the reduction in evapotranspiration during periods when a soil moisture deficit is present.
- ER = R-AE.

6.3 Recharge Coefficient (r_c)

6.3.1 General Comments

The proportion of ER that becomes recharge depends largely on the permeability and thickness of the soils, subsoils and bedrock overlying groundwater. This proportion was called infiltration coefficient in previous calculations of recharge undertaken in Ireland, but is now called **recharge coefficient (r_c)**.

The recharge coefficient (r_c) depends on the properties of the layers overlying groundwater – the soil, subsoil and unsaturated bedrock.

6.3.2 Influence of Soil

The Teagasc soil map distinguishes between 'poorly drained' and 'well drained' soils. The presence of 'poorly drained' soils, such as gleys, will be the limiting factor as some runoff will occur irrespective of the underlying layers.

6.3.3 Influence of Subsoil

As groundwater 'vulnerability' and vulnerability maps depend on the same geological and hydrogeological properties that control recharge, namely permeability and thickness of subsoil, recharge coefficients may be based on vulnerability maps.

The recommended recharge coefficients for the various hydrogeological settings, that are based largely on vulnerability categories, but take account of the influence of soils, are given in Table 1. Details on the vulnerability categories are given in Table 2. The recharge coefficient values are given as ranges for each hydrogeological setting, thereby facilitating the use of local knowledge and expert judgement.

Full vulnerability maps are not available for ~55% of the country. Maps of soils, subsoils and extremely vulnerable areas are available for all of the country. Outside the areas of extreme vulnerability the term "High to Low" vulnerability is used to indicate where the vulnerability is undifferentiated. These areas have been incorporated into the hydrogeological settings in Table 1.

In counties where a complete vulnerability map is not available there will also be no subsoil permeability map. To overcome this problem an interim map can be derived from the FIPS subsoil categories. For certain subsoil categories defined by the FIPS programme it is possible to define a presumed permeability. For instance gravel deposits are assumed to be highly permeable. Table 3 gives a list of the FIPS Subsoil categories and a predicted permeability. It would be advisable to take a precautionary approach, unless there is local knowledge or information.

6.3.4 Influence of Unsaturated Bedrock

Poorly productive aquifers are not capable of accepting all the recharge that may be available, due to their low transmissivity. Therefore, a maximum limit or 'cap' is used to take account of this.

- In areas underlain by poor aquifers (Pl and Pu), the maximum recharge should be taken as 100 mm/yr, irrespective of the vulnerability category.
- In areas underlain by locally important aquifers that are generally unproductive except for local zones (Ll), the maximum recharge should be in the range 150-200 mm/yr depending on local knowledge, irrespective of the vulnerability category.

6.3.5 Methodology, using RBD GIS

1. Produce a layer estimating ER.
2. Using soils and vulnerability maps, calculate recharge coefficients (r_c).
3. Estimate recharge using the equation: Recharge = ER x r_c
4. Amend recharge calculation in areas underlain by poorly productive aquifers, as described in Section 6.3.4.

Table 1: Recharge coefficients for different hydrogeological settings.

Vulnerability category		Hydrogeological setting	Recharge coefficient (rc)		
			Min (%)	Inner Range	Max (%)*
Extreme	1.i	Areas where rock is at ground surface	60	80-90	100
	1.ii	Sand/gravel overlain by 'well drained' soil	60	80-90	100
		Sand/gravel overlain by 'poorly drained' (gley) soil			
	1.iii	Till overlain by 'well drained' soil	45	50-70	80
	1.iv	Till overlain by 'poorly drained' (gley) soil	15	25-40	50
	1.v	Sand/ gravel aquifer where the water table is ≤ 3 m below surface	70	80-90	100
	1.vi	Peat	15	25-40	50
High	2.i	Sand/gravel aquifer, overlain by 'well drained' soil	60	80-90	100
	2.ii	High permeability subsoil (sand/gravel) overlain by 'well drained' soil	60	80-90	100
	2.iii	High permeability subsoil (sand/gravel) overlain by 'poorly drained' soil			
	2.iv	Moderate permeability subsoil overlain by 'well drained' soil	35	50-70	80
	2.v	Moderate permeability subsoil overlain by 'poorly drained' (gley) soil	15	25-40	50
	2.vi	Low permeability subsoil	10	23-30	40
	2.vii	Peat	0	5-15	20
Moderate	3.i	Moderate permeability subsoil and overlain by 'well drained'soil	25	30-40	60
	3.ii	Moderate permeability subsoil and overlain by 'poorly drained' (gley) soil	10	20-40	50
	3.iii	Low permeability subsoil	5	10-20	30
	3. iv	Basin peat	0	3-5	10
Low	4.i	Low permeability subsoil	2	5-15	20
	4.ii	Basin peat	0	3-5	10
High to Low	5.i	High Permeability Subsoils (Sand & Gravels)	60	85	100
	5.ii	Moderate Permeability Subsoil overlain by well drained soils	25	50	80
	5.iii	Moderate Permeability Subsoils overlain by poorly drained soils	10	30	50
	5.iv	Low Permeability Subsoil	2	20	40
	5.v	Peat	0	5	20

Acknowledgement: many of the recharge coefficients in this table are based largely on a paper submitted by Fitzsimons and Misstear (in press).

Table 2: **Vulnerability Mapping Subsoil Permeability and Depth Criteria (adapted from DELG/EPA/GSI, 1999)**

Depth to rock	**Hydrogeological Requirements for Vulnerability Categories**				
	Diffuse recharge			**Point Recharge**	**Unsaturated Zone**
	high permeability (*sand/gravel*)	Moderate permeability (*sandy subsoil*)	low permeability (*clayey subsoil, clay, peat*)	*(swallow holes, losing streams)*	(*sand & gravel aquifers only)*
0–3 m	**Extreme**	**Extreme**	**Extreme**	**Extreme (30 m radius)**	**Extreme**
3–5 m	**High**	**High**	**High**	**N/A**	**High**
5–10 m	**High**	**High**	**Moderate**	**N/A**	**High**
>10 m	**High**	**Moderate**	**Low**	**N/A**	**High**

N/A = not applicable

Table 3: Predictive Permeability of FIPS Subsoil Categories

Subsoil Category	Subsoil Code	Subsoil Type	Predicted Permeability
Gravels	**G**	Sands and Gravels (undiffentiated)	High
	Esk	Esker Sands and Gravels	
	G_xxx_	Any other Type of Gravel	
Shale Tills	TCS	Shale Till (Cambrian/ Precambrian)	Low
	TLPS	Shale Till (Lower Palaeozoic)	
	TNSSs	Shale and sandstone till (Namurian)	
Irish Sea Tills	**IRS**_xxx_	Irish Sea Till deposits	Low
Other Tills	**T**_xxx_	Any other Till deposit	Moderate
Peat	Bkt**Pt**	Blanket Peat	Low
	Rs**Pt**	Raised Peat	
	Fen**Pt**	Fen Peat	
	Cut**Pt**	Cut over Peat	
Marine	**M**	Marine Undifferentiated	Moderate
	MGs	Marine sands and gravels	High
	Mbs	Beach raised/beach sand	
	Mbg	Beach raised/beach gravel	
	Msi	Marine Silts	Low
	Mc	Marine Clay	
	MEsc	Estuarine sediments (silts/ clays)	
Alluvium	**A**	Alluvium undifferentiated	Moderate
	Ag	Alluvial gravels	High
	As	Alluvial sands	
	Asi	Alluvial silts	Low
	Ac	Alluvial clays	
Lacustrine	**L**	Lacustrine Undifferentiated	Moderate
	Lg /**L**s	Lacustrine gravels / sands	High
	Lsi / **L**c	Lacustrine silts / clays	Low

7. Receptor Sensitivity

Apart from the groundwater body itself and groundwater abstractions in that body, the receptors at risk from abstraction are as follows:

1. Main river channels;
2. 'Large' lakes;
3. Stream headwaters;
4. 'Small' (need definition of these) lakes (say, <10ha);
5. GWDTEs.

The first two – main river channels and large lakes – are relatively insensitive in comparison to stream headwaters, small lakes and, in particular, GWTDEs. However, the sensitivity of GWDTEs will vary, depending on the importance of groundwater relative to surface water, as the source of water. For instance, fens and turloughs are more sensitive than raised bogs.

8. Assessment of Impact and Assignment of Risk Categories

8.1 General Approach

The general approach is based on a comparison of the abstraction pressure in each groundwater body (calculated as an average annual quantity anticipated in 2015, but based on existing abstraction rates) with the recharge to that body. The decision on the degree of risk posed by the abstraction is based on an evaluation of abstraction as a proportion of annual average recharge, and is indicated as a threshold, which depends on the sensitivity of the receptors. The percentage thresholds are intended to leave sufficient recharge to meet ecological needs.

8.2 Thresholds for Rivers

The thresholds in Table 4 are based on the work on the Environment Agency (England and Wales). In Ireland all our bedrock aquifers have a low (<5%) specific yield, whereas the specific yield of our sand/gravel aquifers is >10%.

Table 4: Thresholds for rivers and large lakes

	Average Specific Yield or Storage of GW Screening Unit	
GWABS/Average Recharge	**Low Storage (<5%)**	**High Storage (>=10%)**
>30%, i.e., if groundwater abstraction is greater than 30% of long term average recharge	High Potential Impact	High Potential Impact
20 to 30%	High Potential Impact	Mod Potential Impact
10 to 20%	Mod Potential Impact	Low Potential Impact
2 to 10%	Low Potential Impact	Low Potential Impact
<2%	No Potential Impact	No Potential Impact

Acknowledgement: this table is based on UK TAG Guidance.

8.3 Thresholds for Sensitive Receptors

Assessing the impact of abstraction on sensitive receptors and setting thresholds is complicated for the following reasons:

1. Sensitive receptors have varying degrees of dependency on groundwater, thus making generalisations difficult.
2. The ecological significance of differing degrees of groundwater abstraction in the zone of contribution (ZOC) of receptors is seldom known, particularly at low levels of abstraction.

3. The connection between groundwater and receptors, such as GWTDEs, is usually not well understood, and is seldom investigated for individual receptors.

8.3.1 UKTAG Guidance

Consideration of these issues in Britain is not completed, and therefore we cannot 'piggy back' readily on the approach of UK TAG. However, UKTAG Task 7(h) Guidance recommends the following approaches (text copied from Guidance report):

1) *Identify the simple presence or absence of any groundwater abstractions within a specified buffer distance (or distances) from the wetland or lake (e.g. 5 km would be consistent with Habitats Directive); or/and*
2) *Estimate the total rates of groundwater abstraction present within the same specified buffer distances; or/and*
3) *Estimate the proportion of the buffer areas occupied by the abstraction source centred equivalent recharge circles ; or/and*
4) *Estimate the cumulative drawdown at the wetland associated with groundwater abstraction based on 'no recharge' time period assumptions and T and S estimates specified by receptor or abstraction source or aquifer type where appropriate ; or/and*
5) *Identify known impacts or the results of existing detailed assessments: List and map those wetlands or lakes where groundwater abstraction impacts are considered to have been damaging to dependent ecologies or to groundwater quality. This could include the results of any more detailed investigations previously undertaken (e.g. results of Habitats Directive assessments).*

The existence of dependent surface water bodies or wetland receptors where groundwater abstraction pressures (e.g. predicted drawdown) are above threshold levels but evidence of ecological impacts is not available will be given less weighting in determining the final risk category but will flag the need for further monitoring.

8.3.2 Recommended Approaches for GWTDEs

1. Categorise GWTDEs into those with a 'high'[1] dependence (e.g. fens) and those with a 'moderate' or 'low' dependence (e.g. blanket and raised bogs).
2. If ZOCs of GWTDEs are known or can be readily estimated, include in GIS.
3. For GWTDEs where the ZOC is not known, create a buffer zone. The buffer zone may be varied depending on local knowledge. For example, a buffer zone of 5 km radius is recommended around highly dependent GWTDEs, whereas 1 km may be sufficient around GWTDEs that have a moderate or low dependency on groundwater.
4. Apply thresholds in Table 5.
5. Groundwater abstractions in the immediate vicinity (say 250 m) of GWTDEs may pose a particularly high threat. We need to develop an approach to deal with this situation, perhaps by estimating drawdowns.
6. Check assessment with any existing impact data/information.

---

[1] As defined in UKTAG WP 5a-b draft guidance on the identification of GWTDEs.

Table 5: Relationship between the potential impact to a sensitive habitat of groundwater abstraction.

GWABS as a % of average recharge in 'catchment' of GWTDE	GWTDE with 'high' dependency on groundwater	GWTDE with 'moderate' or 'low' dependency on groundwater
>20%	High Potential Impact	High Potential Impact
10 to 20%	High Potential Impact	Mod Potential Impact
5 to 10%	Mod Potential Impact	Low Potential Impact
<5%	Low Potential Impact	Low Potential Impact

8.4 Assignment of Risk Category

The risk category is obtained from the combination of the potential impact derived from the risk screening process, the presence or absence of monitoring data, and where available, the results of the monitoring, as shown in Table 6.

Table 6: Thresholds and risk categories

Potential Impact	Evidence for GW level decline	No/ insufficient evidence for GW level decline	Evidence of no GW decline
High	At Significant Risk (1a)	Probably at risk (1b)	Not at significant risk (low confidence) (2a) to Not at significant risk (2b) based on confidence in the data
Moderate	At Significant Risk (1a)	Not at significant risk (low confidence) (2a)	Not at significant risk (2b)
Low	At Significant Risk (1a) to Probably at risk (1b) based on confidence in the data	Not at significant risk (low confidence) (2a)	Not at significant risk (2b)

9. Membership of the Working Group on Groundwater

Organisation	Representative(s)
Geological Survey of Ireland (GSI)	Donal Daly (Convenor) Geoff Wright Vincent Fitzsimons Coran Kelly Taly Hunter Williams Monica Lee
Camp Dresser McKee (CDM)	Henning Moe
Compass Informatics Ltd.	Paul Mills
Department of the Environment, Heritage and Local Government (DEHLG)	Pat Duggan Jim Ryan (NPWS) Aine O'Connor (NPWS)

Environment and Heritage Service/ Geological Survey of Northern Ireland (EHS/GSNI)	Peter McConvey
Environmental Protection Agency (EPA)	Margaret Keegan Micheal McCarthaigh
Kirk McClure Morton (KMM)	Grace Glasgow Kieran Fay
O'Callaghan Moran (OCM)	Sean Moran Gerry Baker
O'Neill Groundwater Engineering (OGE)	Shane O'Neill
Shannon Pilot River Basin – EPA/TCD Research Fellow	Garrett Kilroy
Southeastern River Basin District (SERBD)	Colin Byrne
Teagasc	Karl Richards
Trinity College, Dublin (TCD)	Paul Johnston Catherine Coxon

10. References

DoELG/EPA/GSI (1999) *Groundwater Protection Schemes*. Department of the Environment and Local Government, Environmental Protection Agency & Geological Survey of Ireland, 24 pp.

Fitzsimons, V. and Misstear, B. (in press) Groundwater recharge through tills: uncertainties in applying soil moisture budgeting and river baseflow approaches in Ireland. *Hydrogeology Journal*.

Entec UK Limited (2003) *SNIFFER: Derivation of a Methodology for Groundwater Recharge Assessment in Scotland and Northern Ireland*. Final Report March, 2003 68 pp.

UK Technical Advisory Group WP 5a-b(01) (2003) *Draft guidance on the identification of terrestrial ecosystems & groundwater* (v5 PR2 27-01-03), 10 pp.

UK Technical Advisory Group Task 7h(01) (2004) *Draft Guidance on the Assessment of Abstraction and Recharge Pressures on Bodies of Groundwater* (P2v3.24-01-04), 10 pp.

Working Group on Groundwater and Working Group on Characterisation and Reporting (2003) *Guidance on Pressures and Impacts Assessment Methodology*. August 2003, 40 pp.

11. Appendix 1 Application of Risk-based Analysis to Abstraction Pressures

The risk assessment process involves background, source, pathway and receptor factors, undertaken in a series of steps[2] and combined together to give the required outcomes. The overall approach is outlined in Figure 1.

In undertaking risk assessment, as part of River Basin District projects, all compilation of relevant information and analyses will be undertaken using, as far as practicable, a GIS.

Initial Factors

1. Delineation, evaluation and description of water bodies (step 1).
2. Development of a 'conceptual understanding' of the river basin as a 3-dimensional entity, where emphasis is placed on the interconnection and interdependencies between the various components of the water cycle (step 2).
3. Assessment of existing monitoring data (step 3). Where data are adequate to enable conclusions on impact and/or trends, classify water body into the appropriate category – either 'at risk', 'potentially at risk' or 'not at risk'.

Source (pressure magnitude) Factors

1. Identification of pressures (step 4).
2. Estimation of volume of abstracted groundwater (step 5).
3. Development of threshold values for particular pressure magnitudes and receptors, in the form of matrices (e.g. more than a certain % of recharge abstracted in relation to main river channels) (step 6).

Pathway Factors

1. Compilation and characterisation of relevant elements, such as rainfall, evapotranspiration, soils, subsoils, aquifers, vulnerability (step 7).
2. Estimation of recharge for different hydrogeological settings (step 8).

Receptor Factors

1. Evaluation of the sensitivity of different receptors to pressures (abstraction), e.g. fens are more sensitive than raised bogs to groundwater abstraction (step 9).

Integrating Source, Pathway and Receptor Factors (step 10)

1. Where impact/monitoring data for the receptor are adequate to determine the water body risk category, combining the factors enables a sufficient conceptual understanding to provide the basis for designing the monitoring network and deciding on the Programme of Measures.
2. Where impact data are inadequate, combining the factors will enable the risk category to be determined and will provide the basis for designing the monitoring network and deciding on the Programme of Measures. Existing monitoring data can be used to refine the analysis and confirm the risk category.

Acknowledgement

This is a summary of a draft report "Pressures and Impacts Assessment Methodology" (August, 2003), prepared by a sub-committee of the WFD Working Group on Characterisation and Reporting, chaired by Micheál Lehane, EPA. The sub-committee members included: Donal Daly, Grace Glasgow, Garrett Kilroy, Martin McGarrigle, Jim Bowman, Francis O'Beirn, Thomas Quinlivan and Paul Mills.

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[2] Some of these steps may be undertaken simultaneously and can be in a different order

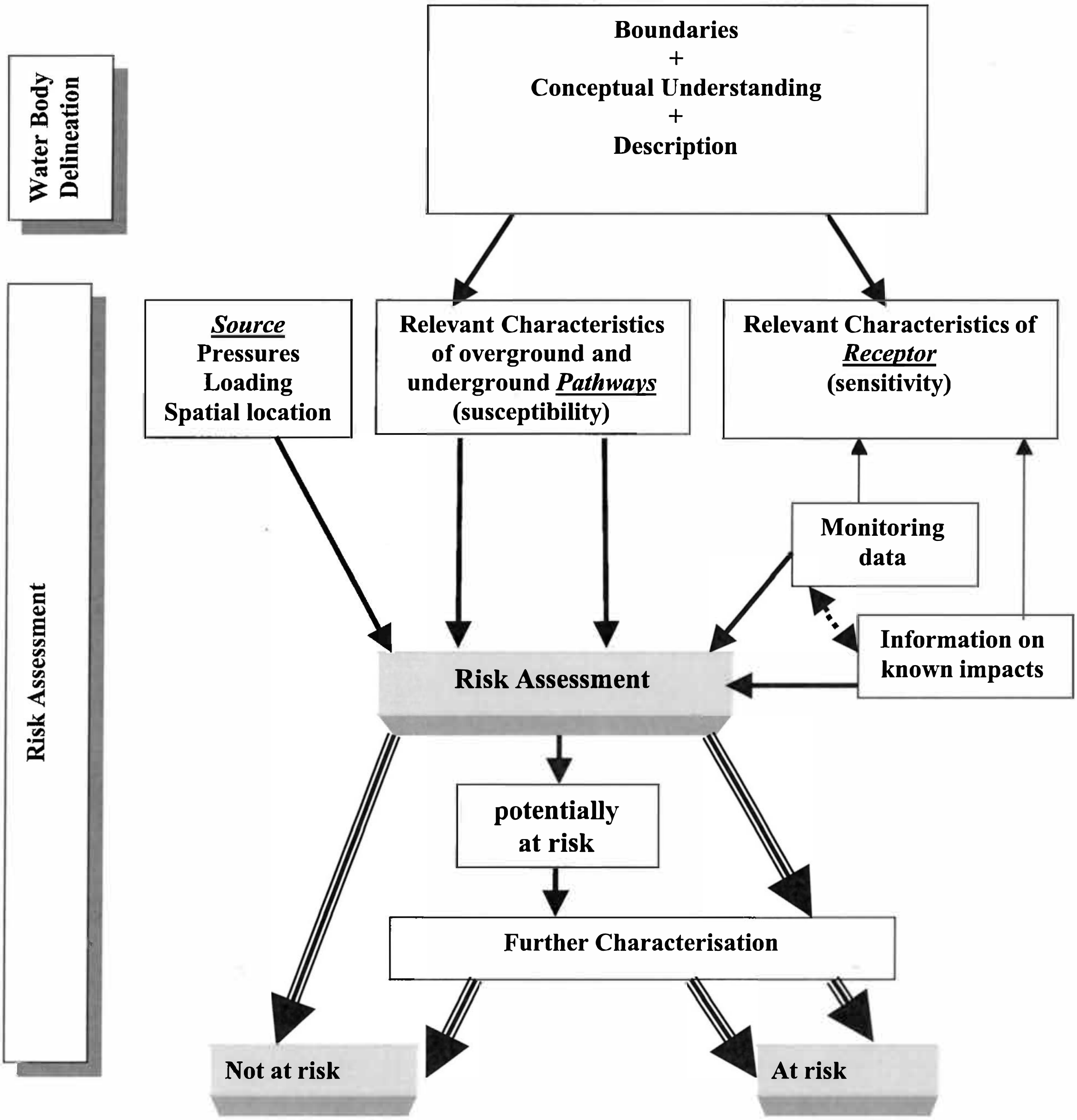


Figure A.1 Summary of risk assessment approach

12. Appendix 2 UKTAG Task 7(h) Guidance on the Assessment of Abstraction and Recharge Pressures on Bodies of Groundwater

UK TECHNICAL ADVISORY GROUP ON THE WATER FRAMEWORK DIRECTIVE

UKTAG Task 7(h) Guidance on the Assessment of Abstraction and Recharge Pressures on Bodies of Groundwater

(Groundwater Task Team)

1. Purpose of this paper

This paper sets out guidance on the assessment of abstraction and recharge pressures on bodies of groundwater for the purposes of initial characterisation [UKTAG Task 7(h)].

2. Background

As part of the characterisation of bodies of groundwater required under Article 5 of the Directive, Member States must: (a) identify the pressures to which bodies of groundwater, or groups of such bodies are subject; and (b) carry out an assessment of the risk of failing to meet the Directive's environmental objectives. For those bodies identified as being at risk on the basis of the initial characterisation, and for any bodies that cross the boundary between Member States, specific information on pressures must be collected and maintained.

Member States must complete the first risk assessment by 22nd December 2004, and report the results to the Commission by 22 March 2005. The assessments are therefore urgent priority tasks in the implementation of the Directive.

3. Common description of pressure and purpose types

The UKTAG Drafting Group 7h remit includes the task of producing a common descriptive classification of the main abstraction and recharge alteration pressures liable to affect the levels/flow regime of bodies of groundwater. The aim of this task is to establish a common system for describing, and referring to, the pressures. In undertaking this task, it is recognised that options based on existing UK classification systems have been summarised in the drafting for Task 7b (surface water body abstraction and flow regulation pressures). The Task 7b guidance should be adequate for the classification of groundwater abstraction pressures and is not repeated here. This paper will, however, consider pressures, such as alterations to natural recharge, which are not covered under the remit of drafting group 7b.

- Purpose types for groundwater abstractions should be recorded according to the guidance paper for Task 7b.
- In general, discharges to groundwater are unlikely to have a major impact on quantitative status, with the possible exception of artificial recharge for water resource management. For the purposes of initial characterisation, discharges to groundwater will therefore be ignored unless the discharge is for artificial recharge purposes.
- For the purpose of calculating the groundwater balance for initial groundwater characterisation, it is conservatively assumed that all groundwater use is consumptive. This approach still allows account to be taken of the return of groundwater to another surface water catchment or to a downstream discharge point. Where use is non-consumptive, e.g. the local return of groundwater

abstracted for sand and gravel washing to the aquifer from which it was pumped this may be relevant to further characterisation.

- Minewater rebound (associated with abstraction cessation) is a major issue in terms of quality, and in this instance the rising groundwater (rebound) is one of the pressures. Areas identified as having rising water tables associated with abandoned mines should be identified as at risk from groundwater pollution. Rising groundwater associated mostly with the decline of industrial abstractions in cities and towns should also be identified; though these represent positive quantitative pressures the body should be considered to be at risk of failing to meet its chemical objectives if this is likely to result in poor groundwater quality.

Other 'Recharge Pressures' might be considered to include impacts on recharge associated with land use e.g. impermeable paving associated with urbanisation or effective rainfall reductions associated with increased evapotranspiration following a crop switch from wheat to maize. For initial characterisation, however, it is suggested that the recharge associated with 'current landuse' should be considered as a benchmark to which any major planned changes to land use should be additionally considered (to 2015). Any planned or predicted changes from current land use at any scale - such as changes to urban drainage, crop types, or forestry cover - should be listed but would only need to be considered as part of further characterisation if other pressures or impacts suggest that the groundwater body is at risk. Taking into account the potential impact on recharge of planned changes in land use (2015) is consistent with the proposed approach for groundwater abstractions which first considers current rates of abstraction and then goes on to consider potential increase in abstraction rate to 2015 (using a more detailed assessment for further characterisation).

4. Common specification of data needs.

This guidance focuses on information that will be required to assess the risks to groundwater bodies associated with groundwater abstraction and discharge pressures. This will include the collation of sufficient abstraction and discharge data to assess the potential impact of groundwater abstractions and discharges on dependent terrestrial ecosystems (Task 5b) and associated surface water body flows (Task 7b).

Assessment of the deterioration of groundwater quality associated with over-abstraction and flow direction changes near coastal or other saline interfaces is also addressed here as an essential part of groundwater resources assessment, although its impacts are on groundwater quality (Paper 7i).
Information is also required on the extent and rate of rising groundwater associated mostly with the decline of industrial abstractions in cities and towns.

This paper identifies both 'minimum' data collection requirements, which should be aimed for by all responsible authorities, as well as data sets which are desirable where available. It must be considered that some sites/areas/Agencies will have considerable data whilst others will have very little data. This will need to be taken into account when considering confidence. The assessment should be such that it can be undertaken irrespective of data availability. For all data sets some consideration of reliability and uncertainty will be required so that a degree of confidence can be assigned to the assessment results. Data and assumption audit trails will also be essential to support the assessments.

Where a particular groundwater abstraction pressure type is known to exist but there is insufficient data pertaining directly to the operation at that point, generic data related to the purpose/industry sector/usage may be used to enable the risk assessment to be completed. The level of confidence in, and effort exerted in collecting relevant data should reflect the level of risk to which the water body may be subject. As an example, although Annex II requires that data on sources greater than 10 m3/d for human consumption are to be held, there are currently no abstraction licensing data in Scotland or Northern Ireland. Equally, NALD abstraction licensing data for England and Wales will not include unlicensed sources (licence exempt areas and small sources). Information on such sources down to 10 m3/day will have to be collated, estimated or derived for WFD. Methods have been outlined & trialled in 'Small Licence Exempt Groundwater Sources' - NGWCLC, EA 1999, and in the joint

EA/BGS R&D project P2/260, Phase 1 & 2 reports, and some areas hold registers from Local Authority Environmental Health records of private supplies.

Data needs for groundwater abstraction and discharge pressures
For each groundwater abstraction or discharge the following should be aimed for as a minimum. It is, however, recognised that this will not be achievable by all agencies in all areas:

<u>Abstraction or discharge</u>

- Location (national grid reference): generally one source, one location, but may aggregate together boreholes which are 'very close' (say within 100 m);
- Purpose (e.g. public water supply, spray irrigation etc.), 'pressure type' (GW abstraction or GW discharge) and 'source type' (borehole, spring or well)
- Abstraction or discharge rate: either 'licensed' or '2015 estimated'

Additional optional information may also be useful as follows (e.g. for further characterisation):

- Further reference information (e.g. licence number, site name etc.);
- The aquifer 'type' and GW Body from which the water is abstracted and the existence of any overlying drift or confining layers. This would need to relate to the 'aquifer types' mapped as part of the initial hydrogeologically based step of groundwater body delineation (see Task 6a guidance);
- Consumptiveness of abstractions, if known; and
- Aquifer parameters (T and S) – for optional calculation of associated drawdown impacts.
- Construction details/performance data

<u>Minewater rebound (and other industrial areas where rebound is an issue) also future lowering of water table due to mine pumping</u>

- Location (possibly including an area drawn on a map),
- Rate of rise
- Former pump locality
- Connectivity of workings (where applicable)

<u>Changes to natural recharge</u>

- Landuse – assumed current landuse benchmark presented plus major land use changes planned to occur between now and 2015 (as obtained through planning consultations) in map form.
- Anticipated changes to recharge – optionally presented as map annotations, though this is likely only to be used for further characterisation

<u>Evidence of intrusion of saline or poor quality water</u>

- Location (possibly including an area drawn on a map), these data can be collected where an intrusion is known to be occurring from liaison with local hydrogeologists. In the absence of these data it is possible to determine whether this may be occurring by assessing quantitative status as for example saline intrusion will only occur in an area that is overabstracted.
- Rate of movement/dynamics (if known)

<u>Artificial recharge</u>

- Location,
- Discharge type,
- Volumes/rates of discharge,
- Receiving strata/aquifer.

'Natural' recharge data needs to set thresholds
An annual average recharge estimate is needed for each groundwater body, or a map of distributed annual average recharge, or an estimate of recharge appropriate for each groundwater abstraction. This is required to enable comparison of recharge with groundwater abstraction through the use of appropriate impact thresholds, as part of the risk assessment (see Section 5). Estimates of recharge should reflect available data held by the respective agencies as well as the likely significance of the abstraction pressure. The approach should be such that the potential for assessing groundwater bodies as not at risk by, for example, over-estimating recharge, is minimised.

A record of the assumptions used to derive recharge estimates and the method used, including current landuse assumptions where relevant, is particularly important as these estimates may be refined through further characterisation, or may be modified by future changes in land use which could be considered as recharge 'pressures'.

Contextual information on groundwater bodies
The list of information which follows is proposed as a minimum which should be aimed for so that the pressures and impacts on groundwater bodies can be assessed. However, it is important to emphasise that the process of groundwater body delineation and characterisation described in guidance for Task 6a is inherently iterative as it partly depends on the distribution and types of pressures and impacts acting on it. It is possible, for example, that a concentration of groundwater abstraction pressures on one part of an initially delineated groundwater body may justify sub-dividing it to facilitate better targeted programmes of measures. At the end of this iteration (as well as during it) the following information will be needed for risk assessment:

- The boundaries and size of the groundwater bodies – needed to estimate the recharge to them, to identify the abstractions from (and discharges to) them, and to determine an appropriate groundwater balance.
- The location and extent of dependent terrestrial ecosystems and surface water bodies within them (including rivers, lakes and transitional waters) – needed as part of the 'dependent receptor' focussed element of risk assessment for groundwater bodies ;
- The aquifer type of the groundwater bodies and the predicted degree of connection between them and the dependent surface water or wetland eco-systems; and
- The location of any boundaries with natural groundwaters of poorer, or more saline quality, where the prevention of over abstraction is important to avoid quality deterioration within the groundwater body.

5. Approach to risk assessment for abstraction and recharge pressures on groundwater bodies.

Aim

The aim is to provide an overview of an appropriate approach for initial characterisation of groundwater bodies with respect to abstraction and recharge pressures. This framework should ensure consistency across the UK whilst being sufficiently flexible to accommodate the wide variety of groundwater body types, pressures and information which may exist between the UK states.

The approach takes account of:

- The need to rapidly screen large numbers of water bodies;
- The susceptibility of the groundwater body and the sensitivity of any associated dependent ecosystems to abstraction or recharge pressure (though these assessments may be detailed in UKTAG Paper 5b); and
- The methods available, or likely to be available, to the agencies for risk assessment work, and the timetable for applying those methods.

Map the aquifers, pressures and receptor data

GIS layers could be prepared to show:

- the location, type and magnitude of all the groundwater abstraction and recharge pressures (including artificial recharge schemes and large scale sewage treatment works discharging to the ground but noting that recharge is based on current land use assumptions);
- the river network and delineated surface water bodies;
- catchment boundaries;
- the location of the significant 'dependent terrestrial ecosystem' sites, lakes and coastal salinity boundaries which will also be considered as 'receptors' as part of the groundwater body pressures and impacts screening; and
- areas where rising water levels due to cessation of pumping, such as in abandoned mines, may lead to quality problems.

Groundwater abstraction pressures could be represented by:

- Symbols indicating the presence of an abstraction, optionally classed according to its purpose based 'type'; or/and
- Symbols sized or classed according to the abstraction rate; or/and
- Source centred 'equivalent recharge' circles. These circles have an area which, when multiplied by the average annual recharge to the aquifer, is equivalent to the annual volume of water abstracted. When coloured according to the number of overlapping circles they provide a simple representation of the areas of ground where natural recharge is potentially committed to abstraction.

Risk assessment pressure thresholds for GW bodies and dependent receptors

The initial risk assessment of groundwater bodies with respect to abstraction pressures is undertaken in stages. The first step is to assess the groundwater balance by reference to the balance of groundwater abstraction pressures versus recharge to the groundwater body with the intention of protecting the main surface watercourses. The second step is develop predictions of risk and impacts, based on assessments of the susceptibility (storage) and sensitivity of key receptors. Where impact evidence is available, this step should also incorporate the assessment of groundwater dependent terrestrial ecosystems (GWDTEs) and surface water bodies (rivers, lakes and transitional waters) to determine whether any impacts are due to groundwater. This latter assessment is receptor focussed to assess the evidence of local impact due to any pressure, and this will include consideration of groundwater dependent terrestrial ecosystems (together with some upland streams and lakes). The third step also focuses on evidence for impacts by identifying areas where groundwater levels are re-bounding and areas where there are poorer quality waters resulting for e.g. from saline intrusion or up-coning. In the case of these intrusions, they will be subject to further analysis to assess their likely impact on groundwater quality, dependent surface waters and terrestrial ecosystems.

<u>Pressures Assessment: GW abstraction as a % of GW body recharge</u>

For initial characterisation purposes and to protect the main surface water courses, significance thresholds for abstraction pressures are likely to be defined as a percentage or series of percentages of average annual recharge (see Table 1 below). These pressure thresholds will be combined with evidence for overabstraction impacts on the groundwater body (Table 2) to map the perceived risk of failure of quantitative status objective in 2015. The percentage thresholds are intended to leave sufficient recharge to meet ecological needs irrespective of the sensitivity of the dependent river reach. It is recognised that a water balance approach may not necessarily protect sensitive areas such as headwater streams (where flows would naturally be low), however:

- the surface water body flow screening assessment should also flag-up the impacts of particularly large groundwater abstractions on headwater streams (paper 7b);
- large abstractions are less common in upland areas; and
- where there is concern about the close proximity of groundwater abstractions to headwaters etc, then a more localised assessment of the likely impact could be made.

The thresholds shown in the table below are suggested as appropriate groundwater balance thresholds on the basis of groundwater resource estimates carried out as part of completed and ongoing CAMS assessments in England and Wales. These previous studies suggest that appropriate percentage recharge thresholds are likely to depend on the hydraulic properties of the GW body. A minimum abstraction threshold of a 10% ratio of abstraction to long term average recharge to indicate a moderate pressure, whilst appropriate to maintaining acceptable summer baseflow from a low storage aquifer (e.g. a fissured limestone), may thus be over precautionary for a higher storage aquifer (e.g. a sandstone). In the table below it is therefore proposed to distinguish GW Bodies with a high specific yield (Sy) from those with a lower Sy, but alternative splits may also be applied (e.g. based on the speed of aquifer flow response). The suggested thresholds (10% abstraction to long term average recharge for lower Sy aquifers, and 20% abstraction to long term average recharge for higher Sy aquifers for moderate pressure and 20% and 30% respectively for high pressure) may not be appropriate for all GW Bodies and may need to be revised or refined in the light of the results of the broader, more representative data set which will become available through the risk assessment for initial characterisation and/or local knowledge. Account may also need to be taken of the reliability and availability of abstraction data when undertaking the pressure assessment, with the thresholds adjusted to reflect poor data availability.

Estimates of GW abstraction/recharge percentages could be carried out for each groundwater body in a number of ways as part of a tiered screening process as follows:

- The simple absence of any pressures (e.g. no existing groundwater abstractions or new sources predicted before 2015) would immediately suggest that the groundwater body was at no pressure and therefore not at significant risk of failing to achieve good quantitative status in terms of recharge and abstraction pressures; or
- An estimate of recharge input to the groundwater body (in Ml/d) can be compared to abstraction rates (in Ml/d) for sources located within it to determine the pressures as shown in Table 1 and then followed by an assessment of impact to determine the risk; or
- The proportion of the groundwater body occupied by the abstraction centred equivalent recharge circles could be calculated in GIS to determine the exposure pressure and again followed by an assessment of groundwater level impacts to determine the risk.

Having mapped the groundwater abstraction pressures consideration must be given to their distribution. Clusters of borehole abstractions could trigger further, more localised assessments of potential impact using, for example, catchment or sub-catchment boundaries (e.g. Hydrometric Areas or CAMS boundaries or SW body typology catchment boundaries). Scale is very important to get the right balance between manageability and pressure recognition and local knowledge could be sought, where available, to reduce iterations by rapid identification of abstraction hotspots.

Table 1

	Average Specific Yield or Storage of GW Screening Unit	
2015 GWABS/Average Recharge	**Low Storage (<5%)**	**High Storage (>=5%)**
>40% i.e. if groundwater abstraction is greater than 40% of long term average recharge	High Pressure	High Pressure
30 to 40%	High Pressure	High Pressure
20 to 30%	High Pressure	Mod Pressure
10 to 20%	Mod Pressure	Low Pressure
2 to 10%	Low Pressure	Low Pressure
<2%	No Pressure	No Pressure

NB Note that the assessment of pressure may also need to take account of distance from particular pressures in certain receptors. Where data availability is poor the thresholds for high and moderate pressure may need to be more stringent.

Dependent Terrestrial and surface water body ecosystem assessments and impact evidence
The combination of this pressures assessment and evidence of groundwater abstraction related impacts will be used to determine the risk category (which is currently based on the risk classifications in UKTAG Paper 7a). The pressure assessment is summarised in Table 1. An example of the combined pressure and impacts assessment is given in Table 2 for recharge and abstraction pressures.

The long term average abstraction/recharge assessment results provide an indication of the abstraction pressure acting on the groundwater body (High/Moderate/Low/No). In order to determine the risk of failing to achieve Good Quantitative Status, other assessments of the evidence for overabstraction impacts will be made. These include any groundwater level monitoring evidence of long term declining groundwater levels. Groundwater level decline is regarded as significant where it is felt to indicate an imbalance between groundwater recharge and groundwater abstractions.

Assessment results from groundwater dependent terrestrial ecosystems (UKTAG Paper 5b) and surface water bodies (UKTAG Paper 7b) will be used to amalgamate the results from all the assessments for the groundwater body, including abstraction and recharge pressures as detailed here.

The individual assessments on GWDTEs and surface water systems will be based on the sensitivity of the receptors and the combining of pressures will only be undertaken to assess whether the pressure/impact on the GWDTE or surface water system is due to groundwater (See Section 6)

Table 2

Exposure Pressure	**Evidence for GW level decline**	**No/ insufficient evidence for GW level decline**	**Evidence of no GW decline**
High Pressure	At Significant Risk (1a)	Probably at risk (1b)	Not at significant risk (low confidence) (2a) to Not at significant risk (2b) based on confidence in the data
Moderate Pressure	At Significant Risk (1a)	Not at significant risk (low confidence) (2a)	Not at significant risk (2b)
Low Pressure	At Significant Risk (1a) to Probably at risk (1b) based on confidence in the data	Not at significant risk (low confidence) (2a)	Not at significant risk (2b)

NB Note that the assessment of risk may vary in receptors known to be of a very high or very low sensitivity.

GW Dependent Ecosystem Receptors
It is intended that detailed guidance will be provided in TAG Paper 5b. In the absence of specific guidance in these papers the risk screening might include the following approaches, depending on data availability across the different UK Agencies:

- Identify the simple presence or absence of any groundwater abstractions within a specified buffer distance (or distances) from the wetland or lake (e.g. 5 km would be consistent with Habitats Directive); or/and
- Estimate the total rates of groundwater abstraction present within the same specified buffer distances; or/and
- Estimate the proportion of the buffer areas occupied by the abstraction source centred equivalent recharge circles ; or/and
- Estimate the cumulative drawdown at the wetland associated with groundwater abstraction based on 'no recharge' time period assumptions and T and S estimates specified by receptor or abstraction source or aquifer type where appropriate ; or/and
- Identify known impacts or the results of existing detailed assessments: List and map those wetlands or lakes where groundwater abstraction impacts are considered to have been damaging to

dependent ecologies or to groundwater quality. This could include the results of any more detailed investigations previously undertaken (e.g. results of Habitats Directive assessments).
The existence of dependent surface water bodies or wetland receptors where groundwater abstraction pressures (e.g. predicted drawdown) are above threshold levels but evidence of ecological impacts is not available will be given less weighting in determining the final risk category but will flag the need for further monitoring.

Groundwater Rebound or Abstraction Related Saline Intrusion
Areas known to be adversely impacted by contamination from rising groundwater level pressures (e.g. in former mining areas) should be identified and mapped based on local knowledge. Areas at risk of groundwater quality deterioration (e.g. saline intrusion) by changing flow directions due to over-abstraction should also be identified and mapped, prompted by a review of the distribution of known abstraction pressures and groundwater quality boundaries. For initial characterisation purposes, such impact evidence will be taken into account alongside the abstraction/recharge pressure assessment results to determine the risk category for the groundwater body (Table 2) and flag the need for further characterisation. Groundwater monitoring data can be used to validate risk assessment.

6. Further GW Body Delineation and Characterisation

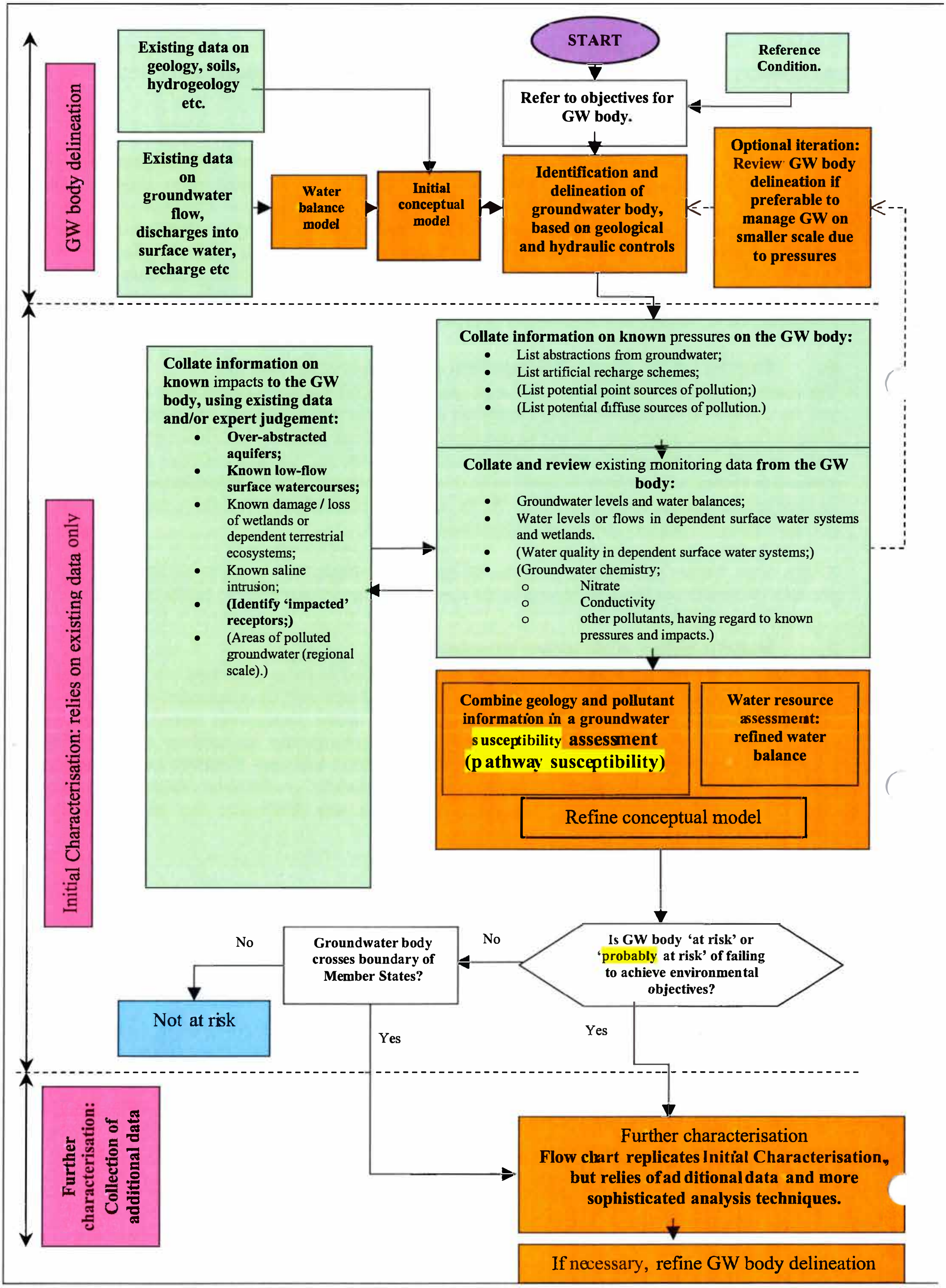
The results of pressures and impacts assessments for both for the groundwater body as a whole (7h) and for the GW dependant ecological receptors (7b and 5b) will need to be combined to determine whether the groundwater body would be considered to be at risk of failing to achieve good quantitative status in 2015. The final assessment will determine whether the risk that has been identified at the wetland or surface water system is likely to be due to groundwater. An additional paper or matrix will be used to combine the assessments from 7b, 5a, and 7h to determine whether the groundwater body is at risk of failing to achieve good quantitative status in 2015.

At this stage, further sub-division may also be an option, although it should be remembered that the pressure thresholds are likely to depend on the size of the groundwater body to which they are applied.

7. Relationship with other pressures

The results of the assessment of groundwater abstraction and recharge pressures will be fed into the overall risk assessment framework where they will be combined with the assessment of surface water body flow impacts and water quality impacts. Surface water abstractions from dependent river reaches may, for example, exacerbate the impacts of groundwater abstractions on river flows. Abstraction related flow reductions will also reduce dilution and may therefore exacerbate water quality problems. An iterative approach is needed whereby groundwater abstraction pressure assessment informs surface water assessment which in turn feeds into the next iteration of groundwater assessment.

Annex 1 Flow chart describing overall approach to pressures and impacts assessment



APPENDIX 7-3 DOCUMENTS SUBMITTED FOR NEW DISCHARGE LICENCE (2019)

SLR
global environmental solutions

7th August 2019

Environment Section,
Sligo County Council,
Riverside,
Sligo.

By Post

Our Ref: 190521.0501.00396.038.L.Rev0.Aghamore DL Cover Letter

To Whom it Concerns,

RE: APPLICATION FOR REVIEW OF DISCHARGE LICENCE REF: DL(W)139 UNDER SECTION 4 OF THE LOCAL GOVERNMENT (WATER POLLUTION) ACT 1977, FOR LAGAN BITUMEN LTD. AT AGHAMORE QUARRY, AGHAMORE NEAR AND CARROWNAMADDOO TOWNLANDS, CO. SLIGO.

Please find enclosed an application for a review of the existing Discharge Licence (DL(W)-139) to discharge effluent to surface waters from Aghamore quarry.

The following information is included in support of the application:

i. Completed Application Form (Appendix A);
ii. Cheque for required fee of €380;
iii. Figures:
    - Figure 1 - Site location Map (1:25,000); and
    - Figure 2 - Site layout (1:2,500).
iv. Existing Discharge Licence - DL(W)-139 (Appendix B);
v. Application to Transfer Discharge Licence DL(W)-139 (Appendix C);
vi. Lagan Bitumen Ltd. - Name Certificate and Certificate of Incorporation (Appendix D);
vii. Original page from Irish Times newspaper dated 30th July 2019 containing Public Notice (Appendix E);
viii. Environmental Management Plan (Appendix F);
ix. Receiving water and quarry discharge water quality results (Appendix G);
x. Assimilative Capacity Assessment and Mass Balance Results for Receiving Waters (Aghamore Stream and Lough Gill) (Appendix H);
xi. Natura Impact Statement (Appendix I);
xii. Details of Settlement Lagoon and Construction Environmental Management Plan (CEMP) (Appendix J); and
xiii. Details of proposed wheel wash (Appendix K).

1.0 INTRODUCTION

A review of the existing discharge licence for the Lagan Aghamore quarry is undertaken here for the discharge of water from the quarry site to the Aghamore Stream, which flows to lough Gill. This review of the existing discharge to waters licence (DL(W)139) is being undertaken prior to recommencement of activities at the site based on the updated hydrogeological and water management assessment of the quarry carried out as part of the Environmental Impact Assessment Report (EIAR) and Planning Application which is currently under consideration by Sligo County Council (planning ref: 18/345)

A trade effluent discharge licence (DL(W)139) was granted by Sligo County Council in November 2011, following an application and submission of further information by the former quarry owner, CEMEX (ROI) Ltd. ('Cemex'). An application to formally transfer this discharge licence from CEMEX (ROI) Ltd. to Lagan Bitumen Ltd. was submitted to Sligo County Council on 8th April 2019.

The quarry site was acquired by Lagan Bitumen Ltd. ('Lagan') from Cemex in November 2014, and at that time none of the water monitoring/treatment infrastructure proposed in the discharge licence application (October 2010) and further information submitted (September 2011) had been installed by Cemex.

Lagan formally notified Sligo County Council on 28th May 2015 that the site had been acquired from Cemex on 28th November 2014 and closed from that date. It was proposed to give Sligo County Council 8 weeks' notice prior to commencement of activities at the site.

Dewatering of the site and discharge to the Aghamore Stream leading into Lough Gill have been occurring for more than 10 years. The current floor level (c. -21 mOD) of the quarry is below the water table requiring surface water and groundwater to be pumped from the quarry to a nearby stream which leads directly to Lough Gill c. 800m downstream.

The discharge point at the Aghamore Stream is c. 330m east of the quarry void.

2.0 SITE WATER MANAGEMENT

2.1 Existing Site Water Management

The current water management within the quarry involves pumping a combination of rainwater and groundwater from the quarry floor directly to the Aghamore Stream. This is an interim measure agreed with Sligo County Council as there is no activity on site and no sources of potential water pollution remain within the quarry void.

Incidental rainwater and groundwater seepages entering the quarry drain across the quarry floor to a sump located in the southern corner. Two electric submersible pumps are installed in the sump, which operate on float switches and discharge directly to the Aghamore Stream via two 160mm uPVC pipelines. The discharge point at the Aghamore Stream is c. 330m east of the quarry void.

When the two pumps are operating, a maximum volume of 3,456m^3/day is discharged from the quarry. However, during prolonged dry periods, the groundwater table lowers and only one pump is required to dewater the quarry. When this occurs, only one pump is operation and the maximum volume of 1,750m^3/day.

Plate 7-1: Pumping, quarry floor dry (12/7/2017)

Plate 7-2: No pumping, quarry floor partially flooded (24/5/2018)

There is no point discharge arising from the processing area of the site (located to the east of the public road) as this area of the site has been inactive. Any historical discharges arising from the processing area would have originated from the wash-water associated with concrete production activities. Should any of the concrete production activities located within the processing area be recommenced at any point in the future, it is the applicant's intention to contain all washwater arising from these activities within the site, whereby the washwater would be directed through a series of settlement ponds, prior to being recirculated back into the concrete production process, i.e. a closed loop system. Any surface water run-off arising from the paved block yard area will be directed to french drains located around the perimeter of the paved area. The French drains will consist of stone filled drainage channels which will allow surface water run-off to naturally percolate to ground.

All storm water from the processing area to the east of the quarry will percolate to ground. There will be no stormwater discharge from this part of the site; it is not the applicant's intention to resume any point discharges from the processing area of the site at any point in the future. Consequently, there will be no requirement for the treatment and disposal of run-off and wastewater from the processing area of the site.

2.2 Proposed Site Water Management

It is proposed to install a settlement lagoon with an impermeable high-density polyethylene (HDPE) liner at the site, to treat surface water and storm water run-off from the quarry for suspended solids, see Figure 2. Site specific drawing of the proposed settlement lagoon, and cross sections through the proposed lagoon are provided in Appendix J, including details of the HDPE lagoon lining, in terms of protection of surface water and groundwater.

A Construction Environmental Management Plan (CEMP) has been prepared for the construction of the settlement lagoon at the site. The CEMP outlines how potential adverse impacts on the water environment that may arise during the construction of the proposed settlement lagoon will be managed and a copy of the plan is included in Appendix J.

The quarry operator will conduct daily documented checks of the lagoon to ensure there are no signs of leaks or instability. The lagoons will also be inspected every 2 years by a geotechnical engineer as part of the geotechnical assessment of the quarry.

Any sediment contained in the discharge waters will be collected from surface-water run-off only. Primary settlement of any sediment within the discharge waters will take place within the quarry sumps on the quarry floor. Due to the nature of the proposed development, and proposed water management system, it is not considered that there will be any significant build-up of sediment within the settlement lagoon.

However, desludging of the lagoon will be carried out periodically (typically bi-annually, or as required). Sediment will be excavated from the settlement lagoon, dried out in thin layers prior to use in the restoration of the previously extracted quarry area located within the landholding of Lagan Bitumen Ltd.

2.3 Storm Water Runoff

It is proposed that all surface water & storm water run-off from within the quarry area will be directed to a separate quarry sump for dewatering stormwater, see Figure 2. All water from this stormwater sump will be directed to the proposed settlement lagoon, prior to discharge off site to the Aghamore Stream. No surface water run-off or stormwater from the quarry area will bypass the proposed settlement lagoon.

It is proposed that all groundwater inflows into the quarry void will be intercepted as it enters the excavation and directed to a separate quarry sump for dewatering clean groundwater via a system of drains located along the toe of the excavation faces. These drains will be maintained separate from the quarry floor. Water from the dewatering sump will be discharged directly to the Aghamore Stream via a sediment trap - refer to Drawing FI 2 in Appendix J.

The permeability within the limestones at the site is entirely related to fracturing and there is no primary permeability in the limestone matrix. Groundwater inflows into the quarry are delineated by calcium-carbonate deposits on the quarry faces (yellow-white staining); inflows tend to be diffuse through a network of bedding and joint planes, with more seepage in some areas than others (fracture controlled). Some more discrete localised inflows occur specifically along bedding planes.

On this basis it will be a relatively straightforward task to establish a system of groundwater interception drains as the dominant point sources of groundwater inflows to the quarry void will be readily identifiable.

All water (stormwater and groundwater inflows) pumped from the quarry void will be discharged in compliance with the requirements of this reviewed discharge licence and in accordance with the emission limit values specified under the discharge licence.

2.4 Discharged Water Quality

Water samples of the discharge collected from January - April 2018 show all parameters below the TEDL emission limit values. Four additional rounds of surface water sampling were collected on 27th August 2018, 6th November 2018, 7th January 2019 and 28th March 2019, including the discharge, upstream of discharge, downstream of discharge, at bridge before Lough Gill, and from Lough Gill. A copy of the surface water results is included in Appendix G.

BOD is occasionally slightly elevated upstream of the discharge; however, BOD has not been detected above the laboratory reporting limit in discharge samples from 2018/2019. Low levels of MRP are occasionally detected both upstream and in the discharge.

The environmental monitoring programme will resume on site prior to activities recommencing, as notified to Sligo County Council in 2015.

Background water quality in the Aghamore Stream in these samples is quite good, and elevated parameters are typical of runoff from an agricultural catchment (faecal bacteria and traces of total ammonia). All other parameters are below the relevant water quality standards, with total ammonia levels mostly below these standards (one exceedance only downstream). The effect of the quarry discharge is noted downstream of the discharge, with slightly raised conductivity, calcium and sulphate; BOD and orthophosphate levels are normal. There is no change in water quality between the samples downstream of the discharge and before the stream enters Lough Gill, indicating no further discharges downstream.

Regionally, the status of the Lough Gill lake waterbody is considered to be 'at risk' of not meeting the requirements of the WFD and accordingly Lough Gill is named as one of the 190 Areas of Action identified in the River Basin Management Plan 2018-2021 for better targeting of existing measures and the addition of supplementary measures to prevent deterioration and achieve the WFD objectives for the waterbody.

2.5 Water Supply

The area surrounding the quarry is rural, with farms and ribbon development comprising one-off houses along secondary roads. Sligo County Council has confirmed that the area is served by a mains water supply, with each of the public roads surrounding the quarry having its own water main supply; a local well survey in the area was undertaken and most private houses in the area were built within the last 10-20 years and are connected to the mains water supply.

The quarry site is on the mains water supply. A supply well located in the processing area is used for non-potable use in the processing area at the site (when operational).

2.6 Processing Area

The processing area is located on the eastern side of the local road from the quarry and includes the service compound / workshop and fuel storage.

The workshop is an enclosed and covered building and therefore does not require an oil interceptor. Bunded areas and spill trays are provided in the workshop to contain all oils and lubricants stored in the workshop.

Fuels will be held within the existing bunded area located within the processing area to the east of the quarry. The volume of fuel to be held at the site will be minimal as all mobile crushing and screening plant will be refuelled on an 'as required' basis by a local fuel supplier and HGV's serving the site will refuel at local service stations. Therefore, fuel will only be required to serve mobile equipment such as front-end loaders at the site.

There is bunded fuel storage at the site with a hard-standing area for refuelling. The bunded storage is equal to 110% of the largest tank. A hydrocarbon separator will be provided to treat all runoff from the refuelling hard stand area; treated runoff from the hydrocarbon separator will percolate naturally to the ground.

All oils / chemicals to be held at the site will be stored in the existing workshop / store, located within the processing area to the east of the quarry. The volume of oils / chemicals to be held at the site will be minimal and they will be stored within the existing bunded areas provided in the workshop. Any oils not stored within the bunded area, will be held on dedicated spill trays. Dedicated storage bins will also be provided in the workshop for oil filters and oily rags.

2.7 Environmental Management Measures

Lagan Bitumen Ltd. have an Environmental Management Plan for the site, see Appendix F. Spill control arrangements include the following:

- Oil interceptor in washout bay;
- Bund fuel storage and bunded admixture tanks; and
- Spill kits available on-site for any accidental small spillages outside the bunded areas.

2.8 Hydrocarbon Interceptors

The site is currently inactive and there are no hydrocarbon interceptors installed at present. As an interim measure agreed with Sligo County Council, a combination of rainwater and groundwater is pumped from the quarry floor directly to Aghamore Stream as there is no activity on site and no sources of potential water pollution remain within the quarry void.

It is proposed to install a hydrocarbon interceptor at the bunded fuel storage area located within the processing area of the site.

2.9 Wheel Wash

It is proposed to install a wheel wash system within the existing quarry and a second wheel wash will be installed before the weighbridge located within the processing area to the east of the quarry. Both wheelwash systems will be closed loop systems. The locations of the wheel wash and the design of the closed loop systems are included in Appendix K.

3.0 DISCHARGE LICENCE APPLICATION

The Application Form for the discharge trade effluent to waters, under the Local Government (Water pollution) Acts, 1977 & 1990, has been completed and is included in Appendix A.

This section includes additional information for the attached completed discharge licence application form for discharge to groundwaters.

The site location is shown in Figure 1, the site water management system and discharge point is shown in Figure 2.

3.1 Activities Carried Out on Site (PART II – Section 2 A(iii))

The site comprises an existing quarry and processing / manufacturing area. A planning application for the site has been submitted to Sligo County Council for:

- Continued use and operation of the existing permitted quarry area (c. 10.9ha) within an overall application area of c.18 hectares;
- Deepening of the existing permitted quarry area by a further bench from -34.5 m OD to -50 m OD;
- Provision of a Water Settlement Lagoon (c. 2,800 m^2).

Aggregate extracted from the quarry will be processed within the quarry void and transported by HGVs to the existing processing area located on the eastern side of the local road for further processing.

The current water management within the quarry involves pumping a combination of rainwater and groundwater from the quarry floor to the Aghamore Stream. This is an interim measure agreed with Sligo County Council as there is no activity on site and no sources of potential water pollution remain within the quarry void.

It is proposed to install a settlement lagoon of c. 2,800m^2 in advance of quarrying activities recommencing at the site to treat surface water and storm water run-off pumped from the quarry floor before being discharged to the Aghamore Stream. The settlement lagoon will have a water depth of 1.5m, a minimum freeboard of 0.5m and will be lined to prevent leakage. Interceptors will be installed close to areas of potential risk such as the fuel storage area and refuelling station.

The discharge point from the settlement lagoon will remain at the current location.

3.2 Discharge Volumes (PART III – Section 1(A)

There are two electric submersible pumps installed in the sump located in the southern corner. There is a larger 37kW pump and a smaller 22kW pump. The larger pump operates at c. 36 l/s and the smaller pump operates at c. 3-6 l/s. The pumps operate on float switches and discharge directly to the Aghamore Stream via two 160mm uPVC pipelines.

When the two pumps are operating, a maximum volume of 3,456 m^3/day is discharged from the quarry. However, during prolonged dry periods, the groundwater table lowers and only one pump is required to dewater the quarry. When this occurs, only one pump is operation and the maximum volume is 1,750 m^3/day.

The proposed discharge water volumes are set out in Table 1 below.

Table 1 -
Proposed Discharge Volumes

	Discharge Volume
Normal per day	2,592 m^3/day
Maximum per day	3,456 m^3/day
Maximum per hour	144 m^3/hour

A channel survey was carried out along the Aghamore Stream from the quarry discharge point to Lough Gill for the EIAR submitted as part of the planning application.

The stream was divided into a number of separate reaches between culverts, between which 40 No. cross-sectional profiles were measured and a longitudinal profile constructed.

The maximum bank-full flows for each cross-section were calculated and the maximum pipe-full gravity flows in the culverts were calculated using the Manning Equation. These were compared with the estimated peak flow in the stream in response to a storm with a 100-year return period calculated by the Rational Method, calibrating the runoff coefficient against monitored events in the existing monitoring record (events with unimodal distributions with durations close to the time of concentration for the catchment).

The peak flow for the Aghamore Stream at the quarry discharge point is estimated as c. 500-800 l/s, which exceeds the maximum flow capacity of the culvert by the Top Coast Oil depot entrance. Anecdotal evidence would suggest this culvert floods onto the road every few years for a few days at a time. Estimation of peak flow for the catchment by the Flood Studies Update methodology yields a higher peak flow but these methods are not suitable for catchments under 5-10 km^2. A new 5-parameter regression equation for flood estimation in small rural ungauged catchments developed by the OPW (FSU 4.2a) gives a similar result (c. 450 l/s) to that calculated using the Rational Method.

On the basis of the channel assessment undertaken, five areas are considered liable to flooding along the Aghamore Stream. The most sensitive location is Location 3 (Culvert 4) where the restricted size of the pipe culvert may result in flooding of the adjacent road in extreme weather events. Any discharge of water from the quarry at such times could exacerbate such flooding downstream, however it is noted that relative to the existing situation the change in discharge volume is negligible.

The potential impact of flooding downstream was assessed in the Environmental Impact Statement Report (EIAR) submitted in support of the Planning Application for the quarry. The assessment undertaken for the EIAR indicated that the probability of potential operational phase impacts relating to increased risk of flooding from the proposed deepening of the quarry is assessed as low. The magnitude of increased risk of flooding caused by the proposed deepening of the quarry is 'negligible' to 'mild', and the overall risk of flooding is '*low*'.

3.3 Water Treatment System (PART III – Section 2)

It is proposed to install a settlement lagoon at the site to treat water from the quarry void, see Section 2.2 above.

The size of the settlement lagoon was calculated based on the pumping rate and calculations presented in submitted with the EIAR. The maximum discharge rate in the existing trade effluent discharge licence to the Aghamore Stream is 40.5 l/s. Groundwater inflows into the quarry at the final floor level of -50 mOD would be c. 12.2 l/s, leaving a maximum headroom of 28.3 l/s to pump storm water out of the quarry at its lowest floor level. For a discharge rate of 28.3 l/s, a settlement lagoon with a surface area of 2,830 m^2 is required.

The settlement lagoon will have a water depth of 1.5m, a minimum freeboard of 0.5m and will be lined to prevent leakage. Interceptors will be installed close to areas of potential risk such as the fuel storage area and refuelling station.

3.4 Effluent Monitoring (PART III – Section 3)

Monthly environmental monitoring will be carried out from the discharge water at the point where it enters the receiving water (Aghamore Stream) and at locations upstream (SW1) and downstream (SW2) of the discharge point, to assess water quality. Water samples will be analysed for pH, electrical conductivity, BOD, MRP, nitrate, nitrite, ammonia and suspended solids.

Two electromagnetic flowmeters (Siemens SITRANS FM Mag8000) have been installed on the two discharge lines running from the quarry sump pumps to monitor the volumes of water discharged off-site. An ultrasonic-Doppler flowmeter (Unidata Starflow 6526H) has been installed in the culvert upstream of where the quarry discharges to the Aghamore Stream to measure upstream flows.

The discharge quality parameters and monitoring programme will be as per the existing discharge license (DL(W)-139) and are shown below in Table 2 below.

Table 2 -
Discharge Quality Parameters, Limits and Monitoring Frequency

Parameter	Unit	ELV	Sample Frequency
Temperature	°C	20	Monthly
pH	pH Units	6 to 9	Monthly
BOD	mg/l	2	Monthly
Total Ammonia	mg/l	0.1	Monthly
Suspended Solids	mg/l	25	Monthly
MRP	mg/l	0.05	Monthly
Total Phosphorus	mg/l	2	Monthly
Sulphates	mg/l	200	Quarterly
hydrocarbons	mg/l	1	Yearly

3.5 Environmental Management Plan (Part III - Section 3B)

Lagan has an Environmental Management Plan for the Aghamore site, see copy in Appendix F.

3.6 Newspaper Notice (Part IV - Section 1)

The newspaper notice advertising this application for a review of the discharge licence was published in the Irish Times dated the 30 July 2019, and a copy of the notice is included in Appendix E.

3.7 Receiving Waters (Part IV - Section 2A)

The site was granted a Trade Effluent Discharge Licence (TEDL) from Sligo County Council in December 2011 (DL(W)139) to discharge water from the quarry to the Aghamore Stream.

The Aghamore Stream lies c. 300m to the east of the quarry void and drains water from Lough Nameenbrack, (c. 450m to the southeast of the quarry) to Lough Gill (c. 800m to the northeast of the quarry). The discharge location is shown in Figure 2.

The Aghamore Stream does not have any ecological designations. Lough Gill is a designated Special Area for Conservation (SAC), it is a source of drinking water for Sligo town and its environs (Foxes Den Water Treatment Plant) and is also a popular lake for fishing.

Sligo County Council maintain a level gauge on Lough Gill (station no. 35073) c. 1.2 km north of where the Aghamore Stream discharges into Lough Gill. Long-term records (Figure 7-2) show that lake water levels rarely rise above 4.4 mOD at this station, however levels as high as 5.285 mOD have been recorded. Ground levels in the land adjacent Lough Gill in Aghamore Far slope from c. 5 mOD to <4 mOD close to the lake, showing the potential for flooding in this area.

3.8 Receiving Waters (Part IV - Section 2Aii)

Water quality monitoring for the receiving waters was undertaken from January 2018 - April 2018 and between August 2018 and March 2019, including upstream of discharge, downstream of the discharge, at bridge before Lough Gill and from Lough Gill. A copy of the surface water results are included in Appendix G.

Background water quality in the Aghamore Stream in these samples is quite good, with elevated faecal bacteria and traces of total ammonia typical of runoff from an agricultural catchment. All other parameters are below the relevant water quality standards, with total ammonia levels mostly below these standards (one exceedance only downstream). One instance of elevated BOD above the assessment criteria was recorded upstream of the quarry discharge and thus related to background quality. Levels of faecal bacteria and ammonia are higher in the upstream samples than the downstream samples, indicating that agricultural activity is the dominant influence on water quality in this stream. The effect of the quarry discharge is noted downstream of the discharge, with slightly raised conductivity, calcium and sulphate; BOD and orthophosphate levels are normal. There is no change in water quality between the samples downstream of the discharge and before the stream enters Lough Gill, indicating no further discharges downstream.

Regionally, the status of the Lough Gill lake waterbody is considered to be 'at risk' of not meeting the requirements of the WFD and accordingly Lough Gill is named as one of the 190 Areas of Action identified in the River Basin Management Plan 2018-2021 for better targeting of existing measures and the addition of supplementary measures to prevent deterioration and achieve the WFD objectives for the waterbody.

3.9 Assimilative Capacity Assessment and Mass Balance Calculation (Part IV – Section 3.A)

Lough Gill

To investigation the potential impact of water quality on Lough Gill, a simple assimilative capacity model used by the EPA in 2011 to assess licence compliance with the Surface Water Regulations was used to examine the potential impact of these parameters in the discharge on water quality in Lough Gill. The average depth of water in the lake within 100m of the discharge point is required for the model; a bathymetric survey of Aghamore Bay was carried out as part of this assessment and the results are presented in Appendix H.

The results show that using the median concentrations of total ammonia and orthophosphate in the discharge and in Lough Gill (EPA WFD monitoring data), the change in background concentrations in the mixing zone 100m from the discharge point is a negligible c. 0.5% increase for each parameter. This is a reflection of the large volume of water that dilutes the discharge on entry to the lake. The model is highly conservative as it only considered the first 100m from shore, in reality a much larger volume of Aghamore Bay is available for dilution.

Aghamore Stream

The Aghamore Stream, at the discharge point, drains a small rural catchment (c. 2.7 km^2) and during prolonged dry weather there is very little flow. Flow monitoring undertaken between September 2017 and June 2018 estimates the 95th percentile flow at only 2 l/s. Consequently, there is little assimilative capacity available in the stream at times of low-flow. At such times, the stream essentially acts as a conduit for the discharge to reach Lough Gill directly where it dilutes/disperses on entry to the lake water body.

The actual assimilative capacity available in the Aghamore Stream at times of low flow can be calculated using the estimated 95th percentile flow and background concentrations for individual parameters upstream of the discharge. For the general-case scenario, where background concentrations are taken as the mean of recent upstream monitoring data, the calculated assimilative capacity available is presented in Appendix H.

To determine whether there is a negative impact on water quality in the stream, the concentrations downstream of the discharge have been estimated using a conservative mass balance. The mass balance uses the upstream flow (95th percentile flow) and background concentrations (mean of recent upstream monitoring data), as well as the discharge flow (maximum under existing trade effluent discharge licence) and concentrations (mean of recent discharge monitoring data), to estimate the fully mixed downstream concentrations. None of the calculated concentrations downstream of the discharge exceed the relevant water quality standards, therefore no negative impact on water quality in the stream is expected as a result of the discharge.

The only parameters that exceed the Surface Water Environmental Quality Standards downstream of the discharge are single occurrences of slightly elevated mercury in November 2018 (0.2µg/l) and nickel (125µg/l) in January 2019. The slightly elevated mercury in November 2018 is also seen in the discharge (0.077µg/l), but neither parameter is elevated in samples further downstream at the bridge before Lough Gill, suggesting that the sampling location downstream of the discharge is within the mixing zone of the discharge and not far enough downstream (c. 30m) to represent fully mixed downstream concentrations. Traces of mercury and nickel are occasionally seen in groundwater surrounding the quarry, most likely as a result of either chemical fertilizers in the agricultural lands adjacent the quarry or atmospheric deposition from coal burning – there are no sources of mercury or nickel within the quarry itself. Coliform bacteria (including *E.coli*) exceed the Drinking Water Parametric Values both upstream and downstream of the discharge and this is related to poor background bacterial quality in both the stream and in groundwater surrounding the quarry – there are no sources of coliform bacteria within the quarry.

The percentage of the assimilative capacity available in the stream that is used up by the discharge is estimated in Appendix H. This is based on a comparison of the 'headspace' available in the stream before and after the discharge (i.e. 'headspace' is the difference between the stream concentration and the maximum permissible concentration). For the general-case scenario, only low percentages of the available assimilative capacity are used by some parameters (maximum of 27% by orthophosphate). In some cases, additional assimilative capacity is made available (e.g. TSS and BOD) as the mean concentrations in the discharge are lower than the background concentrations upstream of the discharge.

In summary, the assimilative capacity of the Aghamore Stream has been assessed in relation to the discharge and no negative impact on water quality is expected. The only exceedances of the Surface Water Environmental Quality Standards in recent monitoring downstream of the discharge point were single occurrences of slightly elevated mercury in November 2018 and nickel in January 2019, and these are believed to be related to background groundwater quality surrounding the quarry and not any activity within the quarry site itself, which is currently inactive.

3.10 Water Quality Results - Characteristics of Emission (Appendix C)

3.10.1 Quarry Void

As noted above, four rounds of surface water monitoring were undertaken from January 2018 – April 2018 which included discharge samples from the quarry void. The results from discharge samples from the quarry void are presented in Appendix G. The only exceedance noted is for total coliforms and ecoli, which were identified in most samples, ranging from 1 – 178mpn/100ml. All other parameters were below the relevant assessment criteria, indicating that the water being discharged from the quarry void is similarly impacted by agricultural practices as the upstream and downstream samples. The results indicate that overall the physiochemical water quality in the quarry void, as sampled and tested, is reasonable.

Yours sincerely
SLR Consulting Ireland

Peter Glanville

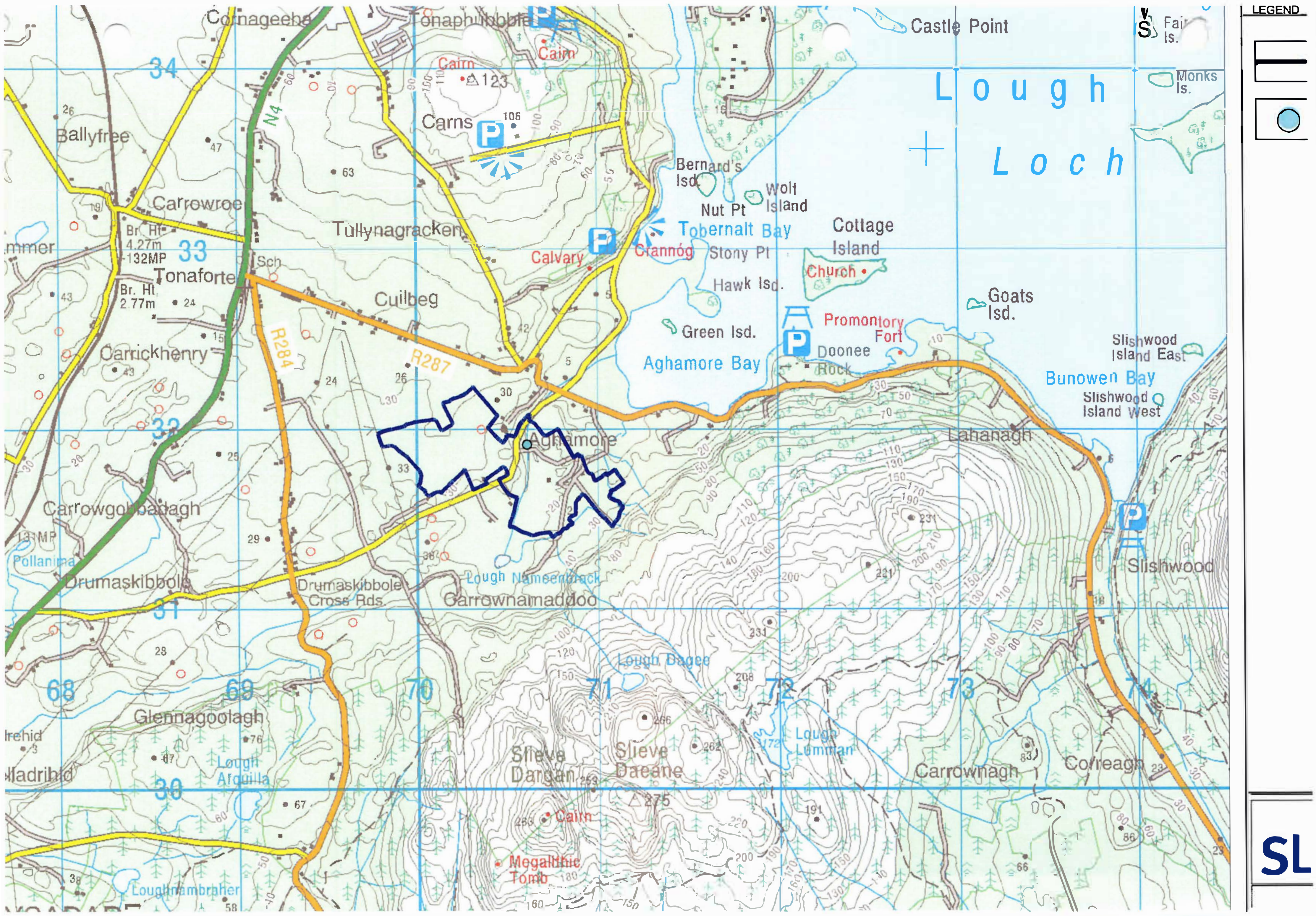
Peter Glanville
Principal

cc. Mr. Brian Downes (Lagan Bitumen Ltd.)
Enc. One original copy and four hard copies of the complete application documentation (five copies in total)

FIGURES

Figure 1 -
Site Location Map (1:25,000)

Figure 2 -
Site Layout and Sample Locations (1:2,500)


LEGEND
SL
Cornageeha
Tonaphubble
Cairn
Carns
123
106
Castle Point
Lough Gill
Monks Is.
Ballyfree
Carrowroe
Tullynagracken
Calvary
Crannóg
Tobernalt Bay
Bernard's Isd.
Wolf Island
Nut Pt
Stony Pt
Cottage Island
Church
Hawk Isd.
Goats Isd.
Green Isd.
Promontory Fort
Doonee Rock
Aghamore Bay
Slishwood Island East
Bunowen Bay
Slishwood Island West
Lahanagh
Br. Ht 4.27m
132MP
Tonaforte
Sch
Br. Ht 2.77m
Cuilbeg
Carrickhenry
R284
R287
N4
Aghamore
Carrowgobbadagh
Pollanima
Drumaskibbole
Drumaskibbole Cross Rds
Lough Nameenbrack
Carrownamaddoo
Lough Dagee
Slishwood
Glennagoolagh
Lough Arquilla
Slieve Dargan
Slieve Daeane
Lough Lumman
Carrownagh
Colreagh
Cairn
Megalithic Tomb
Loughnambraher
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72
73
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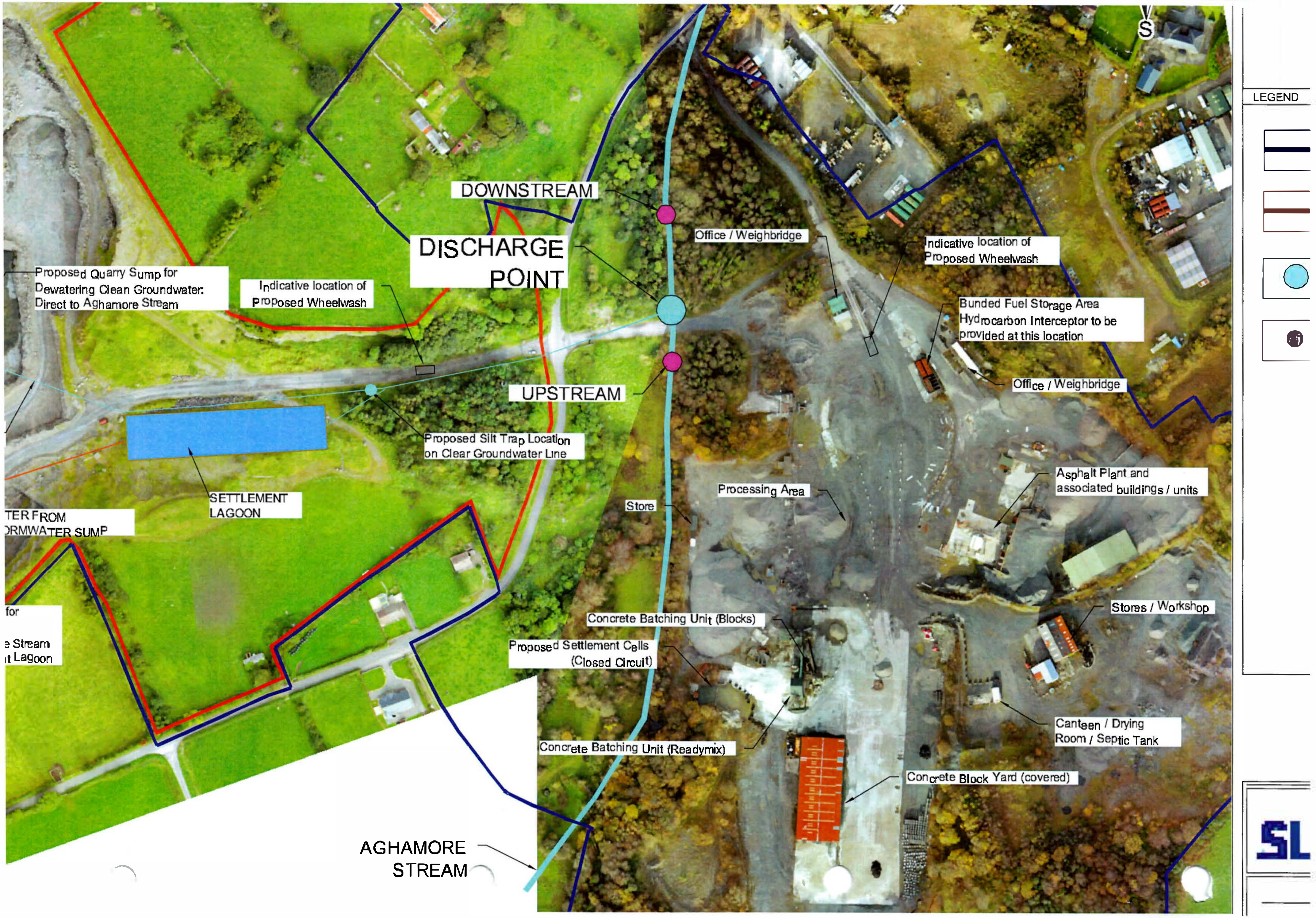
33
32
31
30
275
231
221
266
262


DOWNSTREAM
DISCHARGE POINT
UPSTREAM
Proposed Quarry Sump for Dewatering Clean Groundwater: Direct to Aghamore Stream
Indicative location of Proposed Wheelwash
Office / Weighbridge
Indicative location of Proposed Wheelwash
Bunded Fuel Storage Area Hydrocarbon Interceptor to be provided at this location
Office / Weighbridge
Proposed Silt Trap Location on Clear Groundwater Line
SETTLEMENT LAGOON
TER FROM
ORMWATER SUMP
Processing Area
Store
Asphalt Plant and associated buildings / units
Stores / Workshop
for
e Stream
t Lagoon
Concrete Batching Unit (Blocks)
Proposed Settlement Cells (Closed Circuit)
Canteen / Drying Room / Septic Tank
Concrete Batching Unit (Readymix)
Concrete Block Yard (covered)
AGHAMORE STREAM
S
LEGEND
SL

APPENDICES

Appendix A -
Application Form Discharge to Surface Waters

SLIGO COUNTY COUNCIL
Comhairle Chontae Shligigh

Local Government (Water Pollution) Acts, 1977 & 1990

APPLICATION FOR A LICENCE TO DISCHARGE TRADE AND/ OR DOMESTIC WASTE WATER TO SURFACE WATER

Your completed application accompanied by all relevant information and payment is to be sent to the following address:

Address:

Sligo County Council
Environment Section
Riverside
Sligo

PART I - Section 1

A. Guidance on Applying for a Discharge Licence

Any person who intends to discharge domestic waste water or trade effluent to surface waters must attain permission to do so from either the Local Authority or the Environmental Protection Agency (EPA) before the discharge is commenced.

Where the discharge is licensable by the Local Authority, this Application Form is to be completed and submitted to the Local Authority.

The Applicant is requested to read the "Guidance on Applying for a Discharge Licence" before completing this licence application form.

B. Completing the Application Form

Guidance on what information is to be included in each Part of the Application Form is provided in the "*Guidance on Applying for a Discharge Licence*".

The Applicant is asked to contact the Licensing Authority in the event that:

- they are unsure as to whether the discharge is licensable by the Local Authority or the EPA
- they are having difficulty in providing all the information required in the application form
- they are unsure as to what information they are to provide in the form
- they are unsure as to where to source the information required in the form
- they require any information or guidance on filling out the form

The Licensing Authority WILL NOT be able to process an incomplete application.

Where multiple discharges are proposed, the applicant for a discharge licence must first contact the Licensing Authority for advice on whether one application form will suffice or whether multiple forms need to be submitted.

Additional Sheets

Where any part of the Application Form does not afford sufficient space to provide the required information, the Applicant should attach additional sheets to the form containing such information.

The additional sheets should be cross-referenced to the appropriate section in the Application Form. Mark each sheet with the name of the Applicant and the name of the premises from which the discharge is generated and indicate the section and part of the Application Form to which the additional sheets relate. An example of an Additional Sheet

B. Completing the Application Form

cross reference is provided in "*Guidance on Applying for a Discharge Licence - Groundwaters*".

Request for Further Information

The Licensing Authority is entitled under Section 7(3) of the *Local Government (Water Pollution) Regulations, 1978* to request the Applicant to submit additional information that the Licensing Authority deems necessary for the consideration of an application for a discharge licence.

Where additional information is not provided by the Applicant within a three month period of receiving such a request then the Licensing Authority may carry out the necessary investigations to acquire the information, the cost of which is to be borne by the Applicant. Alternatively the Licensing Authority may proceed to make a determination on the application in the absence of such information.

PART I – DECLARATIONS & SIGNATURES

C. Signatures of the Applicant & Agent

Identify the class of discharge to which this application pertains.

I hereby make an application for a licence to discharge trade effluent to Surface Waters under the Local Government (Water Pollution) Act 1977 in respect of the particulars included in this application on behalf of Lagan Bitumen Limited.

**indicate whether trade or domestic or both*

Where this application is made by an Agent on behalf of an Applicant, the signature of the Applicant must be provided below confirming the authorisation of the Agent to apply for a licence on their behalf:

I hereby authorise SLR Consulting to apply for a discharge licence on behalf of Lagan Bitumen Ltd.

Signed: Brian Downes **Date:** 06/08/2019

(provide signature of Applicant)

I hereby declare that I am fully aware of my responsibilities to implement the conditions of any licence granted on the basis of this application and acknowledge that I may be subject to criminal liability whereby the terms of the licence are not complied with.

Signed: Brian Downes **Date:** 06/08/2019

(provide signature of Applicant)

Refer to the "Guidance on Applying for a Discharge Licence" for definitions of the Applicant and the Agent.

PART I - Section 2

A. Disclosure of Information

The Freedom of Information Act, 1997 (as amended) states that every person has a right to access any record held by a public body. This includes discharge licenses (and associated applications) held by the Local Authority. The Local Authority may refuse to provide access to records held by them where the information was provided to the Local Authority with the understanding that it is to be treated as confidential. Circumstances under which confidentiality may apply include where information submitted in the application contains commercially sensitive information or matters of National security.

The Applicant is requested to identify all information submitted with the application which is to be treated as confidential and is requested to identify the grounds on which the information may be categorised as confidential.

B. False or Misleading Information

It is an offence under the *Local Government (Water Pollution) Act, 1977* to knowingly submit false or misleading information in the licence application and an Applicant is liable to a fine on summary conviction of such an offence.

Please provide signature of the authorised representatives of the Applicant and where appropriate the Agent confirming that all the information submitted in this application is correct and also that they have made themselves aware of the provisions of the Freedom of Information Act.

I/we hereby declare that I/we have made myself/ourselves aware of the provisions of the Freedom of Information Act and that I/we understand that there is a legal obligation on the Local Authority to make this discharge licence application available for inspection by third parties.

I/We hereby declare that to the best of my/our knowledge all of the information provided in this application is true and correct.

Signed: Brian Downes **Date:** 06/08/2019

(provide signature of the Applicant)

Signed: Peter **Date:** 06/08/2019

(provide signature of the Agent)

PART II – GENERAL DETAILS

PART II – Section 1

A. Contact Details – Applicant

A. (i) Provide contact details for the Applicant below

The Applicant is:	☐ An Individual ☐ A Group of Individuals ☑ A Corporate Body
Name (Principal Contact)*	Brian Downes
Address	Lagan Bitumen Ltd. Rosemount Business Park, Ballycoolin Road, Dublin 11, D11 K2TP
Phone Number (day)	01 995 9999
Phone Number (night)	086 0081209
Fax	
e-mail	bdownes@breedongroup.com

*** Where the Applicant is a group of individuals or a corporate body, provide the name of one individual to be the principal contact for the purpose of correspondence relating to a licence granted by the licensing authority.**

A. (ii)Where the Applicant is an Individual provide the following details:

Relationship to the premises from which it is proposed to discharge	na. Owner/occupier na. Landowner na. Responsible for treatment facility na. Other __________________ *(please specify)*

A. (iii) Where the Applicant is a Group of Individuals provide the following details:

Type of Group	na. Management Company na. Residents Association na. Voluntary Group na. Club na. Other __________________ *(please specify)*

A. (iv) Where the Applicant is a Corporate Body provide the following details:

PART II – GENERAL DETAILS

Type of Corporate Body	☑ Limited Company ☐ Public Limited Company ☐ Sole Trader ☐ Co-operative ☐ Partnership ☐ Other - Unlimited Company
Certificate of Incorporation must be included with the application listing the names of Directors.	

B. Contact Details – Agent	
B. Where an Agent is making this application on behalf of an Applicant the Agent's contact details must be provided	
Name	Peter Glanville
Address	SLR Consulting, 7 Dundrum Business Park, Windy Arbour, D14 N2Y7
Phone Number (day)	01 2964667
Phone Number (night)	
Fax	01 2964676
e-mail	pglanville@slrconsulting.com
Relationship to the Applicant e.g. employee, consultant, partner.	Consultant

PART II – Section 2

A. Site Details

A. (i) Provide details below of the site / activity from which it is proposed to discharge.

Name of Site (where applicable)	Aghamore Quarry
Address	Aghamore, Co. Sligo
Site location (Co-ordinates)	**Easting** 5 7 0 1 0 0 **Northing** 8 3 1 8 0 0
Is the site an existing development or a new development?	☑ Existing ☐ New
Is there any existing discharge license(s) granted in relation to the site?	☑ Yes Reference Number: DL(W)139 Reference Number ________ ☐ No
Is planning permission granted for any proposed / existing development at the site?	☑ Granted (Reference Number: 02/271). ☑ Pending (Section 34 Planning Application submitted to Sligo Co. Council, October 2018. Plan File Ref. No. 18/345) ☐ Not Applied For
Have copies of the following maps / drawings been included?	☑ Site Location Map (see Figure 1) ☑ Site Layout Map (see Figure 2) ☑ Site Drainage System Drawings (see Figure 2) ☐ None of the above
Outfall Details	The discharge from the site goes to Aghamore Stream grid reference 570566,831895, as shown on Figure 1. The discharge pipe consists of two (2No.) 150mm Bauer pipes fed by two (2No) submersible 20kW flight pumps located in the sump on the working quarry floor.

Provide copies of the outfall drawings.

PART II – GENERAL DETAILS

A. (ii) Identify the sector(s) from which the proposed discharge will be generated.

Type of Premises		*Please tick the box as appropriate*	√
	Accommodation	Household / Holiday Home	
		Hotel / Guesthouse / B&B	
		Caravan Park / Camp Site	
		Nursing Home	
	Education	Non-residential facility	
		Boarding School	
		College / University	
	Commercial / Service	Office	
		Hairdresser / Beauty Salon	
		Doctor Surgery	
		Dentist	
		Launderettes and Dry Cleaners	
		Petrol Station	
		Hospital	
		Churches, Monasteries etc.	
		Amenities (golf course, sport facilities etc.)	
	Food & Drink	Public House (with or without food preparation)	
		Restaurant / Café / Take Away	
	Transport	Airport	
		Train station	
		Bus station	
	Industrial	Dry process industry without canteen	
		Dry process industry with canteen where food is prepared	
		Chemicals industry	
		Wood, paper, textiles and leather	
		Food and drink	
		Minerals and other materials	
		Energy	
		Metals	
		Mineral fibres and glass	
		Fossil fuels	
		Cement manufacture	
		Waste	
		Surface coatings	
	Other *(Please specify)*	Existing quarry site	✓

A. (iii) Activities Carried Out on Site.

Provide details of the activities carried out on site. Where this involves a process, provide an overview of the process. In particular indicate where domestic waste water / trade effluent is generated.

See attached cover letter for details of the existing site and the proposed activities at the site.

Provide additional sheets where necessary.

Process Materials & Waste Disposal	Where applicable, complete **Appendix A and Appendix B** of this form.

PART III – EFFLUENT DETAILS

PART III – Section 1

A. Effluent Details	
PART III – Section 1 A is to be completed by All Applicants.	
Type of effluent	☐ Domestic Waste water Only ☑ Trade Effluent Only ☐ Both Domestic and Trade Effluent
Indicate the type of discharge to which this application relates.	☐ New Discharge ☑ Existing Discharge
Domestic Waste water only (if relevant)	Population Equivalent (p.e.) na. Expected Dry Weather Flow (DWF) na. m^3/day. *Provide details of how the P.E. & DWF were calculated.*
Trade Effluent only or Domestic & Trade (if relevant)	• the normal volume of effluent discharged in one day will be c. 2,592 m^3/day; • the maximum volume of effluent discharged per day will be 3,456 m^3/hour; and • the maximum volume of effluent discharged per hour will be 144 m^3/hour (c. 40l/s)
Provide details of how the trade effluent flows are calculated.	
Effluent Characteristics.	**Complete Appendix C and Appendix D of this form.** *Provide additional sheets where necessary.*

B. Effluent Details	
<u>PART III – Section 1 B is</u> to be completed by All Applicants. *Provide additional sheets where necessary.*	
Discharge Variability	Briefly identify whether there is likely to be variability in the discharge flow or characteristics e.g. due to process changes, due to seasonal variation, due to diurnal changes etc. Natural seasonal variations in rainfall and groundwater inflow to quarry.
Date of Discharge	Discharge at the site is ongoing. Prior to resumption of activities at the site, the settlement lagoon will be installed. The site was granted a Trade Effluent Discharge Licence (TEDL) from Sligo County Council in December 2011 (DL(W)139) to discharge water from the quarry to the Aghamore Stream, subject to conditions. Dewatering of the site and discharge to the stream leading into Lough Gill have been occurring for more than 10 years.
Fats, Oils and Grease (FOG) (if relevant)	Provide details of control measures proposed for the removal of FOG from the effluent prior to discharge. Provide technical data sheets for any equipment proposed. Not relevant – No fats, oils and grease in discharge.
Food Waste (if relevant)	Provide details of provisions for source segregation and disposal of food waste. None
Other Discharges	Provide particulars of any other discharges from the premises (e.g. storm water). None.
Water Supply	Provide details of the source of water that will form part of the discharge e.g. mains, borehole, river etc. na.
	Water is only required at the site for employee welfare and hot drinks.
Other Effluent Details	You may be required to furnish such other particulars as the Licensing Authority may reasonably require for consideration of the application e.g. effluent toxicity testing, bioaccumulation testing, biodegradation testing. See attached cover letter and supporting documentation including water quality results from quarry void to be discharged.

PART III – Section 2

A. Effluent Treatment		
PART III – Section 2 A is to be completed where the effluent is to be treated prior to discharge.		
Operator of Treatment System:	**Where the treatment system is to be maintained and operated by a third part please provide the following:**	
	Contact Name	n/a
	Company Name	
	Address	
	Phone Number (day)	
	Phone Number (night)	
	Fax	
	e-mail	
	Registered Company Details	
Waste Water Treatment System Overview	Provide particulars of the existing / proposed effluent treatment system. Details of the proposed settlement pond is included with the cover letter and attachments. *Provide additional sheets where necessary.*	
Provide copies of the treatment system process drawings.		

PART III – EFFLUENT DETAILS

B. Effluent Treatment	
<u>PART III – Section 2 B</u> is to be completed where the effluent is to be treated prior to discharge. *Provide additional sheets where necessary.*	
Treatment System Maintenance	Provide details of the proposals for the treatment system maintenance. The settlement lagoon will be maintained by site staff. There are no mechanical parts to the settlement lagoon which would require a maintenance programme.
Plant Failure	Identify how any failure of the treatment system will be detected. The settlement lagoon will be inspected on a daily basis (visual inspection) and the discharge will be sampled on a monthly basis and tested for suspended solids to confirm that the lagoon is operating correctly.
Sludge	Provide details of proposals for dealing with sludge (where relevant). Material from the settlement lagoon will be removed on an as need basis and will be used on site as part of the restoration process. A monitoring/management will be put in place for the Settlement Lagoon and this is detailed in the cover letter with this application.

PART III – Section 3

A. Effluent Monitoring													
PART III – Section 3 A is to be completed by All Applicants. **Provide details of the monitoring proposed for the effluent discharge** *Provide additional sheets where necessary.*													
Monitoring the Discharge.	Provide details of any proposals to monitor the discharge e.g. o Parameters to be analysed; o Monitoring programme; o Details of any sampling equipment to be used. The discharge quality parameters and monitoring programme are as per the existing discharge licence (DL(W)-139) and are set out in the cover letter.												
Location of sampling point(s) (Co-ordinates)	**Easting**	**5**	**7**	**0**	**5**	**6**	**6**	**Northing**	8	3	1	8	9	5
Effluent Flow Monitoring	Provide details of any proposals to monitor the discharge flow. Two flowmeters have been installed on the two discharge lines running from the quarry sump pumps to the stream to monitor the volumes of water discharged off-site. A further flowmeter has been installed in the culvert upstream of where the quarry discharges to the Aghamore Stream to measure upstream flows.												
Licensing Authority Monitoring	Provide a description of how the Licensing Authority will be provided access to the effluent in order to take samples and indicate the point at which such samples may be taken e.g. last manhole before outfall. *(Provide grid reference below).* Existing discharge water locations are at accessible locations: the point where it enters the receiving water (Aghamore Stream) and at locations upstream (SW1) and downstream (SW2) of the discharge point												
Location of Licensing Authority sampling point(s) (Co-ordinates)	**Easting**	**5**	**7**	**0**	**5**	**6**	**6**	**Northing**	8	3	1	8	9	5

B. Pollution Control		
PART III – Section 3 B is to be completed by All Applicants. **Provide details of any pollution control measures proposed.** *Provide additional sheets where necessary.*		
Accidental Discharges	Provide details of arrangements to prevent accidental discharges. The two pumps from the sump in the quarry void can be switched off at any time to prevent an accidental discharge from the site. In addition, the outlet from the settlement lagoon can be closed off and discharge stopped if required.	
Provide below, details of emergency procedures, contact persons and facilities available to respond to unexpected incidents.		
Emergency Response	**Contact Name**	Fraser Thom (Operations Director)
	Phone Number (day)	01 885 9999
	Phone Number (night)	086 172 5612
	Provide details of any emergency procedure. In the event of an accident, discharges from the site can be prevented by switching off the pumps from the quarry sump and/or by closing the outfall from the settlement lagoon.	
Environmental Management Plan	Is there an Environmental Management Plan in place in respect of the site? ☑ Yes – see attached cover letter and supporting documentation for copy of site Environmental Management Plan ☐ No *If 'Yes' please submit a copy with this application.*	

PART IV – Section 1

A. General Details	
Identify why it is not feasible to discharge to sewer.	No sewer is available at the site
Provide details of the newspaper notice.	Name of Publication: Irish Times Date of Print: 30th July 2019 *Please include one original plus the required copies of the notice.*

PART IV – Section 2

A. (i) Receiving Water Details - Discharge to Inland Surface Water

PART IV – Section 2 A is to be completed where the application pertains to a discharge to inland surface waters i.e. streams / rivers / lakes.

Name of Receiving Water	The discharge point at the Aghamore Stream (the receiving waters) is c. 330m east of the quarry void.

Location of Discharge (Co-ordinates)	**Easting**	5	7	0	5	6	6	**Northing**	8	3	1	8	9	5

Add additional rows where necessary.
All discharge locations to be indicated clearly on OS Map.

Existing Uses	The receiving water is the Aghamore stream.
	Water uses are na.______________ *(e.g. angling, recreational, navigation etc.)*
Designation*	The receiving water is located within the boundary of : *(tick as appropriate)* ☐ An SAC, site code ____________. ☐ An SPA, site code ____________. ☑ None of the Above ** Note: Where the discharge is located within the boundary of a Natura 2000 site (SAC or SPA), an Appropriate Assessment (Natura Impact Statement) must be submitted with this application as required by Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (Habitats Directive).*
	The receiving water is designated as: *(tick as appropriate)* ☐ A Salmonid Water ☐ An Inland Bathing Water ☐ A Pearl Mussel Water ☐ A Drinking Water ☐ A Sensitive Water ☑ None of the Above

PART IV – DISCHARGE TO SURFACE WATER

A. (i) Receiving Water Details - Discharge to Inland Surface Water (continued)	
Name of River Basin District	Provide the name of the River Basin District in which the discharge is located: Irish RBD – multiple RBDs no longer in use, according to 2018-2021 management plan
Water Framework Directive Waterbody Status	☐ No Status ☐ Moderate ☐ Bad ☐ Good ☑ Poor ☐ High
Refer to "Guidance on Applying for a Discharge Licence" for sources of information.	
Receiving Water Flow Data:	*Where available include information from existing hydrometric station / flow estimation tool.* *Na.* m^3 /sec Dry Weather Flow (DWF). 0.002 m^3 /sec 95th%ile flow. (estimated from stream flow monitoring undertaken by TMS) Source of Information: Manual stream flow monitoring ☐ EPA ☐ OPW
	Include information from on-site flow measurement where it has been undertaken.
Where a discharge is to a lake dispersion modelling is likely to be required. The Applicant should consult with the Licensing Authority. ***– See attached cover letter for assessment of Lough Gill***	

A. (ii) Receiving Water Details - Discharge to Inland Surface Water		
Receiving water background chemical data. ***See attached cover letter with water monitoring results.***	**Parameter**	**Result**
	BOD_5 mgO_2/l	
	Suspended Solids mg/l	
	pH (pH units)	
	Dissolved Oxygen mg/l O_2	
	Temperature °C	
	Total Ammonia as mg/l N	
	Un-ionised Ammonia as mg/l N	
	Orthophosphate as mg/l P (unfiltered MRP)	
	Total Phosphorus as mg/l P	
	Nitrite as mg/l N	
	Nitrate as mg/l N	
	Total Nitrogen mg/l N	
	Chloride mg/l	
	Sulphate mg/l	
Refer to "Guidance on Applying for a Discharge Licence" for guidance on reporting monitoring data and on sampling.		

PART IV – DISCHARGE TO SURFACE WATER

B. (i) Receiving Water Details - Discharge to Transitional / Coastal Water	
PART IV – Section 2 B is to be completed where the application pertains to a discharge to coastal or transitional waters i.e. estuaries / marine waters.	
Name of Receiving Water	***Not Applicable***
Location of Discharge (Co-ordinates)	**Easting** ☐☐☐☐☐☐ **Northing** ☐☐☐☐☐☐
Add additional rows where necessary. **All discharge locations to be indicated clearly on OS Map.**	
Designation*	The receiving water is located within the boundary of (or the discharge point is in the boundary of or within 3km of): *(tick as appropriate)* ☐ An SAC, site code ____________. ☐ An SPA, site code ____________. ☐ None of the Above ** Note: Where the discharge is located within the boundary of or is within 3km of an SAC/SPA, an Appropriate Assessment (Natura Impact Statement) must be submitted with this application as required by Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (Habitats Directive).* The receiving water is designated as: *(tick as appropriate)* ☐ A Shellfish Water ☐ A Bathing Water ☐ A Sensitive Water ☐ None of the Above
Name of River Basin District	Provide the name of the River Basin District in which the discharge is located ____________________.
Water Framework Directive Waterbody Status	☐ No Status ☐ Moderate ☐ Bad ☐ Good ☐ Poor ☐ High
Refer to "Guidance on Applying for a Discharge Licence" for sources of information.	

PART IV – DISCHARGE TO SURFACE WATER

B. (i) Receiving Water Details - Discharge to Transitional / Coastal Water (continued)

Position of outfall	The outfall is/will be positioned _______ metres above/below *(delete as appropriate)* Mean High Water Spring Tide and The outfall is/will be positioned _______ metres above/below *(delete as appropriate)* Mean Low Water Spring Tide
Bathymetric Survey	A bathymetric survey **has/has not** *(delete as appropriate)* been undertaken. *Where a bathymetric survey has been undertaken, please include a copy with this application.*
Foreshore Licence	A Foreshore Licence is: ☐ Granted ☐ Pending ☐ Not Applied For ☐ Not Required *Where the Foreshore Licence has been granted, please include a copy with this application.*

B. (ii) Receiving Water Details - Discharge to Transitional / Coastal Water

<u>PART IV – Section 2 B is</u> to be completed where the application pertains to a discharge to coastal or transitional waters i.e. estuaries / marine waters.

Receiving water background chemical data.	**Parameter**	**Result (mean)**
	Chlorophyll a µg/l	
	Transparency Secchi depth	
	Salinity psu	
	Temperature °C	
	Dissolved Oxygen % saturation	
	Dissolved Inorganic Nitrogen mg/l N	
	Un-ionised Ammonia as mg/l N	
	Orthophosphate as mg/l P	
	Total Phosphorus as mg/l P	
	Nitrite as mg/l N	
	Nitrate as mg/l N	
	Total Nitrogen mg/l N	
	BOD_5 mg/l (Transitional Waterbody)	

Refer to "Guidance on Applying for a Discharge Licence" for guidance on reporting monitoring data and on sampling.

PART IV – Section 3

A. Impact of Discharge - Discharge to Inland Surface Waters

PART IV – Section 3 A is to be completed where the application pertains to a discharge to Inland Surface Waters.

Have any of the following assessments been carried out in terms of your proposed discharge / receiving waters?	☐ Toxicity Testing ☐ Bioaccumulation Testing ☐ Biodegradation Testing ☐ Aquatic / Fisheries Study ☐ Modeling of Mixing Zone ☑ Other: Assimilative Capacity and Mass Balance Assessment of receiving waters (Aghamore Stream and Lough Gill) and Natura Impact Statement *If 'Yes' please submit a copy of the report with this application:* **See attached cover letter and accompanying documentation**

B. Impact of Discharge - Discharge to Transitional / Coastal Waters

PART IV – Section 3 B is to be completed where the application pertains to a discharge to Transitional / Coastal Waters.

Have any of the following assessments been carried out in terms of your proposed discharge / receiving waters?	☐ Toxicity Testing ☐ Bioaccumulation Testing ☐ Biodegradation Testing ☐ Aquatic / Fisheries Study ☐ Dispersion Modeling ☐ Other ____________________(*please specify*) *If 'Yes' please submit a copy of the report with this application.*
Effluent Dispersion	Provide details for proposals for the dispersion of effluent. *Provide additional sheets where necessary.*

PART IV – Section 4

Checklist for Applicant when applying for a licence to discharge to Water	
Details to be Submitted	**Tick Box where included**
1. Fully completed, signed and dated application form (One original plus one hard copy and one electronic copy)	✓
2. Name & address of Applicant (& Agent where appropriate)	✓
3. Has the type of discharge been identified i.e. new or existing / domestic or trade?	✓
4. Has location of discharge been identified on a location map?	✓
5. Newspaper Notice (One original plus one hard copy)	✓
6. Application fee	✓
7. Site location map at scale 1:50,000	✓
8. Site layout map at scale of 1:2500	✓
9. Drainage system drawings at scale no greater than 1:2500	✓
10. Description of process giving rise to trade effluent	✓
11. Description of the proposed method of effluent treatment (including measures for the control of FOG where appropriate)	✓
12. Treatment system process drawings	✓
13. Outfall details and drawings	✓
14. Treatment system operation & maintenance details	✓
15. Effluent quality, discharge volume and flow details	✓
16. Receiving water quality assessment (physico-chemical & biological) and flow calculations	✓
17. Assessment of the impact of the discharge on the receiving water - Assimilative capacity calculations - Details of designated areas (including designation of waters) - Details of sensitivity of waters	✓
18. Proposals for dealing with sludge (where relevant)	✓
19. Emergency procedures in case of plant breakdown or pollution incident (including details of storage facilities onsite).	✓
20. Has one original plus one hard copy and one electronic copy of all associated documentation been included?	✓

Please include any additional information which you deem to be pertinent to the application / discharge.

See Cover Letter and supporting documentation for additional information in support of this licence review.

Appendix A - Provide details of process related raw materials, products etc. used or generated on site.

Substance	EC Number	Nature of Use	Amount Stored (tonnes)	Annual Usage (tonnes)	Danger Classification	Risk Phrase	Safety Phrase

Include copies of *Material Safety Data Sheets (MSDS) for materials.*

Ref. European Communities (Classification, Packaging, Labelling and Notification of Dangerous Substances) Regulations, 1994

Appendix B - Off-site Waste Disposal					
Waste Description	**EWC. Catalogue No.**	**Quantity (Tonnes per annum)**	**Name of site accepting waste**	**Reference ~~Number of site~~ environment licence**	**State whether recycling, recovery or disposal**

Appendix C - Characteristics of Trade and/or Domestic Effluent

The following list of parameters is indicative only. Additional physical, chemical or other characteristics as are pertinent to the effluent in question should also be identified.
Complete for all applicable sections, giving concentration ranges where available.

Emission Point co-ordinates (One table per emission point): **See supporting documentation with cover letter for this review application**

Parameter *Concentrations in mg/l unless otherwise stated*		***Prior to Treatment (if any)***			***As discharged***			
Characteristic *Note:* *Section A = to be completed where discharging domestic effluent only* *Section A-E = to be completed where discharging a trade effluent.*		***Max. Hourly***	***Max. Daily***	***Mg/l***	***Max. Hourly***	***Max. Daily***	***Mg/l***	***% Removal***
A	Temperature °C							
	pH							
	Biological Oxygen Demand (5 day)							
	Chemical Oxygen Demand							
	Suspended Solids							
	Total Ammonia (as N)							
	Nitrate (as N)							
	Total Phosphorus (as P)							
	Conductivity							
	Molybdate Reactive Phosphorus (MRP)							
	Oils, Fats and Greases							
	Sulphates (as SO_4)							
	Chlorides (as Cl)							
	Phenols (as C_6H_5OH)							
	Detergents (as Lauryl Sulphate)							
	Faecal Coliforms CFU							
B	**Metals** µg/l							
	Arsenic							
	Chromium							

	Copper							
	Cyanide							
	Fluoride							
	Lead							
	Nickel							
	Zinc							
	Other *(please specify)*							
C	**Pesticides & Solvents:**							
	Atrazine							
	Dichloromethane µg/l							
	Simazine µg/l							
	Toluene µg/l							
	Xylenes µg/l							
D	Organohalogen Compounds (Specify)							
	Organophosphorus Compounds (Specify)							
	Organotin Compounds (Specify)							
	Mineral Oils or Hydrocarbons of petroleum origin							
	Other toxic substances (Specify)							
	Colour (degrees hazen)							
E	**Other:**							
	Other relevant characteristics including fish toxicity data from tests carried out on all or part of the effluent							

Appendix D - Dangerous Substances

Are any of the following chemicals used in the process or stored on the premises	*Yes/No*	*Are residual chemical process materials or chemical tailings from a process recovered or discharged?*
EDC (1, 2 dichloroethane ($C_2H_4C1_2$)) **TRI trichloroethylene (C_2HC1_3);** **PER perchloroethylene (C_2 $C1_4$);** **TCB trichlorobenzene**		
Carbon tetrachloride, DDT and pentachlorophenol		
Aldrin, dieldrin, isodrin, HCB (hexachlorobenzene), HCBD (hexachlorobutadiene) and $CHCl_3$ (chloroform)		
Cadmium		
>100 kg of raw asbestos		
Atrazine		
Dichloromethane		
Simazine		
Toluene		
Tributyltin		
Xylenes		
Arsenic		
Chromium		
Copper		
Cyanide		
Fluoride		
Lead		
Nickel		
Zinc		

Appendix B -
Discharge Licence DL(W)-139

COMHAIRLE CHONTAE SHLIGIGH
SLIGO COUNTY COUNCIL

Local Government (Water Pollution) Act, 1977 & Local Government (Water Pollution) (Amendment) Act 1990

LICENCE TO DISCHARGE TRADE EFFLUENT TO WATERS

TO:	Cemex (ROI) Ltd., Killeen Road, Dublin, 12.
File Ref:	DL(W)139
Application received:	22nd October, 2010.
Further Information Received:	6th September, 2011.

Notice is hereby given that Sligo County Council in exercise of the powers conferred on it by the Local Government (Water Pollution) Act, 1977, as amended, decided to grant a licence, by Order No. 69 dated 4th November, 2011, to Cemex (ROI) Ltd., Killeen Road, Dublin, 12, to discharge trade effluent from Aghamore Quarry, Aghamore, Co. Sligo, to the Aghamore stream subject to the 8 conditions as set out in attached schedule.

Signed on behalf of Sligo County Council.

E. Garvin

Administrative Officer.

Date: 9th December, 2011.

SCHEDULE OF CONDITIONS

CONDITION 1: SCOPE

1.1 The Licensee shall only discharge settled water to the Aghamore Stream.

1.2 The installation shall be controlled, operated, maintained and emissions shall take place as set out in this licence. All programmes required to be carried out under the terms of this licence, become part of this licence.

1.3 No alteration in the activity or treatment process which would, or is likely to, result in a change in

- The nature or quantity of the final discharge,
- The treatment systems,
- The fuels, raw materials, products or wastes generated,
- Changes in the site management and control with adverse environmental significance

shall be carried out or commenced without the prior written agreement of the licensing authority.

CONDITION 2: INTERPRETATION

2.1 Emission limit values for emissions to waters in this licence shall be interpreted in the following way:

2.1.1 Continuous monitoring:
No flow value shall exceed the specified limit

2.1.2 Composite Sampling
No pH value shall deviate from the specified range.
No temperature value shall exceed the limit value.
For parameters other than pH, temperature and flow, eight out of ten consecutive composite results, based on flow proportional composite sampling, shall not exceed the emission limit value. No individual result similarly calculated shall exceed 1.2 times the emission limit value.

2.1.3 Discrete Sampling
For parameters other than pH and temperature, no grab sample shall exceed 1.2 times the emission limit value.

CONDITION 3: EMISSIONS TO WATERS

3.1 The maximum volume of trade effluent discharged from the site shall not exceed 3500m^3/day and the maximum volume of trade effluent discharged in any hour shall not exceed 146m^3.

3.2 The Licensee shall not discharge, or cause or permit to be discharged from the site any trade effluent whose characteristics exceed the emission limit values specified in Table 1 below. There shall be no other emissions of environmental significance.

TABLE 1: Trade Effluent Discharge Limit Values

Parameter	Discharge limit value	Units of measurement
Temperature	20	Degrees Centigrade
pH	6-9$^{\text{Note 1}}$	pH Units
BOD	2	mg/l
Total Ammonia	0.1	mg N/l
Total Suspended Solids	25	mg/l
Molybdate Reactive Phosphorus (MRP)	0.05	mg P/l
Total Phosphorus (as P)	2	mg/l P
Sulphates	200	Mg/l
Hydrocarbons	1	mg/l

Note 1: Exceedances outside the pH range of 6-9 are permitted for instrument calibration or maintenance, records to be kept of these exceedances.

3.3 No material change in the quality or quantity of the trade effluent being discharged shall be made without prior consent of the Licensing Authority.

3.4 The licensee shall not discharge, or cause or permit to be discharged from the site any effluent that will or is likely to result in the receiving water exceeding the limits set out in the European Communities Environmental Objectives (Surface Waters) Regulations, 2009.

CONDITION 4: MANAGEMENT OF THE SITE

4.1 All groundwater, floodwater and surface water arising from the operation of the quarry shall be directed/pumped to a settlement tank/cell/pond prior to discharge.

4.2 The Licensee shall submit an Environmental Management System (EMS) as detailed in the Environmental Protection Agency, *Environmental Management Guidelines for Environmental Management in the Extractive Industry* for approval by the licensing authority within 3 months of the date of grant of this licence.

4.3 Details in relation to the testing and certification of the new settlement lagoons, cells, pond and storm water channel to ensure they are watertight shall be submitted to the licensing authority for approval prior to use.

4.4 The Licensee shall nominate suitably qualified person(s) who shall be responsible for all environmental aspects on site including operation, maintenance & monitoring of the treatment/settlement system. The name of this person(s) shall be identified to Licensing Authority in writing within one month of the date of issue of this licence. The licensee shall provide appropriate training, for all personnel whose work could have a significant effect upon the environment.

4.5 The Licensee shall submit details of the ferric dosing system alarm including who will be alerted and how they will be alerted within 2 months of the date of this licence.

4.6 A penstock valve shall be installed to prevent a discharge from the facility in the event that monitoring and/or a visual inspection should indicate that -

(a) Discharge is not within its discharge licence limits or is liable to give rise to a breach in licence limits.

(b) Contamination of water has taken place on site which could adversely affect the quality of the water to be discharged.

4.7 Sediments shall be removed from all settling lagoons, cells, ponds on a regular basis, as deemed necessary by the rate of deposition and shall be disposed of in accordance with current waste legislation.

4.8 In the event of quarrying activities having an adverse impact on wells in the vicinity, the developer shall identify and take appropriate mitigating measures to address the cause of any adverse impact created by quarrying activities and undertake appropriate remedial measures as agreed with the Licensing Authority, at the developer's expense.

4.9 All vehicle maintenance shall take place in a roofed area.

CONDITION 5: MONITORING and REPORTING

5.1 The company shall install and maintain on the final effluent discharge pipe a flow proportional sampler and an automatic flow measuring device with a chart recorder which will record instantaneous rate of flow. An integrated unit shall be provided and daily records of the discharge shall be kept. Flow records shall be submitted quarterly to the licensing authority.

5.2 The final effluent shall be monitored in accordance with the requirements set out in Table 2 below. All analysis shall be carried out by an independent laboratory accredited for each of the parameters specified.

Table 2

Parameter	Monitoring Frequency	Analysis method
Flow	Continuous	On-line flow meter with recorder
Temperature	Monthly	Temperature meter
pH	Monthly Note 1	Standard Method
BOD	Monthly Note 1	Standard Method
Total Ammonia	Monthly Note 1	Standard Method
Total Suspended Solids	Monthly Note 1	Gravimetric
Molybdate Reactive Phosphorus	Monthly Note 1	Standard Method
Total Phosphorus (as P)	Monthly Note 1	Standard Method
Nitrite	Monthly Note 1	Standard Method
Sulphates	Quarterly Note 1	Standard Method
Hydrocarbons	Yearly	Standard Method
Conductivity	Monthly Note 1	Standard Method

Note 1: 24 hour composite sample

5.3 Within three months of the date of issue of this licence, the licensee shall install to the satisfaction of the licensing authority an automatic turbidity monitor on the final effluent discharge pipe from the site. The set point on this monitor shall automatically shut down the discharge pumps and activate an alarm in the site management office. The set point and who will be alerted shall be subject to the agreement of the licensing authority at commissioning and shall be reviewed quarterly for the first year of operation and annually thereafter. Any variation on the set point shall be agreed by the licensing authority.

5.4 The Aghamore Stream shall be monitored upstream and downstream of the discharge in accordance with the requirements set out in Table 3 below

TABLE 3

Parameter	Monitoring Frequency	Analysis method
Temperature	Monthly	Temperature meter
pH	Monthly	Standard Method
BOD	Monthly	Standard Method
Total Ammonia	Monthly	Standard Method
Total Suspended Solids	Monthly	Gravimetric
Molybdate Reactive Phosphorus	Monthly	Standard Method
Total Phosphorus (as P)	Monthly	Standard Method
Nitrite	Monthly	Standard Method
Sulphates	Quarterly	Standard Method
Conductivity	Monthly	Standard Method

5.5 The company shall install and maintain an automatic flow measuring device with a chart recorder to record the rate of flow in the Aghamore stream upstream of the discharge point. Flow records shall be submitted quarterly to the licensing authority.

5.6 The Licensing Authority shall reserve the right after giving advance notice in writing to increase or decrease the frequency of sampling, analysis, flow measurement and method and scope of monitoring and analysis.

5.7 The licensee shall record all sampling, measurements, flow records, examinations, calibrations and maintenance carried out in accordance with this licence and these records shall be submitted to the licensing authority on a quarterly basis or on request by the licensing authority.

5.8 Certified monitoring results of the final effluent quality and Aghamore Stream shall be submitted to Licensing Authority on a quarterly basis.

5.9 The licensee shall record all complaints of an environmental nature related to the operation of the activity. Each such record shall give details of the date, time and nature of the complaint, the name of the complainant. A record shall also be kept of the response made in the case of each complaint.

5.10 The settlement lagoons, ponds, cells should be inspected monthly and tested every three years to ensure they are watertight.

5.11 All automatic monitors and samplers shall be functioning at all times (except during maintenance and calibration) when the activity is being carried on unless alternative sampling or monitoring has been agreed in writing by the Licensing Authority for a limited period. In the event of malfunction of the continuous monitor, the licensee shall contact the Licensing Authority as soon as practicable and alternative sampling and monitoring facilities shall be put in place.

5.12 All treatment, monitoring equipment and the interceptors shall be maintained on a regular basis in accordance with the manufactures instructions. A log shall be put in place to record the time and date of maintenance, together with any observations made during these inspections. This log shall be made available for inspection on request.

5.13 Records of the type and quantity of waste taken off site, date taken offsite and the name of the company taking the waste to be kept and submitted to Licensing Authority on request.

5.14 The licensee shall submit to the Licensing Authority, a year from the date of grant of this licence, and each calendar year thereafter, an Annual Environmental Report. This report shall include as a minimum the following information

- Surface water emission limit and flow exceedances
- Waste management report
- Complaints summary
- Pollution emission and environmental incident report, including the date and time of incidents and the steps taken to minimise the emissions and avoid recurrence
- Lagoon, ponds and cells testing and inspection report.

5.15 The Licensee shall provide safe and permanent access to the trade effluent discharge pipeline prior to discharge to the stream. This sampling point shall be accessible at all times to any authorised person under the Local Government (Water Pollution) Act, 1977 & 1990. This shall include access to on-site instrumentation for sampling and flow measurement.

CONDITION 6: WASTE and OIL MANAGEMENT

6.1 All tank and drum storage areas shall be provided with an adequately designed bund and shall be rendered impervious to the materials stored therein. All tank and drum storage areas shall, as a minimum be bunded to a volume not less than the greater of the following:

i. 110% of the capacity of the largest tank or drum within the bunded area; or
ii. 25% of the total volume of substance which could be stored within the bunded area.

6.2 (i) All drainage from bunded areas shall be treated as hazardous waste unless it can be demonstrated to be otherwise. All drainage from bunded areas shall be diverted for collection and safe disposal. While awaiting disposal, all materials shall be collected and stored in designated areas protected against spillage.

(ii) The integrity and water tightness of all the bunding structures and their resistance to penetration by water or other materials stored therein shall be tested by the licensee at least once every three years.

6.3 Concrete aprons that drain to a hydrocarbon interceptor shall be provided at all locations where the storage or handling of hydrocarbons takes place. Where plant is being fuelled on the quarry floor, drip trays shall be used to prevent spillage.

6.4 The licensee shall install and maintain adequately designed oil separators at the site to ensure that all storm water discharges from the site pass through an oil separator in advance of discharge. The separator shall be a Class I full retention separator.

6.5 A maintenance contract shall be entered into with the supplier of the oil separators. A copy of the maintenance contract to be submitted to the Environment Section within 6 months of grant of this licence and thereafter annually.

6.6 Drums of oil, fuels and other chemicals to be stored in the workshop/maintenance shed on spill pallets, unless otherwise agreed in writing with the licensing authority.

6.7 All wastes including waste oils, used batteries etc shall be collected and stored in the workshop. The storage area shall be bunded or otherwise designed so that surface and ground waters cannot be contaminated by spillage.

6.8 All waste shall be recovered or disposed of in accordance with current Waste legislation.

6.9 All tanks, containers and drums shall be labelled to clearly indicate their contents.

CONDITION 7: ACCIDENT PREVENTION and EMERGENCY PROCEDURES

7.1 The licensee shall notify The Licensing Authority by telephone and electronic mail as soon as practicable of any occurrence of an accidental spillage, discharge or deposit of any pollutant, which enters or is likely to enter waters or cause environmental pollution. The licensee shall include as part of the notification, date and time of the incident, summary details of the occurrence, and the steps taken to minimise any emissions.

7.2 In the event of an incident the licensee shall immediately-

- (i) carry out an immediate investigation to identify the nature, source and cause of the incident and any emission arising
- (ii) isolate the source of such an emission
- (iii) evaluate the environmental pollution, if any caused by the incident
- (iv) identify and execute measures to prevent further contamination and to minimize the emissions and the effects thereof

7.3 The Licensee shall have in storage an adequate supply of containment booms and/or suitable absorbent material to contain and absorb any spillage.

CONDITION 8: GENERAL

8.1 The company shall pay a sum of €1,200 per annum, subject to annual review, and updated in accordance with Consumer Price Index, to cover the cost of monitoring by the licensing authority.

Appendix C -
Application for Transfer of Discharge Licence DL(W)-139

Sligo County Council
Environment Section
County Sligo

APPLICATION TO TRANSFER A DISCHARGE TO WATERS LICENCE ISSUED UNDER SECTION 4 OF THE LOCAL GOVERNMENT (WATER POLLUTION) ACT 1977, AS AMENDED BY THE LOCAL GOVERNMENT (WATER POLLUTION) (AMENDMENT) ACT 1990.

Part A

EXISTING LICENSEE DETAILS

DISCHARGE LICENCE NUMBER: DL(W)139

LICENSEE: CEMEX (ROI) Ltd.

DATE DISCHARGE LICENCE GRANTED: 9th December 2011

I am the Licensee with responsibility for compliance with the above referenced discharge licence.

SIGNED BY LICENSEE (Company Secretary)

DATE 27th March 2019

Part B

NEW COMPANY DETAILS

If applicant is a registered company, state:

Registered Company Name: LAGAN BITUMEN LTD.
(accompanied with a Certificate of Incorporation)

Address of Registered Office: ROSEMOUNT BUSINESS PARK, BALLYCOOLIN ROAD
DUBLIN 11, D11 K2TP

Name of Company Secretary: CIARA CASSIDY

List of Company Directors: TERENCE LAGAN

ROBERT WOOD

ROSS McDONALD

CIARA CASSIDY

Registered Head Office Address ROSEMOUNT BUSINESS PARK
BALLYCOOLIN ROAD
DUBLIN 11, D11 K2TP

I confirm that I am aware of the provisions of the discharge to waters licence as referenced above and will comply in full with the conditions of the discharge licence.

CIARA CASSIDY

SIGNED

Company Secretary

Dated the 5th **day of** April **2019**

Appendix D -
Lagan Bitumen Ltd. Certificate of Incorporation

Companies Registration Offic

FEE IN FULL PAID
DOC. SEQ. No. 025
DEL. -9 FEB 1998
REGD.
COMPANIES REGISTRATION OFFICE

Change of Name
Special Resolution

Companies Acts 1963 to 1990

Company Number

1 2 3 4 9 4

G1Q

REGIS -5 MAR 1998

Company name

PRESSEAST EMULSIONS Limited

The following Special resolution of the above-named company was passed

☐ in writing pursuant to Section 141 (8)

☑ pursuant to Section 141 at an extraordinary general meeting of the members of the company convened and held at

ROSEMOUNT,
BALLYCOOLIN ROAD, DUBLIN 11

on the 31 Day JANUARY Month Year 1998

Subject to the approval of the Minister, the name of the company shall be changed to

LAGAN BITUMEN Limited

I hereby certify that the above particulars are correct

Signature ☑ Director ☐ Company secretary Date 31/1/

Name JOHN PATRICK KEVIN LAGAN

C.R.O.

Presenter's Name

Address

Telephone Number

Reference

Appendix E -
Newspaper Notice: Irish Times 30 July 2019

Irish Open could face calendar shift

It all feels a bit like crash, bang, wallop after all. Any chance of the Dubai Duty Free Irish Open avoiding a direct clash with the WGC-St Jude Invitational next year would appear to be scuppered after the PGA Tour confirmed that the championship in Memphis will next year move forward by three weeks into the slot which the Irish Open has occupied in the European Tour schedule in recent years.

If the Irish Open stays put, then there is an unavoidable clash with the WGC. So, there are basically two options: stay – and, just as the French Open did in 2016 – don't offer any Ryder Cup points or Race to Dubai points for those European players who opt for Memphis over Ireland; or move, releasing the tournament from the Links Swing and take another date in the revised European Tour schedule.

In reacting to the PGA Tour's decision to move the WGC, Keith Pelley (above), the chief executive of the European Tour, said: "We have had discussions with the PGA Tour in recent months about the challenges presented by the global golfing calendar in 2020. We are currently finalising our full European Tour schedule for 2020 which we will announce in due course."

Next year's itinerary is complicated by the Olympics and also the Ryder Cup, which has seen the PGA Tour – which yesterday announced an expanded 2019-20 schedule of 49 tournaments – move to "accommodate" those complications.

The PGA Tour has also announced the staging of two new tournaments, one of them, the Zozo Championship, in Japan.

The lead-up to the Olympics sees the most notable changes to the US circuit's calendar, with the 3M Open in Minnesota (which this year clashed with the Irish Open) switching dates with the WGC-St Jude.

"After a very successful first year with our new schedule, we are thrilled to expand the number of events to 49 while maintaining a great flow from start-to-finish," said PGA Tour commissioner Jay Monahan.

It all smacks of the PGA Tour looking after itself without regard for the impact caused on the PGA European Tour and, most specifically, to the Irish Open. Time will tell us how Mr Pelley & Co react.

Word of mouth (I)

> "I always take less time on Sunday. I'm already loose when I get to the golf course. I don't even need to hit balls. I've already stretched. I don't know why everybody is in a panic. I'm not. I'm not stressed at all"

– Brooks Koepka on his laid-back approach, in arriving to the course just 45 minutes ahead of his

By the numbers

2-4-1

Barely a matter of weeks into his professional career, and Collin Morikawa (above) has made a sensational impact. In six events, he has made every single cut . . . and his hot streak – runner-up in the 3M Open earlier this month and third in the John Deere Classic – got even hotter with a breakthrough tournament

Mount Juliet enjoy home comforts as they make final cut for The K Club

Philip Reid
Golf Correspondent

Hosts pip Waterford with Kilkenny claiming the third spot

fer.

Indeed, it was the host club team of captain Kevin McCartan, lady captain Freda Mullen and lady vice-captain Annette Hogan who claimed the top honours – by the narrowest of margins – from Waterford Golf Club, which is where the technicality comes in: despite its

Mount Juliet qualifiers

80pts
Mount Juliet (Kevin McCartan, 12; Freda Mullen, 12; Anette Hogan, 26).
79pts
Waterford GC (Fa

which has water down th
off the tee. Cleary's boge
was as good as it got ther
them.

Happy

As if to show the fine line
tween winning and finis
runner-up, Mount Juliet

Word of mouth (II)

> “There’s nobody in the game so far has won more than nine, and this is my 11th, so it means a great deal to have done something that nobody else has done, not even the great Jack Nicklaus or Gary Player, or we can do down a long list, the Tom Watsons and on and on”

– The evergreen Bernhard Langer on winning a fourth British Senior Open and 11th career Senior Major

Twitter twaddle

“Well that was on ehell of a week. From the bottom of my heart I would like to thank everyone for all their kind messages. I’d like to thank my sponsors @SrixonGolf @Kingspan_IRL @bankofireland @immedis @Paddypower and @KearysBMW for their support. Time to push the reset button.”

– Shane Lowry is apparently ready to resume playing following his British Open celebrations.

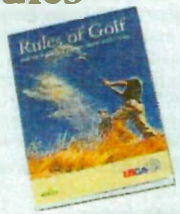
“Fantastic to see the momentum in Irish golf continues to gather pace. JP has done so much for Ireland and its golfers. His renovation of @TheAdareManor has created an amazing stage for one of the greatest shows in golf. Congrats to all involved #Adare2026.”

– Graeme McDowell, considered a possible European captain for the match against the USA at the Co Limerick venue.

“Surreal”

– Twenty-two-year-old Collin Morikawa, winner of the Barracuda championship, keeps it short and sweet after winning in just his sixth start as a professional.

Know the rules



Q After two players hole out, each discovers they have finished the hole with the other player’s ball but cannot establish where the balls were exchanged during play of the hole. Both players rewind their respective playing of the hole and are certain they started and finished the hole with the same ball. What is the ruling?

A There is no per[illegible] In this situation, and [illegible]use a player is allowed to start each hole with any

In the bag

Jin Young Ko (Evian Championship)

Driver – Callaway Epic Flash (9 degrees)
3-wood – Callaway Epic Flash (15 degrees)
5-wood – Callaway Epic Flash (18 degrees)
Hybrid – Titleist HI
Irons – Bridgestone Tour B Forged (5-PW)
Wedges – Ping Glide

5	Tiger Woods (USA)	6.93
6	Francesco Molinari (Ita)	6.45
7	Jon Rahm (Spa)	6.42
8	Bryson DeChambeau (USA)	6.37
9	Justin Thomas (USA)	6.10
10	Patrick Cantlay (USA)	6.08
11	Xander Schauffele (USA)	5.95
12	Tommy Fleetwood (Eng)	5.58
13	Tony Finau (USA)	5.47
14	Gary Woodland (USA)	5.26
15	Matt Kuchar (USA)	5.21
16	Rickie Fowler (USA)	5.20
17	Webb Simpson (USA)	5.09
18	**Shane Lowry** (Ire)	4.94
19	Paul Casey (Eng)	4.82
20	Adam Scott (Aus)	4.77
Other Irish		
99	**Graeme McDowell**	1.47
207	**Paul Dunne**	0.83
306	**Séamus Power**	0.57
323	**Pádraig Harrington**	0.55
355	**Cormac Sharvin**	0.51
703	**Gavin Moynihan**	0.21

USPGA Tour money winners

(USA unless stated)

1	Brooks Koepka	€9,551,384
2	**Rory McIlroy** (N Ire)	€7,373,708
3	Matt Kuchar	€6,273,119
4	Gary Woodland	€5,615,961
5	Xander Schauffele	€5,497,346
6	Dustin Johnson	€5,439,066
7	Patrick Cantlay	€4,946,738
8	Jon Rahm (Spa)	€4,102,110
9	Justin Rose (Eng)	€4,096,778
10	Paul Casey (Eng)	€4,068,651
18	**Shane Lowry** (Ire)	43,444,879

European Tour Order of Merit

(Irish in **bold**, British unless stated)

1	**Shane Lowry**	3,344.6pts
2	Bernd Wiesberger (Aut)	2,812.3
3	Jon Rahm (Spa)	2,658.3
4	Tommy Fleetwood	2,114.5
5	Matt Wallace	2,103.2
6	Kevin Kisner (USA)	1,822.8
7	Louis Oosthuizen (Rsa)	1,792.6
8	Xander Schauffele (USA)	1,691.1
9	Matthew Fitzpatrick	1,686.8
10	Jorge Campillo (Spa)	1,658.6

roof top plantroom. The demolition of a temporary steel framed walkway and timber deck and removal of various mechanical plant will be required to facilitate the development. The development is located at the Hospital level 0 in the external courtyard between the McGivney Wing to the west and the Whitty Wing to the East and will connect to both Wings. This is within the centre of the Mater Hospital Campus, Eccles Street, Dublin 7 and has a total floor area of 744m². The works form part of the ongoing enabling works for the development of the Hospital s facilities. The planning application may be inspected or purchased at a fee not exceeding the reasonable cost of making a copy, at the offices of Dublin City Council. Planning Department, Block 4, Ground Floor, Civic Offices, Wood Quay, Dublin 8 during its public opening hours (9.00a.m.- 4.30p.m.). A submission or observation in relation to the application may be made in writing to the planning authority on payment of the prescribed fee (€20.00) within the period of 5 weeks beginning on the date of receipt by the authority of the application, and such submissions or observations will be considered by the planning authority in making a decision on the application. The planning authority may grant permission subject to or without conditions or may refuse to grant permission.

FINGAL COUNTY COUNCIL - We, Mylan Ireland Ltd intend to apply for planning permission for development at Mylan, Damastown Industrial Estate, Mulhuddart, Dublin 15. The development will consist of the construction of a new 235 sq/m, part 6.35 metre high, part 4.35 metre high single storey storage area extension and associated works located to the rear (North) of the existing main production building. The application relates to a development on a site which comprises an activity requiring an integrated pollution prevention and control license. The planning application may be inspected or purchased at a fee not exceeding the reasonable cost of making a copy at the offices of the planning authority during its public opening hours and a submission or observation may be made to the authority in writing on payment of the prescribed fee within the period of 5 weeks beginning on the date of receipt by the planning authority of this application.

County Council to review Discharge Licence No. DL(W)139 to discharge Trade Effluent comprising surface water and groundwater to the Aghamore Stream and Lough Gill from their premises located at Aghamore Near and Carrownamaddoo townlands, Co. Sligo.

All relevant documentation relating to the licence review is available for inspection at Sligo County Council Environment Section, Riverside, Sligo. Representations relating to the licence review may be made in writing to the Local Authority at the above address within one month from today's date.

Date 30 July 2019

LICENSED PREMISES

SELLING OR BUYING a 7 Day Liquor Licence. Contact 0404 42832.

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(Scale B)

The hours of work are tho prescribed under Public Sector Agreements in respect of Academic staf

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[illegible]AS & CHAIRS

Appendix F -
Lagan Bitumen Ltd. Environmental Management Plan for Aghamore Quarry

LAGAN BITUMEN

AUGHAMORE

ENVIRONMENTAL MANAGEMENT PLAN

CONTENTS

Lagan Bitumen
A Lagan Company

LAGAN BITUMEN

AUGHAMORE

ISO 14001: 2015

ENVIRONMENTAL MANUAL

AMENDMENT RECORD

Date	Section	Amendmen No.	Amendment
31/01/2006	All	1	Various changes to align document for both quality and environmental procedures and include reference to specific Air Emissions Licence where applicable.
31/01/2007	All	2	Various changes including personnel updates
31/03/2008	All	3	Implementation of FPC in accordance with EN 13108-21:2006 and issue 7 of SS14.
18/04/2008	All	4	Updated to include cross-references to site-specific Permits & Licences and to site-specific procedures
16/01/2009	All	5	Various changes made to the Procedures to account for changes at the site and to accommodate a change in the inspection sheets
01/02/2017	All	6	Complete revision and update to comply with requirements and format of ISO 14001:2015.
08.04.2019	All	7	Revised to incorporate Lagan Bitumen name
08.04.2019	DP008	2	Revision to incorporate updated water quality monitoring commitments and reporting requirements to the Local Authority

Clause Title **Page**

INTRODUCTION

Lagan Macadam Ltd and Lagan Bitumen Ltd operate Asphalt Plants in strategic locations aimed at being able to service all but the remotest regions of Ireland. The Asphalt plants are located at:

Keady, Co Armagh;
Ballycoolin, Co Dublin;
Rossmore, Carrigtwohill, Co Cork;
Tulla, Co Clare;
Bennetsbridge, Co Kilkenny;
Kinnegad, Co Westmeath;
Belcare, Tuam, Co Galway;
Ballisodere, Co Sligo;
Bweeng, Mallow, Co Cork.

Lagan Bitumen Ltd also operates aggregate quarries in Duleek, County Meath and Aughamore, Co Sligo and a sand and gravel quarry at Dolans Pit, Coolrain, County Laois.

Lagan Quarries Ltd operates aggregate quarries in the following locations:

Rossmore, Carrigtwohill, County Cork;
Bweeng, Mallow, County Cork.

The Companies head office facility is based on the outskirts of Dublin at Rosemount Business Park, Ballycoolin.

The Companies have established an integrated management system (IMS) designed to comply with the Environmental requirements of the ISO 14001:2015 standard and the Quality Management requirements of ISO 9001:2015. The IMS is a two-tier system with this top-level Environmental Manual based on ISO EN 14001:2015 being applicable to all activities. The top-level Quality manual then feeds down to the Factory Production Control (FPC) Quality Plans and the depot specific Environmental Management Plans.

The FPC Quality Plans incorporate the procedures and controls in place to reflect the quality system for asphalt and aggregate production. The Environmental Management Plans (EMP) are depot specific and have been designed to comply with the requirements of ISO EN 14001:2015. The EMP's record the procedures and controls in place to reflect the Quality System and the specific environmental aspects and impacts and the legislative requirements applicable at each depot.

The Company has implemented a quality assurance system and an environmental management system and has certification to the ISO 9001 and ISO 14001 standards. The Company's experience and implementation of the systems has identified the advantages of a structured and systematic approach in achieving managerial objectives.

The establishment of an IMS will ensure that the objectives and targets that the Companies sets themselves in the environmental and quality policies are appropriate.

1 SCOPE

The Environmental Management System of Lagan Bitumen is outlined in this Environmental Manual and is based on the requirements of ISO 14001:2015.

Consistent with Lagan Bitumen's Environmental Policy, the intended outcomes of the Environmental Management System (EMS) include:

- enhancement of environmental performance;
- fulfilment of compliance obligations;
- achievement of environmental objectives

The EMS is applicable to the activities within the control and boundary of the Lagan Bitumen facility at Aughamore, Sligo, Co. Sligo.

2 NORMATIVE REFERENCES

There are no normative references applicable to this document.

3 TERMS AND DEFINITIONS

For the purpose of this manual the terms and definitions used are as defined in Section 3 of ISO 14001:2015.

4 CONTEXT OF THE ORGANISATION

4.1 Understanding the organisation and its context

Lagan Bitumen has determined external and internal issues that are relevant to its purpose and that affect its ability to achieve the intended outcomes of its environmental management system. Such issues include environmental conditions being affected by or capable of affecting the organisation.

An environmental review of internal and external issues relevant to Lagan Bitumen was completed and considered the following:

- environmental conditions relating to climate, air quality, water quality, flora and fauna, archaeological quality, land use, natural resource availability and biodiversity that can either affect the company's purpose or be affected by its environmental aspects.

- the external cultural, social, political, legal, regulatory, financial, technological, economic, natural and competitive circumstances

- the activities, products and services, strategic direction, culture and capabilities (people, knowledge , processes, systems)

This review provided an understanding of the context of Lagan Bitumen and is used to establish, implement, maintain and continually improve its EMS. The internal and external issues that were and continue to be determined can result in risks and opportunities to Lagan Bitumen or to the EMS. The organisation determines those that need to be addressed and managed as described in the following sections of this manual.

4.2 Understanding the needs and expectations of interested parties

The company has determined the interested parties that are relevant to the EMS. All stakeholders in both the operation of the facility and recipients of the goods produced onsite are considered interested parties. The interested parties for the company include the Licensing Authorities, the Health and Safety Authority, the facility neighbours, customers and anybody who may be impacted directly or indirectly by the company activities on and off-site or the goods produced.

Lagan Bitumen clearly understands the requirements of all stakeholders as described above including the applicable statutory and regulatory requirements. The stakeholders and their associated requirements and any associated risks are routinely reviewed and updated. These are reviewed at strategic level as part of the management review process and are documented with appropriate minutes maintained. Actions and targets associated with this are added to the Lagan Bitumen Objectives and Targets.

The compliance obligations are determined from the above stakeholder requirements and these are set out in the Environmental Management Plan for the site.

4.3 Determining the scope of the environmental management system

Lagan Bitumen has determined the boundaries and applicability of its Environmental Management System to establish its scope. When determining the scope Lagan Bitumen considered the following:

- The external and internal issues referred to in 4.1;
- The compliance obligations referred to in 4.2;
- Its organisational units functions and physical boundaries;
- Its activities, products and services;
- Its authority and ability to exercise control and influence;

The scope of the Lagan Bitumen EMS is defined as all activities, products and services of the organisation operated or directed from within the physical boundaries of the site as detailed in the Planning Permission Application and as detailed in the Environmental Management Review which is carried out annually and is available to interested parties.

4.4 Environmental management system

To achieve the intended outcomes including enhancing its environmental performance Lagan Bitumen has established, implemented, maintains and continually improves its Environmental Management System including the processes needed and their interactions in accordance with the requirements of International Standard ISO 14001:2015 as detailed in this manual and associated documents and processes.

The Environmental Manual is a controlled document, which identifies the overall organization responsibilities, products, services and facilities, and the scope of operation of Lagan Bitumen. It also defines all procedures devised to ensure that the policy objectives are met.

There is also the controlled subsidiary "Depot Procedures" manual, which contain procedures and instructions, which govern the environment-critical activities of the product / service in accordance with the stated objectives of the Environmental Manual.

5 LEADERSHIP

5.1 Leadership and commitment

Top management demonstrates leadership and commitment with respect to the Environmental Management System by:

- Taking accountability for the effectiveness of the EMS;
- Ensuring the environmental policy and environmental objectives are established and are compatible with the strategic direction and the context of the organisation;
- Ensuring the integration of the EMS requirements into the organisations business processes;
- Ensuring that the resources needed for the EMS are available;
- Communicating the importance of effective EMS and of conforming to the EMS requirements;
- Ensuring that the EMS achieves it intended outcomes;
- Directing and supporting persons to contribute to the effectiveness of the EMS;
- Promoting continual improvement;
- Supporting other relevant management roles to demonstrate their leadership as it applies to their areas of responsibility.

5.2 Environmental policy

Top management has established, implemented and maintains an environmental policy that within the defined scope of its Environmental Management System:

- Is appropriate to the purpose and context of Lagan Bitumen including the nature, scale and environmental impacts of its activities, products and services;
- Provides a framework for setting environmental objectives;
- Includes a commitment to the protection of the environment, including prevention of pollution and other specific commitments relevant to the context of the organisation;
- Includes a commitment to fulfil it's compliance obligations;
- Includes a commitment to continual improvement of the EMS to enhance environmental performance.

The environmental policy is maintained as documented information, is communicated within the organisation at induction, awareness training and is available to interested parties as detailed in the Depot Procedures. The policy applies to all staff at Lagan Bitumen and a copy is clearly displayed in the reception area which is accessible to all staff and the public. A copy of the policy is also available to the public on request. Contractors will also be made aware of the relevant sections of the Environmental Policy that are applicable to them. A copy of the Environmental Policy is presented below.

Environmental Policy

Lagan Bitumen recognises that our operations directly impact on the natural and human environment and aim through our Environmental Policy to continually assess the environmental implications of our activities and will actively seek the co-operation of clients, sub-contractors, suppliers, and all our employees in minimising adverse effects during the operation of all plant and machinery and associated activities at the Site.

The Environmental Management System established by Lagan Bitumen is designed to comply with the requirements of the ISO 14001:2015 standard and site specific licences, where applicable and is appropriate to the nature, scale and environmental impacts of the activities undertaken.

Implementation of this policy is the responsibility of every member of staff, starting with the Managing Director who takes policy decisions, which enable the correct action to be implemented throughout the company. The Technical Manager is responsible for maintaining the implementation of the Environmental Policy.

The Company is committed to the protection of the environment including the prevention of pollution, sustainable resource use and the protection of biodiversity and ecosystems and will establish a register of applicable legislation, with particular emphasis placed on those items of legislation that relate to or are applicable to the environmental aspects associated with the Companies activities at the Site. The Company is committed to complying with these and any other relevant environmental legislative requirements, regulations and contractual obligations enforced by local authorities, councils, planning bodies, environmental groups and interested parties including stakeholders.

Lagan Bitumen is committed to continual improvement in all aspects of our environmental performance and will ensure that every effort is made to protect the environs in and around the site and will seek to prevent emissions outside the designated area.

Lagan Bitumen will set environmental targets and objectives. These targets and objectives will where possible be quantitative. The targets and objectives will be reviewed and will be modified from time to time in order to affect a process of continual improvement. Targets and Objectives established will cover all aspects of Lagan Bitumen activities and will ensure that all significant impacts are identified and measures taken to mitigate against them.

Lagan Bitumen will implement, maintain and will communicate this policy to all employees and will ensure that sub-contractors used by Lagan Bitumen will be fully aware of this policy.

Terry Lagan
Director

Date: 8th February 2017

5.3 Organisational roles, responsibilities and authorities

Top management ensures that the responsibilities and authorities for relevant roles are assigned and communicated within the organisation.

Top management assigns the responsibility and authority for:

- Ensuring that the Environmental Management System conforms to the requirements of ISO 14001:2015;
- Reporting on the performance of the EMS including environmental performance to top management.

Lagan Bitumen roles are shown in the company's organisation chart below. In the absence of the responsible person the relevant manager or subordinate will undertake the assigned duties or delegate as required. The organization chart identifies functions and their interrelations within the companies. This chart is posted within the organisation to communicate and facilitate effective quality management.

The Technical Director establishes and monitors the EMS systems and disseminates pertinent information to the Technical & Environmental Manager who will be responsible for ensuring that the company EMS requirements are implemented and maintained in order to comply with the requirements of ISO 14001.

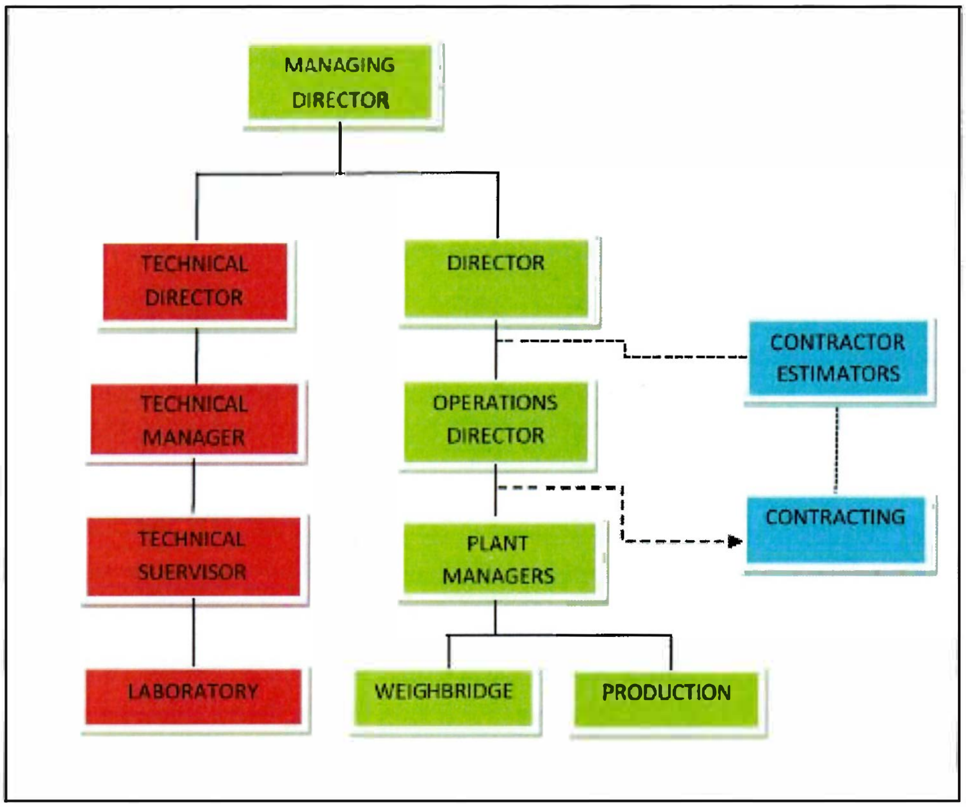
The Technical Supervisor will liaise on a regular basis with the Technical Manager and will report on the effectiveness of its operation.

The Operations Director implements the company requirements at regional level.

The Depot Manager implements the day to day requirements at depot level.

The Group Directors will ensure that sufficient resources are allocated to the system to ensure its satisfactory operation.

ORGANISATION CHART



Responsibilities

Lagan Bitumen employees and sub-contractors have the authority and responsibility to protect the environment at all times. Responsibilities are detailed during the site induction. The Technical Supervisor is the environmental representative on site. It is the responsibility of all staff to report any environmental accidents, incidents, near misses or anything that could potentially cause any of these.

Managing Director

The Board of Lagan Bitumen will ensure that adequate resources are provided

Technical Manager

The Technical Manager is responsible for the establishment of the ISO 9001 and 14001 management systems and providing support to the company. He will be responsible for auditing the system as per the requirements of the audit schedule. He will be responsible for ensuring that environmental aspects are reviewed and that their significance has been determined. He will be responsible for ensuring that the system is being maintained in a satisfactory manner. He will ensure that adequate training has been given to all appropriate personnel and that they are fully familiar with their roles and responsibilities.

Operations Director

The Operations Director is responsible for the management of all operational matters at Depots and functions within his area.

Plant Manager

The Plant Manager will be responsible for ensuring that directives from the Managing Director and the Environmental Department are implemented at the depot. He will liaise on a regular basis with the Technical Manager and Operations Director.

The Plant Manager is responsible for the implementation and maintenance of the EMS for all activities carried out at the Depot. An element of the following list of responsibilities may be delegated as required but responsibility remains with the Site Manager.

Responsibilities include:

- Maintenance of all on site environmental records;
- Ensuring that emergency procedures are implemented in the event of an accident or emergency situation;
- Performing weekly H&S, QA and Environmental Inspections;
- Ensuring site targets and objectives are completed within their allocated time scales;
- Resolution of all NCR's;
- Ensuring all monitoring requirements are fulfilled including monitoring stack emissions;
- Ensuring a licensed waste contractor is used for removal and disposal of waste leaving site;

Laboratory Technician

The Laboratory technician reports to the Operations Director/Plant Manager.

Responsibilities include:

- Maintaining all testing and Sector Scheme 14 records;
- Carrying out stockpile checks;
- Maintenance of all calibration records for the Depot;
- Carrying out weekly environmental checks;
- Carrying out daily weather recording;

Weighbridge Operator

The Weighbridge Operator reports to the Operations Director/Plant Manager.

Responsibilities include:

- Weighing of Lorries, incoming and outgoing;
- Maintenance of goods inwards records;
- Logging bitumen deliveries;
- Carrying out daily dust checks.

6 PLANNING

6.1 Actions to address risks and opportunities

6.1.1 General

The organisation has established, implemented and maintains the process needed to meet the planning requirements.

When planning for the EMS, Lagan Bitumen considers the issues referred to in Section 4.1 and the requirements referred to in Section 4.2 and also the scope of the EMS. The company determine the risks and opportunities that are required to be addressed to:

- give assurance that the EMS can achieve its intended outcomes;
- prevent or reduce undesired effects, including the potential for external environmental conditions to affect the organisation and
- achieve continual improvement.

The scope of the EMS includes the determination of potential emergency situations, including those that can have an environmental impact.

The organisation maintains documented information of its:
- risk and opportunities that need to be addressed;
- processes needed in Sections 6.1.1 to 6.1.4 to the extent necessary to have confidence they are carried out as planned.

A risk analysis review is performed at monthly board meetings and the resulting actions form part of the Objectives and Targets for the company. Lagan Bitumen will then, were appropriate, plan actions to address these risks and opportunities through setting of Objectives and Targets and integrate and implement the actions into its EMS processes. These actions are then evaluated for the effectiveness on an ongoing basis

Actions taken to address risks and opportunities shall be proportionate to the potential impact on the conformity of products and services.

6.1.2 Environmental aspects

Lagan Bitumen has made an environmental impact assessment of the activities to be undertaken by the Company. It will evaluate these documents in conjunction with existing assessments made as a requirement of its own ISO 14001 management system to identify the environmental aspects and impacts of their activities and determine those which are deemed significant. Lagan Bitumen will determine those over which it is possible to have an influence, which will be consistent from a life cycle perspective. The life cycle stages that are considered by the company include raw material acquisition (external and internal), facility design, raw material usage and production process, transportation and delivery of product, research and development, waste generation and management, facility reinstatement and end-of life treatment.

Lagan Bitumen will evaluate its aspects and identify the means by which the aspects and impacts are classified.

Lagan Bitumen will seek to minimise the environmental impacts of its operations and will seek to monitor throughout each activity the environmental aspects and impacts of its activities in relation to the production of material products. Aspects and impacts will be evaluated on a continual basis. Lagan Bitumen has in the establishment of this manual considered the requirements of the local communities and regulatory obligations.

The Technical Manager will be responsible for re-assessing environmental aspects and impacts prior to work actually commencing; this is to facilitate for any environmental or ecological changes that may have emerged since the impact statements were conducted. This will include potential impacts based on emergency or abnormal operating conditions. They will ensure that work planned for the future has environmental aspects considered and the possible impacts that these may have.

Aspect Significance

Lagan Bitumen will employ a competent person to identify the environmental aspects and determine those activities over which it is possible for Lagan Bitumen to have an influence, in order to determine those which may have significant impacts on the environment.

Aspects and impacts will be evaluated and any aspect will be deemed significant if:

1. There is a requirement to meet legislative criteria e.g. Air Emission Licence, planning conditions.
2. The impact could cause a prolonged or long term nuisance.
3. The impact could have long term effect to the environment outside the confines of the site.
4. It is assigned a score of over 10 after analysis using a risk matrix.

Environmental aspects will be reviewed and identified by the Technical Manager. The review will take place annually and will be recorded in the management review meeting minutes. The review will consider the following:

a. Legislative updates or amendments
b. Introduction of any new item of plant or machinery
c. Introduction of any new procedure or operational change
d. Any change to the environment outside the site boundary that could be impacted by the Companies activities.

Risk Matrix Analysis

Methodology

Lagan Bitumen will assign aspects to a ranking matrix based on the probability of occurrence and severity of consequences. Individual matrix cells give an indication of significance.

Step 1:

All possible aspects and impacts will be identified and listed for all processes, activities and areas under normal, abnormal and emergency conditions. Consideration will also be given to past and planned activities.

Step 2:

Lagan Bitumen will categorise each aspect under all identified conditions by probability and severity from the criteria given below. The scores for probability and severity are multiplied together and can then be plotted on the ranking matrix (below).

E.g. probability 3 and severity 4 would be priority 12. The numbers in each cell of the matrix represent ranking for priority to determine which management actions will be taken to control or improve the aspect.

Any aspect that scores a priority of 10 or more is significant and requires management actions (operational control or objectives and targets for improvement).

RANKING MATRIX FOR SIGNIFICANCE EVALUATION:

Probability	V. High	5	5	10	15	20	25
	High	4	4	8	12	16	20
	Medium	3	3	6	9	12	15
	Low	2	2	4	6	8	10
	V. Low	1	1	2	3	4	5
			Trivial	Minor	Moderate	Serious	Major
			1	2	3	4	5
			Severity				

PROBABILITY FACTORS:

1. Very Low: Every 10 years
2. Low: 1 – 10 years
3. Medium: Monthly
4. High: Daily / Weekly
5. Very High: Continuous / Hourly

SEVERITY FACTORS:

1 Very Minor Environmental Damage
2 Minor environmental Damage / Business interruption.
3 Moderate Environmental Damage – nuisance to public.
4 Serious Environmental Damage – Off site clean up required, possibility of prosecution.
5 Major Environmental Incident – Fatality.

Aspect Evaluation for the Sligo Depot

Aspect	Condition	Priority Score	Significant	Reason for Significance
Fugitive Dust Emissions	Normal	P3 x S2 = 6	Y	1 & 2
	Abnormal	P4 x S2 = 8	Y	1 & 2
	Emergency	P4 x S2 = 8	Y	1 & 2
	Past	P3 x S2 = 4	Y	1 & 2
	Planned	P2 x S2 = 6	Y	1 & 2
Dust deposition as a result of emissions could cause off-site nuisance. Limits are in place.				
Discharges to Water	Normal	P2 x S3 = 6	N	
	Abnormal	P3 x S4 = 12	N	
	Emergency	P3 x S4 = 12	Y	1, 3 & 4
	Past	P2 x S2 = 4	N	
	Planned	P2 x S2 =4	N	
A major fuel spillage could damage flora and fauna and habitat and cause land contamination and could damage groundwater. Controls and limits are in place.				
Groundwater dewatering	Normal	P1 x S3 = 3	N	
	Abnormal	P1 x S3 = 3	N	
	Emergency	P1 x S3 = 3	N	
	Past	P1 x S3 = 3	N	
	Planned	P1 x S3 = 3	N	
There is no dewatering at the facility and only very modest water consumption in production.				
Use of resources / Energy consumption	Normal	P4 x S1 = 4	N	
	Abnormal	P2 x S1 = 2	N	
	Emergency	P2 x S1 = 2	N	
	Past	P4 x S1 = 4	N	
	Planned	P4 x S1 = 4	N	
Storage & use of Fuels / Chemicals	Normal	P4 x S2 = 8	Y	1
	Abnormal	P4 x S2 = 8	Y	1
	Emergency	P2 x S5 = 10	Y	1 & 4
	Past	P4 x S2 = 8	Y	1
	Planned	P4 x S2 = 8	Y	1
Aspect is controlled through the use of proper storage arrangements.				
Resource Usage	Normal	P5 x S1 = 5	N	
	Abnormal	P2 x S1 = 5	N	
	Emergency	P2 x S1 = 2	N	
	Past	P5 x S1 = 5	N	
	Planned	P5 x S1 = 5	N	

Aspect	Condition	Priority Score	Significant	Reason for Significance
Waste Generation	Normal	P4 x S3 = 12	Y	4
	Abnormal	P4 x S3 = 12	Y	4
	Emergency	P4 x S3 = 12	Y	4
	Past	P4 x S3 = 12	Y	4
	Planned	P4 x S3 = 12	Y	4
All waste removed from site will be taken away by fully licensed contractors; copies of waste disposall licence and duty of care documentation will be maintained.				
Noise & vibration	Normal	P4 x S3 = 12	Y	1, 2 & 4
	Abnormal	P4 x S3 = 12	Y	1, 2 & 4
	Emergency	P4 x S3 = 12	Y	1, 2 & 4
	Past	P4 x S3 = 12	Y	1, 2 & 4
	Planned	P4 x S3 = 12	Y	1, 2 & 4
Noise from site activities could cause nuisance. Limits are in place.				
House Keeping	Normal	P4 x S4 = 16	Y	1 & 4
	Abnormal	P4 x S4 = 16	Y	1 & 4
	Emergency	P4 x S4 = 16	Y	1 & 4
	Past	P4 x S4 = 16	Y	1 & 4
	Planned	P4 x S4 = 16	Y	1 & 4
Ecology	Normal	P4 x S2 = 8	N	
	Abnormal	P4 x S2 = 8	N	
	Emergency	P4 x S2 = 8	N	
	Past	P3 x S2 = 6	N	
	Planned	P3 x S2 = 6	N	
Visual Impact	Normal	P2 x S1 = 2	N	
	Abnormal	P2 x S1 = 2	N	
	Emergency	P2 x S1 = 2	N	
	Past	P2 x S1= 2	N	
	Planned	P2 x S1 = 2	N	

Aspect	Condition	Priority Score	Significant	Reason for Significance
Site Security	Normal	P2 x S4 = 8	N	
	Abnormal	P2 x S4 = 8	N	
	Emergency	P2 x S4 = 8	N	
	Past	P2 x S4 = 8	N	
	Planned	P2 x S4 = 8	N	
Ground Contamination	Normal	P2 x S2 = 4	N	
	Abnormal	P2 x S2 = 4	N	
	Emergency	P1 x S5 = 5	N	
	Past	P2 x S2 = 4	N	
	Planned	P2 x S2 = 4	N	
In an emergency situation ground contamination may occur from chemicals/fuels stored on site. Controls in place				
Archaeology	Normal	P2 x S2 = 4	N	
	Abnormal	P2 x S2 = 4	N	
	Emergency	P1 x S5 = 5	N	
	Past	P2 x S2 = 4	N	
	Planned	P2 x S2 = 4	N	
Air Emissions	Normal	P2 x S2 = 4	Y	1
	Abnormal	P2 x S3 = 6	Y	1
	Emergency	P3 x S3 = 9	Y	1
	Past	P2 x S2 = 4	Y	1
	Planned	P2 x S2 = 4	Y	1

6.1.3 Compliance obligations

Lagan Bitumen will be responsible for liaising and communicating with the regulatory authorities, local councils and environmental groups.

Lagan Bitumen has produced a register of applicable environmental legislation, which is controlled by means of the IBEC updating service. Each update will be reviewed by the Technical Manager. These reviews will be recorded and required legislative amendments will be implemented into the EMS.

Lagan Bitumen will aim to meet or exceed all legislative regulations and standards and will adopt monitoring systems to ensure compliance. In the absence of governmental legislation Lagan Bitumen will adopt recognised international standards or will recommend sound environmental practices.

All regulatory authority documents with environmental requirements or conditions are included in Section 3 of the Environmental Management Plan for the site.

6.1.4 Planning action

As discussed in section 6.1.1 a risk analysis review will be performed at the monthly board meeting for any environmental issues that are raised and the resulting actions will form part of the Objectives and Targets. The senior management team will hold an annual environmental management meeting where the Objectives and Targets for the year ahead will be set out and the previous years Targets and Objectives will be reviewed and assessed. The annual environmental management meeting has ten specific areas for discussion and review including risks and opportunities, compliance obligations and environmental aspects. The specific areas for discussion are considered for technological options and financial, operational and business requirements.

6.2 Environmental objectives and planning to achieve them

6.2.1 Environmental Objectives

Lagan Bitumen shall establish and maintain documented environmental objectives and targets at each relevant function and level within the Company. The objectives and targets are set, recorded and reviewed at the annual environmental management meeting.

When establishing and reviewing its objectives, the company shall consider all legal and other requirements, its significant environmental aspects, its technological options and its financial and business requirements, and the views of interested parties.

The environmental objectives established by the Company will be environmental goals, arising from the Company's environmental policy, that the Company will set itself to achieve, and shall be:

- consistent with the environmental policy;
- measurable (where possible);
- monitored;
- communicated;
- updated as appropriate.

6.2.2 Planning actions to achieve environmental objectives

The Company will establish environmental objectives and targets that will be applicable to the production of company products and to ensure that all site activities are in keeping with company policy requirements. Environmental objectives will be achieved by:

- Regularly monitoring the Company performance on an on-going basis and this will be achieved by internal and external environmental audits carried out by trained personnel. This will include auditing compliance with the Companies Environmental Policy;
- Where there are no recognised standards or environmental parameters the Company will establish well defined and where possible quantifiable standards, to ensure environmental concerns are controlled as far as is reasonably practicable. This will be important where there are subjective concerns to deal with or where, as may be the case in overseas operations, no environmental legislation exists;
- Use production methods and processes which have minimum impact on the environment and those affected by the company's operations where practical and where possible develop and improve operations to minimise waste and dispose of it safely to prevent pollution. To this end the Company will where possible or feasible use recycled or sustainable materials;
- Take responsible action to report and correct environmental incidents when they occur and ensure that employees and contractors follow Company policies and report any environmental concerns to facilitate rapid response;
- The Company throughout its operations will use all energy resources conscientiously and efficiently;
- Ensure that industry best practices, techniques and methods are employed and that these are reviewed and implemented when appropriate;
- The Company will seek to communicate and liaise with the local community;
- Wherever possible the Company will seek to influence the customer to adopt cost effective environmentally positive materials and solutions.

When planning how to achieve its environmental objectives, the company will determine:

- what will be done;
- what resources will be required;
- who will be responsible;
- when it will be completed;
- how the results will be evaluated, including indicators for monitoring progress towards achievement of its measurable environmental objectives.

The Senior Management Team are responsible for defining the list of environmental objectives and making any subsequent changes to it. Environmental objectives are reviewed at the annual Management Review Meeting and at regular interim management meetings where specific trend targets are communicated.

7 SUPPORT

7.1 Resources

The Lagan Bitumen Directors will ensure that sufficient resources are allocated to the EMS to ensure its satisfactory operation and continually improve its effectiveness. This will include internal resource but may also include external resource where necessary.

7.2 Competence

Personnel who are assigned responsibilities defined in the environmental management system and organisational chart are assessed for competency on the basis of appropriate education, training, skills and experience.

The Depot Manager and the Technical Manager will be responsible for identifying training needs. They will ensure that all personnel whose work may create a significant impact upon the environment have received appropriate training covering all aspects of the permit and planning conditions where applicable.

Lagan Bitumen retains appropriate documented information as evidence of competence on file at the site.

7.3 Awareness

The Company will establish and maintain procedures to make its employees and sub-contractors at each relevant function and level aware of the importance of conformance with the Company's environmental policy and procedures and with the requirements of the Company's environmental management system.

The Company will ensure that employees and sub-contractors are aware of the significant environmental impacts, actual and potential of their work activities and the environmental benefits of improved environmental performance.

The Company will ensure that employees and sub-contractors are fully aware of their roles and responsibilities in achieving conformance with the environmental and quality policy, procedures and requirements of the Company's environmental and quality management system. This will include awareness of emergency preparedness and response requirements and the potential consequences of departure from specified operating procedures, including not fulfilling the organisations compliance obligations.

All members of staff will be made fully aware of the operational procedures and methods used by the Company to ensure that the environmental impact of its operations will be minimised. Staff will be aware of the requirements of the quality system.

This will entail ensuring that the person chosen to perform a task which could cause significant environmental impacts is competent on the basis of appropriate education, training and/or experience.

7.4 Communication

7.4.1 General

The company will establish, implement and maintain the procedures needed for internal and external communication relevant to the EMS including:

- on what it will communicate;
- when to communicate;
- with whom to communicate;
- how to communicate.

Communication of information will be categorised as external or internal.

7.4.2 Internal communication

The Company has identified the importance of communication with respect to the functioning of it's EMS and have identified the following points as important to communicate:

1. Environmental Policy and Lagan Bitumen corporate profile that is committed to achieving certification to ISO 14001 in all Companies within the Group.
2. Established Targets and Objectives
3. Measurable environmental performance evaluation such as recycling, energy and fuel savings etc.
4. Independent verification of communicated results.

Internal communication will or can take the following forms:

1. The Technical Manager & Operations Director reports on a monthly basis to the Lagan Group Board member responsible for environment. At this meeting an update on environmental matters will be provided and this meeting will be minuted and timescales and agendas set for subsequent meetings. This will be the main top down and down up means of communication.
2. The Board can be contacted at anytime in the case of emergency situations.
3. Internal memo's and network e-mail system communicate all internal information and it is Corporate Policy to utilise this means of communication, as it is secure, fast, traceable and recorded. This will be the main means of communication at a managerial level.
4. Communication to persons / employees who do have access to the network will be by payslip inserts, verbal discussions, issued operational procedures and notice boards.
5. Internal audits and associated interviews will also be used as a means of communication both to and from employees.
6. A statement of compliance with the requirements of the sites permits will be communicated at monthly management meetings.

7.4.3 External communication

External communication will be concerned primarily with communication with the Local Authority, local residents and adjacent businesses including farmers.

External communication will or can take the following forms:

1. Face to face meetings
2. Specific written communication
3. E-mail where appropriate.
4. Phone calls. These calls will be recorded.
5. Lagan Group publications such as 'Lagan View' and press releases will be used to highlight the fact that Group policy is for all 'in house' Companies to achieve ISO 14001.

The communication processes for the company will consider its compliance obligations and ensure that communicated environmental information is reliable and consistent with information generated within the EMS. The company will respond to relevant communications on its EMS and shall retain documented information as evidence of its communications.

7.5 Documented information

7.5.1 General

The Company will establish and maintain information that will describe the 'core' elements of the management system and their interaction and will, through the documentation provide direction to the related documentation.

The Company will establish and maintain procedures and will be able to demonstrate the systems in place to ensure that environmental reports required by government regulations and policies are routinely prepared and submitted, as appropriate, on a timely basis.

7.5.2 Creating and updating

All documentation will be created to ensure appropriate identification and description, format and media. Documented procedures have been established to:

- Approve documents for adequacy prior to issue.

- Review and update as necessary and re-approve documents.

- Ensure that changes and that the current revision status of documents are identified.

- Ensure that relevant versions of applicable documents are available at points of use.

- Ensure that documents remain legible, readily identifiable.

- Ensure that documents of external origin are identified and their distribution controlled.

- Prevent the unintended use of obsolete documents, and to apply suitable identification to them if they are retained for any purpose.

7.5.3 Control of documented information

The Company will establish and maintain procedures for controlling all documents required by the ISO 14001 standards to ensure that documents are:

1. Easily located and retrievable.
2. They are made as soon as is reasonably practicable.
3. They will be periodically reviewed, revised as necessary and approved for adequacy by authorised personnel.
4. The current versions of relevant documents will be available at all locations where operations essential to the effective functioning of the system are performed.
5. Obsolete documents will be removed promptly from all points of use or otherwise to assure against unintended use.

6. Obsolete documents will be retained for legal and or knowledge preservation purposes and will be suitably identified.
7. A specific file will be established for Environmental documentation including monitoring reports, checklists and communication details with Environmental Protection Agency, Council, etc.

Documentation will be legible, dated (with dates of revision) and readily identifiable. They will be maintained in an orderly manner and will be retained for a period of time specified as specified in the Document Control Matrix/Table.

Procedures have been established concerning the creation and modification of the various types of document. These procedures are detailed below:

- The EMP manual, master copy (Issue 01) will be filed at the relevant site and a copy will be available at the Company headquarters.
- The amendment number of the EMP Manual will only change when an amendment had been made to the text or layout of the document itself. This amendment must be agreed by all parties involved.
- The Depot Procedures will each have an amendment number. This number will be clearly stated in the Depot Procedure Contents Page.

8 OPERATION

8.1 Operational planning and control

The life cycle stages that are considered by the company include raw material acquisition (external and internal), facility design, raw material usage and production process, transportation and delivery of product, research and development, waste generation and management, facility reinstatement and end-of life treatment. The company will carry out the following to ensure a consistent life cycle perspective:

- establish controls as appropriate to ensure its environmental requirements are addressed in the design and development process for the product or service considering each life cycle;
- determine its environmental requirements for the procurement of raw materials, products and services, be they internal or external;
- establish controls to ensure its waste management requirements are addressed
- communicate its relevant environmental requirements to external providers and contractors;
- consider the need to provide information about potential significant environmental impacts associated with the transportation or delivery, use, end-of-life treatment and final disposal of its products and services;
- determine its environmental requirements for the reinstatement works and end-of life treatment for the facility at point of closure.

The Company will wherever possible adopt procedures based on the Pollution Prevention Guidelines including the measures outlined below.

Management & site control

A copy of the Environmental Policy Statement will be displayed in the weighbridge. All work will be carried out in compliance with the Company's Health and Safety requirements.

The Company will, at the planning stage, define all methods of working to prevent the potential of pollution in all its forms.

Rules defined for the site set out in the sites permit conditions form the key operational issues of operating hours, site contacts, approved site extents and operating plans, monitoring and reporting requirements.

Human Beings

The likely significant direct effects on human beings associated with the site relate to potential impacts on water, air quality, noise, landscape change, and public and employee health and safety. Indirect impacts relate to potential effects on flora and fauna. These impacts are addressed as follows:

- Fencing will be maintained around the lands being excavated for the safety of the general public and to prevent livestock straying into the excavated areas.
- All work will be carried out in compliance with the Company's Health and Safety requirements.
- The nature and extent of potential impacts envisaged in respect of water, air quality, noise and landscape are addressed in detail in the Depot Procedures for the site presented in Section 2 of the Environmental Management Plan.

There are specific conditions relating to management, monitoring and control of site ecology, surface water discharges, trade effluent discharges and groundwater dewatering and management, air quality and air emissions management, noise and vibration, landscaping, traffic and archaeology all of which are covered I the Depot Procedures.

Incidents, Communications and Complaints

A Log of all communications received from and issued to the Public will be maintained. In particular, records will be maintained to document any environmental concerns raised by members of the local community. The Company will investigate, take samples as appropriate and provide feedback by way of corrective actions and communication with the interested party as appropriate.

Fuel, Oil, Bitumen and Chemical Storage

The Depot manages the storage of fuels and chemicals in accordance with Depot Procedure – Management of Fuel, Oils, Bitumen and chemical storage.

Energy Consumption

Using energy efficiently and thereby reducing unnecessary pollution is recognised as one of the most effective ways of slowing down global warming. There is a specific Depot Procedure developed to deal with energy conservation methods.

Waste Management

The Waste Management Depot Procedure details how waste management is carried out.

8.2 Emergency preparedness and response

In order to prevent and mitigate the environmental impacts of accidents and emergency situations the Company has established and maintains procedures to identify and respond to these situations. The Emergency Preparedness and response Depot Procedure details how this function is managed.

The Company will review and revise, where necessary its emergency preparedness and response procedures. Special emphasis will be placed on such reviews and revisions should an accident or emergency situation actually arise.

Where practical or applicable to do so the Company will periodically test these procedures.

In addition to emergency response procedures developed the Company will provide staff with emergency and event–based instructions. Management will also ensure that if an employee is absent from work that his or her roles in an emergency event is reassigned to another adequately trained employee.

9 PERFORMANCE EVALUATION

9.1 Monitoring, measurement, analysis and evaluation

9.1.1 General

Checking and corrective actions will be used by the Company to evaluate its performance with respect to established targets and objectives.

To enable the Company to comply with all conditions and objectives and to track environmental performance, relevant to operational controls and conformance with the Company's objectives and targets, documented procedures will be established and maintained to monitor and measure on a regular basis the key characteristics of its operations and activities that have a significant impact on the environment.

All inspection, measuring and test equipment used by the Company will be calibrated and maintained in a manner that will ensure that measurements taken can be verified.

Procedures will be established and maintained describing how each item of measuring equipment is calibrated and maintained.

The Company will establish and maintain procedures for periodically evaluating compliance with relevant environmental legislation and regulations. The detailed procedures to be followed, in respect of monitoring for the purpose of demonstrating compliance with Permits/Licences etc are outlined in Depot Procedures Manual. Monitoring procedures, recording and reporting procedures and specific procedures for dealing with non-compliances and corrective actions are outlined in these procedures.

The company will communicate its relevant environmental performance information both internally and externally as required and will also retain documented information as evidence of the monitoring, measurement, analysis and evaluation results.

9.1.2 Evaluation of compliance

Consistent with its commitment to compliance, the Company will periodically evaluate compliance with applicable legal requirements and other requirements to which it subscribes and will maintain records of these evaluations. The company will also maintain a knowledge and understanding of its compliance status.

The company will prepare an Annual Compliance report which will evaluate compliance with all the site specific legal and other requirements relative to the environment.

9.2 Internal audit

9.2.1 General

The Company places great emphasis on the importance and need for regular internal auditing of the EMS. To this end and to comply with the requirements of ISO 14001 the Company will establish and maintain procedures for ensuring that management system audits are carried out in order to achieve the following goals:

a) To determine whether or not the environmental management systems are conforming to planned arrangements for environmental management. (including the requirements of ISO 14001)

b) To determine whether or not the system has been properly implemented and maintained.

9.2.2 Internal audit programme

Results of internal and external audits will be used to provide information to management as a means of improving the system and ensuring that adequate measures are taken to ensure that audit findings are acted upon in a manner that is effective and designed to prevent reoccurrence were this is applicable.

This procedure covers the conduct of internal quality audits of the EMS in all areas of the Company’s activities, to ensure that the EMS is systematically reviewed on a regular basis to check its continuing suitability and effectiveness.

1 The Technical Manager shall establish an Internal Audit Schedule covering all elements of the Environmental Management System and at least one site per set of audits. The timescale should be such that all elements of the System are audited at least twice per year.

2 Audits will normally be carried out by the Operations Director or Auditor however; other appropriately trained personnel may carry out audits in areas other than their own.

3 The audit shall be conducted against the agreed check sheet and audit findings recorded on the check sheet.

4 Prior to the audit the auditor shall check any areas of outstanding action from any previous audit and add these to the check sheet.

5 Audit findings shall be discussed with the personnel in the area under audit. Deficiencies and corrective actions required, together with the target dates for implementation, shall be recorded on the Internal Audit Report form.

6 Internal Audit Report Forms are maintained by the Technical Manager and confirmation of deficiencies and corrective actions notified verbally to the person responsible by the Auditor.

7 Progress on the implementation of agreed corrective actions shall be monitored by the Technical Manager at monthly intervals by reference to the Report Forms. Where actions are not completed the Audit Report form shall be forwarded to the Managing Director for appropriate action.

8 On completion of all actions the report shall be filed for evaluation as part of the Management Review of the EMS.

9.3 Management review

Lagan Bitumen will review the integrated management system at twelve monthly intervals. This review will be comprehensive, documented and will assess all elements of the system.

The review will ensure that:
- the system is effective and complies with the requirements of ISO 14001;
- that sufficient information is available to adequately review the system;
- that the environmental and quality policy statements are still applicable to the Company;
- targets and objectives are being met or require to be changed in light of results of internal audits, changing circumstances, contractual obligations or the need to demonstrate commitment to continual improvement;
- that any system non-conformances, complaints from third parties, legislative non-compliance and audit findings both internal and external have been adequately dealt with and that corrective and preventive actions taken to prevent reoccurrence have been effective.

The management review shall include consideration of:
a) The status of actions from previous management reviews;
b) Changes in:
    1) External and internal issues that are relevant to the environmental management system;
    2) The needs and expectations of interested parties, including compliance obligations;
    3) Its significant environmental aspects;
    4) Risks and opportunities;
c) The extent to which environmental objectives have been achieved.
d) Information on the organisation’s environmental performance, including trends in:
    1) Nonconformities and corrective actions;
    2) Monitoring and measurement results;
    3) Fulfilment of its compliance obligations;
    4) Audit results;
e) Adequacy of resources;
f) Relevant communication(s) from interested parties, including complaints;
g) Opportunities for continual improvement.

The outputs of the management review shall include:

- Conclusions on the continuing suitability, adequacy and effectiveness of the environmental management system;
- Decisions related to continual improvement opportunities;
- Decisions related to any need for changes to the environmental management system, including resources;
- Actions, if needed, when environmental objectives have not been achieved;
- Opportunities to improve integration of the environmental management system with other business processes, if needed;
- Any implications for the strategic direction of the organisation.

10 IMPROVEMENT

10.1 General

Lagan Bitumen plan and manage the processes necessary for the continual improvement of the environmental management system. The company facilitates the continual improvement of the EMS using their environmental policy, environmental targets and objectives, audit results, corrective and preventive actions and management reviews.

10.2 Non-conformity and corrective action

The Company will establish and maintain procedures for defining responsibility and authority for dealing with and investigating non-conformance, taking action to mitigate any impacts caused and for initiating and completing corrective and preventive action.

Any corrective and preventive action taken to eliminate or minimise the causes of actual or potential non-conformance will be appropriate to the magnitude of problems and proportional with the impact encountered.

The Company will implement and record any changes in the documented procedures resulting from corrective and preventive action.

In addition, the Company will establish procedures to address the following aspects of non-conformance issues

- Tracking and reporting of all compliance issues.
- Planning of corrective action
- Establishing resolution due dates
- Assignment of responsibilities for corrective and preventive action
- Follow-up and tracking systems to verify corrective and preventive actions were implemented and were effective
- Identification of recurring issues, root cause analysis, underlying causes and compliance trends
- Planning of actions to prevent recurrence of compliance issues
- Communication with the regulatory authority on Environmental issues

A pro-forma non-conformance report will be completed in the event of a non-conformance, this will be completed by the Depot Manager (or an appointed deputy) and only signed off when the corrective action taken to prevent recurrence has proven to be effective. The implementation of the corrective action should not be deemed to have been completed until the effectiveness of all the above has been demonstrated and any changes in procedure, documentation etc. completed.

The detailed specific procedures for dealing with environmental non-compliances and corrective actions are outlined in the Depot Procedures Manual.

Regular scheduled process reviews will take place rather than simply correcting problems after they occur. This element of the EMS will include identification of systematic problems with the implementation of the EMS as well as non-compliance with regulations and legislative requirements. Lagan Bitumen will retain documented information as evidence the nonconformities and any subsequent actions taken and the results of any corrective action.

10.3 Continual improvement

Lagan Bitumen will continually improve the suitability, adequacy and effectiveness of the environmental management system to enhance environmental performance by implementing the findings of the review of the EMS carried out as part of the annual environmental management meeting.

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ISO 14001: 2015

DEPOT PROCEDURES MANUAL

AMENDMENT RECORD

Depot Procedure No.	Depot Procedure Title	Amendment No.	Date of Issue	Review Date
DP001	Air Quality & Air Emissions Management	1	01.02.2017	
DP002	Energy Management	1	01.02.2017	
DP003	Waste Management	1	01.02.2017	
DP004	Emergency Preparedness & Response	1	01.02.2017	
DP005	Legislation Management	1	01.02.2017	
DP006	Fuel oil, Bitumen & Chemical storage	1	01.02.2017	
DP007	Oil Interceptor Management	1	01.02.2017	
DP008	Water Management	2	08.04.2019	
DP009	Ecological Management	1	01.02.2017	
DP010	Noise & Vibration Management	1	01.02.2017	
DP011	Landscape & Visual Impact	1	01.02.2017	
DP012	Traffic Management	1	01.02.2017	
DP013	Archaeology Impact Management	1	01.02.2017	
DP014	End-of-Life Plant Management	1	01.02.2017	
DP015	Site Security	1	01.02.2017	
DP016	Contractor Management	1	01.02.2017	
DP017	Communications, Incidents & Complaints	1	01.02.2017	
DP018	Corrective & Preventive Actions	1	01.02.2017	
DP019	Site Inspection Checklists	1	01.02.2017	
DP020	Accident Prevention Policy	1	01.02.2017	

DP001 Air Quality and Air Emissions Management

Scope: This procedure defines the specific conditions relating to management, monitoring and control of air emissions and air quality which are contained in the sites Licensing Permits and Authorisations.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

Lagan Bitumen operates to ensure that dust levels associated with the activities at the site do not cause adverse impacts at sensitive locations. The controls and mitigation measures for minimisation of impacts on air quality as a result of dust generated include the following:

- A wheel wash facility shall be used at the entrance to the site;
- Fixed and mobile water sprays shall be used to control dust emission from material stock piles, road and yard surfa as necessary in dry and/or windy weather. Records shall be maintained on the water spraying schedule;
- Trucks entering and leaving the site with dusty materials shall be covered and they shall pass through a wheel wash before exiting the site;
- A daily inspection programme shall be formulated and implemented in order to ensure that dust control measures are inspected to verify effective operation and management. Findings shall be recorded on the Daily Site Inspection Sheet;
- Dust deposition monitoring shall be carried out in accordance with the requirements of the authorisation permits in order to verify the continued compliance with relevant standards and limits.
- Plant and conveyers should be operated to minimise dust generation by ensuring all dust mitigation functions such as dust covers, wind boards, netting, extraction and collection systems are all functioning correctly. Regular visual inspections shall be carried out on all such plant and equipment.
- Under-trays and chutes should be provided to collect material dropping from conveyors. The height of free-fall of material from the under-tray should be minimised.
- Blowers, belt-scrapers or other devices should be fitted to clean conveyors to prevent build-up of spillage. Spillage should be cleared promptly.

Odour monitoring shall be carried out on a weekly basis at representative off-site locations during operating hours of a activity (eg asphalt plant, etc) to ensure that all operations on site are being carried out in a manner such that odours do not result in impairment of or interference with amenities or the environment beyond the site boundary. All weekly odour inspections carried out around the vicinity of the site shall be recorded on the Weekly Site Checklist.

3. Monitoring and Reporting

Environmental monitoring reports will be prepared by external consultants and shall contain all information as required by the various conditions set out in the permissions. A hardcopy report with the results assessed against the permit limits will be issued to the permitting authority and also to the site. A soft-copy will be issue to the Lagan Bitumen head office.

4. Corrective Actions

If a dust monitoring result or air emission monitoring result is out of compliance or if an odour is identified within the vicinity of the site, an immediate review will be undertaken to identify the cause of the non-compliance. The details of the investigation together with details of corrective actions to be taken will be recorded in accordance with the Corrective Action Depot Procedure.

DP002 Energy Management

Scope: This procedure defines the specific conditions relating to energy management for all activities at the site.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

Lagan Bitumen operates to ensure that energy usage associated with the site is minimised through the implementation of focused energy-saving procedures. Energy use shall be minimised by the adoption of energy efficient practices including the routine servicing of plant such as mobile generator units and vehicles. The Company will ensure that the following measures are considered and care is given to how energy is as far as is reasonably practicable on all contracts:

- Lighting levels should be appropriate for each task;
- Use the most efficient and up-to-date type of lighting;
- All external lighting should be maintained in a clean condition;
- Make best use of daylight by keeping windows and roof lights clean;
- Routine servicing and maintenance of all plant to ensure efficient energy consumption at all times;
- Conveyors and other parts to be shut down when not in use;
- Sufficient lubrication on all machinery and drives;
- Use of dry sand where possible to reduce energy inputs;
- Turn off all water taps completely and report any leak or drip as soon as discovered;
- Switch off any appliance or item of equipment which is not being used;
- Heated storage tanks, process pipework and vessels should be at the correct temperature and adequately insulated;
- Inlet filters on compressors should not be blocked and compressor houses well ventilated;
- Machinery and drives should be properly lubricated and not allowed to run unnecessarily.

3. Monitoring and Reporting

Records of fuel consumption per tonne of production are generated on a monthly basis for the site. This information is utilised to show performance of the plant on a monthly basis and is included in the annual appraisal for the site. This tistical information is recorded and filed at Lagan Bitumen head office.

A summary of monitoring data and energy usage shall be prepared and included in the Annual Environmental Report prepared for the site. This report will be available for consultation at the Site Office on request.

4. Corrective Actions

If a non-compliance with an Objective or Target is noted, an immediate review will be undertaken to identify the cause of the non-compliance. The details of the investigation together with details of corrective actions to be taken will be recorded in accordance with the Corrective Action Depot Procedure.

DP003 Waste Management

Scope: This Procedure sets out the operating instructions that shall be followed to ensure that all waste, hazardous and non-hazardous, is stored and disposed of in accordance with the relevant waste legislation.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

The targets for waste management are to ensure that waste generation is minimised, that waste is stored in an environmentally protective manner and that waste disposal is in accordance with regulatory requirements. Daily and weekly inspections of the site shall be completed to ensure waste management is correctly carried out at the site and shall be recorded in the site inspection sheets.

The Company will take whatever action is deemed necessary to comply with legal requirements, whilst in addition do what is practicable and commercially viable to minimise waste. A policy of Reduce, Reuse, Recycle shall be encouraged with all employees

2.1 Waste Segregation and Storage

A system of bins and skips will be used to segregate waste. The following sections identify the types of waste that can be expected and identifies storage and disposal requirements for each.

Non-Hazardous Wastes likely to be generated for disposal off-site include the following: domestic waste, food, paper, plastic, cardboard, packaging, clean timber, road sweepings, sewage effluent waste, metals, tyres and sludge.

Hazardous Wastes likely to be generated for disposal off-site include the following: waste oils, oil contaminated materials, oily water, batteries, Waste Electrical and Electronic Equipment (WEEE), printer toner cartridges, oil filters, light bulbs, aerosols, interceptor sludge, interceptor sludge, contaminated soils, waste resin and paint tins.

Waste shall be properly segregated and contained in appropriate containers (skips, bins, bags etc) and covered where required to prevent water ingress or vermin damage and stored in dedicated waste storage areas. Waste stor containers shall be clearly labelled and bunded where required. Waste shall be identified as recyclable, non-hazardous or hazardous.

2.1 Waste Documentation

All waste contractors collecting and removing waste from the site must have a current valid Waste Collection Permit and the Waste Facility Permit details of the location that the waste is going to. A copy of the Waste Collection Permit and the Waste Facility Permit shall be kept on file at the Lagan site for all waste contractors involved in removing and/or receiving any wastes from the site. Prior to consigning any waste off-site the following actions must be considered and completed:

- Determine the nature of the waste and determine if a hazardous or a non-hazardous waste contractor is needed;
- Examine the credentials of prospective waste contractors and the suitability of their services and facilities for handling and managing the waste;
- The waste haulage contractor who collects your waste must hold a valid waste collection permit from the relevant local authority;
- The waste management facility that your waste is destined for must hold either a valid Waste Facility Permit or Waste Licence.
- Inform your waste contractor of the safe working procedures on-site and any temporary hazards associated with the collection and handling of the waste.

- Seek and record documentary proof of waste receipt and final disposal/recovery from the waste contractor and any other parties involved.

The documentation that is required for each waste consignment leaving the site shall be checked for the following before final signing and approval:

- Address: Ensure the correct address of the site the waste is departing from is used;
- Waste Description: Ensure the waste is correctly described and has the correct 6 digit EWC code assigned. The description needs to provide enough information to enable subsequent holders to avoid mismanaging the waste or causing injury;
- Quantity and Containment: Ensure the type of container (skip, bin) and capacity volume (10m^3) and/or waste weight (500 kg) is recorded;
- Waste Carrier Details: Ensure the name, address and Waste Collection Permit Number of the waste carrier removing the waste form the site is recorded;
- Waste Receiver Details: Ensure the name, address and Waste Permit Number or Waste Licence number of the next destination/recipient of the waste is recorded;
- Date and time of transfer;
- Signatures of the waste carrier and the authorised Lagan depot personnel.

The waste transfer note copy shall be retained and kept on file at the Lagan site for two years and hazardous waste consignment notes shall be kept for three years after date of removal from the site.

3. Monitoring and Reporting

Details of all wastes generated for recovery or disposal on or off the site must be recorded. Records shall include the quantity of waste for disposal or recovery, description and nature of the waste, the EWC code, contractor details, method of disposal, date of dispatch and documentation reference numbers in relation to the waste consignment. The Waste Record Sheet Form shall be used for recording details of quantities of waste generated, recovered and disposed of on a daily basis or otherwise as required. The purpose of the records is to identify areas for waste reduction, to track the quantities of waste being recovered and to provide the necessary documentation to demonstrate that regulatory requirements for waste disposal are being complied with.

A summary of all waste statistics shall be prepared and an Annual Report shall be compiled for inclusion in the Annual ironmental Report for the site. This report will be available for consultation at the Site Office on request.

4. Corrective Actions

If a non-compliance with an Objective or Target is noted, an immediate review will be undertaken to identify the cause of the non-compliance. The details of the investigation together with details of corrective actions to be taken will be recorded in accordance with Corrective Action Depot Procedure.

DP004 Emergency, Preparedness and Response

Scope: This Emergency Response Procedure sets out the procedure for dealing with environmental emergencies during the activities at the facility.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

At all times, there shall be at least one person responsible for co-ordinating emergency measures at the site. The Emergency Co-ordinator shall be thoroughly familiar with this procedure, the Emergency Plan, all operations and activities on site and the location of emergency response and spill clean-up equipment.

2.1 Spills and Leaks

In the event of a chemical or oil or fuel spillage, the Emergency Co-ordinator is notified and is responsible for managing the spill. The following major actions shall be taken:

- The Emergency co-ordinator will determine the exact source of the spill or leak and the area affected. External emergency aid will be immediately summoned if required;
- Any source of ignition will be eliminated eg equipment that sparks, naked flames, hot surfaces in the spill area and all areas immediately downwind of the spill area;
- The Spill Crew wearing appropriate protective equipment as designated by the Emergency co-ordinator will remedy and stop the source of the spill if safe to do so (seal off visible leaks, turn off pumps etc)
- The area of the spill will be immediately contained (to prevent contamination of the surface water or groundwater) by the use of containment booms if the spill is not already within a fixed containment bund.
- The spill material will be absorbed using absorbent granules/material. This material will be contained and will be treated as hazardous waste for disposal.

An adequate supply of containment booms, absorbent granules, containers, clean up materials and protective equipment shall be stored on site at all times.

2.2 Fire

In the event of a fire the firm alarm should be sounded by activating the nearest alarm. On hearing the fire alarm personnel must evacuate the building by the nearest exit and assemble at the site entrance just in front of the weighbridge. If safe to do so and if trained to use a fire extinguisher then tackle the fire. If the fire cannot be controlled then the fire services should be called. The water used for extinguishing any fire shall be contained if possible for assessment before disposal or discharge through the surface water drainage system.

2.3 Surface Water Contamination

Surface water contamination may arise on site from a number of sources; these include greases, oils, fuel, chemical spill or suspended solids. In the event of surface water contamination immediate action shall be taken to stop the flow of contamination into the receiving water. Where there has been a discharge of oils or greases, oil booms and/or mats shall be used as necessary to remediate the surface water contamination and the mats disposed of according to the procedure for waste oil disposal.

2.4 Groundwater Contamination

In the unlikely event of groundwater contamination arising onsite, immediate action shall be taken to stop the flow of contamination into the area that is seeping to groundwater. If the source is not identifiable then an investigation shall be instigated until the source is identified. The extent of contamination shall be assessed and a clean up programme shall be implemented where necessary. An investigation shall be carried out as to the cause of the contamination and corrective actions will be taken to prevent a re-occurrence.

2.5 Flooding

In the event of flooding at the site all electrical components should be powered down and isolated where possible. The Emergency Co-ordinator should be immediately notified. All bunded areas should be checked to ensure their integrity. The fire brigade should be called if the situation is classified as an emergency and all site personnel should assemble at a safe location outside of the site. The fire services will handle the emergency situation and all site personnel should remain off site until the fire services authorise a return to the site.

2.6 Power Failure

In the event of a power failure at the site the electrical supply company should be notified immediately. The emergency shut down procedure for the various plant items should be followed and an inspection of the entire site should be carried out to ensure that there are no possible sources of pollution at the site due to the power loss. The site manager should be immediately informed and is responsible for ensuring the safe return of power supply the site.

3. Emergency Equipment

Two medium sized (200L) Oil Spill Kits and 1 mediums sized (200L) hazardous/non-hazardous spill kit shall be held on-site at all times including absorbent pads, booms and mats and disposable bags and ties. These kits shall be replaced immediately following their use during an emergency.

4. Monitoring and Reporting

The company will immediately notify the relevant licensing authority of the occurrence of any incident including:
(i) an emergency;
(ii) any emission which does not comply with the requirements of the licence;
(iii) any indication that environmental pollution has, or may have, taken place.

The incident notification form for the EMP shall also be filled out and shall include the following information:

- Date and time of incident;
- Details of the incident and circumstances giving rise to it;
- An evaluation of environmental pollution caused if any;
- Actions taken to minimise the effects on the environment;
- Steps taken to avoid recurrence;
- Any other remedial action taken.

A report on incidents shall be prepared and an Annual Report shall be compiled for inclusion in the Annual Environmental Report. This report will be available for consultation at the Site Office on request.

5. Corrective Actions

If a non-compliance with an Objective or Target is noted, an immediate review will be undertaken to identify the cause of the non-compliance. The details of the investigation together with details of corrective actions to be taken will be recorded in accordance with the Corrective Action Depot Procedure.

DP005 Legislation Management

Scope: This procedure defines the management of environmental legislation for all activities at the site.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

Lagan Bitumen shall be responsible for liaising and communicating with the regulatory authorities, local councils and environmental groups and ensuring familiarity with all relevant environmental legislation applicable to the site and its activities. The company shall also be responsible to ensure that updates and changes to relevant environmental legislation and all new relevant environmental legislation are considered and accounted for in the operations and activities at the site.

Lagan Bitumen maintains a register of applicable environmental legislation on it filing system at head office, which is controlled by means of the IBEC updating service. IBEC provide a review and update of all relevant environmental Legislation each quarter for the Lagan Bitumen group operations. Each update shall be reviewed by the Technical Manager. These reviews shall be recorded and required legislative amendments where applicable will be implemented into the EMS.

Lagan Bitumen shall aim to meet or exceed all legislative regulations and standards and shall adopt monitoring systems to ensure compliance. In the absence of governmental legislation Lagan Bitumen shall adopt recognised international standards or will recommend sound environmental practices.

3. Evaluation of Compliance

The Company will prepare an Annual Compliance report which will evaluate compliance with all the site specific legal and other requirements relative to the environment. The compliance rate for the site will be evaluated by reviewing the non-compliances issued and the rate of failure to meet site Permission Limits and Conditions. The compliance rates are evaluated every quarter for the Group Board Meetings and also for the annual environmental review meeting for the site.

DP006 Fuel Oil, Bitumen and Chemical Storage

Scope: This procedure defines specific conditions relating to the sourcing, acceptance and storage of fuel, oil, bitumen and chemicals to ensure the protection of the environment and public health.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

All fuels and oils purchased for use at the facility shall be sourced from a company which has been approved by Lagan Bitumen head office. All suppliers shall be either ISO9001 accredited or the supplier shall be audited by or on behalf of Lagan Bitumen prior to addition to approved suppliers list. Every batch of reprocessed oil received at the depot must be accompanied by a test certificate; otherwise the batch will not be accepted. These certificates shall be filed at site office d made available for inspection if necessary. The relevant Test Specifications are attached to this procedure as Acceptance Criteria for Thompsons and Acceptance Criteria for ENVA.

The fuel oil stores shall be bunded to 110%. Overfill protection mechanisms shall be installed on all fuel tanks. Refuelling operations shall only take place in suitably protected hard stands near the fuel tanks and any accidental spillages shall be contained using absorbent booms as stated in procedure DP004.

Bund integrity testing shall be carried out by a suitably qualified independent consultant at least every three years. The test procedure shall include the following:

- A thorough inspection of the bund;
- A photographic record of defects and other relevant issues of note;
- A bund integrity test in accordance with BS8004 shall be carried out at 3 year intervals or sooner if visual inspection indicates a potential requirement;
- On completion of the test and review of the data a detailed test report shall be prepared and held onsite for inspection and review.

Water or other liquid collected in the bund will be tested to determine its suitability for disposal. If there is visible oil esent, the waste will be disposed as hazardous waste as described in Procedure DP003. If testing shows that the liquid is not contaminated, it may be disposed by diverting it to the interceptor.

3. Monitoring and Reporting

A report on any integrity testing completed at the site shall be prepared and included in the Annual Environmental Report. Both reports will be available for consultation at the Site Office on request.

4. Corrective Actions

If a non-compliance with an Objective or Target is noted, an immediate review will be undertaken to identify the cause of the non-compliance. The details of the investigation together with details of corrective actions to be taken will be recorded in accordance with the Corrective Action Depot Procedure.

5. Attachments

Acceptance Criteria for Thompsons
Acceptance Criteria for ENVA

DP007 Oil Interceptor Management

Scope: This procedure defines specific conditions relating to the management of oil interceptors onsite.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

Oil interceptors shall be properly maintained to prevent discharge of oil to surface water, groundwater, land or sewer. The outflow from the interceptor should be checked weekly for any signs of contamination. All interceptors shall be inspected in accordance with the manufacturers instructions or every six months as a minimum. Inspections of the interceptor shall be carried out to ensure:

- correct operation and functioning of the interceptor;
- acceptable depth of accumulated oils and silts;
- no signs of leaking or physical damage to the interceptor;
- correct functioning of mechanical parts and warning devices where fitted.

A record of the inspection should be kept and any faults or damage should be reported and corrective action taken.

The interceptor should be periodically cleaned by a specialist contractor to remove accumulated oils and silts and the material should be disposed of according to the requirements set out in depot procedure DP003. The interceptor should be refilled with clean water after it has been emptied.

3. Monitoring and Reporting

The interceptor cleaning shall be monitored and recorded on the Waste Management Record Sheet as per depot procedure DP003.

4. Corrective Actions

If a non-compliance with an Objective or Target is noted, an immediate review will be undertaken to identify the cause of the non-compliance. The details of the investigation together with details of corrective actions to be taken will be recorded in accordance with the Corrective Action Depot Procedure.

DP008 Water Management

Scope: This procedure defines the conditions relating to management, monitoring and control of surface water discharges, trade effluent discharges and groundwater dewatering and management for the site.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

A current and accurate site drawing showing all surface water drainage and discharge points shall be held on site and should clearly differentiate between surface and foul water drainage. A map showing all groundwater monitoring locations shall be maintained at the site. All water usage at the site shall be monitored and recorded. Any significant changes in water usage shall be investigated and the findings documented.

All discharge points shall be visually inspected daily unless otherwise specified in any regulatory requirement. A sampling regime that is in line with the requirements of the discharge licence and the site's pollution risks shall be established. This shall include testing of samples where appropriate. Where any visual pollution is detected in the discharge, a sample shall be taken immediately and tested.

Water with high suspended solids shall be prevented from entering watercourses and surface water drains by proper onsite management of surface water and by using silt traps, interceptors and settlement systems where appropriate. Settlement systems shall be carefully managed to ensure effective settlement capacity by desilting or rotation.

Effective controls to prevent contamination of groundwater resources and an effective monitoring programme to monitor groundwater quality and supply shall be put in place. The main controls planned for the protection of groundwater resources at the site and in the area include:

- Measures shall be taken to minimise water demand where appropriate;
- Wheel washing water travels into the underground interceptor for treatment prior to discharge into storm drain. Sampling is carried out at this discharge point.
- The drainage arrangements proposed for the site shall ensure that no uncontrolled discharge of drainage from the site occurs at any time, and hence no infiltration to groundwater.
- Storage of wastes, fuels and hazardous materials shall be in designated bunded storage areas to prevent any risk of contamination of groundwater.

In instances when an actual or suspected uncontrolled release of pollutants occurs to a watercourse or ground water, site management shall inform the Technical Manager immediately and the emergency response procedures as per depot procedure DP004 shall be implemented.

3. Monitoring and Reporting

Environmental monitoring reports will be prepared by external consultants and shall contain all information as required by the various conditions set out in the permissions. A hardcopy report with the results assessed against the permit limits will be issued to the permitting authority and also to the site. A soft-copy will be issue to the Lagan Bitumen head office.

The monitoring plan for the site shall be as agreed with the Local Authority. The current monitoring plan is attached together with Maps showing the locations of all monitoring points.

4. Corrective Actions

If a non-compliance with an Objective or Target is noted, an immediate review will be undertaken to identify the cause of the non-compliance. The details of the investigation together with details of corrective actions to be taken will be recorded in accordance with the Corrective Action Depot Procedure.

DP009 Ecological Management

Scope: This procedure defines the conditions relating to the management of the site in terms of its impact on ecology.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

Lagan Bitumen operates to ensure that the activities carried out on site will not cause adverse impacts on the terrestrial or aquatic habitat of the area. The main potential impacts relate to the impacts of discharges to surface water. These impacts are managed, monitored and controlled as outlined in depot procedure DP008.

To ensure that due care is taken to prevent damage to wildlife and to enhance biodiversity where possible the company carries out appropriate risk assessments where necessary by:
identifying the valuable ecology at the site;
assessing potential threats or impacts to the ecology;
identifying ways of avoiding or minimising impacts.

Where significant impacts have been identified, an ecological survey shall be carried out. Where the wildlife is protected under legislation stringent controls shall be followed.

To ensure that site ecology and biodiversity is preserved and enhanced the following actions shall be taken at the site:

- native vegetation and natural habitats shall be retained where practicable;
- unnecessary site clearance shall be avoided;
- unnecessary disturbance to vegetation and soil shall be avoided;
- areas that cannot be disturbed shall be clearly cordoned off;
- ensure that any protected species such as bats, badgers or sand martins are adequately monitored and stand offs maintained.
- invasive weeds and plants such as Giant Hogweed, Japanese knotweed, Ragwort and Himalayan Balsam shall be controlled effectively

3. Monitoring and Reporting

Where required environmental monitoring reports on ecological findings at the site will be prepared by external consultants and shall contain all information as required by the various conditions set out in the permissions or as requested by the relevant authority. A hardcopy report will be issued to the permitting authority and also to the site. A soft-copy will be issue to the Lagan Bitumen head office.

DP010 Noise and Vibration Management

Scope: This procedure defines the conditions relating to management, monitoring and control of noise and vibration impacts at the site. The Procedure sets out the operating instructions to be issued to Contractors and employees to minimise noise and vibration impacts associated with the development.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

Noise levels at noise sensitive locations in the vicinity of the site shall be strictly controlled in accordance with the requirements of the conditions imposed by the permits for the site. Lagan Bitumen operates to ensure that noise levels associated with the development do not cause adverse impacts at noise sensitive locations. Practical instructions in accordance with the guidance in *BS5228: Noise Control on Construction and Open Sites* are issued to all contractors employees and include the following:

- Working hours shall be strictly confined to the hours stated in the sites permissions.
- There shall be no works on Sundays or Bank Holidays.
- The lowest possible noise level reverse warning alarms consistent with site safety shall be utilised;
- Compressors and pumps shall be enclosed and insulated where possible when in use;
- Muffling devices shall be fitted to ensure that effective noise control is achieved;
- Unnecessary revving of engines shall be avoided;
- Equipment shall be switched off when not in use;
- Plant and vehicles shall be properly maintained and, in particular, the effectiveness of silencers and lubrication of bearings and moving parts shall be carefully monitored; cutting edges of relevant equipment shall be kept sharp;
- For directional noise sources e.g. reversing trucks, the noise source shall be pointed away from the nearest noise sensitive receptors wherever possible;
- Internal haul roads shall be effectively maintained and constructed in such a way as to minimise gradients;
- Acoustic enclosures for pumps and generators and similar plant shall be used to minimise noise levels associated with their operation where possible;
- Drop heights for materials shall be minimised;
- Plant and vehicles shall be started sequentially rather than all at once;
- When working in close proximity to noise sensitive receptors the works programme shall be carefully controlled so that noisy activities are planned in such a way that they do not all occur simultaneously;

3. Monitoring and Reporting

Monitoring results shall be used to demonstrate compliance with the requirements imposed by the permit conditions and monitoring results shall be kept at the site and made available for inspection at all reasonable times. A hardcopy report with the results assessed against the permit limits will be issued to the permitting authority and also to the site. A soft-copy will be issue to the Lagan Bitumen head office.

4. Corrective Actions

If a monitoring result is out of compliance, an immediate review will be undertaken to identify the cause of the non-compliance. The details of the investigation together with details of corrective actions to be taken will be recorded in accordance with the Corrective Action Depot Procedure.

DP011 Landscape and Visual Impact

Scope: This procedure defines the measures to be taken on site to ensure protection of the landscape and visual amenity of the area surrounding the site as quoted in the sites permissions.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

The detailed landscaping plan for the site is available upon request. The landscaping plan shall be implemented as follows:

- Seeding and planting of screening bunds;
- Progressive restoration with replanting where appropriate;
- Growth will be encouraged on all medium to long term earth storage areas, with the aim of "greening up" any bare earth, thus blending it with the surroundings;
- Any new earthworks will be shaped to avoid "engineered" slopes which have a tendency to appear artificial and therefore out of place;
- Tree and shrub planting will be encouraged to support and strengthen existing hedgerow habitats;
- Earth ripping will be undertaken in compacted areas once access is no longer required, and clearance of potentially detriment waste identified;
- Earthworks and stored overburden will be kept to a reasonable height avoiding any breaking the horizon line from key visual receptors;
- Ecological management of the site will be carried out in accordance with depot procedure DP009.

3. Monitoring and Reporting

A summary report shall be prepared and an Annual Report shall be compiled for inclusion in the Annual Compliance Report. This report will be available for consultation at the Site Office on request.

DP012 Traffic Management

Scope: This procedure defines the measures to be taken to protect the amenities of the area and traffic safety as quoted in the Permissions for the site.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

The mitigation measures for minimising the impact of increased traffic on the local road infrastructure are summarised as follows:

- In general, acceptance of deliveries shall only take place outside the AM and PM peak travel periods whenever possible;
- Traffic entering and leaving the site shall comply with any directions given by site management regarding the route to and from the site and also while on the site;
- Traffic entering and leaving the site shall comply with the speed limits in place on the public road and on the site;
- Upon arrival at the site all drivers shall report to reception before proceeding into the site;
- Site reception shall check the delivery to the site ensuring the correct materials are being transported in the proper manner;
- Site reception shall check that the Driver Authorisation Licence is valid for any new persons delivering to the site;
- Site reception shall check all deliveries leaving the site ensuring the correct materials are being transported in the proper manner;

3. Monitoring and Reporting

There is no monitoring or reporting requirement associated specifically with this procedure.

4. Corrective Actions

If a non-compliance with an Objective or Target is noted, an immediate review will be undertaken to identify the cause of the non-compliance. The details of the investigation together with details of corrective actions to be taken will be recorded in accordance with the Corrective Action Depot Procedure.

If drivers are found to, or are reported to, have followed an incorrect route, a verbal warning may be issued. If two verbal warnings are issued, a written warning will be issued for the next offence and disciplinary proceedings will be initiated.

DP013 Archaeological Impact Management

Scope: This procedure defines specific conditions relating to archaeology preservation and protection of archaeological materials devised for the site.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

The mitigation measures relating to archaeology preservation and protection of archaeological materials for the site are summarised as follows:

- If any virgin ground development is proposed for the existing site, a full archaeological assessment will be required before the work commences;
- Pre-development assessment shall include a geophysical survey and/or the excavation of test trenches carried out by a licensed archaeologist prior to the commencement of any groundworks;
- Any topsoil stripping within the site and any other site clearance or earthmoving works shall be monitored by a qualified archaeologist if required by the relevant authorities.

3. Monitoring and Reporting

A summary report shall be prepared for any archaeological works completed at the site and shall be compiled for inclusion in the Annual Environmental Report. This report will be available for consultation at the Site Office on request.

4. Corrective Actions

If a non-compliance with an Objective or Target is noted, an immediate review will be undertaken to identify the cause of the non-compliance. The details of the investigation together with details of corrective actions to be taken will be recorded in accordance with the Corrective Action Depot Procedure.

DP014 End-of-Life Plant Management

Scope: This procedure defines specific conditions relating to the management of plant and equipment that is no longer in use at the site and has become redundant and will no longer be used at the site.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

In order to ensure that end-of-life plant and equipment is managed so that the item is either re-used elsewhere, recycled or disposed of before any pollution or contamination occurs the following actions shall be undertaken:

- Identify any plant and equipment that is stored on site but is no longer required for use;
- Determine if the plant and equipment is still useful and could be deployed at another Lagan site or sold;
- Check if the plant and equipment contain oils, lubricants, fuels or other potential contaminants which could res in pollution if the equipment is not properly managed;
- Drain plant and equipment of any potential contaminants to reduce potential for spillage if it is safe to do so;
- All plant and equipment disposed of as scrap metal should be drained of potential contaminants and these should be disposed of in accordance with depot procedure DP003;
- Ensure that end-of-life plant and equipment is securely stored with no potential to result in environmental pollution.

3. Monitoring and Reporting

Details of all wastes generated for recovery or disposal on or off the site shall be recorded in accordance with depot procedure DP003.

A summary of all waste statistics shall be prepared and an Annual Report shall be compiled for inclusion in the Annual Environmental Report for the site. This report will be available for consultation at the Site Office on request.

4. Corrective Actions

If a non-compliance with an Objective or Target is noted, an immediate review will be undertaken to identify the cause the non-compliance. The details of the investigation together with details of corrective actions to be taken will be record in accordance with the Corrective Action Depot Procedure.

DP015 Site Security

Scope: This procedure defines specific conditions relating to the site security and the prevention of intruders accessing the site.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

In order to ensure that reasonable precautions are taken to prevent intruders from accessing the Lagan Bitumen site resulting in damage to themselves or Lagan property the following actions shall be undertaken:

- A secure boundary fence shall be erected along all areas readily accessible by the public to prevent access to the site. A screening bank or boundary wall shall be erected along other areas which are not accessible from public roads etc;
- A lockable entrance gate shall be erected at the site entrance for all public access points into the site;
- Regular inspections of the security fence shall be carried out to identify and potential weaknesses;
- Buildings and offices shall be secured and locked before daily lock-up at the site;
- All access gates shall be locked by the last person leaving the site on a daily basis;
- All alarms shall be set by the last person leaving the site on a daily basis;
- Security lighting shall be activated if available;
- All plant and machinery shall be locked and/or stored away when not in use;
- All tools, materials and other sundry items shall be stored in locked containers or sheds when not in use and at the end of each working day;
- All volatile and/or polluting materials such as fuel, oils, paints etc shall be securely stored and not visible from the site boundaries accessible by the public.

3. Monitoring and Reporting

Any break-ins, thefts of damaged caused by intruders at the site shall be reported to the Gardai and to senior management immediately upon discovery.

4. Corrective Actions

If a break-in at the site occurs, an immediate review will be undertaken to identify the cause and source of the break-in. The details of the investigation together with details of corrective actions to be taken will be recorded in accordance with the Corrective Action Depot Procedure.

DP016 Contractor Management

Scope: This procedure defines specific conditions relating to the management of any contractors that enter the site to carry out works of any nature on the site.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

In order to ensure that the onsite activities of any contractor that carries out any works on the site are managed accordingly the following actions shall be undertaken:

- All Contractors that carry out any works on the site shall be inducted on the environmental, health and safety (EHS) rules for contractors and be made aware of the sites Environmental Policy and the various environmen control measures that are in place on the site that may be relevant;
- All contractors shall identify how their activities could impact on the environment and detail their works to be undertaken and the associated precautions to be taken before permission for work is granted;
- The contractor must advise Lagan Bitumen of any sub-contractors they are planning to use and ensure that the sub-contractor complies with the above requirements;
- The contractor shall notify Lagan Bitumen of any hazardous substances they will be using on site and how these will be controlled;
- A point of contact for the contractor shall be established with Lagan Bitumen site management prior to the commencement of any works on site;
- All contractors shall ensure that all plant and equipment brought onto site is fit for purpose and meets the relevant legislative standards;
- Contractors shall sign in and out at reception each time they enter and leave the site.

3. Monitoring and Reporting

The contractors work should be checked daily by site management to ensure they are working in accordance with the requirements of this procedure. The work should be assessed to ensure that the contractor is competent to complete the works without adverse risk to environmental and health and safety standards.

4. Corrective Actions

If the required standards are not being achieved by the contractor, their works shall be stopped and a review will be undertaken to identify the cause of the non-compliance. The details of the investigation together with details of corrective actions to be taken will be recorded in accordance with the Corrective Action Depot Procedure.

DP017 Communications, Incidents and Complaints

Scope: This procedure describes the processes which will be followed to deal with all communications received from and issued to the public with particular concern to any environmental matter raised by members of the local community. It also deals with the procedures to follow for any communication to and from the permitting authorities.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

2.1 Company Communication

Internal management communication on environmental issues shall be carried out via Environmental Management Review Meetings, informal meetings, and monthly senior management board meetings. Environmental review meetings held quarterly. The agenda includes a review of the following:

- Environmental monitoring reports
- Corrective action reports
- Environmental audits
- Environmental system effectiveness
- Environmental policy, objectives, targets and programme
- Emergency preparedness and response

A Community Liaison Officer shall be available on site at all times and shall be appointed to ensure that the local community are kept updated on developments. Inquiries by the public either verbal or written shall be directed to the Community Liaison Officer. The following information shall be available to the public on request:

- Environmental Policy
- Environmental Objectives, Targets and Programme
- Monitoring Reports
- Complaints Log, Complaint Investigation Reports and Follow up
- Waste Disposal Log
- Non-compliance reports and associated Corrective Action Reports

All managers are responsible for promoting environmental awareness amongst their employees, which includes keeping relevant personnel informed of environmental performance and related issues. The Company shall also use notice boards, update meetings, memo, email, phone etc. to keep employees informed of relevant environmental issues. A record of Environmental Training is kept at the site. This record must be signed and dated by both trainer and trainee at time of training and the area of training that has taken place must be indicated on the record form. All records shall be stored on file at the site office.

2.2 Recording of Environmental Communications

Environmental communications between interested parties shall be recorded at all sites. All incoming and out-going mail shall be recorded by the site manager or alternatively a nominated representative and a log of these records shall be kept on file at the site and made available for inspection. Details of date received/sent, sender, subject matter and action taken shall be recorded on the log.

2.3 Incidents

The Procedure for the reporting of Incidents is documented in Depot Procedure DP004. This procedure shall be followed the notification of any incidents at the site.

2.4 Complaints

Lagan Bitumen has an Environmental Policy that includes a commitment to deal with concerns and queries of interested parties on environmental issues and to meet and exceed where possible the requirements of the interested parties. To ensure that the Company is complying with its Environmental Policy and Targets, records shall be kept to document any environmental concerns raised by members of the local community. The Company must investigate, take samples as appropriate and provide feedback by way of corrective actions and communication with the interested party and also notify the licensing authority of the complaint and subsequent actions taken.

Environmental complaints are to be directed to the Site Manager who is responsible for recording complaint details and carrying out the necessary investigations and corrective actions. All complaints will be recorded on the Environmental Complaints Register. Details of the management and follow up are recorded on the Environmental Complaint Investigation Form. Details to be recorded includes the date reported, complaint details, person responsible for dealing with the complaint, complainant's description of the problem, site notes and the action which has to be carried out. A Corrective and Preventive Action form may be raised where non-compliances are identified following a complaint.

3. Monitoring and Reporting

The monitoring and reporting should be carried out for all training, incidents and complaints of an environmental nat as described in the procedure above.

4. Corrective Actions

If a non-compliance with an Objective or Target is noted, an immediate review will be undertaken to identify the cause of the non-compliance. The details of the investigation together with details of corrective actions to be taken will be recorded in accordance with the Corrective Action Depot Procedure.

DP018 Corrective and Preventive Actions

Scope: Specific corrective actions for environmental issues are documented in this procedure and shall be used by the Company to deal with non-compliances which may arise when targets and objectives are not being met.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

It is Company policy to deal with all environmental non-conformances as soon as possible. A series of checks and audits throughout the process are designed to check for non-conformances. Corrective and preventative action shall be initiated immediately. Any changes in procedures resulting from these actions shall be implemented and recorded.

hen any non-compliance is identified the Employee or Contractor must complete the Corrective and Preventative Action form according to the following steps:

- Enter the Corrective and Preventative Action (CPA) reference number use the format, CPA # - yr e.g. CPA 01-2017 for the first corrective and preventative action in the year 2017, numbering sequentially;
- Enter the type of non-conformance e.g. noise, dust, vibration, surface water, water supply, other air emissions or traffic nuisance;
- Identify how the non-conformance was found;
- Record the name of the person who found the non-conformance and issued the form;
- Record the details of the non-conformance i.e. which policy, objective or target is not being met and what is causing the non-conformance;
- Recommend the corrective and/or preventative action required. Take action immediately where the delegated authority exists in the Company's structure; or forward the recommendation to the appropriate person for approval of actions. Record the date and who the form was sent to for action;
- Record the corrective and preventative actions taken, the date and the initials of the person who took the action;
- Enter any follow up requirements and a date for reassessment to check future compliance;
- Report the non-compliance and action to the Technical Manager and forward the record to the Technical Manager for final check and sign off that the required actions have been taken to ensure ongoing compliance.

It is the responsibility of the Technical Manager to ensure that the necessary Corrective Action is implemented. Records of all Corrective Actions shall be kept in file at the site.

3. Monitoring and Reporting

A summary report will be prepared for inclusion in the Annual Environmental Report for the site.

DP019 Site Inspection Checklists

Scope: This procedure defines the requirement for site inspections to ensure that Lagan Bitumen is complying with its regulatory requirements and Environmental Policy and Targets.

1. Relevant Permits, Licences, Authorisations & Conditions

A copy of all Permits, Licences and Authorisations must be held on site and available for inspection by the relevant Authorities at all times.

2. Management and Control

The Technical Manager has overall responsibility for ensuring compliance with this procedure and the co-operation of all personnel is essential to its effectiveness. The Depot Manager is responsible for ensuring day-to-day compliance with the procedure.

Daily and weekly site inspections shall be undertaken by on-site staff to check on the environmental performance. T daily inspection form and the weekly inspection forms shall be used to carry out the inspection and its recording. Where the site inspection reveals any non-compliance with the Company's Environmental Policy, Objectives or Targets the Employee or Contractor must raise a Corrective and/or Preventative Action according to Procedure DP018. The Corrective Preventative Action (CAP) reference number must be recorded on the daily and weekly inspection forms as appropriate.

3. Monitoring and Reporting

Records of daily and weekly site inspections undertaken shall be recorded on the assigned forms and these shall be filed on site and shall be made available to the permitting authorities on request. Alternatively, provision is made to document daily and weekly site inspections electronically on the "Effective Software" on a Tablet Device and these records shall be filed centrally on the company Server. These files shall be made available to the permitting authorities on request. Site inspections undertaken and corrective actions issued or taken shall be reported to the Technical Manager on a monthly basis.

A summary of the Inspection Findings shall be prepared annually and included in the Annual Compliance Report.

DP020 Accident Prevention Policy

Scope: The purpose of this Accident Prevention Policy (APP) is to set out the policies of the Company in respect of Accident Prevention at the Lagan Bitumen site. The objective of this APP is to outline the protection provided for man and the environment by appropriate means, structures and management systems. The key features of this objective are:

- No major accidents
- No “near miss” incident capable of leading to a major accident
- No requirement to evacuate persons from areas on the site
- No injury to neighbours or employees or damage to environment as a result of accidental emissions.

The APP contains objectives set out under the following headings which are required to be addressed by the Safety Management System for the site.

1. Management and Control

Organisation Personnel and Training

The company (Lagan Bitumen) will ensure that;

- The organisational structure is appropriate to minimise the risk of a major accident, and to minimise the consequences should one occur.
- All staff are made aware of the potential for major accidents and are trained, where relevant, in procedures needed to ensure that policy objectives are met.
- All contractors’ staff are made aware of the potential for major accidents and are trained, where relevant, in procedures needed to ensure that policy objectives are met.
- All employees are aware of their responsibilities in the management of major accidents and are selected and trained to ensure that they have the necessary skills and experience to perform their duties.
- All the Company's employees have access to safety information and to data on Material Safety Data Sheets. All employees working directly with chemicals receive Chemical Safety Training upon induction. All employees are issued with a copy of the Company Safety Statement upon induction.
- Feedback from employees is encouraged on major accident issues in the course of training, risk assessment review and Health & Safety and Environmental audits. Employees are also encouraged to make suggestions and raise specific major accident concerns, which they may identify during operational activities.
- The necessary resources are made available for training of management and employees in the prevention of accidents, including major accidents.
- Systems are in place to co-ordinate the Health & Safety and Environmental Management System and ensure its effectiveness.

1.2 Identification and Evaluation of Hazards

The company (Lagan Bitumen) will ensure that;

- The levels of risk are reduced to 'as low as reasonably practicable'.
- Major hazards arising from normal and abnormal operations are identified and their likelihood and severity assessed.
- The identification and evaluation of hazards covers all phases of operations including manufacturing, storage, product transfer, waste disposal and control of emissions to the environment.
- Hazard Identification extends to evaluating potential risk to the site posed by events originating outside the site including risks from abnormal meteorological conditions such as flooding and power failure.
- All recommendations made as a result of the hazard identification process are implemented.

1.3 Operational Control

The company (Lagan Bitumen) will ensure that;

- The risk of incidents with the potential for accidental damage to people or the environment is minimised by exercising control over all aspects of the company's operations.

- Operating Procedures are written and implemented for all phases of site operations.
- Operating Procedures are reviewed on a regular basis and amended when and where necessary.

1.4 Planning for Emergencies

The company (Lagan Bitumen) will ensure that;

- Operations are carried out in a manner, which serves to protect the community and the company employees from injury or illness and which avoids damage to the environment.
- An on-site emergency plan is prepared and maintained, which details the required response of the company personnel in the event of a major accident.
- The emergency plan includes arrangements for contacting the emergency services. The emergency services will in turn contact those people in the surrounding environment that might be affected.
- The relevant personnel are trained in their emergency response duties under the on-site plan, together with first aid and fire-fighting training.
- The emergency plan / emergency evacuation plan is tested periodically and reviewed to ensure their continued effectiveness.
- The company co-operates fully with the local Fire Authority and other emergency services for emergency planning.

2. Monitoring and Reporting

2.1 Monitoring Performance

The company (Lagan Bitumen) will ensure that;

- Systems are developed, implemented and maintained which actively monitor adherence to all safety procedures adopted in order to minimise the risk from major accident hazards. Active monitoring includes inspections and preventative maintenance of safety critical plant, equipment and instrumentation as well as checking compliance with training, instructions and safe working practices.
- All accidents and incidents are systematically reported and investigated by the Company's investigation team. Investigations examine both the immediate cause of an incident and any underlying causes. All accidents and incidents are discussed at Safety Committee Meetings.
- Corrective and preventative actions determined by such investigations are recorded in the Standard Operating Procedure DP018 and implemented accordingly.

2.2 Audit and Review

The company (Lagan Bitumen) will ensure that;

- The Health & Safety and Environmental Management System is systematically reviewed for effectiveness and suitability.
- Regular internal audits are conducted.
- Procedures are developed, adopted and maintained to audit the achievement all Health & Safety and Environmental objectives.
- All relevant procedures are reviewed following all accidents or incidents with the potential to escalate into a major accident.
- The APP is reviewed regularly and also in the event of any modification to the site which could have significant impact on major accident hazards.

DP008-01M Environmental Monitoring Plan

The Environmental Monitoring Plan for the facility is detailed in this procedure.

1. Water Monitoring plan

The Water Monitoring Plan for the site includes the following.

1.1 Discharges to Aghamore Stream

There will be 2 No. discharges to Aghamore Stream when the site is operational:

- the discharge from the proposed quarry sump for dewatering stormwater via the proposed settlement lagoon, and
- the discharge from the proposed quarry sump for dewatering clean groundwater direct to Aghamore Stream.

The discharge lines from both sumps will be fitted with turbidity sensors for continuous monitoring of turbidity in water discharged to Aghamore Stream. Telemetry will communicate real-time turbidity readings to the 'Cloud' which can be accessed online.

Continuous flow monitoring of the discharge from both sumps on the quarry floor will be carried out (inline flowmeters to be installed), and continuous flow monitoring in the Aghamore Stream will also be carried out (flowmeter already installed).

1.2 Groundwater Monitoring

- Groundwater level monitoring in the existing monitoring wells (dataloggers with occasional manual dips at quarterly intervals (Figure 1);
- Biannual GW sampling from a representative number of wells (6 No.) around the quarry ;

3 Surface Water monitoring

- Water level monitoring off-site in the culvert by the entrance to the Top Coast Oil depot during periods of high rainfall;
- Monthly sampling of discharge, upstream, downstream at designated locations (Figure 2)

Figures 1 and 2 are attached which show the GW monitoring wells and SW sampling locations. The list of analysis parameters for SW and GW is attached in Table 1 and Table 2.

Fig. 1 Monitoring Well Location Map (Google Earth)

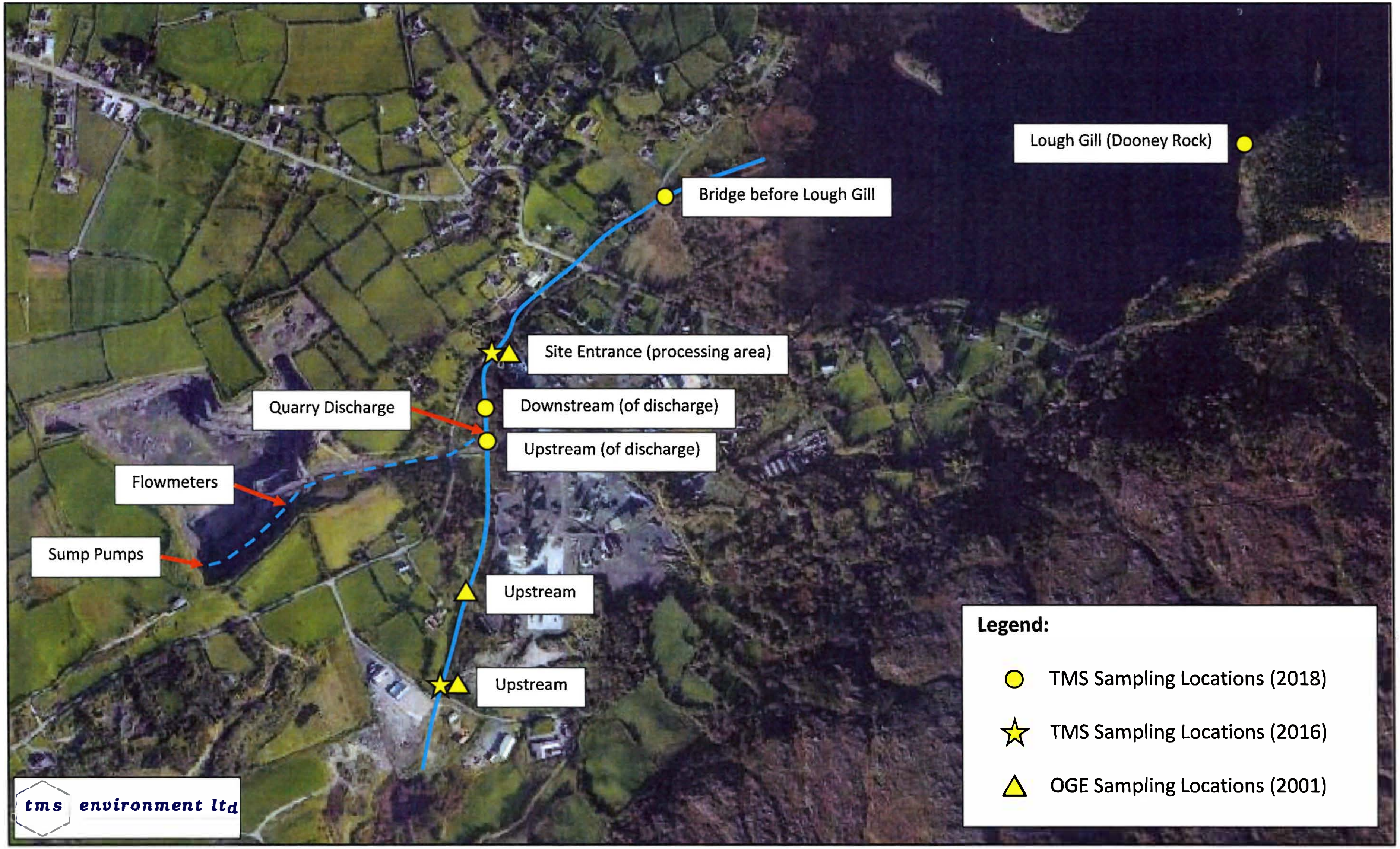


Fig 2 Surface Water Sampling Locations Map (Bing Maps)

Table 1 Groundwater Analysis

	Parameter	Units
Field	Temperature	°C
	Conductivity (field)	µS/cm @ 25°C
	pH	-
	Dissolved Oxygen [1]	% sat
	Dissolved Oxygen [1]	mg/l O_2
Whole Sample	Conductivity (lab) [2]	µS/cm @ 25°C
	Total Suspended Solids [3]	mg/l
	Turbidity [3]	NTU
	Biological Oxygen Demand	mg/l O_2
	Total Organic Carbon	mg/l
	Total Alkalinity	mg/l $CaCO_3$
Major Constituents	Calcium	mg/l
	Magnesium	mg/l
	Sodium	mg/l
	Potassium	mg/l
	Bicarbonate	mg/l
	Chloride	mg/l
	Sulphate	mg/l
Minor Constituents	Fluoride	mg/l
	Nitrate	mg/l NO_3
	Nitrite	mg/l N
	Total Ammonia	mg/l N
	Total Nitrogen	mg/l N
	Orthophosphate	mg/l P
	Total Phosphorus	mg/l P
	Iron (Dissolved) [4]	mg/l
	Manganese (Dissolved) [4]	mg/l
Trace Metals	Aluminium (Dissolved) [4]	µg/l
	Arsenic (Dissolved) [4]	µg/l
	Boron (Dissolved) [4]	µg/l
	Cadmium (Dissolved) [4]	µg/l
	Chromium (Dissolved) [4]	µg/l
	Copper (Dissolved) [4]	µg/l
	Lead (Dissolved) [4]	µg/l
	Mercury (Dissolved) [4]	µg/l
	Nickel (Dissolved) [4]	µg/l
	Selenium (Dissolved) [4]	µg/l
	Zinc (Dissolved) [4]	µg/l
Hydrocarb	Total Petroleum Hydrocarbons	µg/l
	Volatile Organic Compounds	µg/l
	Polycyclic Aromatic Hydrocarbons	µg/l
Micro	Total Coliforms	mpn/100ml
	Faecal Coliforms	mpn/100ml
	E. coli	mpn/100ml

Table 2 Surface Water Analysis Parameters

	Parameter	Units
Field	Temperature	°C
	Conductivity (field)	µS/cm @ 25°C
	pH	-
	Dissolved Oxygen	% sat
	Dissolved Oxygen	mg/l O_2
Whole Sample	Conductivity (lab)[1]	µS/cm @ 25°C
	Total Suspended Solids	mg/l
	Turbidity	NTU
	Biological Oxygen Demand	mg/l O_2
	Total Organic Carbon	mg/l
	Total Hardness	mg/l $CaCO_3$
Major Constit	Calcium	mg/l
	Magnesium	mg/l
	Chloride	mg/l
	Sulphate	mg/l
Minor Constituents	Nitrate	mg/l NO_3
	Nitrite	mg/l N
	Total Ammonia	mg/l N
	Total Nitrogen	mg/l N
	Orthophosphate	mg/l P
	Total Phosphorus	mg/l P
Trace Metals	Aluminium (Total)	µg/l
	Arsenic (Total)	µg/l
	Boron (Total)	µg/l
	Cadmium (Dissolved)[2]	µg/l
	Chromium (Total)	µg/l
	Copper (Total)	µg/l
	Lead (Dissolved)[2]	µg/l
	Mercury (Dissolved)[2]	µg/l
	Nickel (Dissolved)[2]	µg/l
	Selenium (Total)	µg/l
	Zinc (Total)	µg/l
Hydrocarb	Total Petroleum Hydrocarbons	µg/l
	Volatile Organic Compounds	µg/l
	Polycyclic Aromatic Hydrocarbons	µg/l
Micro	Total Coliforms	mpn/100ml
	Faecal Coliforms	mpn/100ml
	E. coli	mpn/100ml

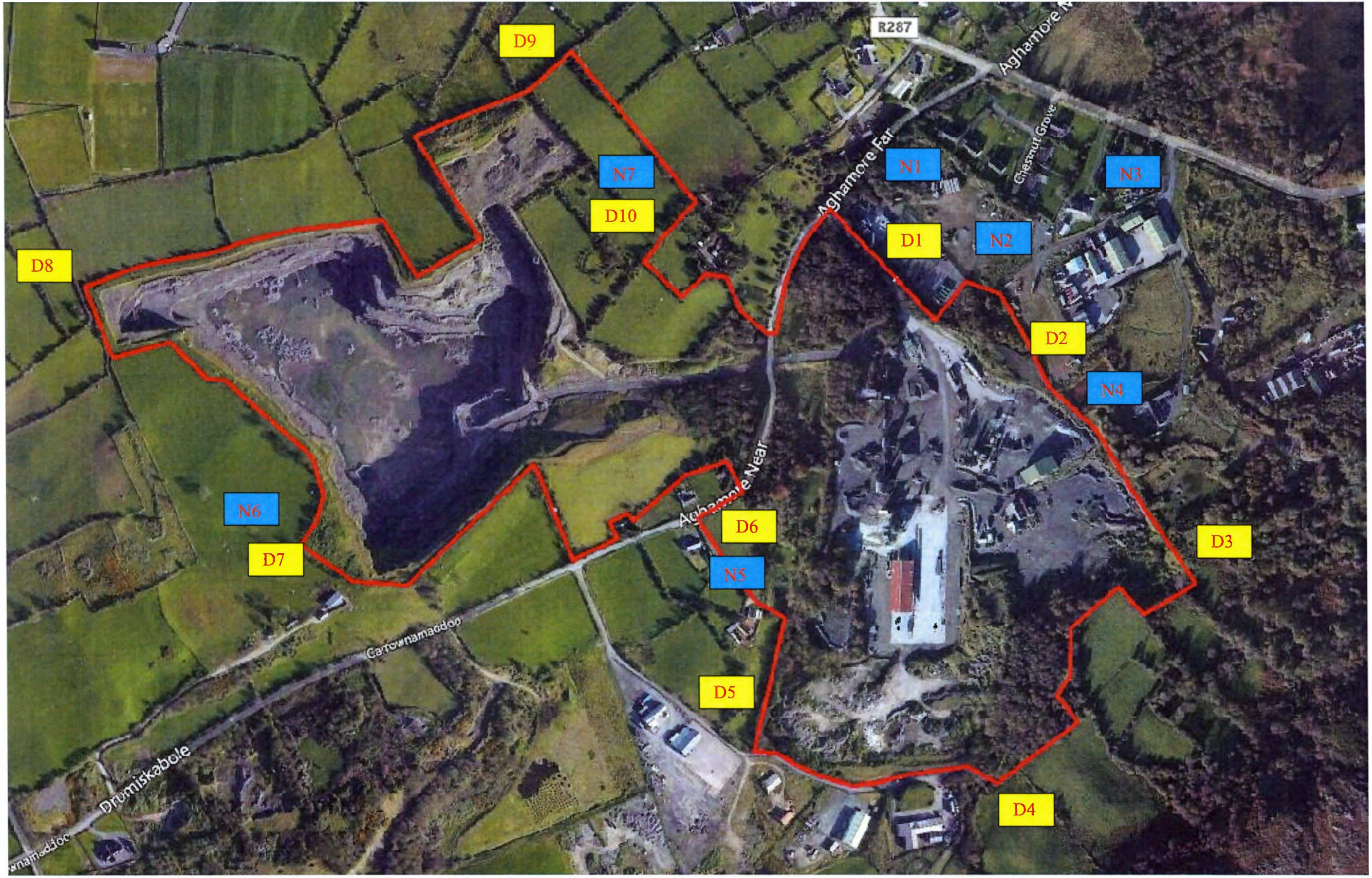
2.0 Air Emissions Monitoring Plan

Dust deposition will be measured at site boundaries at 10 locations as shown in Figure 3. Monitoring will be carried out at quarterly intervals. Stack emissions monitoring will be carried out every two months with an Annual calibration of the in-stack dust emissions monitor.

3.0 Noise Monitoring Plan

Noise monitoring will be carried out at 7 locations as shown in Figure 3. Monitoring will be carried out at quarterly intervals.

Figure 3 Dust and Noise Monitoring Locations



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A Lagan Company

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AUGHAMORE

ISO 14001: 2015

AUDIT AND INSPECTION SHEETS

AMENDMENT RECORD

Sheet ID No.	Audit and Inspection Sheet Title	Amendment No.	Date of Issue	Review Date
AIS001	Daily Environmental Site Inspection Check Sheet	1	01.02.2017	
AIS002	Weekly Environmental Site Inspection Check Sheet	1	01.02.2017	
AIS003	Odour Assessment Check Sheet	1	01.02.2017	
AIS004	Water Spraying Schedule	1	01.02.2017	
AIS005	Waste Record Sheet	1	01.02.2017	
AIS006	Incident Notification Form	1	01.02.2017	
AIS007	Environmental Complaints Register	1	01.02.2017	
AIS008	Environmental Compliant Investigation Form	1	01.02.2017	
AIS009	Environmental Training Record	1	01.02.2017	
AIS010	Incoming Post Register	1	01.02.2017	
AIS011	Outgoing Post Register	1	01.02.2017	
AIS012	Corrective & Preventive Actions	1	01.02.2017	
AIS013	Environmental Management Review Form	1	01.02.2017	

AIS001 DailyEnvironmental Site Inspection Check Sheet

Week Commencing ______________ Depot ______________ **DAILY SITE INSPECTION**

DAY	TIME	AIR QUALITY - VISUAL ASSESSMENTS										HOUSEKEEPING				CORRECTIVE ACTION	SIGNATURE
		WEATHER				Stack Ringelmann Record	SITE LOCATIONS					FUEL STORAGE		WASTE			
		General	Temp	Wind Speed	Wind Direction		Stockpile	Plant & loading areas	Haul Roads & Entrance	Conveyor Drums	Site Boundary	Bunding	Spillages	Adequate Storage Facilities	Disposal Documents on file		
Mon	am																
	pm																
Tue	am																
	pm																
Wed	am																
	pm																
Thur	am																
	pm																
Fri	am																
	pm																
Sat	am																
	pm																

Additional information

Notes *	General	Sunny / Overcast / Fog / Drizzle / Rain / Heavy Rain / Snow / Ice
	Temperature	Freezing / Very cold / Cold / Cool / Warm / Hot
	Wind speed	Calm / Gentle Breeze / Breeze / Strong Breeze
	Wind direction	North / North East / East / Southeast / South / Southwest / West / Northwest
	Visual assessment	None / Insignificant / Visible (No offsite Impact) / Obvious (Offsite)
	Corrective action	Brief description of problem and corrective action taken

TASK DESCRIPTION	DETAILS & COMMENTS	CPA REF

1 Surface Water Discharges				
Look for visual contamination at the following locations. If Yes initiate corrective action.	**YES**	**NO**	**DETAILS**	**CPA REF**
(i) Discharge from the settlement lagoon.				
Was a sample taken?				
Was the Technical Director called?				
(ii) Discharge Point into receiving surface waters				
Are any abnormalities observable? (colour, oil, flow)				
Was a sample taken or Technical Director called?				

2 Dust Management System				
Check the effectiveness of the dust suppression system at the following locations. If dust levels are high initiate ective action.	**YES**	**NO**	**DETAILS**	**CPA REF**
(i) Material Stockpiles, storage bays and bins				
(ii) Exposed surfaces				
(iii) Haul roads				
(iv) Wheel washes				
(v) Site entrance roadway				
(vi) Neighbouring residences				

3 Dust gauges

Check the dust gauges for the following:

GAUGE	GAUGES CHECKED	ARE THEY STILL IN POSITION	IS THE WATER LEVEL OK	PHOTO	OTHER COMMENTS	CPA REF
D1						
D2						
D3						
D4						
D5						
D6						

4 Storage area bunds				
Check bunds around the fuel, oil and waste and chemicals storage areas for build up of water (above 10% line) . Are there signs of bund water contamination? If yes:	**YES**	**NO**	**DETAILS**	**CPA REF**
(i) is there a leak or spill from a tank or container?				
(ii) arrange a test of the COD of the bund water.				
If there is a leak issue a corrective action and repair the container immediately				
If the water level is more than 50% of the bund level and is uncontaminated pump to the settlement pond				
If the water is contaminated arrange for storage and disposal as per hazardous wastes as specified in procedure DP003.				

TASK DESCRIPTION	DETAILS & COMMENTS			CPA REF
5 Site housekeeping				
Is there litter around the site? If yes initiate corrective action.	YES	NO	DETAILS	CPA REF
6 Waste Storage area				
Is the area generally tidy and waste stored in appropriate containers? If no initiate corrective action.	YES	NO	DETAILS	CPA REF
Is there any evidence of contamination of soil? If yes initiate corrective action.				
7 Hazardous Waste Storage area				
(i) Is the area generally tidy and waste stored in appropriate containers? If no initiate corrective action.	YES	NO	DETAILS	CPA REF
(ii) Are all labels clearly visible and readable? If no initiate corrective action.				
(iii) Is there any evidence of contamination of soil? If yes initiate corrective action.				
8 Surface Water Management System				
Inspect the following locations and check for visual contamination. If there is contamination initiate corrective action:	YES	NO	DETAILS	CPA REF
Settlement Lagoon				
Drainage Ditches				
Site stream upstream of site				
Site stream downstream of site				
Inspect the drainage ditches for signs of erosion. If there is erosion initiate corrective action such as lining the channel or altering the gradient				
9 Vehicles and plant				
Check vehicles to ensure that they are not excessively noisy.	YES	NO	DETAILS	CPA REF
Check plant and machinery to ensure that it is not excessively noisy.				
10 Stockpiles and temporary fill areas				
Is there potential for erosion to nearby watercourses? If yes initiate corrective action to cover the area with polythene	YES	NO	DETAILS	CPA REF
11. Oil Interceptors				
Are there any signs of contamination from the outflow of the interceptors?	YES	NO	DETAILS	CPA REF

Complaints

Were any complaints made. **Yes / No**

If Yes please complete the Environmental Complaints Register and the Environmental Complaints Investigation Form.

Type of complaint eg Noise, dust vibration, surface water, water supply traffic nuisance

Other relevant information

Contact the Technical Manager in the event of non-compliance/site observations, problems etc.

Inspection Completed By ____________________

Date __________ **Time** __________

Odour Assessment Log sheet

Date____________________

Location	Time	Weather		Wind		Visual Assessment	Odour Identified		Description of Odour Identified (e.g. character, intensity)
		General	Temp	Speed	Direction		YES	NO	

Notes *	Location	Upwind or downwind of plant (state whether north, south, east or west of plant)	**Additional information**
	General	Sunny / Overcast / Fog / Drizzle / Rain / Heavy Rain / Snow / Ice	
	Temperature	Freezing / Very cold / Cold / Cool / Warm / Hot	
	Wind speed	Calm / Gentle Breeze / Breeze / Strong Breeze	
	Wind direction	North / North East / East / Southeast / South / Southwest / West / Northwest	
	Visual assessment	None / Insignificant / Visible (No offsite Impact) / Obvious (Offsite)	
	Corrective action	Brief description of problem and corrective action taken	

WATER SPRAYING SCHEDULE						
DATE	TIME	AREAS SPRAYED				
		External roads	Entrance Road	Haul Roads	Stockpiles	Other (specify)

DATE OF DISPATCH	CONTRACTOR DETAILS	DESCRIPTION OF WASTE	EWC Code	HAZARDOUS / NON-HAZARD	METHOD OF DISPOSAL	QUANTITY
					R□□□□□□□L□□d□□□□□	

AIS006 Incident Notification Form

Notification reference		**Incident (Tick one or more)**				**Source of information (tick one or more)**	
Issued by		**Traffic**		**Water supply**		**Monitoring**	
		Noise		**Surface water**		**Complaint**	
		Vibration		**Odour**		**Site Inspection**	
Date issued		**Dust**		**other**		**Other**	
Date of incident		**Time of incident**					

Incident details (include details and circumstances giving rise to)

valuation of environmental pollution (if any) caused by incident

Recommended corrective and/or preventive action

Sent to: ____________________

Date: ____________________

Action Taken:

Date:_______________ **Signed:**_______________

Date for reassessment:

____

Done? YES/NO

Follow up action (if any recommended):

Reported to Technical Manager YES / NO	**Date:** ____________________________ **Signed:** ____________________________
Action Completed? **YES / NO**	**Date:** ____________________________ **Signed:** ____________________________

01.02.2017

Depot	

Date	**Time**	**Complaint from**	**Contact details**	**Nature of complaint**	**Complaint taken by**	**Complaint notified to**	**Date notified**	**Follow up**

AIS008 Environmental Complaint Investigation Form

Complaint reference number		**Received by**	
Date Received		**Time received**	

Complainant's details	
Name:	
Address:	
Contact numbers:	

Complaint Type	**Noise**		**Traffic**		**Water supply**		**Odour**	
	Vibration		**Dust**		**Surface water**		**Other**	

Details & location of complaint e.g. dust settling on property under southerly wind	

Investigation: e.g. weather conditions at time, site activities

Monitoring results (where available):

Actions taken:	Is there a non-compliance requiring corrective or preventative action? YES/NO If Yes please fill out Corrective and Preventive Action Record

Recommendation for further monitoring:

Date outcome communicated to:

Complainant	**Relevant Authority**	**Technical Manager**
Date ____________________ **Signed:**	**Date** ____________________ **Signed:**	**Date:** ____________________ **Signed:**

Completed? Yes / No	Date ____________________ Signed ____________________ Technical Manager

TRAINER:	**(Print Name)**	**(Signature)**

TRAINEE (Print)	**TRAINEE (Signature)**	**Date**

SUBJECT:	**DOCUMENT REFERENCE:**	**PLEASE TICK AS APPROPRIATE:**
Air Quality & Air Emissions Management	DP001	
Energy Management	DP002	
Waste Management	DP003	
Emergency Preparedness & Response	DP004	
Legislation Management	DP005	
Fuel, oil, Bitumen & Chemical Storage	DP006	
Oil Interceptor Management	DP007	
Water Management	DP008	
Ecological Management	DP009	
Noise & Vibration Management	DP010	
Landscape & Visual Impact	DP011	
Traffic Management	DP012	
Archaeology Impact Management	DP013	
End-of-Life Plant Management	DP014	
Site Security	DP015	
Contractor Management	DP016	
Communications, Incidents & Complaints	DP017	
Corrective & Preventive Actions	DP018	
Site Inspection Checklists	DP019	

Trainer

Date

Depot:

Incoming Correspondence – Environmental Matters			
Date Received	**From Whom**	**Subject Matter**	**Action Taken**

NOTE: Include Routine Reports

Depot:

Outgoing Correspondence – Environmental Matters

Date Sent	To Whom	Subject Matter	Remarks

AIS012 Corrective & Preventive Actions

CPA reference number		**Non-conformance (Tick one or more)**				**Source of information (tick one or more)**	
Issued by		**Traffic**		**Water supply**		**Monitoring**	
		Noise		**Surface water**		**Complaint**	
		Vibration		**Odour**		**Site Inspection**	
Date issued		**Dust**		**other**		**Other**	

Non-compliance details

Recommended corrective and/or preventive action

Sent to: ____________________

Date: ____________________

Action Taken:

Date:_______________ **Signed:**_______________

Date for reassessment:

____

Done? **YES/NO**

Follow up action (if any recommended):

Reported to Technical Manager **YES / NO**

Date: ____________________________

Signed: ____________________________

Action Completed?

YES / NO

Date: ____________________________

Signed: ____________________________

Annual Environmental Management Review

Site Name:

Date of Review:

Attendees:

Topics to be covered:

1. Review of objectives and targets for previous year;
2. Objectives and targets and risks & opportunities for coming year;
3. Review of internal and external audits completed for the site;
4. Review of non-compliances issued in the previous year;
5. Review of legal compliance for the previous year;
6. Review of communication (Internal and External) for the previous year;
7. Review of legislation changes, compliance obligations and other legal requirements that impact the EMS;
8. Review of minutes from previous years meeting;
9. Follow up actions from previous management reviews;

7\. Review of performance of contractors and suppliers;

8\. Improvements to the EMS;

9\. Resource needs;

10\. Review of environmental aspects;

Appendix G -
Water quality results

		[illegible]	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250	< 250
< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9
< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.01
6	4	7	< 3	< 3	< 3	6	< 3	3	< 3	5	< 3
1.21	1.3	1.07	< 0.8	< 0.8	< 0.8	1.07	< 0.8	1.09	1.22	1.06	< 0.8
< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18
< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
0 cfu/100ml	15	20	132	68	60 cfu/100ml	67	240	68	30 cfu/100ml	137	57
0	3	3	23	21	70	40	39	21	46	22	22
0 cfu/100ml	1	1	24	15	60 cfu/100ml	58	32	13	30 cfu/100ml	43	5

urface Waters)(Amendment) Regulation 2015 (S.I. No. 386 of 2015)

Attachmen Recent Surface Water Samples (BOD and Ort hosphate)

		Upstream										
Parameter	Units	30/01/2018	27/02/2018	27/03/2018	23/04/2018	27/08/2018	06/11/2018	07/01/2019	28/03/2019	Surface Water Environmental Quality Standards[2]	Salmonid Water Quality Standard[3]	Drinking Water Parametric Value[4]
Biological Oxygen Demand	mg/l O_2	1	< 2	4	< 1	2	< 1	< 1	Not available	≤ 1.5 (mean) or ≤ 2.6 (95%ile)[5]	≤ 5	-
Orthophosphate	mg/l P	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.05	< 0.02	0.04	≤ 0.035 (mean) or ≤ 0.075 (95%ile)[5]	-	-

		Discharge (W)[1]								Discharge (E)[1]			
Parameter	Units	30/01/2018	27/02/2018	27/03/2018	23/04/2018	27/08/2018	06/11/2018	07/01/2019	28/03/2019	30/01/2018	Surface Water Environmental Quality Standards[2]	Salmonid Water Quality Standard[3]	Drinking Water Parametric Value[4]
Biological Oxygen Demand	mg/l O_2	< 1	< 2	< 1	< 1	< 1	< 1	< 1	Not available	< 1	≤ 1.5 (mean) or ≤ 2.6 (95%ile)[5]	≤ 5	-
Orthophosphate	mg/l P	< 0.02	< 0.02	< 0.02	0.02	< 0.02	0.08	< 0.02	< 0.02	< 0.02	≤ 0.035 (mean) or ≤ 0.075 (95%ile)[5]	-	-

		Downstream										
Parameter	Units	30/01/2018	27/02/2018	27/03/2018	23/04/2018	27/08/2018	06/11/2018	07/01/2019	28/03/2019	Surface Water Environmental Quality Standards[2]	Salmonid Water Quality Standard[3]	Drinking Water Parametric Value[4]
Biological Oxygen Demand	mg/l O_2	< 1	< 2	< 1	< 1	< 1	1	< 1	Not available	≤ 1.5 (mean) or ≤ 2.6 (95%ile)[5]	≤ 5	-
Orthophosphate	mg/l P	< 0.02	< 0.02	< 0.02	0.02	< 0.02	0.06	< 0.02	< 0.02	≤ 0.035 (mean) or ≤ 0.075 (95%ile)[5]	-	-

		Bridge before Lough Gill										
Parameter	Units	30/01/2018	27/02/2018	27/03/2018	23/04/2018	27/08/2018	06/11/2018	07/01/2019	28/03/2019	Surface Water Environmental Quality Standards[2]	Salmonid Water Quality Standard[3]	Drinking Water Parametric Value[4]
Biological Oxygen Demand	mg/l O_2	< 1	< 2	2	< 1	< 1	< 1	< 1	Not available	≤ 1.5 (mean) or ≤ 2.6 (95%ile)[5]	≤ 5	-
Orthophosphate	mg/l P	< 0.02	< 0.02	0.02	0.03	< 0.02	0.07	< 0.02	0.02	≤ 0.035 (mean) or ≤ 0.075 (95%ile)[5]	-	-

		Lough Gill (Dooney Rock)										
Parameter	Units	30/01/2018	27/02/2018	27/03/2018	23/04/2018	27/08/2018	06/11/2018	07/01/2019	28/03/2019	Surface Water Environmental Quality Standards[2]	Salmonid Water Quality Standard[3]	Drinking Water Parametric Value[4]
Biological Oxygen Demand	mg/l O_2	< 1	< 2	< 1	< 1	< 1	2	< 1	Not available	≤ 1.5 (mean) or ≤ 2.6 (95%ile)[5]	≤ 5	-
Orthophosphate	mg/l P	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.03	< 0.02	< 0.02	≤ 0.035 (mean) or ≤ 0.075 (95%ile)[5]	-	-

Notes:

1. Discharge from the West stream bank (W) or East stream bank (E)
2. European Communities Environmental Objective (Surface Waters) Regulations 2009 (S.I. No. 272 of 2009), European Union Environmental Objectives (Surface Waters)(Amendment) Regulation 2015 (S.I. No. 386 of 2015)
3. European Communities (Quality of Salmonid Waters) Regulations 1988 (S.I. No. 293 of 1988)
4. European Union (Drinking Water) Regulations 2014 (S.I. No. 122 of 2014)
5. Surface Water EQS for 'Good' status

Concentration shaded where standard/limit value exceeded

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Attachment IV: All Discharged Water Samples (BOD and Orthophosphate)

Historic Samples (Cemex/Golders, 2007 - 2011):

	Units	Discharge	Discharge	Discharge	Discharge	Discharge	Discharge	Discharge	Discharge	Discharge	Discharge	Discharge	Discharge	Discharge	**Emission Limit Value**
		02/07/2007	26/08/2008	30/07/2009	31/08/2009	30/10/2009	26/02/2010	30/04/2010	31/05/2010	30/06/2010	30/07/2010	27/08/2010	02/09/2010	19/04/2011	
Biological Oxygen Demand	mg/l O_2	< 2	2	4	8	1	< 1	4	4	4	2	4	2	< 1	2
Molybdate Reactive Phosphorus (MRP)	mg/l P	< 0.002	0.02	< 0.01	0.07	0.1	0.03	0.12	0.08	0.07	< 0.01	0.14	< 0.019	< 0.005	0.05

Recent Samples (TMS, 2016):

	Units	Discharge (W)	Discharge (E)	Discharge (W)	Discharge (E)	Discharge (W)	Discharge (E)	Discharge (W)	Discharge (E)	Discharge (W)	Discharge (E)	**Emission Limit Value**
		22/02/2016	22/02/2016	31/03/2016	31/03/2016	19/04/2016	19/04/2016	06/05/2016	06/05/2016	15/06/2016	15/06/2016	
Biological Oxygen Demand	mg/l O_2	< 2	< 2	< 2	< 2	2.24	< 2	3.55	3.43	< 2 *	< 2 *	2
Orthophosphate	mg/l P	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	0.05

Recent Samples (TMS, 2018 - 2019):

	Units	Discharge (W)	Discharge (E)	Discharge (W)	Discharge (W)	Discharge (W)	Discharge (W)	Discharge (W)	Discharge (W)	Discharge (W)	**Emission Limit Value**
		30/01/2018	30/01/2018	27/02/2018	27/03/2018	23/04/2018	27/08/2018	06/11/2018	07/01/2019	28/03/2019	
Biological Oxygen Demand	mg/l O_2	< 1	< 1	< 2	< 1	< 1	< 1	< 1	< 1	Not available	2
Orthophosphate	mg/l P	< 0.02	< 0.02	< 0.02	< 0.02	0.02	< 0.02	0.08	< 0.02	< 0.02	0.05

Notes:

1. Trade Effluent Discharge Licence DL(W)139 (issued 9/12/2011)
2. All TMS Environment samples are grab samples/all previous samples assumed to be grab samples
3. Two discharge pipes at discharge point: W - West bank, E - East bank
4. Condition 2.1.3 of the licence: for discrete sampling, no grab sample shall exceed 1.2 times the Emission Limit Value (other than pH and temperature)
5. Condition 3.4 of licence: discharge will not cause receiving water to exceed limits in the Surface Water Regulations
6. BOD in discharge samples from 15/6/2016 (*) corrected following review of laboratory file

Concentration shaded where ELV exceeded

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Attachment V: BOD and MRP compliance with Surface Water Regulations (Recent Samples 2016-2019)

BOD:

Sample Date	BOD (mg/l O_2)	Representative Value [Notes 1 & 2]
22/02/2016	< 2	1
31/03/2016	< 2	1
19/04/2016	< 2 to 2.24	1.62
06/05/2016	3.43 to 3.55	3.49
15/06/2016	< 2	1
30/01/2018	< 1	0.5
27/02/2018	< 2	1
27/03/2018	< 1	0.5
23/04/2018	< 1	0.5
27/08/2018	< 1	0.5
06/11/2018	< 1	0.5
07/01/2019	< 1	0.5
28/03/2019	Not available	-

	Discharge	Good Status [Note 3]
Mean	1.01	≤ 1.5
95%ile	2.46	≤ 2.6

Notes:

1. Where BOD below laboratory reporting limit, half the limit used as the representative value
2. For the 2016 samples, average BOD calculated for samples from 2 pipes pumping from quarry sump
3. Good Status oxygenation conditions (BOD) as per Surface Water Regulations 2009

MRP/Orthophosphate:

Sample Date [Note 1]	MRP (mg/l P)	Representative Value [Note 2]
30/01/2018	< 0.02	0.01
27/02/2018	< 0.02	0.01
27/03/2018	< 0.02	0.01
23/04/2018	0.02	0.02
27/08/2018	< 0.02	0.01
06/11/2018	0.08	0.08
07/01/2019	< 0.02	0.01
28/03/2019	< 0.02	0.01

	Discharge	Good Status [Note 3]
Mean	0.020	≤ 0.035
95%ile	0.059	≤ 0.075

Notes:

1. 2016 samples not included as laboratory reporting limit too high (< 0.6mg/l P)
2. Where MRP below laboratory reporting limit, half the limit used as the representative value
3. Good Status nutrient conditions (MRP) as per Surface Water Regulations 2009

tms environment ltd

Appendix H -
Assimilative Capacity Assessment and Mass Balance Calculation for Receiving Waters (Aughamore Stream & Lough Gill) – TMS Report

ge point to estimate the number of dilutions available is 100m
ume is an assumed velocity (s = 0.1m/s)
half the forward velocity

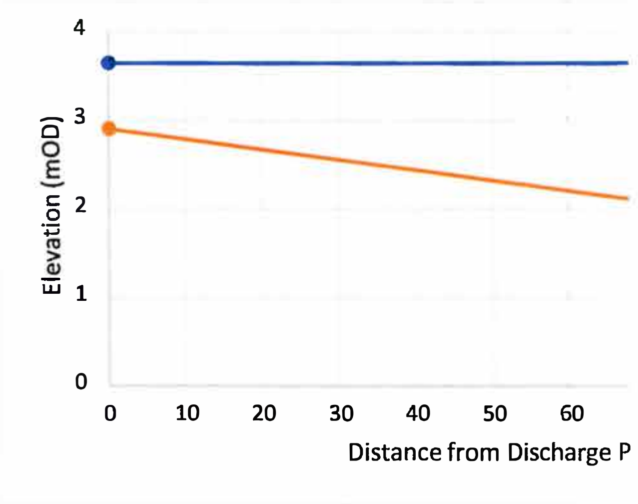
lume
c

b = average depth and F = max hourly flow rate

concentration in receiving water, Ce = background concentration in receiving water and Ce = concentration in trade effluent

en in Aghamore Bay:

Distance from Discharge Point (m)	0	77	100
Water Level (mOD)	3.6	3.6	3.6
Base of Lake (mOD)	2.9	2	1.6
Water Depth (m)	0.7	1.6	2



se (lowest dilution)

.3m

	Notes
	From above
r	From licence

	Dilutions available

trations):

Appendix I -
Natura Impact Statement

Response to Request for Further Information

NATURA IMPACT STATEMENT

Planning application for continued use and operation of the existing permitted quarry at Aghamore, Co. Sligo.
(Planning Reference 18/345)

Prepared for: Lagan Bitumen Ltd.

SLR Ref: 501.00396.00007
Version No: 1
April 2019

SLR

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CONTENTS

INTRODUCTION

1.1 SLR Consulting Ireland (SLR) was commissioned by Lagan Bitumen Ltd. in 2018 to prepare the response to a Request for Further Information (RFI) from Sligo County Council (Planning Reference No. 18/345) for the proposed continued use and deepening of the existing permitted quarry at Aghamore, Co. Sligo.

Background to the Commission

1.2 Lagan Bitumen submitted an application for permission for continuation of use and deepening of the existing quarry at Aghamore Near, Co. Sligo on 30 August 2018. Sligo County Council issued an RFI on 22 October 2018. This report sets out the response to the Natura Impact Schedule requesting provision of a stage 2 Appropriate Assessment, in the form of a Natura Impact Statement (NIS).

1.3 Aghamore Quarry ("the Site") is located in the townlands of Aghamore Near and Carrownamaddoo, approximately 3.5 km south of Sligo Town. The quarry is set in an agricultural landscape with the most common land use in the surrounding area being pasture for grazing animals.

1.4 The Site is screened by planted trees at the Site entrance and a short distance along either side of the access track. The northernmost corner of the Site is also well vegetated with dense scrub and well-structured field boundaries. The remaining length of the Site perimeter consists of post & wire / stock proof fencing with occasional semi-mature trees present. The quarry void is itself largely unvegetated with occasional ruderal species growing sparsely.

Brief Project Description

1.5 The proposed development being applied for is similar to that previously granted under Sligo County Council Ref. No 02/271 and will consist of:

- Continued use and operation of the existing permitted quarry area (c. 10.9ha) within an overall application area of c. 18 hectares;
- Deepening of the existing permitted quarry area by a further bench from -34.5m OD to -50m OD;
- The provision of a settlement lagoon (c. 2,830m2).

1.6 Upon the cessation of extraction operations it is proposed to return the worked lands to natural habitat[1] after-uses. Where feasible, restoration of exhausted and redundant areas will be carried out at the earliest opportunity. However, it is envisaged that the majority of restoration proposals will only be carried out after extraction operations at the site have ceased.

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[1] Natural habitat (lake, wetland – nature conservation) as defined by the EPA Environmental Management Guidelines for the Extractive Industry (2006)

Aims of the Report

1.7 This aim of this report is to provide supporting information to assist the competent authority to carry out appropriate assessment to determine if there will be an adverse effect on the integrity of Natura 2000 sites as a result of the proposed development at Aghamore Near and Carrownamaddoo townlands, Co. Sligo.

1.8 This NIS will address the Natura Impact Schedule of the RFI issued by Sligo County Council.

Objectives of Appropriate Assessment

1.9 The Habitats Directive promotes a hierarchy of avoidance, mitigation and compensatory measures to be addressed in the AA process as follows:

- Firstly, a plan / project should aim to avoid any negative impacts on Natura 2000 sites by identifying possible impacts early and designing the project / plan to avoid such impacts.
- Secondly, mitigation measures should be applied during the appropriate assessment (stage 2) process to the point where no adverse impacts on the site(s) remain.
- Thirdly a plan / project may have to undergo an assessment of alternative solutions. Under this stage of the assessment, compensatory measures are required for any remaining adverse effects, but they are permitted only if (a) there are no alternative solutions and (b) the plan / project is required for imperative reasons of overriding public interest (the 'IROPI test'). European case law highlights that consideration must be given to alternatives outside the plan / project boundary area in carrying out the IROPI test.

Evidence of Technical Competence and Experience

1.10 This Natura Impact Statement (NIS) was prepared by Elaine Dromey MCIEEM with input from Owen Twomey.

1.11 Elaine Dromey holds a BSc in Earth Science from University College Cork and an MSc in Vegetation Survey and Assessment from the University of Reading, UK. She is a full member of the Chartered Institute of Ecology and Environmental Management. Elaine has prepared AA screening reports and Natura Impact Statements (NIS) for a range of different projects and plans including quarries, large wind farms, single turbine developments, power lines, pit developments, anaerobic digesters, industrial development and single small developments.

1.12 Owen Twomey has worked in ecological consultancy since 2016. Owen holds a BSc in Environmental Science (Zoology) and a Postgraduate Diploma in Ecological Assessment. Owen has prepared ecological reports including Appropriate Assessment (AA) screening reports and Natura Impact Statements (NIS) for a wide range of projects, including other quarry developments within Co. Sligo.

RELEVANT LEGISLATION

European Nature Directives (Habitats and Birds)

1.13 The Habitats Directive (Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora) forms the basis for the designation of Special Areas of Conservation. Similarly, Special Protection Areas are classified under the Birds Directive (Council Directive 2009/147/EEC on the Conservation of Wild Birds). Collectively, Special Areas of Conservation (SAC) and Special Protection

Areas (SPA) are referred to as the Natura 2000 network. In general terms, they are considered to be of exceptional importance for rare, endangered or vulnerable habitats and species within the European Community.

1.14 Under Article 6(3) of the Habitats Directive an 'appropriate assessment' must be undertaken for any plan or project that is likely to have a significant effect on the conservation objectives of a Natura 2000 site. An Appropriate Assessment is an evaluation of the potential impacts of a plan or project on the conservation objectives of a Natura 2000 site, and the development, where necessary, of mitigation or avoidance measures to preclude negative effects.

1.15 Article 6, paragraph 3 of the EC Habitats Directive 92/43/EEC ("the Habitats Directive") states that:

> *"Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public".*

European Communities (Birds and Natural Habitats) Regulations 2011

1.16 Part 5 of the European Communities (Birds and Natural Habitats) Regulations 2011 sets out the circumstances under which an 'appropriate assessment' is required. Section 42(1) requires that '*a screening for Appropriate Assessment of a plan or project for which an application for consent is received, or which a public authority wishes to undertake or adopt, and which is not directly connected with or necessary to the management of the site as a European Site, shall be carried out by the public authority to assess, in view of best scientific knowledge and in view of the conservation objectives of the site, if that plan or project, individually or in combination with other plans or projects is likely to have a significant effect on the European site.*'

1.17 Section 42(2) expands on this, stipulating that a public authority must carry out a screening for Appropriate Assessment before consent for a plan or project is given, or a decision to undertake or adopt a plan or project is taken. To assist a public authority to discharge its duty in this respect, Section 42(3)(a) gives them the authority to direct a third party to provide a Natura Impact Statement and Section 42(3)(b) allows them request any additional information that is considered necessary for the purposes of undertaking a screening. Similarly Section 177T states that a competent authority may give a notice in writing to the applicant concerned, directing him or her to furnish a Natura impact statement and the applicant shall furnish the statement within the period specified in the notice.

1.18 A Natura Impact Statement has to include such information or data as the public authority considers necessary to enable it to ascertain if the plan or project will affect the integrity of a Natura 2000 site. Where appropriate, a Natura Impact Statement also needs to include:

I. the alternative solutions that have been considered and the reasons why they have not been adopted;

II. the imperative reasons of overriding public interest that are being relied upon to indicate that the plan or project should proceed notwithstanding that it may adversely affect the integrity of a European site;

III. the compensatory measures that are being proposed.

1.19 Section 42(6) requires that '*the public authority shall determine that an Appropriate Assessment of a plan or project is required where the plan or project is not directly connected with or necessary to the management of the site as a European Site and if it cannot be excluded, on the basis of objective scientific information following screening under this Regulation, that the plan or project, individually or in combination with other plans or projects, will have a significant effect on a European site*'.

METHODS

Desk Study

1.20 A desk study was carried out to support the preparation of the NIS. Information available on Natura 2000 sites within the potential zone of influence of the proposed works were collated. The Site and the surrounding area were viewed using satellite imagery[2]. Sligo County Council planning portal[3] was accessed for information on other planning applications. The National Parks and Wildlife Service (NPWS) website[4] was accessed for information on Natura 2000 sites. Environmental Protection Agency (EPA) Maps[5] was accessed for other environmental information relevant to preparation of this report.

1.21 The Chapters prepared for the Environmental Impact Assessment (EIA) submitted with this planning application; such as Chapter 2 (Project Description), Chapter 7 (Water), Chapter 10 (Noise) and Chapter 13 (Landscape) for the proposed project at the existing permitted quarry at Aghamore Near and Carrownamaddoo townlands were also reviewed to inform this report.

Natura Impact Statement

1.22 The report prepared for the second stage of AA is referred to as NIS and the approach taken to preparing the NIS is as follows: -

- Set out information on the Natura 2000 sites identified at screening stage as likely to be significantly affected by the project.
- Describe the elements of the project or plan (alone or in combination with other projects or plans) that are likely to give rise to significant effects on the environment.
- Set out the conservation objectives of the site.
- Describe how the project or plan will affect key species and key habitats. Acknowledge uncertainties and gaps in information.
- Describe how the integrity of the site (determined by structure and function and conservation objectives) is likely to be affected by the project or plan (e.g. loss of habitat, disturbance, disruption, chemical changes, hydrological changes and geological changes, etc.). Acknowledge also uncertainties and any gaps in information.
- The appropriate assessment is carried out by the competent authority and is supported by the NIS[6].

1.23 The approach taken in preparing the NIS is based on standard methods and guidance, as listed in the references section of this report.

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[2] https://www.google.ie/maps & http://www.bing.com/maps/ (last accessed 06 March 2019)

[3] http://www.sligococo.ie/planning/SearchPlanningApplications/ (last accessed 06 March 2019)

[4] https://www.npws.ie/protected-sites (last accessed 07 March 2019)

[5] http://gis.epa.ie/(last accessed 07 March 2019)

[6] Page 28 https://www.npws.ie/sites/default/files/publications/pdf/NPWS_2009_AA_Guidance.pdf

DETAILED DESCRIPTION OF THE DEVELOPMENT

1.24 The proposed development being applied for under this current planning application is shown on **Figure 1** and is similar to that previously granted under Sligo County Council Ref. No 02/271 and will consist of:

- Continued use and operation of the existing permitted quarry area (c. 10.9ha) within an overall application area of c. 18 hectares;
- Deepening of the existing permitted quarry area by a further bench from -34.5m OD to -50m OD;
- The provision of a settlement lagoon (c. 2,830m2).

1.25 The quarry extraction area is currently accessed via an existing permitted entrance located on the western side of the Local road that leads to the R287 regional road. There is no other vehicular access to the application site. The access gate is locked outside operational hours. There is no change proposed to the current access arrangements.

1.26 Aggregate extracted from the quarry will be processed within the quarry void and transported by HGV's to the existing manufacturing / processing area located on the Eastern side of the Local road, where further processing will be carried out.

1.27 Within the planning application boundary an area of 10.9 hectares has been used for the extraction of limestone and therefore has been completely stripped of overburden and topsoil material. No further stripping of topsoil or overburden materials will be carried out within the application area as part of the permission being applied for, with the exception of the area required to facilitate the installation of the proposed settlement lagoon.

1.28 Planning permission for a 15-year period is sought for the extraction and processing period and a further two years to complete final restoration of the site. The quarry will operate between 8.00 – 18.00 hrs Monday to Friday; or from 09.00 – 17.00 hrs Saturday. The quarry will not operate on Sundays or Bank Holidays, except in emergency situations.

1.29 Dewatering of the site and discharge to the stream leading into Lough Gill have been occurring for more than 15 years. The current floor level (c. -21mOD) of the quarry is below the water table requiring surface water and groundwater to be pumped from the quarry to a nearby stream (Aghamore Stream) which leads directly to Lough Gill c. 800m downstream.

1.30 The current water management within the quarry involves pumping the combination of rainwater and groundwater from the quarry floor directly to the Aghamore Stream. This is an interim measure agreed with Sligo County Council as there is currently no activity on site and no sources of potential water pollution remain within the quarry void. Incidental rainwater and groundwater seepages entering the quarry drain across the quarry floor to a sump located in the southern corner. Two pumps installed in the sump discharge directly to the Aghamore Stream via two 160mm uPVC pipelines under an existing Discharge Licence (Ref. No. (DL(W)139)). The discharge point at the Aghamore Stream is c. 330m east of the quarry void.

1.31 Measures are implemented to ensure that surface water discharges into Lough Gill are controlled and that the discharge water meets conditions set out in the existing discharge licence. These measures and the Groundwater quality monitoring will continue to be carried out on a biannual basis from a representative number of monitoring wells around the quarry.

1.32 During operation groundwater and stormwater / surface water run-off entering the quarry void will be intercepted separately and will be diverted to different sumps located on the quarry floor. Surface water run-off and storm water will be directed from a dedicated sump to the proposed settlement lagoon, prior to discharge to the Aughamore Stream. Groundwater inflows will be directed to a separate sump and discharged directly to the Aughamore Stream via a sediment trap.

1.33 An Environmental Clerk of Works (EnvCoW) will be appointed by the quarry operator prior to works commencing to monitor surface waters and receiving waters. Daily monitoring of surface waters will be carried out. The quarry operator will keep a record of this monitoring and will be notified of any issues by the EnvCow.

1.34 The proposed c 2,830 m^2 water settlement lagoon will be constructed and fully operational prior to the recommencement of quarrying activities within the Site. The proposed settlement lagoon will be positioned east of the quarry void within improved grassland within the existing quarry lands. Settlement lagoons are standard quarry development features and typical 'designed-in' mitigation features which allow suspended solids to be removed from water prior to discharge.

1.35 Blasting is and will continue to be used within the quarry area to fragment the stone prior to processing (crushing / screening etc.). The processing of the extracted rock, into aggregate products, will consist of crushing and screening by mobile processing plant located within the quarry void. Further processing will take place within the processing area to the east of the quarry. There will be no blasting outside the hours of 11:00 and 18:00 during Monday to Friday and none taking place at the weekend or public holidays. Residents nearby are informed / will be informed on the day prior to planned blasting schedule using house-calls, written note/signage at entrance (or combination). A warning siren will be sounded prior to blast taking place.

1.36 All surface water monitoring required under the existing Trade Effluent Discharge Licence will be carried out once activities recommence on site. Flowmeters are already installed in the discharge pipes from the quarry sump and a flowmeter installed upstream of the quarry discharge to the Aghamore Stream. Monitoring of groundwater levels by datalogger with periodic site visits to download data will be required. Groundwater quality monitoring will continue to be carried out on a biannual basis from a representative number of monitoring wells around the quarry.

1.37 The only hydrocarbons that will be stored on site while the quarry is operational, that have the potential to cause water pollution are lubricating oils, hydraulic oils and diesel fuel. All of these hydrocarbons will continue to be stored in the existing workshop located within the processing area of the east of the quarry. Bunded areas and spill trays are provided in the workshop to contain all oils and lubricants.

1.38 A dust monitoring programme is in place at the existing site, and dust deposition monitoring is carried out as part of the environmental monitoring programme when the site is operational. Monitoring results will be submitted to Sligo County Council on an annual basis.

1.39 Noise monitoring is currently undertaken at the application site, when operational. Noise monitoring locations shall be reviewed and revised where necessary. The results of the noise monitoring will be submitted to Sligo County Council on a regular basis for review and record purposes.

1.40 A restoration plan has been prepared for the planning application area – refer to EIAR Figure 2.2. The application area will be restored to a natural habitat, which is one of the beneficial after uses listed in the EPA Guidelines: '*Environmental Management in the Extractive Industry*' (2006). This will be achieved by the following measures:

- The application area will be left for natural recolonisation by locally occurring grass and shrub/scrub species and the void will fill with water.
- All existing boundary fences and hedgerows will be retained to ensure that the site is secure.
- All plant and machinery will be removed from the quarry void.

NATURA IMPACT STATEMENT

1.41 The screening for appropriate assessment carried out by Sligo County Council concluded that the screening report provided as part of the documentation to support the planning application did not provide sufficient detail to allow them to determine the likelihood of significant effects on the Natura 2000 network.

1.42 The Planner's Report of 18 October 2018 mirrors comments made by NPWS via Development Applications Unit (DAU) on 4 October 2018. The planners comments with respect to appropriate assessment are as follows:

> *"The AA screening report provides that in-combination effects of the proposed development were examined and that no effects were determined. No list or determination is provided for that plans or projects examined for the purpose of assessing in-combination effects. Particular regard should be made to water quality and quantity as they relate to Lough Gill SAC. In addition, there is an in-combination effect arising from the processing plant and any associated discharges to the Aghamore Stream/Lough Gill SAC. This needs to be considered at screening stage and if required further considered a Natura Impact Statement (NIS).*
>
> *Dewatering of the quarry and subsequent discharge to the Aghamore Stream occurs 800m upstream of Lough Gill. The AA screening report Table 2 (p22) provides that the proposed works have the potential to indirectly impact on Lough Gill through increased emissions to water. Accordingly, as the proposed works have the potential to impact on Lough Gill, an assessment on the indirect impacts as associated mitigation measures are required to be undertaken within a Natura Impact Statement (NIS). It is not possible under the Habitats Directive to take account of mitigation measures at screening stage that are intended to reduce or avoid any harmful effects arising from the proposed development"*

1.43 The Competent Authority, in this case Sligo County Council, will be required to carry out an appropriate assessment to determine whether the proposed development would adversely affect the integrity of Lough Gill SAC (001976). The 'integrity of the site' can be defined as 'the coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and / or populations of species for which the site is or will be classified'[7].

Assessment of the Effects of the Project or Plan on the Integrity of Lough Gill SAC

1.44 The headings within the appropriate assessment report template provided in the European Commission guidance document '*Assessment of plans and projects significantly affecting Natura 2000 sites*'[8] have been used to provide a framework to examine the potential impacts of the proposed project on Lough Gill SAC.

1.45 This section of the report sets out the potential implications of the plan or project (either alone or in combination with other projects or plans) on the integrity of the Natura 2000 site with respect to the conservation objectives of the site and to its structure and function. The precautionary principle should be applied when considering the potential implications and the focus should be on

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[7] http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/provision_of_art6_en.pdf

[8] Page 32 http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/natura_2000_assess_en.pdf

demonstrating, with supporting evidence, that there will be no adverse effects on the integrity of Lough Gill SAC. Where this is not the case, adverse effects must be assumed.

Description of European (Natura) 2000 site

1.46 The screening for appropriate assessment carried out by Sligo County Council concluded that Lough Gill SAC is required to be assessed within this NIS. Lough Gill SAC is approximately 520 m east of Aghamore Quarry when measured in a straight line. The following description of Lough Gill SAC is summarised from information within the Natura 2000 Standard Data Form for the site.

> *"Lough Gill is a moderate to large sized lake lying immediately east of Sligo town. It is fed by the River Bonet and drains into the sea via the Garvogue River, a short, wide and slow flowing river which passes through Sligo town. The lake lies along the junction between old metamorphic rocks to the south and limestone to the north. The water of the lake is thus influenced by both acidic and alkaline inputs, although nearly all the basin lies over limestone. The lake is 8 km by 2-3 km and has an area of 1,400 ha. It is a deep lake, with maximum depth at 31 m. Islands are a feature of the lake. Much of the shoreline is wooded and there is also some swamp vegetation, wet grassland and scrub along the shoreline. The lake is an important salmonid and coarse fishery and is used for a range of recreational activities. The site also includes the Shanvans and Owenmore rivers.*
>
> *An important example of a lake which appears to be naturally eutrophic. Quality generally good though blooms of blue-green algae in recent years indicate some artificial enrichment. Significant areas of alluvial forest occur along the Garvoge River (Osmunda - Salicetum atrocinerea type) and at the mouth of the River Bonet (Carici remotae - Fraxientum type). Old oak woodland of varying quality is well scattered along the shoreline and on some of the islands and is an important example of this habitat for western Ireland. At least six Red Data Book plant species have been recorded from site. Site has three species of lamprey and Austropotamobius pallipes. The lake and its associated rivers support an important population of Salmo salar. Lutra lutra has a good population within the site. Of minor importance for birds though the site has a small breeding colony of Sterna hirundo. A wide range of rare or scarce invertebrates are known from the site, as well as several Red Data Book mammal species, including Martes martes"*

Describe the elements of the project or plan (alone or in combination with other projects or plans) that are likely to give rise to significant effects on the environment.

1.47 The elements of the project identified as having potential to affect Lough Gill SAC are as follows:

- Dewatering of the quarry – effects on surface water
- Deepening of the quarry – effects on ground water
- In-combination effects with inactive processing area east of the Site.

1.48 TMS Environment Ltd. in 2019 (refer to response to Further Information Item 5) carried out a groundwater assessment and determined that the discharge of ground water from the quarry to Aghamore Stream will not change the existing hydrological system in the area. This assessment also determined that the quality of the current quarry discharge water is better than that of the Aghamore Stream. The water quality of the Aghamore Stream will not be reduced by discharge of water from the quarry during dewatering as the water being discharged is of better quality than that of the stream. The discharge of water from the quarry during dewatering is not likely to affect water quality in the Aghamore stream and therefore there will be no effect on the water quality of Lough Gill SAC and significant effects are not likely.

1.49 During the construction of the water settlement lagoon, any surface water generated by rainfall will be directed away from the Aghamore Stream to the quarry void. There will be no discharge of surface water run-off to Aghamore stream during construction of the settlement ponds. Surface water run-off and stormwater will be pumped from a dedicated sump on the quarry floor to the water settlement lagoon prior to discharge to the Aghamore stream during operation of the quarry. The settlement lagoon will reduce the volume of suspended solids within the discharge water to level comparable with or better than that of the receiving waters. Groundwater inflows into the quarry void will be directed to a separate quarry sump for dewatering clean groundwater, prior to discharge off site directly to the Aughamore Stream via a sediment trap. There will be no deterioration to the water quality of Aghamore Stream or Lough Gill SAC due to the proposed project.

1.50 There will be a negligible 0.14% increase in the groundwater catchment to Lough Gill as a result of the proposed deepening of the quarry. This will not result in significant effects to the SAC. Both the Aghamore Stream and Lough Gill are outside of the estimated drawdown area radius (286 m) of the deepened quarry. As a result there will be no reduction inflow within the Aghamore Stream or effect on water levels within Lough Gill. There will be no significant effects on Lough Gill SAC as a result of changes in water quantity.

1.51 There is currently no point discharge arising from the processing area to the east of the Site as this area is inactive. There will be no point discharges from the processing area in the future. As the processing area east of the site is inactive and there are no water discharges from this area there is no pathway for the project to act in-combination with it resulting in cumulative effects on Lough Gill SAC. Cumulative effects as a result of the proposed project are not likely to give rise to significant effects on Lough Gill SAC.

1.52 The continuation of use and deepening of Aghamore is not likely to give rise to significant effects on Lough Gill SAC either alone or in-combination with other projects or plans.

Set out the conservation objectives of the site

1.53 The detailed conservation objectives for Lough Gill SAC are not yet available so a generic conservation objective has been supplied by NPWS[9].

1.54 The generic conservation for Lough Gill SAC is as follows:

To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected:

1.55 These Annex I habitats and Annex II species are;

- (3150) Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation
- (6210) Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (*important orchid sites)
- (91A0) Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles
- (91E0) Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)*
- (1092) White-clawed Crayfish *Austropotamobius pallipes*
- (1095) Sea Lamprey *Petromyzon marinus*
- (1096) Brook Lamprey *Lampetra planeri*

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[9] https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO001976.pdf (last accessed 08/03/2019)

- (1099) River Lamprey *Lampetra fluviatilis*
- (1106) Salmon *Salmo salar*
- (1355) Otter *Lutra lutra*

Describe how the project or plan will affect key species and key habitats. Acknowledge uncertainties and gaps in information

1.56 The project, the continuation of use and deepening of the existing quarry at Aghamore Near and Carrownamaddoo townlands, Co. Sligo, is set at a distance of ca. 520 m from Lough Gill SAC. The terrestrial key habitats and species of Lough Gill SAC, such as grassland and woodland habitats, will not be affected by the proposed project as they are at a distance of over 2 km from the Site and lack any ecological connectivity[10] with the quarry. As the Site and the SAC boundary do not overlap there is no risk that the project could cause direct impacts resulting in effects on the habitats and species listed as feature of interest for Lough Gill SAC.

1.57 There will no indirect effect on the key species, such as otter, crayfish, salmon and lamprey, listed as features of interest of Lough Gill SAC as a result of the degradation of water quality as a result of discharge of surface water and groundwater to the Aghamore Stream.

1.58 The proposed project will not result in a deterioration of the water quality of Lough Gill. There will be no indirect effects to the aquatic habitat Natural Eutrophic Lakes (3150) though frequently recorded impacts such as pollution to surface waters, changes in water bodies condition and fertilisation in agriculture[11]

1.59 The proposed project is not likely to affect key species and key habitats of Lough Gill SAC.

Describe how the integrity of the site (determined by structure and function and conservation objectives) is likely to be affected by the project or plan (e.g. loss of habitat, disturbance, disruption, chemical changes, hydrological changes and geological changes, etc.). Acknowledge also uncertainties and any gaps in information.

1.60 The terrestrial habitats for which the SAC is designated for will not be affected by the proposed project as they are set at a distance from the Site and there is no ecological connectivity between them and the Site.

1.61 The key species and habitats of Lough Gill SAC are not likely to be affected as a result of the proposed project.

1.62 The integrity of Lough Gill SAC will not be affected by the proposed project as there are no likely effects to either the key habitats or species for which it has been designated as a European site of importance for nature conservation.

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[10] Structural connectivity is equal to habitat continuity and is measured by analysing landscape structure, independent of any attributes of organisms. This definition is often used in the context of metapopulation ecology. Functional connectivity is the response of the organism to the landscape elements other than its habitats (i.e. the non-habitat matrix). This definition is often used in the context of landscape ecology. (Kettunen *et al*. 2007)

[11] According to Reporting under the Article 17 of the Habitats Directive during the Period 2007-2012

Describe what mitigation measures are to be introduced to avoid, reduce or remedy the adverse effects on the integrity of the site. Acknowledge uncertainties and any gaps in information.

1.63 While no adverse effects on the integrity of Lough Gill SAC are anticipated as a result of the proposed project the following mitigation measures are included as 'designed-in' mitigation and provide certainty that the SAC will not be affected by the proposal to resume quarrying operations at Aghamore Quarry.

- In advance of resuming quarrying operations at Aghamore a water settlement lagoon of c. 2,830m2 will be installed to treat surface water run-off and stormwater pumped from a dedicated sump on the quarry floor, before discharge to the Aghamore Stream. The settlement lagoon will have a water depth of 1.5m, a minimum freeboard of 0.5m and will be lined to prevent leakage.
- Hydrocarbon Interceptors will be installed close to areas of potential risk such as the fuel storage area and refuelling station.
- Ground water entering the quarry void will be intercepted and directed to a dewatering sump for clean groundwater via a system of drains along the toe of the excavation faces. These drains will be maintained separate from the quarry floor. Water from the groundwater dewatering sump will be discharged directly off site to the Aughamore Stream via a sediment trap.
- All water (stormwater and groundwater inflows) pumped from the quarry void will be discharged in compliance with the requirements of discharge licence ref no DI (W) 139 and emission limit values specified under the discharge licence.
- Hydrocarbon and chemical storage will continue at their current location within the workshop located in the processing area to the east of the Site. The only hydrocarbons that will be stored on site during operation of the will be limited to lubricating oils, hydraulic oils and diesel fuel. All of these hydrocarbons will continue to be stored in bunded areas and on spill trays in the workshop area. Bulk fuels will be stored in the existing bunded fuel storage area on site.

1.64 The Quarry Manager will be responsible for implementation of good working practice during construction and mitigation measures as set out in this document. The measures set out above are used as standard to manage discharge of water from quarry developments and are accepted to be effective in preventing emissions of pollutants to surface water receptors.

CONSIDERATION OF FINDINGS

1.65 The continuation of use and deepening of Aghamore is not likely to give rise to significant effects on Lough Gill SAC either alone or in-combination with other projects or plans. The above measures are standard "designed in" mitigation typical of quarry developments and provide certainty that the SAC will not be affected by the proposal to resume quarrying operations at Aghamore Quarry. No additional specific mitigation measures are deemed necessary.

1.66 It is considered that, there will be no adverse effects on the integrity of Lough Gill SAC as a result of the proposed continuation of use and deepening of Aghamore quarry, at Aghamore Near and Carrownamaddoo townlands, Co. Sligo.

1.67 Based on the information set out in this report we submit that the competent authority has sufficient information to allow them to determine that the proposed project, individually or in combination with other plans or projects, will not have an adverse effect on any European sites.

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Google Maps

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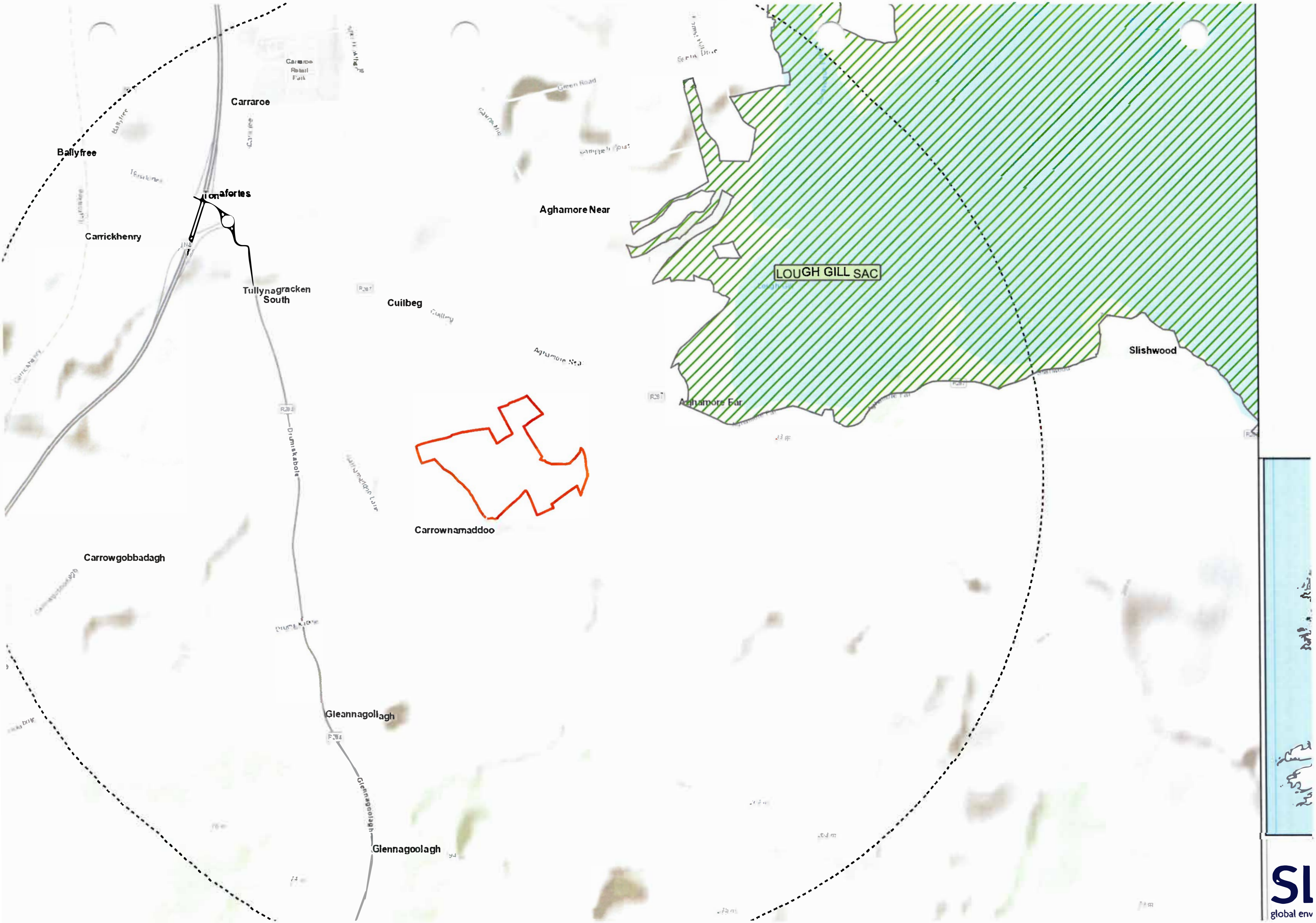
http://gis.epa.ie/

FIGURES


Carraroe Retail Park
Carraroe
Green Road
Ballyfree
Tonafortes
Aghamore Near
Carrickhenry
Tullynagracken South
Cuilbeg
LOUGH GILL SAC
Slishwood
Aghamore Near
R287
Aghamore Far
R286
Drumiskabole
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Appendix J -
Details of Settlement Lagoon and Construction Environmental Management Plan (CEMP)

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

Continued Use & Deepening of Existing Quarry Aghamore Near and Carrownamaddoo townlands, County Sligo

Prepared for: Lagan Bitumen Ltd

SLR Ref: 407.02036.00616
Version No: Issue 1
July 2019

BASIS OF REPORT

This document has been prepared by SLR with reasonable skill, care and diligence, and taking account of the manpower, timescales and resources devoted to it by agreement with Lagan Bitumen Ltd.(the Client) as part or all of the services it has been appointed by the Client to carry out. It is subject to the terms and conditions of that appointment.

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CONTENTS

1.0 INTRODUCTION

Lagan Bitumen Ltd. (Lagan) has instructed SLR Consulting Limited (SLR) to prepare a Construction Environmental Management Plan (CEMP) in response to Item 2(b) of the Further information Schedule submitted under cover of Sligo County Council's Further Information Request dated 10 June 2019.

Item 2(b) states:

> *'Submit a detailed site specific method statement for the construction of the proposed settlement lagoon. The method statement shall take into consideration the potential for negative impacts on water quality and shall clearly outline site specific mitigation measures that will be implemented on site. The method statement shall be supported by site layout plans clearly identifying how the mitigation measures will be implemented in practice.'*

It is considered that the most appropriate means of providing this information is in the form a CEMP that outlines how potential adverse impacts on the water environment that may arise during the construction of the proposed settlement lagoon will be managed. This CEMP should be read in conjunction with Drawings CFI 1, CFI 2 and CFI 3 submitted with the response.

Lagan and Lagan's contractors will be required to implement measures to prevent, or minimise, harm to the environment from the construction of the proposed settlement lagoon. This CEMP sets out the management measures that will be employed during the construction phase, which all contractors will be required to adopt and implement throughout the works. This CEMP will enable the contractors to minimise, avoid and / or manage their potential effect on the water environment.

In the event that contractors identify further environmental impacts arising from their activities they will be required to inform Lagan immediately and implement appropriate measures to managing these further impacts.

1.1 Environmental Management during Construction

When Lagan select the contractors for the works, the contractors will be required to sign a contract that confirms they will comply with the requirements of this CEMP.

All contractors on site will be required to comply with all relevant environmental legislation and to take full account of all published standards, accepted industry practice, national guidelines and codes of practice relevant to the construction works. The environmental performance of the contractors will be monitored by Lagan through site inspections and audits over the duration of the works,

Lagan will ensure that all contractors operate an induction scheme for all employees. This will ensure that all site operatives are aware of the site rules and their environmental responsibilities including adherence to the CEMP. Training needs for site operatives should also be identified as part of this induction process and appropriate training provided as required.

1.2 Communication

This CEMP will be distributed to the contractor and key operatives employed on site during the construction phase of the works. Lagan and the contractor's Environmental Policy will be clearly displayed on site and made the subject of regular toolbox talks.

The contractor will ensure that the following aspects of daily site operations will be communicated to all staff;

- progress reports;
- training of site operatives, if required;
- daily and weekly audits and inspections of site operations;

- management of any complaints received;
- visits by external bodies or authorities; and
- objectives and targets.

Any non-conformances on site will be recorded and Lagan immediately notified and then passed on to all site operatives.

During the regular on site progress meetings, performance to date will be discussed together with:

- the need for improvements (if any);
- results of inspections;
- and any complaints received.

Upcoming work operations will be reviewed to plan any necessary actions to mitigate environmental risks and to disseminate information on best practice.

2.0 GENERAL SITE INFORMATION

2.1 Description of the works

This CEMP has been prepared for the construction of a settlement lagoon and associated infrastructure to manage the quality of surface water runoff accumulating in the base of the quarry. This accumulated runoff is to be discharged to a small watercourse (referred to as the Aghamore Stream) on the eastern side of the local road that separates the quarry from the Processing Area, via the proposed settlement lagoon.

Runoff accumulating in the base of the quarry will be drained to a sump and pumped to the settlement lagoon. Whilst a gravity discharge to the Aghamore Stream from the settlement lagoon would be technically feasible, due to the elevation of the local road, an excessively deep pipe trench would be required and therefore it is proposed that supernatant water in the settlement lagoon will be pumped to a discharge manhole and silt sump on the south western side of the junction of the haul road with the local road from where it can drain by gravity beneath the local road to the Aghamore Stream.

In addition, groundwater accumulating in the groundwater sump will be pumped to the proposed discharge manhole allowing a combined gravity feed to the Aghamore Stream. Pumped groundwater does not require any form of treatment prior to discharge to the Stream.

Pumping mains will be laid on the ground surface adjacent to the haul road suitably protected by Armco Barriers or similar. This has the advantage or reducing the excavation (trenching) required.

The proposed arrangement is illustrated on Drawing CFI1.

Construction of the settlement lagoon will require the excavation by predominantly drill and basting of approximately 42,500m^3 of topsoil, overburden and rock. Excavated rock will be processed in the main Processing Area. Topsoil and overburden will be placed into worked out areas as part of the progressive restoration scheme – refer to EIAR Figure 2.2.

The final profile of the settlement lagoon will be formed by ripping and the formation to accept a geomembrane (welded HDPE liner) regulated by the placement of a minimum thickness of a protective bedding material. The geomembrane will be protected by a suitably specified geotextile which in turn will be overlain by a fine stone protection layer and coarse stone protection layer. The geomembrane will be secured in a perimeter anchor trench. Sections through the proposed settlement lagoon are shown by Drawing CFI2 and the proposed liner installation details and inlet and outlet details by Drawing CFI3.

Inlet and outlet structures will be constructed on top of the geomembrane liner as shown by Drawing CFI3. Inlet and outlet pipework will be protected by a stone protection haunch again over the top of the liner. Where the outlet pipe passes through the liner, a suitable collar will be installed around the pipe to ensure its water-tightness.

2.2 Construction working hours

All construction works will be carried out within the currently permitted operational hours for the quarry.

2.3 Construction site layout

The settlement lagoon will be located entirely within the curtilage of the existing quarry immediately to the south of the existing haul road connecting the quarry with the Processing Area on the other side of the local road.

Key receptors identified in Chapter 7 the EIAR that are of direct relevance to the construction of the settlement lagoon are groundwaters underlying the site and surface water runoff draining into to the base of the quarry that is then pumped to the Aghamore Stream.

To minimise the potential impact of the construction works on key receptors the following general principals will be followed;

- A construction compound including site welfare facilities will be located with the existing Processing Area at a location to be agreed with Lagan;
- Plant and construction materials will be stored in the Processing Area;
- No construction plant will be left unattended within the construction area at any time; and
- Refuelling and servicing of plant and machinery will only be completed in the construction compound;
- Lagan and the contractor will ensure the construction site is secure at all times.

2.4 Construction site security

The construction site is located within the confines of the existing quarry. As shown by Drawing FI4, the site is securely fenced and there are no public rights of way across the site.

It is therefore unlikely that there will be any unauthorised access during the construction works.

2.5 Site access and haul roads

Access to the site is from the local road. Access to the works area from the construction compound in the Processing Area is via the haul road to the quarry and requires crossing the local road. The contractor will follow the procedures established by Lagan for crossing this road with construction plant.

Wheel washes are to be established on the quarry haul road and on the Processing Area at the locations shown on Drawing CFI4.

3.0 POLLUTION PREVENTION PLANNING

The construction site will be operated to minimise, or reduce impacts to the surrounding environment. The following sections of this CEMP include mitigation methods to avoid, or mitigate, the impact of potential pollution arising from the construction of the settlement lagoon and associated infrastructure.

3.1 Excavation

The excavation of the settlement lagoon will require the stripping of topsoil and overburden down to the rockhead. The excavated topsoil and overburden will be placed into worked out areas as part of the progressive restoration scheme – refer to Drawing Fl 4 and EIAR Figure 2.2.

Blasting works will be completed in accordance with Lagan's Quarry Blasting Procedure SOP-BS-01 – refer to Appendix Fl 5. Excavated rock will be removed to the Processing Area for processing.

The formation will be trimmed by ripping and again excavated rock removed to the Processing Area for processing.

The excavated topsoil, overburden or rock are unlikely to give rise to a specific pollution risk other than potentially elevated concentrations of suspended solids in surface water runoff. It is therefore plant failure that gives rise to the greatest pollution risk.

Chapter 7 of the EIAR confirms that groundwater will not be encountered during the excavation of the settlement lagoon and therefore dewatering and/or management of groundwater will not be required. The following measures will be implemented during this phase of the works:

- the management of suspended solids will be implemented as per Section 3.2;
- if any unexpected and potentially contaminated materials, or soils are encountered during the excavation works management and mitigation measures described in Section 3.8 of this Plan will be implemented;
- all plant used during the excavation of the settlement lagoon will have been regularly maintained and serviced in accordance with manufactures recommendations. Service records will be available for inspection by Lagan,
- daily checks will be made on all plant for signs of leaking fuel, lubricants, hydraulic fluids and coolants before they are moved from the Process Area. These inspections will be recorded and made available for inspection by Lagan;
- a spill kit will be maintained at the site of the settlement lagoon at all times; and
- if there is a major plant failure than cannot be managed with the spill kit, the contractor will immediately inform Lagan who will stop the sump pumps in the quarry void until they are satisfied that the accumulated water will meet their discharge consent to the Aghamore Stream.

3.2 Silt Management

Any surface water runoff will follow the local topography and flow down the haul road into the quarry sump. The exposed rock is likely to provide a direct pathway to groundwater through fissure flow.

The exposed rock is expected to be relatively permeable and therefore it is unlikely that once the topsoil and overburden have been removed that significant runoff from the works area will occur as it is likely to drain through the exposed fissures in the rock. Any fine silts generated during the excavation of the intact rock are therefore likely to be filtered out in the fissure flow and in any event are inert. No significant impact from siltation on groundwaters is therefore anticipated during excavation of the rock.

As outlined above, the local topography shown by Drawing CFI1 indicates that any surface water runoff from the site of the settlement lagoon will drain down the haul road into the quarry void and will ultimately drain to the existing quarry sump where any suspended solids will settle prior to discharge from site. This discharge will be regulated under the existing discharge licence (DL(W)139).

3.3 Lagoon Construction

It is anticipated that the Protection Bedding, Fine Stone Protection and Coarse Stone Protection layers will be manufactured in the Processing Area from the excavated rock and delivered to the site of the settlement lagoon along the haul road.

It is only during the placement of the Protection Bedding layer that surface water runoff could potentially occur, however, this is unlikely as it will be placed within a formed depression. The Fine Stone Protection and Coarse Stone Protection layers will be placed over the top of the completed geomembrane and therefore any incident rainfall will be contained by the lining system.

Once the liner has been installed, incident rainfall may have to be managed to allow the installation of the inlet and outlet works. This may require a temporary sump to be created in the stone protection layers and accumulated rainwater pumped out.

This accumulated water can be directed to the existing quarry sump provided it has not been contaminated by any construction activities with the lagoon following installation of the geomembrane such as placing the concrete bases to the inlet and outlet structures.

3.4 Cement, concrete and grout

The only part of the works requiring the use of concrete, cement or grout is the construction of the inlet and outlet structures and these will be completed after installation of the liner, so any potential pollution will be contained.

However, subject to detailed design, a concrete plinth/slab may be required for the supernatant water delivery pump which is located outside the settlement lagoon – refer to Drawing CFI 1 for proposed location. To minimise the risk to groundwater, the pump slab, if required, will be cast over an impermeable membrane laid over the formation.

The concrete will be batched off site (ready-mix) and delivered to site.

3.5 Material Storage, stockpiles and exposed ground

Construction materials must be stored within an area designated by Lagan within the Processing Area. Any such materials will be managed by:

- locating all stockpiles at a suitable distance from watercourses to prevent any potentially silt laden runoff entering these watercourses;
- covering or dampening down stockpiles to prevent windblown dust in particularly dry conditions;
- forming stockpiles on level ground in designated area(s) of the site;
- storing packaging materials in appropriate containers to be removed off site to a suitably licensed facility;
- keeping discharge heights during delivery of materials as low as possible to prevent windblown dust; and
- removal off site of any contaminated material on a daily basis, or storing in a covered area impermeable area of the site which is bunded.

The stockpiling of materials will be controlled by the Site Manager or nominated person so as not to cause excessive storage quantities being held on site at any one time.

3.6 Oil storage, use and refuelling

3.6.1 Preventative Measures

It is considered unlikely that there will be a requirement for storing significant quantities of oil, fuels or chemicals specifically for the construction of the settlement lagoon. However, to prevent potential loss of containment of these hazardous materials and to minimise the risk and impact of releases, the following measures will be implemented:

- all oils, lubricant and fuels used for onsite plant, will be stored in appropriate containers / tanks with secondary containment where required within the contractor's compound provided by Lagan;
- no oils, lubricant or fuels will be stored on unmade ground where there is potential for the pollution of groundwater;
- storage containers and secondary containment will be inspected visually on a daily basis and records maintained for inspection by Lagan. These records should identify any remedial measures required to ensure no loss of containment and any such measure put in place immediately; and
- spill kits appropriate to the materials to be stored will be maintained on site at all times.

In the event of any potentially polluting leak or spillage occurring on site, the following action will be taken:

- minor spillages will be cleaned up immediately, using spill kits. The resultant materials will be placed into containers and will then be removed from site and disposed of at a suitably licenced facility. The incident will be recorded and Lagan informed immediately;
- any dry wastes spilled on site will be collected and transported to the appropriate area of the site; and
- in the event of a major spillage, which is causing, or is likely to cause, polluting emissions to the environment, immediate action will be taken to contain the spillage and prevent liquid from entering watercourses or percolating into the ground. The spillage will be cleared immediately and placed in containers for offsite disposal. Lagan and the appropriate regulator must be informed immediately of any such incident.

3.6.2 Inspection and Maintenance

The Site Manager or nominated person will ensure that an active inspection and maintenance program will be undertaken on a daily and weekly basis. The following inspections will be implemented on site:

- all oil containers, secondary containers and vehicles will be inspected on a daily basis to check for signs of damage, corrosion, bulging, leaks or unauthorised use;
- all required maintenance will be carried out immediately;
- oil levels will be checked within the storage containers frequently; and
- if required, oil and fuel use patterns will be recorded (stock reconciliation), to identify potential leakage not apparent from a visible inspection.

3.7 Chemicals and hazardous substances

The Site Manager or nominated person will ensure that every delivery of chemicals or hazardous substances that may be required during the works is accompanied by a 'Safety Data Sheet' (SDS). This will ensure that all handlers and users of the substances are fully aware of the potential hazards to persons and the environment.

To ensure the any such substances are stored on site to minimise the potential impact to the environment and/or operatives the following measures will be implemented on site:

- all substances will be stored in the contractor's vehicle or other secure lockable location;
- only the required amount of chemicals and hazardous substances will be ordered and stored on site;
- all containers will be clearly labelled and fit for purpose with appropriate lids if required;
- the containers will be regularly inspected for continued integrity;
- spill kits specifically for the use in chemical and hazardous spills will be located in the contractor's vehicle or in the vicinity of the lockable store;
- all site operatives will be trained in the use of these substances and emergency procedures should accidental leakage and/or spillage occur.

3.8 Land contamination and invasive species

Given the setting of the settlement lagoon and historic land use, it is unlikely that land contamination or invasive species will be encountered during the works.

However, if they are encountered or suspected, the Site Manager or nominated person will immediately inform Lagan and follow the protocol set out below.

3.8.1 Measures and mitigation measures if unknown contamination is encountered

The Site Manager or nominated person will ensure that a qualified site operative, with knowledge of ground contamination, is on site during the excavation phase of the project.

In accordance with best practice, if the ground is found to be contaminated all works will be ceased until an assessment can be completed by a suitably trained specialist.

If contamination is found, the following measures will be implemented;

- dust mitigation methods will be employed;
- all site operatives will be provided with personal protective equipment (PPE) such as gloves, overalls, dusk mask, respirators etc. to minimise the effect of any contact with the contaminated material and soils;
- all site operatives will be provided with adequate hygiene facilities and clean welfare facilities; and
- if required, monitoring will occur in confined spaces for any potential gas accumulations and access to these areas will be restricted.

If any contaminated material is found during excavations, it will be stored and covered in a designated area on site which benefits from impermeable surfacing or sheeting. These measures will ensure there is limited surface water runoff of contaminated liquid.

The contaminated material will be taken off site to a suitably licensed facility.

3.8.2 Invasive Species

Lagan are not aware of any invasive species being present on site.

However, if invasive species found or suspected on site, an assessment will be carried out to complete a positive identification. If any species are identified, then a suitably trained specialist will be employed for their removal and disposal to a suitably licensed facility.

4.0 EMISSION CONTROL

All reasonable efforts will be made to ensure that emissions are kept to a minimum on site during the construction phase.

The following section describes the management measures that will be implemented on site to control emissions.

4.1 Noise Management

Construction operations will only be carried out during operational hours, set out in the planning consent.

Mitigation and management measures that will be implemented but not limited to on site include:

- machinery and plant will be chosen, when possible, with noise control measures such as silencers, mufflers etc.;
- all vehicles on site will be regularly and well maintained;
- all equipment will be maintained and operated in accordance with manufacturer's guidance and will be maintained in good working order;
- noise barriers will be constructed, if necessary, in the form of temporary walls or piles of excavated material between the construction activities and any noise sensitive receptors;
- site equipment will be sited away from noise sensitive receptors; and
- construction works will only occur during specific times, detailed in Section 2.2.

Any complaint received will be logged in the Site Diary. The Site Manager or nominated person will investigate the complaint and will take action to identify the source of the nuisance and implement remedial measures where appropriate.

4.2 Vehicle and plant emissions

Vehicle and plant emissions on site will be controlled by implementing the following mitigation measures;

- all vehicles and plant will not be left running whilst not in use;
- if necessary, low emission vehicles will be used and plant will be fitted with catalysts, diesel particulate filters or similar devices;
- if necessary ultra-low sulphur fuels will be used in on site vehicles and plant;
- all vehicles on site will be regularly and well maintained in accordance with the manufacturers recommendations.

4.3 Dust management and monitoring

Dust control measures will be integrated, if required, on site during the construction phase to minimise emissions of dust and other particulates that could potentially adversely affect local air quality.

Daily, visual inspection at all areas of the construction site and site boundary will be carried out by site personnel. In the event that significant visual dust emissions are observed at the boundaries of the operational areas, action will be taken to suppress the dust. A record of the inspection findings & remedial action taken will be made in the Site Diary.

In order to minimise the emissions of dust from the construction works, the following measures will be implemented:

- speed limits will be implemented for vehicles using the site;
- all vehicles entering and leaving the site will be covered;
- all dust suppression equipment will be kept in good condition and be regularly maintained;
- the local road will be inspected on a daily basis at the entrance/exit of the site, and if required will be cleaned;
- any small amounts of cement used on site and other similar materials will be mixed in designated areas of the site;
- any materials prone to emitting dust will be stored/stockpiled away from the construction site boundary and any environmental receptors;
- discharge heights will be kept as low as possible to prevent windblown dust;
- the access road and operational areas will be maintained and repaired to minimise emissions of dust.

4.3.1 Mud and debris

The access road for the site is from the local road. Due to the nature of the construction materials accepted on site and the mitigation methods that will be employed to prevent emissions, it is not anticipated that mud and debris will pose a serious risk, particularly as topsoil / overburden will be managed within the site boundaries and wheelwashes are to be employed on the haul road leading to quarry and the Processing Area as shown by Drawing CFI 4 and CFI 5.

However, within the site the following measures will be taken in order to prevent the deposition or tracking of mud or debris from the site onto public areas or highways:

- haul roads will be adequately drained and maintained free of significant quantities of mud and debris;
- all operational areas will be subject to monitoring by staff throughout the working day to identify accumulations of mud requiring remedial action;
- where necessary road cleaning equipment will be deployed; and
- all vehicles leaving operational areas will, be checked for cleanliness and if necessary before leaving the site will be cleaned and will be checked to ensure that they are clear of loose waste and that any products being exported from the site are secure.

In the event that mud, debris or dust arising from the site is deposited onto public areas outside the site, the following remedial measures will be implemented:

- the affected public areas outside the site will be cleaned;
- traffic will be isolated from sources of mud and debris within the site to prevent further tracking of mud and debris, and measures will be taken to clear any such sources as soon as practicable; and
- provision will be made for road sweepers on the site access roads to stop any mud being carried onto public roads, and bowsers made available to damp down areas during dry periods to ensure that dust is not a problem.

4.4 Lighting management

Light pollution can have an adverse effect on local residents and wildlife. However, due to the permitted construction working hours it is likely that all works will be carried out in the daylight.

Although the site is not located near particularly sensitive receptors, the following management measures will be considered, if required;

- lights will be directed away from any light sensitive receptors;
- areas will not be over lit;
- glare will be kept to a minimum;
- specifically designed construction lighting equipment will be used; and
- lights will be positioned sensibly on site.

5.0 EMERGENCY PLAN

A series of emergency plan procedures will be put in place on site to govern any environmental incidents. All construction operatives will be instructed on these procedures by the Site Manager or nominated person so they will be able to adhere and implement the management of any incident on site.

The emergency procedures will detail all emergency phone numbers for the local authority and specific regulatory bodies. The contact details of key personnel within Lagan will also be provided.

6.0 CONCLUSIONS

The objective of this CEMP is to ensure that during the construction phase, daily operations have a negligible effect on the local environment and sensitive receptors. This report outlines the management and mitigation methods that will be implemented to deal with the impact of construction.

Lagan and the appointed contractor will ensure that this CEMP is implemented on site.

EUROPEAN OFFICES

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BRISTOL
T: +44 (0)117 906 4280

CARDIFF
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EDINBURGH
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Ireland

DUBLIN
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France

GRENOBLE
T: +33 (0)6 23 37 14 14

www.slrconsulting.com

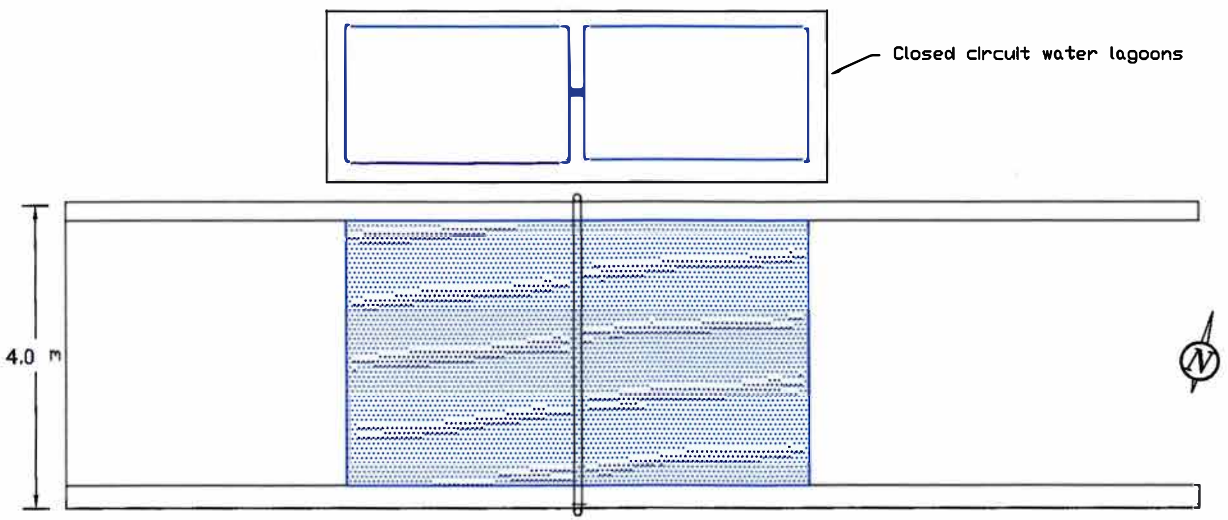
Appendix K -
Details of proposed wheel wash

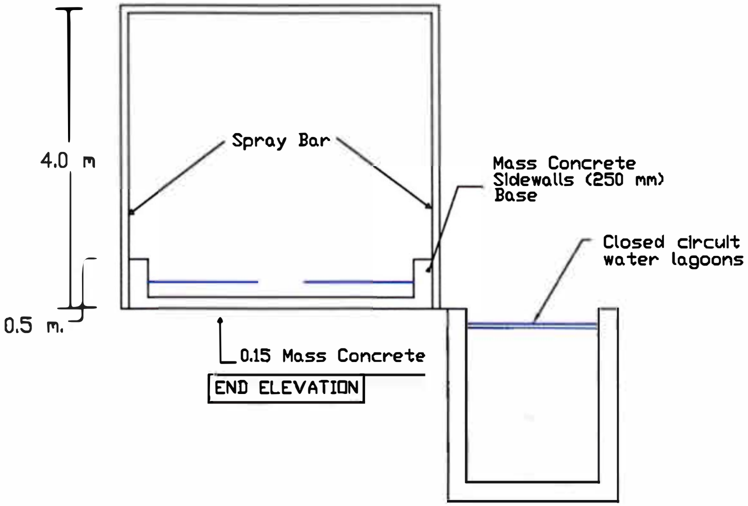

S
Office / Weighbridge
Location of Proposed Wheelwash
osed Wheelwash

LEGEND

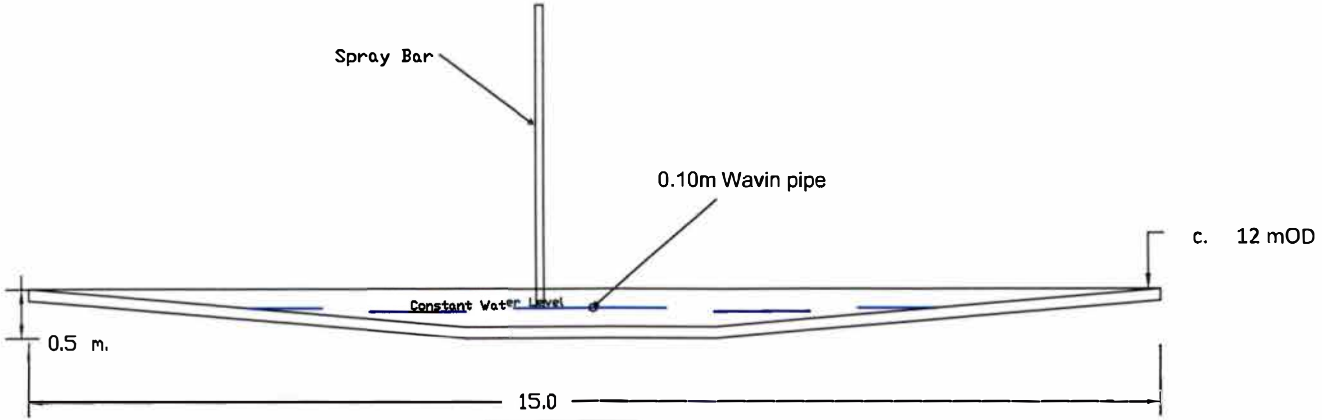
REFER TO DRAWING CFI 4 FOR PROPOSED LOCATIONS

PLAN





END ELEVATION



SIDE ELEVATION

SLR CONSULTING IRELAND
7 DUNDRUM BUSINESS PARK
WINDY ARBOUR
DUBLIN 14
T: +353-1-2964667
F: +353-1-2964676
www.slrconsulting.com

LAGAN BITUMEN LTD.

LIMESTONE QUARRY
AGHAMORE NEAR AND CARROWNAMADDOO
TOWNLANDS, CO. SLIGO

PROPOSED WHEELWASH:
DESIGN DRAWINGS

DRAWING CFI

Scale	Date
1:100 @ A4	JULY 2019

501.00396.00007.DRAWING CFI 5 WHEELWASH.REV.0.dwg

SLR

27th November 2019

Environment Section,
Sligo County Council,
County Hall,
Riverside,
Sligo.

By Registered Post

Our Ref: 191118.501.0396.038.R0.Aghamore DL FI.Rev1
Your Ref: **CRM 326015**

RE: REQUEST FOR FURTHER INFORMATION IN RELATION TO REVIEW OF DISCHARGE LICENCE DL(W)139 FOR AGHAMORE QUARRY CO. SLIGO.

This further Information (FI) submission has been prepared by SLR Consulting Ireland (SLR) on behalf of Lagan Materials Ltd (Lagan) for their quarry at Aghamore, Co. Sligo. The Discharge Licence was submitted on behalf of Lagan Bitumen Ltd, however the company name has subsequently been changed to Lagan Materials Ltd. and a copy of the new certificate of incorporation on change of name is included with this Further Information response.

Item 1 *All the conditions of the existing licence shall be maintained.*

Response:

A review of the existing discharge licence for the Lagan Aghamore quarry is undertaken for the discharge of water from the quarry site to the Aghamore Stream, which flows to Lough Gill. The review of the existing discharge to waters licence (DL(W)139) is being undertaken prior to recommencement of activities at the site; planning permission for the quarry was granted by Sligo Co. Council on the 16/10/2019, Planning Ref No. 18/345 (currently under appeal with An Bord Pleanála ABP 305821-19). An Environmental Impact Assessment Report (EIAR) and Natura Impact Statement (NIS) was prepared and submitted in support of the planning application.

An existing trade effluent discharge licence was granted by Sligo County Council in November 2011, following an application and submission of further information by the former quarry owner, CEMEX (ROI) Ltd. ('Cemex'). An application to formally transfer this discharge licence from CEMEX (ROI) Ltd. to Lagan Bitumen Ltd. was submitted to Sligo County Council on 8th April 2019.

The quarry site was acquired by Lagan from Cemex in November 2014, and at that time none of the water monitoring/treatment infrastructure proposed in the discharge licence application (October 2010) and further information submitted (September 2011) had been installed by Cemex. Lagan have not operated the quarry since the acquisition.

Dewatering of the site and discharge to the Aghamore Stream leading into Lough Gill have been occurring for over 20 years. The current floor level of the quarry is below the water table requiring surface water and groundwater to be pumped from the quarry to the nearby stream which flows directly to Lough Gill which is c. 800m downstream of the discharge point.

Lagan will meet all the conditions set out in a revised discharge licence for the site and operations as set out by Sligo Co. Council in any revised licence.

Item 2 *All refuelling on site must be done in a dedicated hardstand area with surface waters passing through an adequately sized hydrocarbon interceptor prior to discharge to surface waters. A maintenance plan must be put in place for all hydrocarbon interceptors.*

Response:

Fuels will be held within the existing bunded area located within the processing area to the east of the quarry. The volume of fuel to be held at the site will be minimal as all mobile crushing and screening plant will be refuelled on an 'as required' basis by a local fuel supplier and HGV's serving the site will refuel at local service stations. Therefore, fuel will only be required to serve a front-end loader at the site.

The fuel oil stores are bunded to 110% of the maximum tank capacity. Overfill protection mechanisms will be installed on all fuel tanks. Refuelling operations will only take place in suitably protected hard stands near the fuel tanks and any accidental spillages shall be contained using absorbent booms.

The applicant will install a hydrocarbon interceptor at the fuel storage area. No servicing of mobile plant/machinery will be undertaken within the quarry area. A maintenance plan will be put in place for the proposed hydrocarbon interceptor at the refuelling area.

Item 3 *An emergency response plan must be drawn up with I.F.I. included as a contact in case of a polluting discharge to surface or groundwater.*

Response:

A copy of the Emergency Response Plan for Aghamore quarry is included in Appendix FI-A. The Emergency Response Plan is based on the Aghamore Environmental Management Plan 2019 Sections DP004 and DP020, submitted with the discharge licence application.

The contact details for the Inland Fisheries Ireland Ballina office are included in the plan.

Item 4 *The Depot Procedures Manual provided in Appendix F states the wheel-wash water will be treated prior to discharge into storm drain, while other parts of the documentation state that the wheel-wash will operate on a closed loop system. I.F.I. requests clarification to be provided as to the water management system for the wheel wash.*

Response:

It is proposed to install a wheel wash system within the existing quarry and a second wheel wash before the weighbridge located within the processing area to the east of the quarry. Both wheelwash systems will be closed loop systems. The locations of the wheel wash and the design of the closed loop systems are included in Appendix K of the Discharge Licence Application.

Item 5 *A turbidity and pH sensor telemetry system must be fitted to the discharge with an alarm to notify a member of staff of any limit breach.*

Response:

A turbidity and pH sensor with telemetry system will be fitted to the discharge to monitor the discharge quality on a continuous basis, see response to Item 10 below and Appendix FI-B. The monitoring system will be fitted with an alarm to notify a member of staff on site if there is any breach of the limit for these two parameters as set out in the revised discharge licence for the site.

Item 6 *The existing licence refers to a ferric dosing system alarm. All dosing chemicals must be kept in bunded containers with a capacity of 110% of the largest container: The location of the ferric dosing system shall be provided.*

Response:

The previous 2010 discharge licence application for the site indicated that a ferric dosing system, in the form of ferric Sulphate, was required in the quarry to treat the quarry water to remove any elevated ortho-phosphate in the water.

The quarry site was acquired by Lagan from Cemex in November 2014, and at that time none of the water monitoring/treatment infrastructure, including the ferric dosing system, proposed in the discharge licence application (October 2010) and further information submitted (September 2011) had been installed by Cemex. Lagan have not operated the quarry since the acquisition.

The issue around water quality for BOD and Molybdate Reactive Phosphate (MRP), or orthophosphate, are addressed in the Further Information submitted to Sligo Co. Council for the quarry planning application (Ref No. 18/345) dated he 16th April 2019, specifically the Further Information response prepared by TMS Environmental Ltd. for Item 5 of the Further information.

The Further Information response for Item 5 included details relating to additional groundwater and surface water sampling which has being undertaken at the quarry since the planning application was lodged in August 2018.

The monitoring to date shows that BOD and MRP are occasionally detected in groundwater around the quarry and are not continuously detected in any particular monitoring well, indicating a temporary and spatially variable nature to the BOD/MRP detections. The lands within the zone of influence of the quarry dewatering are agricultural and off-site agricultural activities are considered to be the source of this slightly elevated BOD/MRP (e.g. animals, fertiliser application, etc.).

The quarry pumps a combinati onof groundwater and rainwater to the Aghamore Stream, and as the site is currently inactive and there is no source of BOD/MRP within the quarry, the occasional BOD and MRP detected in the site discharge must originate from groundwater, as rainwater would not have elevated BOD or MRP.

It was proposed in the Further Information (Item 5 response) that the discharged waters from the site does not require treatment for the following reasons:

a) The occasionally elevated BOD and MRP seen in discharge samples originates from groundwater seeping into the quarry from the adjoining agricultural lands and not from the quarry itself, which is currently inactive. Lagan should not be responsible for remediating background levels of BOD and MRP that originate upgradient and off-site. There are many examples of this from EPA licenced sites where licencees undertake a baseline assessment which indicates that groundwater contamination is from upgradient/off-site and they do not have to address the groundwater contamination in terms of remediation;

b) The discharge of groundwater from the quarry to the Aghamore Stream does not change the existing hydrological system of the area (i.e. if the quarry was not in place, groundwater in the area would naturally drain to Lough Gill). In terms of Lough Gill's nutrient balance, there is no significant change to the natural BOD/MRP load to Lough Gill, the only difference would be a negligible increase in groundwater catchment to the lake as the quarry zone of influence expands as it is deepened (see Attachment VI). The catchment to Lough Gill covers an area of 126km^2 and the proposed deepening of the quarry would increase the groundwater catchment by 0.18km^2, a negligible increase of 0.14% in groundwater catchment. The only change to the nutrient balance of the lake is from groundwater captured by the expanded quarry zone of influence which would be very small;

c) Recent samples of the discharge from the quarry for the period 2016-2019 comply with the oxygenation (BOD) and nutrient conditions (MRP) required for good ecological status of surface waters. Historic samples of the discharge had higher BOD and MRP concentrations however similarly elevated concentrations have not been detected in recent samples. As outlined above under Heading 3 'Discharge Water', we submit that more weight should be placed on the recent accredited analyses being representative of the discharge quality;

d) The discharge water quality is better overall than the stream water quality therefore the discharge is not having any impact on water quality in the Aghamore Stream.

Based on the available evidence as set out here and the reasons outlined in the response to Item 8 below, it is not therefore proposed to treat the discharge water from the quarry for BOD or MRP.

Planning permission was granted for the site in October 2019 (Reference No PL 18/345) subject to conditions.

All chemicals stored at the site are kept in bunded containers with a minimum capacity of 110% of the single largest container. All chemicals are stored under cover at the site in the stores/workshop building.

Item 7 *The Aghamore Stream floods at times of extreme flows and, therefore, the quarry should not discharge at these times. If the culvert, which is identified as restricting the flow of the stream and resulting in flooding of the adjacent road is within the ownership of Lagan Bitumen Limited, then measures should be taken to increase the capacity of the culvert. Any in-stream works must be carried out in consultation with I.F.I.*

Response:

The culvert restricting flow of the Aghamore Stream is located at the entrance to the Top Coast Oil Depot; the culvert is not on lands owned by Lagan. The Lagan quarry will undertake not to discharge water from the quarry during a Met Éireann Yellow, or higher, rainfall warning for the Sligo area; this measure will ensure that any discharge from the quarry does not increase the risk of flooding in the Aghamore Stream.

Item 8 *IFI requests that the discharge limit for Total Ammonia and Molybdate Reactive Phosphorus be reduced. The limits set are significantly above the mean discharge concentrations provided from 2018 and 2019 monitoring results. IFI is concerned that during times of extended low flows there is a significantly reduced assimilative capacity available in the stream and to ensure water quality is protected the limits be reduced.*

Response:

An updated assimilative capacity assessment was submitted by Lagan to Sligo County Council in April 2019 (in response to a request for further information under planning reg. ref. PL18/345).

There is no maximum permissible concentration for MRP in the Surface Water Regulations 2009; the upper limit provided in the Regulations is the 95th percentile concentration of ≤ 0.075mg/l MRP. In such situations, the EPA recommends the use of the 95th percentile concentration in place of a maximum value (e.g. EPA presentation on review of licences for Environmental Objectives (Surface Water) Regulations 2009, May 2011). This approach is in line with best international practice for carrying out simple mass balance calculations for a discharge to a stream. The substitution of the 95th percentile concentration of 0.075mg/l in place of a maximum value is conservative as, technically, up to 5% of the monitoring data may be above this value, as mentioned above.

EPA guidance requires that the mass balanced discharge concentration (i.e. the fully mixed concentration downstream of the discharge) should not exceed the <u>95th percentile concentration quality standard</u> at the <u>95th percentile flow</u> in the receiving waters.

The inputs to the assimilative capacity assessment calculations were as follows:

- Mean MRP concentration in background 0.019mg/l;
- Mean MRP concentration in discharge 0.035mg/l;
- 95th percentile flow in Aghamore Stream 172.8m^3/d;
- Maximum discharge rate 3,500m^3/d;
- Maximum permissible MRP concentration in Aghamore Stream 0.075mg/l.

The assimilative capacity assessment showed that the mass balanced discharge concentration is 0.034mg/l Molybdate Reactive Phosphorus (MRP), which is below the 95th percentile concentration of ≤ 0.075mg/l. Therefore, based on the most recent monitoring data from 2018/2019, the discharge does not cause a deterioration of water quality in the Aghamore Stream below the nutrient condition for MRP (orthophosphate) required for 'Good' status in a river water body under the Water Framework Directive.

(Note: Even if a mean limit of ≤ 0.035mg/l MRP were considered in the assimilative capacity calculations instead of the 95th percentile concentration of ≤ 0.075mg/l which would not be consistent with best practice, the mass balanced discharge concentration of 0.034mg/l MRP would still be below the mean limit of ≤ 0.035mg/l).

The quarry at Aghamore has not been operational since 2014 and consequently there have been no activities at the site which could have contributed to the MRP values recorded; therefore, the source of MRP recorded could not be as a result of any site activities at the quarry but reflects the landuse activities in the surrounding area.

Lagan will put in place measures to comply with the limits as set out in the Discharge Licence issued by Sligo Co. Council for the operations at Aghamore Quarry.

Item 9 *Taking into consideration ongoing monitoring requirements that will be specified in any reviewed licence issued by the Local Authority, the applicant is requested is submit a site layout plan to an appropriate scale confirming the following:*

(a) *Provision of a readily accessible monitoring location to sample the final effluent discharged to Aghamore Stream. Any licence issued by the local authority will include a requirement to take composite samples of the final effluent as discharged to Aghamore Stream. The applicant is requested to confirm proposals in this regard.*

(b) *The location of flow monitoring equipment associated with the trade effluent discharge.*

Response:

The location of the proposed monitoring point for the final effluent discharge is shown on the attached Figure FI1. This location will be made readily accessible for the Local Authority and Lagan to obtain representative samples as well as composite samples, if required, of the effluent discharged as well as discharge flow monitoring.

Item 10 *The applicant shall submit site specific manufacturer specifications for the proposed/existing turbidity sensors that will be utilised on site. The applicant shall confirm proposals for the ongoing maintenance and calibration of the turbidity sensors provided on site.*

Response:

Specification details of the proposed pH meter and Turbidity sensor are shown in Appendix FI-B. The meters can monitor and record pH and Turbidity in the discharge water on a continuous basis. The meters will be connected to a telemetry system with remote access/dial out alarms based on connecting the field mount controller to the internet, via the GSM Communications.

The sensors and telemetry system can be provided by Xylem, see Appendix FI-B, who can install, commission, calibrate and maintain the discharge monitoring system under an installation and maintenance contract.

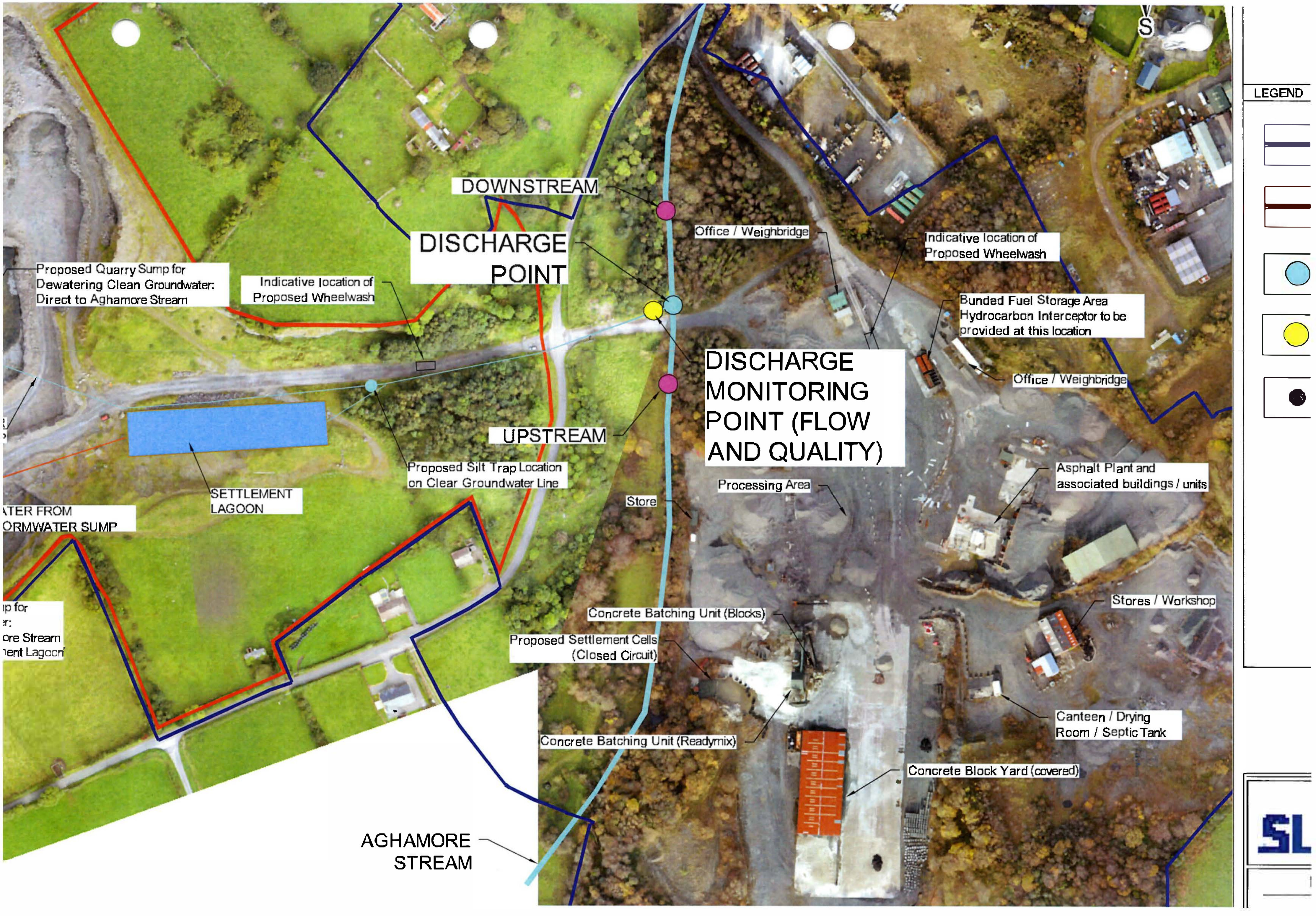
Yours sincerely
SLR Consulting Ireland Ltd

Peter Glanville

Peter Glanville
Principal

FIGURE

Figure FI-1
Site Layout and Monitoring Locations


DOWNSTREAM
DISCHARGE POINT
Proposed Quarry Sump for Dewatering Clean Groundwater: Direct to Aghamore Stream
Indicative location of Proposed Wheelwash
Office / Weighbridge
Indicative location of Proposed Wheelwash
Bunded Fuel Storage Area Hydrocarbon Interceptor to be provided at this location
DISCHARGE MONITORING POINT (FLOW AND QUALITY)
Office / Weighbridge
UPSTREAM
Proposed Silt Trap Location on Clear Groundwater Line
SETTLEMENT LAGOON
ATER FROM
ORMWATER SUMP
Processing Area
Store
Asphalt Plant and associated buildings / units
Stores / Workshop
Concrete Batching Unit (Blocks)
Proposed Settlement Cells (Closed Circuit)
Canteen / Drying Room / Septic Tank
Concrete Batching Unit (Readymix)
Concrete Block Yard (covered)
ıp for
ır:
ore Stream
ıent Lagoon
AGHAMORE STREAM
S
LEGEND
SL

APPENDICES

Appendix FI-A
Aghamore Quarry Emergency Response Plan

AGHAMORE QUARRY – EMERGENCY RESPONSE PLAN

1.0 INTRODUCTION

This Emergency Response Plan (ERP) has been prepared for the Lagan Materials Ltd. (Lagan) Quarry at Aghamore Co. Sligo.

The ERP incorporates the measures set out in the site Environmental Management Plan (Lagan Document No. EM-001 dated 08/04/2019), specifically in relation to the following sections in the ISO 14001:2015 Depot Procedures Manual:

- **DP004 - Emergency Preparedness and Response; and**
- **DP020 - Accident Prevention Policy.**

2.0 SCOPE

This Emergency Response Plan sets out the procedure for dealing with environmental emergencies during the activities at the facility.

3.0 MANAGEMENT AND CONTROL

At all times, there shall be at least one person responsible for co-ordinating emergency measures at the site. The Emergency Co-ordinator shall be thoroughly familiar with this procedure, the Emergency Plan, all operations and activities on site and the location of emergency response and spill clean-up equipment.

4.0 GENERAL EMERGENCY PROCEDURES

- In the event of a fire the firm alarm should be sounded by activating the nearest alarm. On hearing the fire alarm all personnel must evacuate the building by the nearest exit and assemble at the site entrance just in front of the weighbridge.
- If safe to do so and if trained to use a fire extinguisher, then tackle the fire. If the fire cannot be controlled, then the fire services should be called. The water used for extinguishing any fire shall be contained if possible, for assessment before disposal or discharge through the surface water drainage system
- On discovering a fire or some such emergency, raise the alarm with all staff in the immediate area and contact the Plant Manager.

Contact emergency services at 112 or 999.

5.0 EMERGENCY SPILL RESPONSE PROCEDURE

- Surface water contamination may arise on site from a number of sources; these include greases, oils, fuel, chemical spill or suspended solids.
- In the event of surface water contamination immediate action shall be taken to stop the flow of contamination into the receiving water.
- Where there has been a discharge of oils or greases, oil booms and/or mats shall be used as necessary to remediate the surface water contamination and the mats disposed of according to the procedure for waste oil disposal.:
- The main risk associated with oil or chemical spills is the potential for the spill to enter drains, watercourses, soils and the groundwater system, causing contamination and/or fire or explosion risk.

Two medium sized (200L) Oil Spill Kits and 1 mediums sized (200L) hazardous/non-hazardous spill kit shall be held on-site at all times including absorbent pads, booms and mats and disposable bags and ties. These kits shall be replaced immediately following their use during an emergency.

6.0 MONITORING AND REPORTING

The company will immediately notify the relevant licensing authority of the occurrence of any incident including:

(i) an emergency;
(ii) any emission which does not comply with the requirements of the licence;
(iii) any indication that environmental pollution has, or may have, taken place.

The incident notification form for the EMP shall also be filled out and shall include the following information:

- Date and time of incident;
- Details of the incident and circumstances giving rise to it;
- An evaluation of environmental pollution caused if any;
- Actions taken to minimise the effects on the environment;
- Steps taken to avoid recurrence;
- Any other remedial action taken.

A report on incidents shall be prepared and an Annual Report shall be compiled for inclusion in the Annual Environmental Report. This report will be available for consultation at the Site Office on request.

7.0 ACCIDENT PREVENTION POLICY

The purpose of this Accident Prevention Policy (APP) is to set out the policies of the Company in respect of Accident Prevention at the Lagan site. The objective of this APP is to outline the protection provided for man and the environment by appropriate means, structures and management systems.

The key features of this objective are:

- No major accidents
- No "near miss" incident capable of leading to a major accident
- No requirement to evacuate persons from areas on the site
- No injury to neighbours or employees or damage to environment as a result of accidental emissions.

The APP contains objectives set out under the following headings which are required to be addressed by the Safety Management System for the site.

- Management and Control
    - Organisation Personnel and Training
    - Identification and Evaluation of Hazards
    - Operational Control
    - Planning for Emergencies
- Monitoring and Reporting
    - Monitoring Performance
    - Audit and Review

8.0 EMERGENCY TELEPHONE NUMBERS

A list of emergency telephone numbers and contact details is on display at the site office.

The contact details are shown on the following page:

EMERGENCY CONTACT DETAILS

EMERGENCY SERVICES	**112**
SLIGO GARDA STATION	**112**
SLIGO FIRE STATION	**112**
LOCAL GENERAL HOSPITAL A&E (Sligo) (The Mall, Rathquarter, Sligo, F91 H684)	**071 9171111**
INLAND FISHERIES IRELAND (BALLINA) (Ardnaree House, Abbey Street, Ballina, F26 KO29, Ireland Phone: + 353 (0)96 22788 Fax: + 353 (0)96 70543 Website / Email: https://www.fisheriesireland.ie/Inland-Fisheries-Ireland-Ballina.html)	**096 22788**

Lagan Personnel:

PLANT MANAGER	David Vereker - 086 224 4593
OPERATIONS DIRECTOR	Fraser Thom - 086 172 5612
SAFETY OFFICER	Martin Cairns - 086 025 2350
ENVIRONMENTAL OFFICER	Corin Bridson - 087 052 2328

Appendix FI-B
pH and Turbidity Meter Specifications

pH and ORP measurement for wastewater

DIGITAL, RELIABLE, CONVENIENT CALIBRATION

WTW

a xylem brand

pH /ORP armature with integrated preamplifier

left: SensoLyt® 700 IQ;
right: seawater model
SensoLyt® 700 IQ SW

Advantages

- Stable signals by digital signal processing
- Convenient by calibration in the lab and glass breakage detection
- Reliable measured values by integrated temperature sensor

Convenient calibration in the lab by storing calibration values within the sensor. Due to our quick-lock, the sensor can be disconnected and - after laboratory calibration - re-connected at the site easily.

Screens from our How-To video showing the convenient calibration in the lab - see also: https://youtu.be/8p-cef90P3I

Technical Data

Model		**SensoLyt® 700 IQ (SW)**
Measuring principle		Electrochemical
Measuring range	**SEA**	2 ... 12 pH
	SEA-HP	4 ... 12 pH
	DWA	0 ... 14 pH
	ECA	2 ... 12 pH
	PtA	±2000 mV
Temperature measurement		Integrated NTC, -5 ... +60 °C
Operational temperature		0 ... 60 °C
Permissible overpressure		6 ... 10 bar (depends on electrode)

For further technical data please see datasheet D2.03.

below:
measuring head with protection cap, temperature sensor and twist-locked elektrode

SENSOR NET
for Systems
2020 and
282/284

www.iq-sensor.net

Ordering Information

Model	**Description**	**Order No.**
SensoLyt® 700 IQ	Digital pH/ORP fitting for SensoLyt® electrodes, with integrated preamplifier and temperature sensor (please order cable separately)	109170
SensoLyt® 700 IQ SW	Like the SensoLyt® 700 IQ, but as a sea water model	109171
SensoLyt® 700 IQ/SET	SensoLyt® 700 IQ including SensoLyt® SEA pH electrode and 7 m connecting cable	109173
SensoLyt® 700 IQ/SET1	SensoLyt® 700 IQ including SensoLyt® PtA ORP electrode and 7 m connecting cable	109174

a xylem brand

Xylem Analytics Germany Sales GmbH & Co. KG, WTW · Dr.-Karl-Slevogt-Straße 1 · D-82362 Weilheim · Germany
Phone: +49 881 183-0 · Fax: +49 881 183-420 · E-Mail: Info.WTW@Xyleminc.com · **www.WTW.com**

xylem
Let's Solve Water

Optical Turbidity Sensor with Low Maintenance

RELIABLE OPERATION, NO TEAR AND WEAR PARTS

WTW
a xylem brand

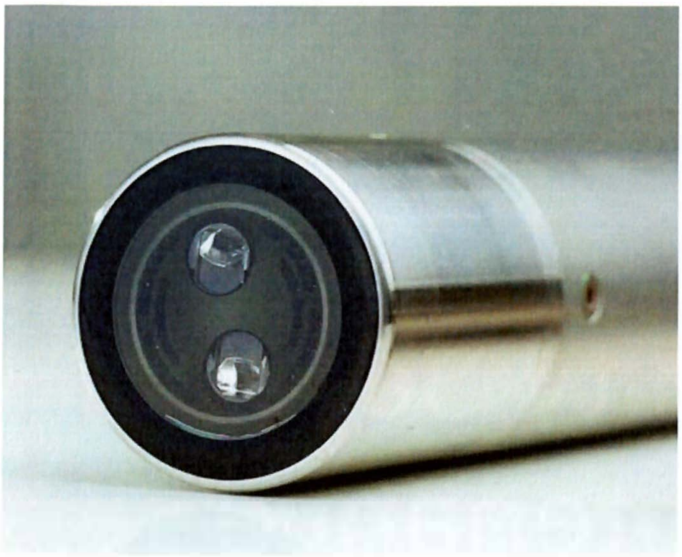
Turbidity monitoring, e.g. in the outlet of a wastewater treatment plant

Advatanges:

- Low maintenance by integrated ultrasonic cleaning
- No exchange of O-rings or movable parts
- Service contract not mandatory
- High operational safety (sensor check function)

The ultrasonic cleaning system ensures the low-maintenance and continuously reliable measuring operation.

left:
VisoTurb® 700 IQ;
right:
seawater model
VisoTurb® 700
IQ SW



Optical measurement windows and sapphire disc with ultrasound cleaning system

Sensor without and with ultrasound cleaning system after 30 days

Technical Data

Model	**VisoTurb® 700 IQ(SW)**
Measuring principle	Nephelometric procedure according to DIN EN 27027 and ISO 7027
Messbereich	FNU 0.05 … 4000 SiO_2 0.1 … 4000 mg/l TS 0.0001 … 400 g/l
Cleaning procedure	Integrated ultrasonic cleaning
Operational temperature	0 … +60 °C
Permissible overpressure	10 bar

IQ SENSOR NET
for Systems
2020 and
282/284

Ordering Information

Model	**Description**	**Order No.**
VisoTurb® 700 IQ	Digital turbidity sensor with integrated ultrasonic cleaning (please order cable separately)	600010
VisoTurb® 700 IQ SW	Like VisoTurb® 700 IQ, but as a sea water model	600011

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Let's Solve Water

Xylem Analytics Germany Sales GmbH & Co. KG, WTW · Dr.-Karl-Slevogt-Straße 1 · 82362 Weilheim · Germany
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999248US November 2018

APPENDIX 7-4 MONITORING WELL SUMMARY DETAILS & BOREHOLE LOGS

Monitoring Well Summary Details

	Date Drilled	Easting	Northing	TOC Elevation	Casing Height	Ground Level	Drilled Depth	Diameter	Open Section	Notes
		ITM	ITM	mOD	magl	mOD	mbgl	mm	mbgl	
MW1	27/06/2017	570276.80	831934.69	27.52	0.84	26.68	80	150	3.0 - 80.0	
MW2	28/06/2017	570386.63	831952.24	28.19	1.01	27.18	39*	150	6.0 - 39.0	*Borehole collapsed at 39m, plumbed depth 26.23mbgl
MW3	28/06/2017	570364.49	831945.75	28.56	1.03	27.53	66*	150	6.0 - 66.0	*Borehole collapsed at 66m, plumbed depth 43.86mbgl
MW4	29/06/2017	570249.17	831768.59	29.28	0.09	29.19	80	150	6.0 - 80.0	
MW5	30/06/2017	569888.26	832094.09	31.15	1.07	30.08	80	150	6.0 - 80.0	
MW6	03/07/2017	569892.70	832048.87	28.01	0.08	27.93	80	150	6.0 - 80.0	
MW7	04/07/2017	569899.80	832011.04	29.41	0.92	28.49	80	150	6.0 - 80.0	
MW8	05/07/2017	570251.68	831761.91	30.25	0.80	29.45	80	150	12.0 - 80.0	
MW9	06/07/2017	570534.46	831885.97	13.51	0.80	12.71	17.3*	150	15.3 - 17.3	*Drilled to 18mbgl
MW10c	21/07/2017	569897.59	832034.33	28.99	1.09	27.90	80*	76	3.0 - 80.0	*Borehole partially blocked at 32-37mbgl
MW11	15/08/2017	570312.05	831936.89	30.85	1.08	29.77	80	76	6.0 - 80.0	
Old Well	Unknown	570334.89	831846.19	12.17	0.47	11.70	7.91*	170	Unknown	*Plumbed depth, drilling details unknown
MW12	31/08/2020	570262.29	831837.85	11.30	1.40	9.90	20	150	6.0 - 20.0	
MW13	31/08/2020	570386.21	831852.49	12.71	1.39	11.32	20	150	6.0 - 20.0	
MW14	01/09/2020	570469.63	831865.95	12.29	0.01	12.28	20	150	6.0 - 20.0	
MW15	01/09/2020	570887.12	831740.65	14.25	1.23	13.02	14*	200	7.0 - 10.0	*Borehole collapsing/washing in, pipe installed to 10mbgl
MW16	01/09/2020	570716.05	831698.81	13.44	1.13	12.31	9*	200	4.0 - 7.0	*Borehole collapsing/washing in, pipe installed to 7mbgl
MW17	01/09/2020	570559.00	831471.46	17.37	1.12	16.25	10*	200	4.0 - 7.0	*Borehole collapsing/washing in, pipe installed to 7mbgl
MW18	02/09/2020	569903.34	832013.60	29.91	1.32	28.59	40	150	6.0 - 40.0	
MW19	03/09/2020	569905.37	832015.16	29.87	1.29	28.58	20	150	6.0 - 20.0	
MW20	17/09/2020	570662.55	831936.35	12.38	0.22	12.16	12	200	6.0 - 12.0	
MW21	18/09/2020	570581.88	831696.51	11.26	0.26	11.00	10.5	200	5.5 - 10.5	
MW22	22/09/2020	570714.20	831519.23	17.04	0.29	16.75	11	200	5.0 - 11.0	
MW23	21/09/2020	570612.52	831594.36	11.56	-0.01	11.58	12	200	6.0 - 12.0	
MW24	24/09/2020	570764.94	831824.11	11.44	0.29	11.15	11	200	5.0 - 11.0	
MW25	25/09/2020	570606.64	831794.11	12.00	0.01	11.99	11.5	200	5.5 - 11.5	

Notes:

ITM - Irish Transverse Mercator
TOC - Top Of Casing
mOD - meters above Ordinance Datum
magl - meters above ground level
mbgl - meters below ground level
mm - millimeters

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DRILLERS LOG

Borehole for: Lagan
at Aghamore Quarry
Sligo

MW1 (top of access ramp on right, near quarry face)

Date	Depth m	Diam	Conditions
27/6/17	0 - 3	200mm	Rock. Install 3m x 150mm steel lining.
	3 - 30	150mm	Grey rock. Dry
	30 - 42	"	Grey rock. Maybe 10 to 20gph at 36m
	42 - 67	"	Grey rock. 20gph.
	67 - 73	"	Grey rock. Water increase at 70m. 30gph.
	73 - 80	"	Grey rock. 30gph.

Total depth of well 80m
Estimated yield 30gph
Depth to rock Ground Level
Steel casing installed 3m of 150mm steel
PVC casing installed none
Well screen
Other remarks Bentonite pellets. Upstand pipe.

Operator Brendan Dunne

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DRILLERS LOG

Borehole for: Lagan
at Aghamore Quarry
Sligo

MW2 (in field on right at top of ramp, furthest away)

Date	Depth m	Diam	Conditions
28/6/17	0 - 4	200mm	Clay. Rock at 4m
	4 - 6	"	Grey rock. Dry. Install 6m x 150mm steel.
	6 - 30	150mm	Grey rock. Dry
	30 - 36	"	Dirty brown broken rock from 30m. 50gph.
	36 - 39	"	Brown rock. Collapsing from 30m.
			Abandon drilling due to collapse.

Total depth of well 39m
Estimated yield 50gph
Depth to rock 4m
Steel casing installed 6m of 150mm steel
PVC casing installed none
Well screen
Other remarks Bentonite pellets. Upstand pipe.

Operator Brendan Dunne

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DRILLERS LOG

Borehole for: Lagan
at Aghamore Quarry
Sligo

MW3 (in field on right at top of ramp, middle bore)

Date	Depth m	Diam	Conditions
28/6/17	0 - 3.5	200mm	Clay. Rock at 3.5m
	3.5 - 6	"	Grey rock. Dry. Install 6m x 150mm steel.
	6 - 24	150mm	Grey rock. Dry
	24 - 42	"	Grey rock. Water strike at 39m. 160gph at 42m.
	42 - 49	"	Grey rock. Water increasing. 720gph at 49m.
	49 - 55	"	Grey rock. Water increasing. Big inflow at 52m. Not possible to measure flow.
			Estimate 3,000 to 4,000gph.
	55 - 61	"	Grey rock.
	61 - 66	"	Grey rock. Very broken. Getting caught. Abandon drilling.

Total depth of well 66m
Estimated yield 3,000 - 4,000gph
Depth to rock 3.5m
Steel casing installed 6m of 150mm steel
PVC casing installed none
Well screen
Other remarks Bentonite pellets. Upstand pipe.

Operator Brendan Dunne

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DRILLERS LOG

Borehole for: Lagan
at Aghamore Quarry
Sligo

MW4 (up ramp on left and in middle of pass)

Date	Depth m	Diam	Conditions
29/6/17	0 - 4.5	200mm	Clay and stones. Rock at 4.5m
	4.5 - 6	"	Soft brown rock. Install 6m x 150mm steel
	6 - 12	150mm	Brown rock. Dry
	12 - 18	"	Grey rock.
	18 - 36	"	Grey rock. Damp.
	36 - 61	"	Grey rock. Damp.
	61 - 80		Grey rock. No flow.

Total depth of well	80m
Estimated yield	no flow
Depth to rock	4.5m
Steel casing installed	6m of 150mm steel
PVC casing installed	none
Well screen	
Other remarks	Bentonite pellets. Flush cap.

Operator Brendan Dunne

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Borehole for: Lagan
at Aghamore Quarry
Sligo

MW5 (Sean Gilmartin field in top corner)

Date	Depth m	Diam	Conditions
30/6/17	0 - 3	200mm	Clay
	3 - 6	"	Grey rock. Dry. Install 6m x 150mm steel.
	6 - 18	150mm	Grey rock. Trickle at 16m.
	18 - 30	"	Grey rock.
	30 - 36	"	Grey rock. 20 - 30gph.
	36 - 42	"	Grey rock. 30gph
	42 - 49	"	Grey rock. 50 - 60gph.
	49 - 55	"	Grey rock. 100gph.
	55 - 61	"	Grey rock. 180gph.
	61 - 67	"	Grey rock. 400gph
	67 - 73	"	Grey rock. 450gph
	73 - 80	"	Grey rock. 450gph

Total depth of well 80m
Estimated yield 450gph
Depth to rock 3m
Steel casing installed 6m of 150mm steel
PVC casing installed none
Well screen
Other remarks Bentonite pellets. Upstand pipe.

Operator Brendan Dunne

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Borehole for: Lagan
at Aghamore Quarry
Sligo

MW6 (Sean Gilmartin field - middle bore)

Date	Depth m	Diam	Conditions
3/7/2017	0 - 2.5	200mm	Clay
	2.5 - 6	"	Grey rock. Dry. Install 6m x 150mm steel.
	6 - 36	150mm	Grey rock. Dry.
	36 - 42	"	Grey rock. Trickle at 42m.
	42 - 49	"	Grey rock. 20gph.
	49 - 55	"	Grey rock. 30 - 40gph
	55 - 61	"	Grey rock. Brown patch at 59m. 90gph.
	61 - 67	"	Grey rock. 200gph.
	67 - 73	"	Grey rock. 225gph.
	73 - 80	"	Grey rock. 275gph

Total depth of well	80m
Estimated yield	275gph
Depth to rock	2.5m
Steel casing installed	6m of 150mm steel
PVC casing installed	none
Well screen	
Other remarks	Bentonite pellets. Flush cap.

Operator Brendan Dunne

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Borehole for: Lagan
at Aghamore Quarry
Sligo

MW7 (Sean Gilmartin field - near quarry face)

Date	Depth m	Diam	Conditions
3/7/2017	0 - 2.5	200mm	Clay
	2.5 - 6	"	Grey rock. Dry. Install 6m x 150mm steel.
	6 - 18	150mm	Grey rock. Dry.
4/7/2017			Water in hole overnight.
	18 -30	"	Grey rock. Dry.
	30 - 36	"	Grey rock. Trickle.
	36 - 49	"	Grey rock. 30gph.
	49 - 55	"	Grey rock. 30gph.
	55 - 61	"	Grey rock. White bits. 80gph.
	61 - 73	"	Grey rock. 190gph
	73 - 80	"	Grey rock. 190gph.

Total depth of well	80m
Estimated yield	190gph
Depth to rock	2.5m
Steel casing installed	6m of 150mm steel
PVC casing installed	none
Well screen	
Other remarks	Bentonite pellets. Upstand pipe.

Operator Brendan Dunne

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DRILLERS LOG

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Borehole for: Lagan
at Aghamore Quarry
Sligo

MW8 (up ramp on left - middle bore)

Date	Depth m	Diam	Conditions
4/7/2017	0 - 8	200mm	Clay & stones.
	8 - 12	"	Soft broken rock. Dry. Install 12m of 150mm steel.
	12 30	150mm	Grey rock. Dry.
5/7/2017			Very little water in hole overnight approx 4 - 5 gallons.
	30 - 49	"	Grey rock. Dry.
	49 - 66	"	Grey rock. 10 to 20gph.
	66 - 73	"	Grey rock.Brown patch at 69 - 70m. 150gph.
	73 - 80	"	Grey rock. 400gph.

Total depth of well 80m
Estimated yield 400gph
Depth to rock 8m
Steel casing installed 12m of 150mm steel
PVC casing installed none
Well screen
Other remarks Bentonite pellets. Upstand pipe.

Operator Brendan Dunne

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DRILLERS LOG

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Borehole for: Lagan
at Aghamore Quarry
Sligo

MW9 (across road on side of entrance road)

Date	Depth m	Diam	Conditions
5/7/2017	0 - 6	200mm	Fill & earth material.
	6 - 8	"	Brown silt. Wet Install 10.4m x 150mm steel with casing shoe.
	8 - 10.4	150mm	Grey silt. Wet.
6/7/2017	10.4 - 15	"	Broken, crumbling rock. Water. Adding lining - cutting, welding, driving.
	15 - 17	"	Grey rock.
	17 - 18	"	Soft brown patch - water. Estimate 1 - 2m3/hr.
			Install 50mm PVC. 2m screen. 15.3m plain. Screen from 15.3 to 17.3m bgl.
			Gravel to 15m. Bentonite pellets. Bentocem grout to GL.

Total depth of well 18m drilled. (17.3m PVC)
Estimated yield 1 - 2m3/hr
Depth to rock 10.4m
Steel casing installed 14.8m x 150mm (300mm above GL. - steel to 14.5m bgl)
PVC casing installed 50mm PVC. - 15.3m plain.
Well screen 50mm PVC. - 2m screen.
Other remarks Bentonite pellets. Upstand pipe.

Operator Brendan Dunne

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old galway road
loughrea

DRILLHOLE LOG

Project Aghamore Quarry		Location Co Sligo		DRILLHOLE No **MW10A**
Job No 17-SO-101	Date 12-08-17 17-07-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 1 of 3 Rev. 1

RUN DETAILS			STRATA						
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION: Discontinuities Detail	DESCRIPTION: Main	Geology	Instrument/ Backfill
0.00						0.00 - 12.00 : overburden.	Open hole drilling - no recovery.		
	0 (-)	NA			(12.00)				

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush

From (m)	To (m)	Type	Return (%)
0	28.00	polymer	

GENERAL REMARKS

6 gallons polydrill used.
BH backfilled.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

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DRILLHOLE LOG

Project Aghamore Quarry		Location Co Sligo	DRILLHOLE No **MW10A**
Job No 17-SO-101	Date 12-08-17 17-07-17	Ground Level (m OD)	Co-Ordinates ()
Engineer TMS Environmental			Sheet 2 of 3 Rev. 1

RUN DETAILS				STRATA					
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION Discontinuities Detail	DESCRIPTION Main	Geology	Instrument/ Backfill
12.00					12.00		Open hole drilling - no recovery. *(continued)*		
13.00	100 (32) 0	NR/NI		▨	(16.00)	12.00 - 28.00 Non-intact as probable weathered rock. No recovery as washout of fines during drilling. No record of cavities.	Weathered LIMESTONE rock. Recovered as subangular and angular fine to coarse gravel sized clasts of light grey cherty bioclastic fine and medium grained limestone with a little light brown silt/clay.		
16.00	22 (6) 0								
19.00	33 (9) 0								
22.00	43 (13) 0								

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush

From (m)	To (m)	Type	Return (%)

GENERAL REMARKS

6 gallons polydrill used.
BH backfilled.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

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DRILLHOLE LOG

Project Aghamore Quarry			Location Co Sligo	DRILLHOLE No **MW10A**
Job No 17-SO-101	Date 12-08-17 17-07-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 3 of 3 Rev. 1

RUN DETAILS				STRATA						
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION: Discontinuities	DESCRIPTION: Detail	DESCRIPTION: Main	Geology	Instrument/ Backfill
25.00	20 (19) 0			▨				Weathered LIMESTONE rock. Recovered as subangular and angular fine to coarse gravel sized clasts of light grey cherty bioclastic fine and medium grained limestone with a little light brown silt/clay. *(continued)*		▨
28.00	28 (8) 0			▨	28.00					▨
								BH terminated at 28.00m bgl on REs instruction.		

Drilling Progress and Water Observations								Rotary Flush			
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From (m)	To (m)	Type	Return (%)

GENERAL REMARKS

6 gallons polydrill used.
BH backfilled.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

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DRILLHOLE LOG

Project Aghamore Quarry		Location Co Sligo		DRILLHOLE No **MW10B**
Job No 17-SO-101	Date 17-07-17 17-07-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 1 of 3 Rev. 1

RUN DETAILS				STRATA					
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION: Discontinuities Detail	DESCRIPTION: Main	Geology	Instrument/ Backfill
0.00	0					0.00 - 22.00 : overburden.	Open hole drilling - no recovery.		

Drilling Progress and Water Observations							
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush			
From (m)	To (m)	Type	Return (%)
0	22.00	water	

GENERAL REMARKS

BH backfilled.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

DRILLHOLE LOG

Project Aghamore Quarry		Location Co Sligo		DRILLHOLE No **MW10B**
Job No 17-SO-101	Date 17-07-17 17-07-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 2 of 3 Rev. 1

RUN DETAILS				STRATA						
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION Discontinuities	DESCRIPTION Detail	DESCRIPTION Main	Geology	Instrument/ Backfill
	(-) -	NA			(22.00)			Open hole drilling - no recovery. *(continued)*		
22.00					22.00					

Drilling Progress and Water Observations								Rotary Flush			
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From (m)	To (m)	Type	Return (%)

GENERAL REMARKS

BH backfilled.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

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DRILLHOLE LOG

Project Aghamore Quarry		Location Co Sligo		DRILLHOLE No **MW10B**
Job No 17-SO-101	Date 17-07-17 17-07-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 3 of 3 Rev. 1

RUN DETAILS				STRATA						
Depth Date	TCR (SCR,) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION Discontinuities	Detail	Main	Geology	Instrument/ Backfill
								BH terminated at 22.00m bgl on REs instruction.		

Drilling Progress and Water Observations								Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From (m)	To (m)	Type	Return (%)	
												BH backfilled.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

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DRILLHOLE LOG

Project Aghamore Quarry		Location Co Sligo		DRILLHOLE No **MW10C**
Job No 17-SO-101	Date 18-07-17 21-07-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 1 of 8 Rev. 1

RUN DETAILS			STRATA						
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION Discontinuities Detail	DESCRIPTION Main	Geology	Instrument/ Backfill
0.00 3.00	0 (-) -	NA			(3.00) 3.00	0.00 - 3.00 : overburden.	Open hole drilling - no recovery.		
3.00 4.00	100 (90) 61	9				3.00 - 80.00 Discontinuities, medium spaced, locally closely spaced, dipping 10 to 12°, stepped, rough, with 0.5 to 3mm thick grey silt smear.	Strong thinly bedded grey and dark grey locally bioturbated sparry bioclastic fine and coarse grained LIMESTONE with vertical and subvertical milky white sparry and calcitic veins and veinlets along extent of core. 4.00m: carried out packer test.		
4.00 7.00	100 (95) 89	5 5 6				4.80 - 4.95 Joint, subvertical dip, stepped, rough, with 0.5mm thick grey silt smear, open.			
7.00 10.00	100 (98) 91	6 4 6							
10.00		5							

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush

From (m)	To (m)	Type	Return (%)
0	80.00	water	

GENERAL REMARKS

HQ casing and shoe left in BH to 3.00m bgl.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

IDL AGS3 UK DH LAGAN QUARRY SLIGO FILE 1 SEPT 1 2017.GPJ IDL TP TEMPLATE.GDT 08/09/17

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DRILLHOLE LOG

Project Aghamore Quarry		Location Co Sligo	DRILLHOLE No **MW10C**
Job No 17-SO-101	Date 18-07-17 21-07-17	Ground Level (m OD)	Co-Ordinates ()
Engineer TMS Environmental			Sheet 2 of 8 Rev. 1

RUN DETAILS			STRATA							
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION Discontinuities	Detail	Main	Geology	Instrument/ Backfill
	100 (95) 91	4						Strong thinly bedded grey and dark grey locally bioturbated sparry bioclastic fine and coarse grained LIMESTONE with vertical and subvertical milky white sparry and calcitic veins and veinlets along extent of core. *(continued)*		
13.00		4						13.00m: carried out packer test.		
	100 (98) 96	3								
		4								
16.00		3								
	100 (98) 94	5								
		4								
19.00		5								
	100 (98) 97	1								
		3								
22.00		2								

Drilling Progress and Water Observations								Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From (m)	To (m)	Type	Return (%)	
												HQ casing and shoe left in BH to 3.00m bgl.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

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DRILLHOLE LOG

Project Aghamore Quarry		Location Co Sligo		DRILLHOLE No **MW10C**
Job No 17-SO-101	Date 18-07-17 21-07-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 3 of 8 Rev. 1

RUN DETAILS			STRATA							
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION Discontinuities	Detail	Main	Geology	Instrument/ Backfill
25.00	100 (95) 92	3 4 2				22.35 - 22.50 Joint, vertical dip, undulating, tight. 22.85 - 23.00 Joint, vertical dip, stepped, tight, open as drilling induced? 23.60 - 23.75 Joint, subvertical dip, stepped, rough, with 0.5mm thick milky white calcite crystal veneer, open as drilling induced? 24.40 - 24.47 Joint, subvertical dip, stepped, rough, with orange brown and dark orange brown iron stain and powder, open.		Strong thinly bedded grey and dark grey locally bioturbated sparry bioclastic fine and coarse grained LIMESTONE with vertical and subvertical milky white sparry and calcitic veins and veinlets along extent of core. *(continued)* 22.00m: carried out packer test.		
28.00	100 (97) 87	8 4 5				27.00 - 27.10 Joint, dipping 60°, stepped, rough, with 0.5mm thick brown silt smear and 0.5mm thick milky white calcite crystal veneer, open.		25.90m to 25.95m: vuggy as 20mm deep 1 to 3mm milky white calcite crystal assemblage. 25.91m to 67.00m: vuggy as 10 to 20mm deep vugs with 1 to 3mm milky white calcite crystal assemblages. 26.45m to 26.60m: vuggy as 25 to 1mm deep 1 to 3mm milky white calcite crystal assemblage.		
31.00	100 (98) 94	3 4 3				30.80 - 30.90 Joint, dipping 60°, stepped, rough, with 0.5 to 1mm thick grey silt smear, open.		28.40m to 28.42m: vuggy as 1 to 4mm milky white calcite crystal assemblage. 29.00m to 29.06m: vuggy as 1 to 4mm milky white calcite crystal assemblage. 29.80m to 29.82m: vuggy as 1 to 4mm milky white calcite crystal assemblage.		
	100 (98) 92	3 2				31.00 - 31.15 Joint, subvertical dip, stepped, rough, with 0.5mm thick grey silt smear, open to 31.10m, then tight.		31.00m: carried out packer test.		

Drilling Progress and Water Observations								
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush			
From (m)	To (m)	Type	Return (%)

GENERAL REMARKS

HQ casing and shoe left in BH to 3.00m bgl.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

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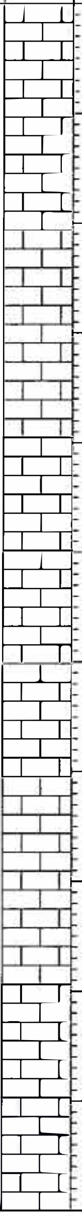
DRILLHOLE LOG

Project Aghamore Quarry		Location Co Sligo		DRILLHOLE No **MW10C**
Job No 17-SO-101	Date 18-07-17 21-07-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 4 of 8 Rev. 1



RUN DETAILS				STRATA					
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION: Discontinuities Detail	DESCRIPTION: Main	Geology	Instrument/ Backfill
34.00		4					Strong thinly bedded grey and dark grey locally bioturbated sparry bioclastic fine and coarse grained LIMESTONE with vertical and subvertical milky white sparry and calcitic veins and veinlets along extent of core. *(continued)*		
37.00	100 (93) 75	3 5 4				34.10 - 34.30 Joint, vertical dip, stepped, rough, with 0.5mm thick grey silt smear, open. 34.45 - 34.55 Joint, dipping 60°, stepped, rough, clean, open as drilling induced? 36.10 - 36.50 2 No parallel joints, vertical dip, undulating, tight.	35.85m to 35.90m: vuggy as 20mm deep 1 to 3mm milky white calcite crystal assemblage.		
40.00	100 (97) 79	6 3 6				37.35 - 37.55 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick brown silt smear, open.	39.48m to 39.51m: vuggy as 20mm deep 1 to 3mm milky white calcite crystal assemblage. 40.00m: carried out packer test.		
43.00	100 (98) 88	5 3 6			(77.00)	40.50 - 40.80 Joint, subvertical dip, stepped, rough, with 0.5mm thick grey silt smear and 0.5mm thick milky white calcite crystal veneer, open. 42.95 - 43.35 Joint, vertical dip, stepped, tight.			
		5				43.65 - 43.85 Joint, subvertical dip,			

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush

From (m)	To (m)	Type	Return (%)

GENERAL REMARKS

HQ casing and shoe left in BH to 3.00m bgl.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

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DRILLHOLE LOG

Project Aghamore Quarry		Location Co Sligo		DRILLHOLE No **MW10C**
Job No 17-SO-101	Date 18-07-17 21-07-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 5 of 8 Rev. 1

RUN DETAILS			STRATA						
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION Detail Discontinuities	DESCRIPTION Main	Geology	Instrument/ Backfill
	100 (98) 93	5				stepped, rough, with 0.5 to 1mm thick grey silt smear, open.	Strong thinly bedded grey and dark grey locally bioturbated sparry bioclastic fine and coarse grained LIMESTONE with vertical and subvertical milky white sparry and calcitic veins and veinlets along extent of core. *(continued)*		
46.00		4							
		4				46.05 - 46.30 Joint, subvertical dip, stepped, tight, open as drilling induced?			
	100 (98) 96	4				47.60 - 47.70 Joint, dipping 60°, stepped, smooth, with 0.5mm thick grey silt smear, open.			
49.00		4							
		4					49.00m: carried out packer test.		
	100 (98) 83	3							
52.00		7				51.40 - 51.55 Joint, subvertical dip, stepped, rough, with minor orange and orange brown iron stain and powder, open. 51.85 - 52.15 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick grey silt smear, open.	51.70m to 51.76m: orange brown with no obvious reduction in strength. 51.90m to 51.93m: orange brown calcite crystal assemblage.		
		4							
	100 (97) 84	3							
55.00		5							

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush

From (m)	To (m)	Type	Return (%)

GENERAL REMARKS

HQ casing and shoe left in BH to 3.00m bgl.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

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DRILLHOLE LOG

Project Aghamore Quarry		Location Co Sligo		DRILLHOLE No **MW10C**
Job No 17-SO-101	Date 18-07-17 21-07-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 6 of 8 Rev. 1

RUN DETAILS			STRATA						
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION Discontinuities Detail	Main	Geology	Instrument/ Backfill
		2					Strong thinly bedded grey and dark grey locally bioturbated sparry bioclastic fine and coarse grained LIMESTONE with vertical and subvertical milky white sparry and calcitic veins and veinlets along extent of core. *(continued)*		
	100 (94) 86	3							
58.00		6							
		3					58.00m: carried out packer test.		
	100 (91) 80	4							
61.00		5				60.85 - 61.15 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick orange brown clay smear, open.			
		5							
	100 (85) 58	6							
64.00		18				63.30 - 64.25 Joint, vertical dip, stepped, rough, with 0.5 to 4mm thick grey silt smear, open to moderately wide.			
		12							
	100 (85) 49	10				65.20 - 65.40 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick grey silt smear, open.			

Drilling Progress and Water Observations								Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From (m)	To (m)	Type	Return (%)	
												HQ casing and shoe left in BH to 3.00m bgl.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

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DRILLHOLE LOG

Project Aghamore Quarry			Location Co Sligo	DRILLHOLE No **MW10C**
Job No 17-SO-101	Date 18-07-17 21-07-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 7 of 8 Rev. 1

RUN DETAILS			STRATA						
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION: Discontinuities Detail	DESCRIPTION: Main	Geology	Instrument/ Backfill
67.00		10				65.85 - 65.95 Joint, dipping 60°, stepped, rough, with 0.5 to 1mm thick grey silt smear, open. 66.25 - 66.35 Joint, dipping 60°, stepped, tight, open as drilling induced. 66.80 - 67.05 Joint, subvertical dip, stepped, smooth, with 0.5 to 1mm thick grey silt smear, open.	Strong thinly bedded grey and dark grey locally bioturbated sparry bioclastic fine and coarse grained LIMESTONE with vertical and subvertical milky white sparry and calcitic veins and veinlets along extent of core. *(continued)* 67.00m: carried out packer test.		
70.00	100 (90) 57	5 8 11				69.00 - 69.26 Joint, subvertical dip, stepped, rough, with 0.5mm thick dark grey silt smear, open. 69.30 - 70.20 Joint, subvertical dip, stepped, rough, with 0.5 to 2mm thick grey silt smear and 0.5 to to 1mm thick milky white calcite crystal smear, open to moderately wide.	68.80m to 68.85m: black coal.		
73.00	100 (87) 35	5 9 26				70.80 - 71.30 Joint, subvertical dip, stepped, rough, with 0.5mm thick orange brown clay smear, open. 71.85 - 73.05 2 No parallel joints, subvertical dip, stepped, rough, with 0.5 to 2mm thick grey silt smear, open.			
76.00	100 (97) 79	3 9 7				75.70 - 76.10 Joint, vertical dip, stepped, rough, with 0.5 to 1mm thick grey silt smear, open.	76.00m: carried out packer test.		
		6							

Drilling Progress and Water Observations								Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From (m)	To (m)	Type	Return (%)	HQ casing and shoe left in BH to 3.00m bgl.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

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DRILLHOLE LOG

Project Aghamore Quarry		Location Co Sligo		DRILLHOLE No **MW10C**
Job No 17-SO-101	Date 18-07-17 21-07-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 8 of 8 Rev. 1

RUN DETAILS				STRATA						
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION Discontinuities	Detail	Main	Geology	Instrument/ Backfill
	100 (91) 82	3						Strong thinly bedded grey and dark grey locally bioturbated sparry bioclastic fine and coarse grained LIMESTONE with vertical and subvertical milky white sparry and calcitic veins and veinlets along extent of core. *(continued)*		
79.00		6								
80.00	100 (95) 61	7			80.00	79.45 - 79.65 Joint, vertical dip, stepped, rough, with 0.5 to 2mm thick dark grey silt smear, open.				
								BH terminated at 80.00m bgl on REs instruction.		

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush

From (m)	To (m)	Type	Return (%)

GENERAL REMARKS

HQ casing and shoe left in BH to 3.00m bgl.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

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DRILLHOLE LOG

Project Aghamore Quarry			Location Co Sligo	DRILLHOLE No **MW11**
Job No 17-SO-101	Date 08-08-17 15-08-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 1 of 8 Rev. 1

Depth / Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thickness)	Discontinuities / Detail	Main	Geology	Instrument/ Backfill
0.00						0.00 - 6.00 : overburden.	Open hole drilling - no recovery.		
	0 (-) -	NA			(6.00)				
6.00					6.00				
	100 (98) 87	6				6.00 - 80.00 Discontinuities, medium spaced, locally closely spaced, dipping 12 to 14°, stepped, rough, with 0.5 to 2mm thick grey silt smear.	Strong thinly bedded grey and dark grey locally bioturbated sparry bioclastic fine and coarse grained LIMESTONE with vertical and subvertical milky white sparry and calcitic veins and veinlets along extent of core. 7.00m: carried out packer test.		
7.00		5							
	100 (96) 67	8							
		8							
10.00		6				10.10 - 10.45 Joint, vertical dip, stepped, rough, with 0.5mm thick grey silt smear and minor orange brown iron stain, open.			

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush

From (m)	To (m)	Type	Return (%)
0	80.00	water	

GENERAL REMARKS

HQ casing and shoe left in BH to 6.00m bgl.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

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DRILLHOLE LOG

Project Aghamore Quarry		Location Co Sligo		DRILLHOLE No **MW11**
Job No 17-SO-101	Date 08-08-17 15-08-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 2 of 8 Rev. 1

RUN DETAILS / STRATA

Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION Discontinuities Detail	DESCRIPTION Main	Geology	Instrument/ Backfill
13.00	100 (97) 68	10 8				11.90 - 12.10 Joint, subvertical dip, stepped, rough, with 0.5mm thick grey silt smear, open.	Strong thinly bedded grey and dark grey locally bioturbated sparry bioclastic fine and coarse grained LIMESTONE with vertical and subvertical milky white sparry and calcitic veins and veinlets along extent of core. *(continued)*		
16.00	100 (97) 74	7 6 9				14.70 - 14.90 Joint, vertical to subvertical dip, stepped, rough, with 0.5 to 1mm thick milky white calcite veneer and minor orange brown iron stain, open.	14.67m to 14.70m: grey silt. 16.00m: carried out packer test.		
19.00	100 (88) 43	8 8 15				17.75 - 18.15 Joint, subvertical dip, stepped, rough, with .05 to 1mm thick grey silt smear, open. 18.50 - 19.00 Joint, subvertical dip, stepped, rough, with 0.5 to 2mm thick grey silt smear, open.			
22.00	100 (92) 50	5 10 10				20.45 - 21.10 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick grey silt smear, open. 21.70 - 22.10 Joint, subvertical dip,			

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush

From (m)	To (m)	Type	Return (%)

GENERAL REMARKS

HQ casing and shoe left in BH to 6.00m bgl.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

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DRILLHOLE LOG

Project Aghamore Quarry			Location Co Sligo	DRILLHOLE No **MW11**
Job No 17-SO-101	Date 08-08-17 15-08-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 3 of 8 Rev. 1

RUN DETAILS			STRATA						
						DESCRIPTION			
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick-ness)	Discontinuities Detail	Main	Geology	Instrument/ Backfill
25.00	100 (94) 66	5 6 9				stepped, rough, with 0.5 to 1mm thick grey silt smear, open. 22.70 - 23.30 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick grey silt smear, open. 24.60 - 25.30 2 No parallel joints, subvertical dip, stepped, rough, with 0.5mm thick grey silt smear and minor dark orange brown iron stain and powder, open.	Strong thinly bedded grey and dark grey locally bioturbated sparry bioclastic fine and coarse grained LIMESTONE with vertical and subvertical milky white sparry and calcitic veins and veinlets along extent of core. *(continued)* 24.30m to 24.35m: vuggy as 10mm deep 1 to 3mm milky white calcite crystal assemblage. 25.00m: carried out packer test.		
28.00	100 (96) 84	8 3 4							
31.00	100 (97) 94	6 3 3							
	100 (98) 97	3 3							

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush

From (m)	To (m)	Type	Return (%)

GENERAL REMARKS

HQ casing and shoe left in BH to 6.00m bgl.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

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DRILLHOLE LOG

Project Aghamore Quarry			Location Co Sligo	DRILLHOLE No **MW11**
Job No 17-SO-101	Date 08-08-17 15-08-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 4 of 8 Rev. 1

RUN DETAILS				STRATA					
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION Discontinuities Detail	Main	Geology	Instrument/ Backfill
34.00		3					Strong thinly bedded grey and dark grey locally bioturbated sparry bioclastic fine and coarse grained LIMESTONE with vertical and subvertical milky white sparry and calcitic veins and veinlets along extent of core. *(continued)* 34.00m: carried out packer test.		
		4							
	100 (98) 82	4							
37.00		5							
		7				37.65 - 38.15 Joint, subvertical dip, stepped, rough, with 0.5mm thick grey silt smear and 0.5mm thick milky white calcite crystal veneer, open.			
	100 (96) 55	6							
40.00		8				39.50 - 39.85 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick greenish grey silt smear, open.			
		6				40.60 - 40.70 Joint, dipping 60°, stepped, smooth, with 0.5mm thick grey silt smear, open.			
	100 (94) 69	7							
43.00		8							
		4			(74.00)		43.00m: carried out packer test.		

Drilling Progress and Water Observations							
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush			
From (m)	To (m)	Type	Return (%)

GENERAL REMARKS

HQ casing and shoe left in BH to 6.00m bgl.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

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DRILLHOLE LOG

Project Aghamore Quarry		Location Co Sligo		DRILLHOLE No **MW11**
Job No 17-SO-101	Date 08-08-17 15-08-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 5 of 8 Rev. 1

RUN DETAILS			STRATA						
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION: Discontinuities Detail	DESCRIPTION: Main	Geology	Instrument/ Backfill
46.00	100 (97) 86	4 7				45.10 - 45.40 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick grey silt smear, open.	Strong thinly bedded grey and dark grey locally bioturbated sparry bioclastic fine and coarse grained LIMESTONE with vertical and subvertical milky white sparry and calcitic veins and veinlets along extent of core. *(continued)*		
49.00	100 (98) 85	4 5 6				48.00 - 48.25 Joint, subvertical dip, stepped, rough, with 0.5mm thick grey silt smear, open.			
52.00	100 (97) 86	6 6 6							
55.00	100 (96) 77	6 9 6					52.00m: carried out packer test.		

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush

From (m)	To (m)	Type	Return (%)

GENERAL REMARKS

HQ casing and shoe left in BH to 6.00m bgl.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

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DRILLHOLE LOG

Project: Aghamore Quarry		Location: Co Sligo	DRILLHOLE No **MW11**
Job No: 17-SO-101	Date: 08-08-17 15-08-17	Ground Level (m OD)	Co-Ordinates ()
Engineer: TMS Environmental			Sheet 6 of 8 Rev. 1

RUN DETAILS Depth / Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION Discontinuities Detail	DESCRIPTION Main	Geology	Instrument/ Backfill
		6					Strong thinly bedded grey and dark grey locally bioturbated sparry bioclastic fine and coarse grained LIMESTONE with vertical and subvertical milky white sparry and calcitic veins and veinlets along extent of core. *(continued)*		
	100 (98) 82	8							
58.00		4							
		4							
	100 (97) 86	8							
61.00		6							
		9					61.00m: carried out packer test.		
	100 (98) 95	4							
64.00		5							
		6							
	100 (98) 82	7				65.30 - 65.40 Joint, dipping 60°, stepped, smooth, with 0.5 to 1mm thick grey silt smear, open.	65.30m to 65.40m: dark grey fine grained chert nodule.		

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush

From (m)	To (m)	Type	Return (%)

GENERAL REMARKS

HQ casing and shoe left in BH to 6.00m bgl.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used: Hydreq	Bit Design: NQ	Driller: DC	Logged By: EAT

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DRILLHOLE LOG

Project Aghamore Quarry		Location Co Sligo		DRILLHOLE No **MW11**
Job No 17-SO-101	Date 08-08-17 15-08-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 7 of 8 Rev. 1

RUN DETAILS			STRATA							
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thickness)	Discontinuities	Detail	Main	Geology	Instrument/ Backfill
67.00		5		▦				Strong thinly bedded grey and dark grey locally bioturbated sparry bioclastic fine and coarse grained LIMESTONE with vertical and subvertical milky white sparry and calcitic veins and veinlets along extent of core. *(continued)*		
		5		▦						
	100 (98) 95	5		▦						
70.00		3		▦						
		6		▦		70.20 - 70.35 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick grey silt smear, open. 70.90 - 71.00 Joint, dipping 60°, stepped, smooth, with 0.5 to 1mm thick grey silt smear, open.		70.00m: carried out packer test.		
	100 (98) 96	5		▦						
73.00		5		▦						
		4		▦						
	100 (98) 96	5		▦						
76.00		5		▦						
		4		▦						

Drilling Progress and Water Observations								Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From (m)	To (m)	Type	Return (%)	HQ casing and shoe left in BH to 6.00m bgl.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

irish drilling ltd
old galway road
loughrea

DRILLHOLE LOG

Project Aghamore Quarry		Location Co Sligo		DRILLHOLE No **MW11**
Job No 17-SO-101	Date 08-08-17 15-08-17	Ground Level (m OD)	Co-Ordinates ()	
Engineer TMS Environmental				Sheet 8 of 8 Rev. 1

RUN DETAILS			STRATA						
						DESCRIPTION			
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thickness)	Discontinuities Detail	Main	Geology	Instrument/ Backfill
79.00	100 (98) 96	5					Strong thinly bedded grey and dark grey locally bioturbated sparry bioclastic fine and coarse grained LIMESTONE with vertical and subvertical milky white sparry and calcitic veins and veinlets along extent of core. *(continued)*		
		3							
80.00	100 (97) 94	5			80.00				
							BH terminated at 80.00m bgl on REs instruction.		

Drilling Progress and Water Observations							
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush			
From (m)	To (m)	Type	Return (%)

GENERAL REMARKS

HQ casing and shoe left in BH to 6.00m bgl.

All dimensions in metres Scale 1:68.75	Client: Lagan Group	Method/ Plant Used Hydreq	Bit Design NQ	Driller DC	Logged By EAT

IDL AGS3 UK DH LAGAN QUARRY SLIGO FILE 2 SEPT 1 2017.GPJ IDL TP TEMPLATE.GDT 08/09/17

DUNNES
DRILLING

DRILLERS LOG

WELL DRILLING AND HORIZONTAL DRILLING ENGINEERS
Dublin Road, Dromiskin, Dundalk, Co. Louth.
E-Mail: info@dunnesdrilling.com website: www.dunnesdrilling.com
Tel: +353 42 9372188 Fax: +353 42 9372714

Borehole for: Lagan
at Aghamore Quarry
Sligo

MW 12 (on left of roadway, nearest quarry)

Date	Depth m	Diam	Conditions
31/8/2020	0 - 1	200mm	Sand.
	1 - 3	"	Weathered rock.
	3 - 6	"	Rock. Install 150mm steel x 6m.
	6 - 12	150mm	Rock. Dry.
	12 - 18	"	Rock. Dry.
	18 - 20	"	Rock. Dry.

Total depth of well 20m
Estimated yield no flow
Depth to rock 1m
Steel casing installed 150mm x 6m.
PVC casing installed
Well screen
Other remarks Bentonite pellets. Upstand pipe.

Operator Brendan Dunne

DUNNES
DRILLING

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DRILLERS LOG

Borehole for: Lagan
at Aghamore Quarry
Sligo

MW 13 (on left of roadway, middle borehole)

Date	Depth m	Diam	Conditions
31/8/2020	0 - 2	200mm	Fill material.
	2 - 6	"	Rock. Dry. Install 150mm steel x 6m.
	6 - 12	150mm	Rock. Dry.
	12 - 18	"	Rock. Dry.
	18 - 20	"	Rock. Dry.

Total depth of well	20m
Estimated yield	no flow
Depth to rock	2m
Steel casing installed	150mm x 6m.
PVC casing installed	
Well screen	
Other remarks	Bentonite pellets. Upstand pipe.

Operator Brendan Dunne

DUNNES
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DRILLERS LOG

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Borehole for: Lagan
at Aghamore Quarry
Sligo

MW 14 (on left of roadway, nearest gate)

Date	Depth m	Diam	Conditions
1/9/2020	0 - 1	200mm	Fill.
	1 - 6	"	Rock. Dry. Install 150mm steel x 6m.
	6 - 12	150mm	Rock. Water - small inflow.
	12 - 18	"	Rock.
	18 - 20	"	Rock. 10 to 20gph.

Total depth of well 20m
Estimated yield 10 - 20gph.
Depth to rock 1m
Steel casing installed 150mm x 6m.
PVC casing installed
Well screen
Other remarks Bentonite pellets. Upstand pipe.

Operator Brendan Dunne

DUNNES
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DRILLERS LOG

Borehole for: Lagan
at Aghamore Quarry
Sligo

MW 15 (in yard, way over to left near perimeter)

Date	Depth m	Diam	Conditions
1/9/2020	0 - 1	200mm	Fill material.
	1 - 2	"	Sand, clayey.
	2 - 5	"	Sand, clayey with stones.
	5 - 6	"	Sand, clayey with large cobbles. Water at 6m.
	6 - 12	"	Sand, clayey with cobbles. Lot of water.
	12 - 14	"	Sand, clayey with cobbles. Getting caught due to collapse. Hole washing in.
			Lot of water - estimate 2 to 3m3/hr.
			Pull rods. Install 2" PVC. Stopped at 10m.
			Place gravel. Bentonite pellets.

Total depth of well	Drilled to 14m. 2" PVC installed to 10m.
Estimated yield	2 - 3 m3/hr
Depth to rock	no rock.
Steel casing installed	no steel.
PVC casing installed	2" plain x 3lgts.
Well screen	2" screen x 3m
Other remarks	Bentonite pellets. Upstand pipe.

Operator Brendan Dunne

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DRILLERS LOG

Borehole for: Lagan
at Aghamore Quarry
Sligo

MW 16 (in yard, on left in middle of yard by sandy bank)

Date	Depth m	Diam	Conditions
1/9/2020	0 - 6	200mm	Sand.Water at 6m.
	6 - 9	"	Sand and cobbles. Lot of water. Hole washing in.
			Pull rods and install 2" PVC.
			Place gravel. Bentonite pellets.

Total depth of well Drilled to 9m. 2" PVC installed to 7m.
Estimated yield 2 m3/hr
Depth to rock no rock.
Steel casing installed no steel.
PVC casing installed 2" plain 2 lgts x 3m
Well screen 2" screen - 3m
Other remarks Bentonite pellets. Upstand pipe.

Operator Brendan Dunne

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DRILLERS LOG

Borehole for: Lagan
at Aghamore Quarry
Sligo

MW 17 (at far perimeter and to the right)

Date	Depth m	Diam	Conditions
1/9/2020	0 - 1	200mm	Fill.
	1 - 6m	"	Sand. Water at 6m.
	6 - 10	"	Sand and cobbles. Lot of water. Hole collapsing. Getting caught.
			Pull rods. Install 2" PVC. Stopped at 7m.

Total depth of well	Drilled to 10m. 2" PVC installed to 7m.
Estimated yield	1 to 2 m3/hr.
Depth to rock	no rock.
Steel casing installed	no steel.
PVC casing installed	2" plain 2 lgts x 3m
Well screen	2" screen - 3m
Other remarks	Bentonite pellets. Upstand pipe.

Operator Brendan Dunne

DUNNES
DRILLING

DRILLERS LOG

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Borehole for: Lagan
at Aghamore Quarry
Sligo

MW 18 (Sean Gilmartin field - near quarry, 40m hole, middle hole)

Date	Depth m	Diam	Conditions
2/9/2020	0 - 1.5	200mm	Clay and stones
	1.5 - 6	"	Rock. Dry. Install 150mm x 6m steel.
	6 - 30	150mm	Grey rock. Dry.
	30 - 40	"	Grey rock. Cuttings damp from 36m.
3/9/2020			Airlift to measure flow. Very small flow. Estimate 5 to 10gph.

Total depth of well	40m
Estimated yield	5 to 10gph.
Depth to rock	1.5m
Steel casing installed	6m of 150mm steel
PVC casing installed	none
Well screen	none
Other remarks	Bentonite pellets. Upstand pipe.

Operator Brendan Dunne

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DRILLERS LOG

Borehole for: Lagan
at Aghamore Quarry
Sligo

MW 19 (Sean Gilmartin field - near quarry, 20m hole, on right looking from quarry)

Date	Depth m	Diam	Conditions
3/9/2020	0 - 1.5	200mm	Clay and stones
	1.5 - 6	"	Rock. Dry. Install 150mm x 6m steel.
	6 - 20	150mm	Grey rock. Dry.

Total depth of well 20m
Estimated yield no flow.
Depth to rock 1.5m
Steel casing installed 6m of 150mm steel
PVC casing installed none
Well screen none
Other remarks Bentonite pellets. Upstand pipe.

Operator Brendan Dunne

IRISH DRILLING LTD., LOUGHREA, CO. GALWAY.

CABLE PERCUSSIVE LOG SHEET

SITE: SLIGO QUARRY

DATE: 16.9.2020 HOURS PER SHIFT:

RIG: DANDO 1000

BOREHOLE COMPLETE: YES/NO

CASED FROM G.L m TO 10.5 m

BORED FROM G.L m TO 12 m

BOREHOLE NO. MW 20	DRILLER B. THOMPSON ASSISTANT R-LOSEVS

DESCRIPTION OF STRATA					DEPTH to base of STRATA m
Soft/Firm/Stiff Loose/Dense	Colour Fine - Coarse Medium	Clayey Silty Sandy etc.	SOIL TYPE	Sand bands Cobbles etc.	
		Start of days drilling			
CLAY BROWN SANDS GRAVELS CLAYS (FILL)					0.8
LOOSE SANDS - GRAVELS LARGE ANGULAR COBBLES					5.8
GREY SANDS CLAY BANDS					6.5
GREY BROWN SANDS ROUNDED COBBLES					7.9
FINE GREY SANDS LAMINATED CLAY BANDS					10m
FIRM GREY LAMINATED CLAYS					12m
		End of days drilling			12m

SAMPLES

No. Type	Pentration m From	Pentration m To	u blows	S.P.T./C.P.T. mms. 0 to 75	75 to 150	150 to 225	225 to 300	300 to 375	375 to 450	450 to 500
B1	1m									
2	2m									
3	3m									
4	4m									
5	5m									
6	6m									
7	7m									
8	8m									
9	9m									
10	10m									
11	11m									
12	12m									

REMARKS WATER ADDED FROM 1m

STANDPIPE DETAILS/SKETCH

CHISELLING: 1hr 7.2.2.6

Water level at start of day ____________ m. below G.L.

Water level at end of day 6.1 m.

	1st Strike	2nd Strike	3rd Strike
Water Strike at	4.7		
ater level after 20 mins.	6m		
Was water sealed?	~~YES~~/NO	YES/NO	YES/NO
Depth sealed?			

Signed - Engineer for client ____________ Signed: B

IRISH DRILLING LTD., LOUGHREA, CO. GALWAY.

CABLE PERCUSSIVE LOG SHEET

SITE: SLIGO QUARRY

RIG: DANDO 2000

CASED FROM ____ m TO ____ m

BORED FROM ____ m TO ____ m

DATE: 17·9·2020

HOURS PER SHIFT:

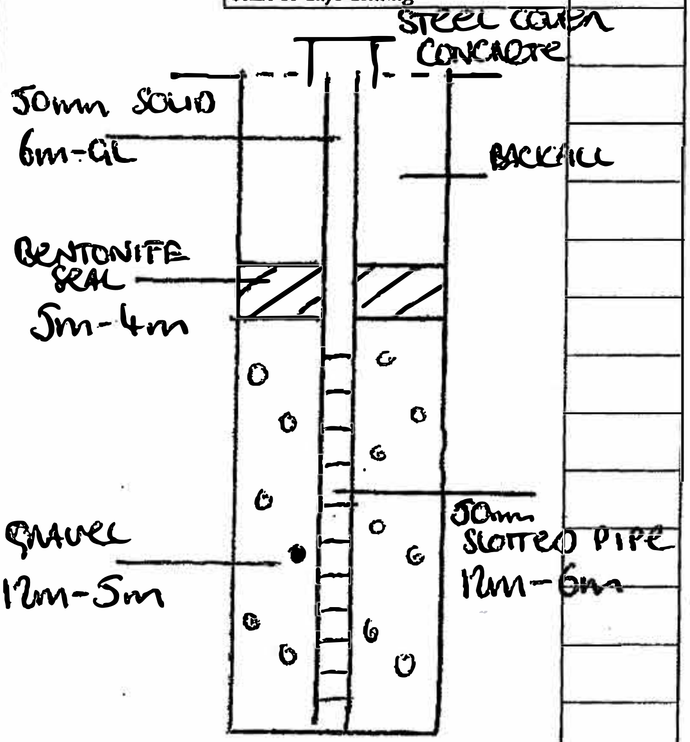
BOREHOLE COMPLETE: YES/~~NO~~

BOREHOLE NO. MW 20

DRILLER B·THOMPSON

ASSISTANT R-LOSERS

DESCRIPTION OF STRATA					DEPTH to base of STRATA m
Soft/Firm/Stiff Loose/Dense	Colour Fine - Coarse Medium	Clayey Silty Sandy etc.	SOIL TYPE	Sand bands Cobbles etc.	
		Start of days drilling			
		End of days drilling			



SAMPLES										
No. Type	Pentration m		u blows	S.P.T./C.P.T. mms.						
	From	To		0 to 75	75 to 150	150 to 225	225 to 300	300 to 375	375 to 450	450 to 500

REMARKS HELPED D·DUANE CUT WELL HEAD STEEL COVER – INSTALLED STANDPIPE THEN RIG SERVICED BY D·DUANE

CHISELLING:

Water level at start of day ____ m. below G.L.

Water level at end of day ____ m.

	1st Strike	2nd Strike	3rd Strike
Water Strike at			
Water level after 20 mins.			
Was water sealed?	YES/NO	YES/NO	YES/NO
Depth sealed?			

STANDPIPE DETAILS/SKETCH

Signed - Engineer for client ____

Signed:

IRISH DRILLING LTD., LOUGHREA, CO. GALWAY.
CABLE PERCUSSIVE LOG SHEET

SITE: SLIGO QUARRY

DATE: 17·9·2020

HOURS PER SHIFT:

RIG: DANDO 2000

BOREHOLE COMPLETE: ~~YES~~/NO

CASED FROM GL m TO 4 m

BORED FROM GL m TO 4 m

BOREHOLE NO. MW21

DRILLER B. Thompson

ASSISTANT R. Losevs

DESCRIPTION OF STRATA					DEPTH to base of STRATA m
Soft/Firm/ Stiff Loose/Dense	Colour Fine- Coarse Medium	Clayey Silty Sandy etc.	SOIL TYPE	Sand bands Cobbles etc.	
		Start of days drilling			
COMPACT GRAVEL FILL					2·8
BROWN CLAYEY COBBLES					4m
		End of days drilling			4m

SAMPLES										
No. Type	Pentration m From	To	u blows	S.P.T./C.P.T. mms. 0 to 75	75 to 150	150 to 225	225 to 300	300 to 375	375 to 450	450 to 500
B1	GL	1m								
B2	2m									
B3	3m									
B4	4m									

REMARKS

STANDPIPE DETAILS/SKETCH

CHISELLING: 1Hr 0·4-1m

Water level at start of day ________ m. below G.L.

Water level at end of day ________ m.

	1st Strike	2nd Strike	3rd Strike
Water Strike at	3·8		
ter level after 20 mins.	3		
Was water sealed?	~~YES~~/NO	YES/NO	YES/NO
Depth sealed?			

Signed - Engineer for client ________

Signed:

IRISH DRILLING LTD., LOUGHREA, CO. GALWAY.

CABLE PERCUSSIVE LOG SHEET

SITE: SLIGO QUARRY

DATE: 18·9·2020

HOURS PER SHIFT:

RIG:

BOREHOLE COMPLETE: YES/~~NO~~

CASED FROM 4 m TO 10·5 m

BORED FROM 4 m TO 10·5 m

BOREHOLE NO. MW21

DRILLER B.THOMPSON

ASSISTANT R LOSEVJ

DESCRIPTION OF STRATA					DEPTH to base of STRATA m
Soft/Firm/ Stiff Loose/Dense	Colour Fine - Coarse Medium	Clayey Silty Sandy etc.	SOIL TYPE	Sand bands Cobbles etc.	
		Start of days drilling			
FINE GREY BROWN SANDS					5·5
FINE GREY SANDS					8·9
FIRM GREEN BROWN ORGANIC SILT/CLAY (DRY)					9·6
MEDIUM GRAVELS COBBLES					10·5
		End of days drilling			10·5

SAMPLES											
No.	Pentration m		u blows	S.P.T./C.P.T. mms.							
Type	From	To		0 to 75	75 to 150	150 to 225	225 to 300	300 to 375	375 to 450	450 to 500
BS	5m										
6	6m										
7	7m										
8	8m										
9	9m										
10	10m										
11	10.50										

REMARKS PULLED CASING MOVED AND SET UP.

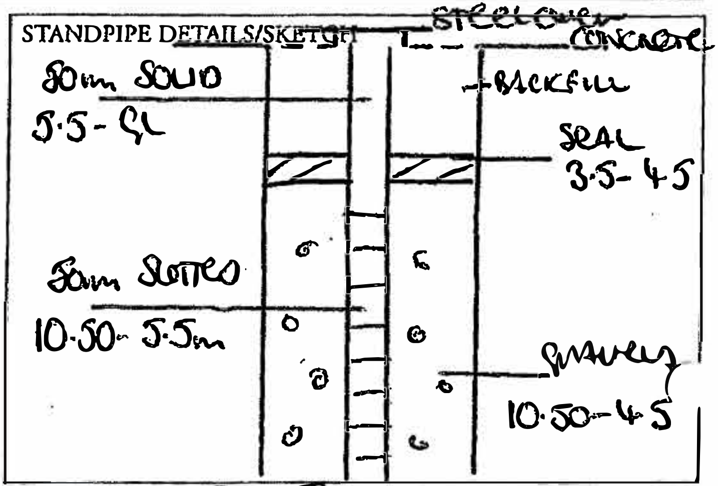
CHISELLING:

Water level at start of day 2 m. below G.L.

Water level at end of day m.

	1st Strike	2nd Strike	3rd Strike
Water Strike at		9·6	
Water level after 20 mins.		4·1	
Was water sealed?	YES/NO	~~YES~~/NO	YES/NO
Depth sealed?			

STANDPIPE DETAILS/SKETCH



Signed - Engineer for client

Signed:

IRISH DRILLING LTD., LOUGHREA, CO. GALWAY.
CABLE PERCUSSIVE LOG SHEET

SITE: SLIGO QUARRY

DATE: 22·9·2020 HOURS PER SHIFT:

RIG: DANDO 2000

BOREHOLE COMPLETE: YES/NO

CASED FROM GL m TO 11 m

BORED FROM GL m TO 11 m

BOREHOLE NO. MW22

DRILLER B. THOMPSON

ASSISTANT R. LOSEVS

DESCRIPTION OF STRATA (Soft/Firm/Stiff, Loose/Dense; Colour, Fine - Coarse Medium; Clayey Silty Sandy etc.; SOIL TYPE; Sand bands Cobbles etc.)	DEPTH to base of STRATA m
Start of days drilling	
COMPACT STONE FILL CONCRETE	2·5
BROWN SANDY GRAVEL COBBLES CLAY BANDS	4·7
FINE BROWN SANDS (BECOMING WET)	8·5
SMALL GRAVEL COBBLES	11m
End of days drilling	11m

SAMPLES

No. Type	Penetration m From	To	u blows	S.P.T./C.P.T. mms. 0 to 75	75 to 150	150 to 225	225 to 300	300 to 375	375 to 450	450 to 500
B1	1m									
B2	2m									
B3	3m									
B4	4m									
B5	5m									
B6	6m									
B7	7m									
B8	8m									
B9	9m									
B10	10m									
B11	11m									

REMARKS 1HR GETTING MACHINE DRIVER ON SITE TO CLEAR UP TO POSITION

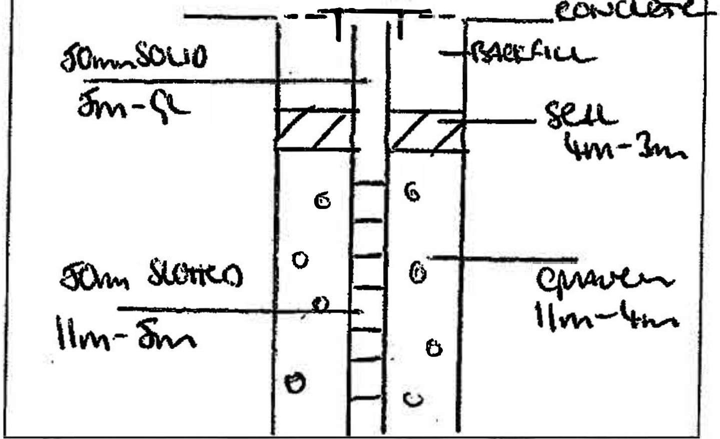
CHISELLING:

Water level at start of day ____ m. below G.L.

Water level at end of day 7.9 m.

	1st Strike	2nd Strike	3rd Strike
Water Strike at	8.8		
Water level after 20 mins.	9m		
Was water sealed?	~~YES~~/NO	YES/NO	YES/NO
Depth sealed?			

STANDPIPE DETAILS/SKETCH



Signed - Engineer for client ____

Signed: B. J

IRISH DRILLING LTD., LOUGHREA, CO. GALWAY.

CABLE PERCUSSIVE LOG SHEET

SITE: SLIGO QUARRY

DATE: 18.9.2020

HOURS PER SHIFT:

RIG:

BOREHOLE COMPLETE: ~~YES~~/NO

CASED FROM GL m TO 4 m

BORED FROM GL m TO 4 m

BOREHOLE NO. MW23	DRILLER B.THOMPSON ASSISTANT R LOSEN

DESCRIPTION OF STRATA					DEPTH to base of STRATA m
Soft/Firm/ Stiff Loose/Dense	Colour Fine - Coarse Medium	Clayey Silty Sandy etc.	SOIL TYPE	Sand bands Cobbles etc.	
		Start of days drilling			
COMPACT GRAVEL CLAYFILL COBBLES					3.5
FINE BROWN SANDS					
		End of days drilling			4m

SAMPLES										
No.	Pentration m		u blows	S.P.T./C.P.T. mms.						
Type	From	To		0 to 75	75 to 150	150 to 225	225 to 300	300 to 375	375 to 450	450 to 500
B1	1m									
B2	2m									
B3	3m									
B4	4m									

REMARKS WATER ADDED FROM GL TO HELP BORING

STANDPIPE DETAILS/SKETCH

CHISELLING:

Water level at start of day ______ m. below G.L.

Water level at end of day ______ m.

	1st Strike	2nd Strike	3rd Strike
Water Strike at			
Water level after 20 mins.			
Was water sealed?.	YES/NO	YES/NO	YES/NO
Depth sealed?			

Signed - Engineer for client ______

Signed:

IRISH DRILLING LTD., LOUGHREA, CO. GALWAY.

CABLE PERCUSSIVE LOG SHEET

SITE: SLIGO QUARRY

RIG: DANDO 2000

CASED FROM 4 m TO 12 m

BORED FROM 4 m TO 12 m

DATE: 21·9·2020

HOURS PER SHIFT:

BOREHOLE COMPLETE: YES/NO

BOREHOLE NO. MW23

DRILLER B·THOMPSON

ASSISTANT R-LOSERT

DESCRIPTION OF STRATA					DEPTH to base of STRATA m
Soft/Firm/Stiff Loose/Dense	Colour Fine- Coarse Medium	Clayey Silty Sandy etc.	SOIL TYPE	Sand bands Cobbles etc.	
		Start of days drilling			
INE BROWN SANDS					5·1
GREY SANDS LAMINATED CLAY/SILT BANDS					9·2
FIRM GREY LAMINATED CLAYS					12m
		End of days drilling			12

SAMPLES										
No.	Pentration m		u blows	S.P.T./C.P.T. mms.						
Type	From	To		0 to 75	75 to 150	150 to 225	225 to 300	300 to 375	375 to 450	450 to 500
B5	5m									
B6	6m									
B7	7m									
B8	8m									
B9	9m									
B10	10m									
B11	11m									
B12	12m									

REMARKS PULLED CASING MOVED AND SET UP.

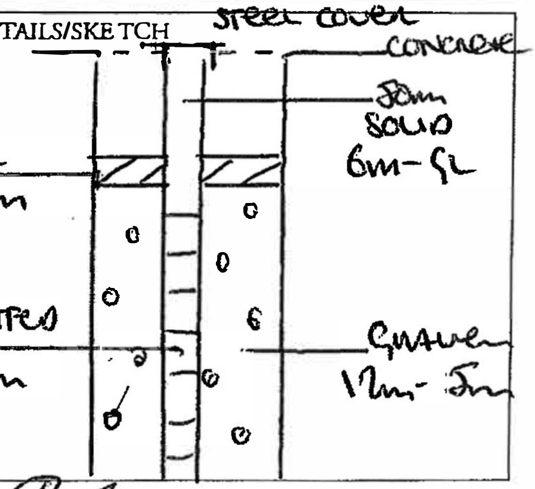
CHISELLING:

Water level at start of day 9.5 m. below G.L.

Water level at end of day 9.5 m.

	1st Strike	2nd Strike	3rd Strike
Water Strike at			
ater level after 20 mins.			
Was water sealed?	YES/NO	YES/NO	YES/NO
Depth sealed?			

STANDPIPE DETAILS/SKETCH



Signed - Engineer for client

Signed:

IRISH DRILLING LTD., LOUGHREA, CO. GALWAY.

CABLE PERCUSSIVE LOG SHEET

SITE: SLIGO QUARRY

DATE: 23·9·2020

HOURS PER SHIFT:

RIG: DANDO 2000

BOREHOLE COMPLETE: ~~YES~~/NO

CASED FROM GL m TO 6 m

BORED FROM GL m TO 6 m

BOREHOLE NO. MW 24C

DRILLER B. THOMPSON

ASSISTANT R. LOSENS

DESCRIPTION OF STRATA					DEPTH to base of STRATA m
Soft/Firm/ Stiff Loose/Dense	Colour Fine -Coarse Medium	Clayey Silty Sandy etc.	SOIL TYPE	Sand bands Cobbles etc.	
		Start of days drilling			
COMPACT/DENSE LIMESTONE FILL					3m
BROWN SANDS - GRAVELS COBBLES					
		End of days drilling			6

SAMPLES										
No. Type	Pentration m		u blows	S.P.T./C.P.T. mms.						
	From	To		0 to 75	75 to 150	150 to 225	225 to 300	300 to 375	375 to 450	450 to 500
B1	1m									
B2	2m									
B3	3m									
B4	4m									
B5	5m									
B6	6m									

REMARKS R. LOSENS TRAVELLED TO YARD LOUGHREA TO REPAIR UNDER SIZED SHELL AND ROPE EYES

CHISELLING: 1hr 0.8-1.3 1hr 1.3-1.8

Water level at start of day __________ m. below G.L.

Water level at end of day __________ m.

	1st Strike	2nd Strike	3rd Strike
Water Strike at	4.5		
Water level after 20 mins.	3.9		
Was water sealed?	~~YES~~/NO	YES/NO	YES/NO
Depth sealed?			

STANDPIPE DETAILS/SKETCH

Signed - Engineer for client __________ Signed:

IRISH DRILLING LTD., LOUGHREA, CO. GALWAY.

CABLE PERCUSSIVE LOG SHEET

SITE: SLIGO QUARRY

RIG: DANDO 2000

CASED FROM 6 m TO 11 m

BORED FROM 6 m TO 11 m

DATE: 24 · 9 · 2020 HOURS PER SHIFT:

BOREHOLE COMPLETE: YES/NO

BOREHOLE NO. MW 24 C	DRILLER B THOMPSON ASSISTANT R LOGAN

DESCRIPTION OF STRATA					DEPTH to base of STRATA m
Soft/Firm/ Stiff Loose/Dense	Colour Fine - Coarse Medium	Clayey Silty Sandy etc.	SOIL TYPE	Sand bands Cobbles etc.	
		Start of days drilling			
ROWN SANDS GRAVELS COBBLES					9.7
GREY SANDS LAMINATED CLAY					10.8
DENSE GRAVEL					11m
		End of days drilling			11m

SAMPLES											
No. Type	Pentration m From	Pentration m To	u blows	S.P.T./C.P.T. mms. 0 to 75	75 to 150	150 to 225	225 to 300	300 to 375	375 to 450	450 to 500	
B7	7m										
B8	8m										
B9	9m										
B10	10m										
B11	11m										

REMARKS PULLED CASING MOVED SET UP

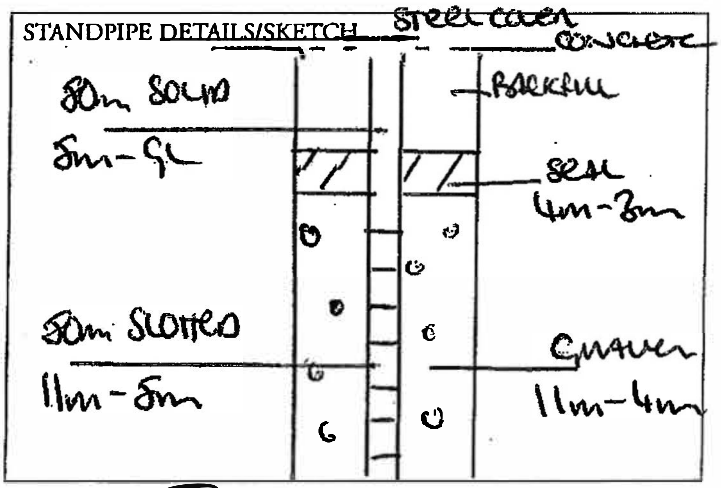
CHISELLING:

Water level at start of day 4.1 m. below G.L.

Water level at end of day m.

	1st Strike	2nd Strike	3rd Strike
Water Strike at			
ater level after 20 mins.			
Was water sealed?	YES/NO	YES/NO	YES/NO
Depth sealed?			

STANDPIPE DETAILS/SKETCH



Signed - Engineer for client

Signed:

IRISH DRILLING LTD., LOUGHREA, CO. GALWAY.

CABLE PERCUSSIVE LOG SHEET

SITE: SLIGO QUARRY

RIG: DANDO 2000

CASED FROM GL m TO 7 m

BORED FROM GL m TO 7 m

DATE: 24·9·2020 HOURS PER SHIFT:

BOREHOLE COMPLETE: ~~YES~~/NO

BOREHOLE NO. MW25	DRILLER B.THOMPSON ASSISTANT R.LOSERS

DESCRIPTION OF STRATA					DEPTH to base of STRATA m
Soft/Firm/Stiff Loose/Dense	Colour Fine - Coarse Medium	Clayey Silty Sandy etc.	SOIL TYPE	Sand bands Cobbles etc.	
		Start of days drilling			
COMPACT LIMESTONE FILL					1·1
FINE BROWN SANDS (BECOMING VERY WET @ 4·8m)					7m
		End of days drilling			7

SAMPLES										
No. Type	Pentration m From	To	u blows	S.P.T./C.P.T. mms. 0 to 75	75 to 150	150 to 225	225 to 300	300 to 375	375 to 450	450 to 500
B1	1m									
B2	2m									
B3	3m									
B4	4m									
B5	5m									
B6	6m									
B7	7m									

REMARKS

CHISELLING: 1hr 0·3-0·8

Water level at start of day ________ m. below G.L.

Water level at end of day ________ m.

	1st Strike	2nd Strike	3rd Strike
Water Strike at			
Water level after 20 mins.			
Was water sealed?	YES/NO	YES/NO	YES/NO
Depth sealed?			

STANDPIPE DETAILS/SKETCH

Signed - Engineer for client ________

Signed:

IRISH DRILLING LTD., LOUGHREA, CO. GALWAY.

CABLE PERCUSSIVE LOG SHEET

SITE: SLIGO QUARRY

DATE: 25 · 9 · 2020

HOURS PER SHIFT:

RIG: DANDO 2000

BOREHOLE COMPLETE: ~~YES~~/NO

CASED FROM 7 m TO 11.5 m

BORED FROM 7 m TO 11.5 m

BOREHOLE NO. MW25

DRILLER B. THOMPSON

ASSISTANT R. LOSEVS

DESCRIPTION OF STRATA					DEPTH to base of STRATA m
Soft/Firm/ Stiff Loose/Dense	Colour Fine - Coarse Medium	Clayey Silty Sandy etc.	SOIL TYPE	Sand bands Cobbles etc.	
		Start of days drilling			
ne BROWN SANDS					7m
GREY BROWN SANDY CLAYS					7-9
FINE GREY SANDS					10·50
FINE GREY SANDS SMALL GRAVEL					11.50
		End of days drilling			11·5

SAMPLES										
No. Type	Pentration m From	To	u blows	S.P.T./C.P.T. 0 to 75	75 to 150	150 to 225	225 to 300	300 to 375	375 to 450	mms. 450 to 500
B8	8m									
B9	9m									
B10	10m									
B11	11m									

REMARKS PULLED CASING LOADED ALL EQUIPMENT TRAVELLED TO N4 COLLONEY SITE.

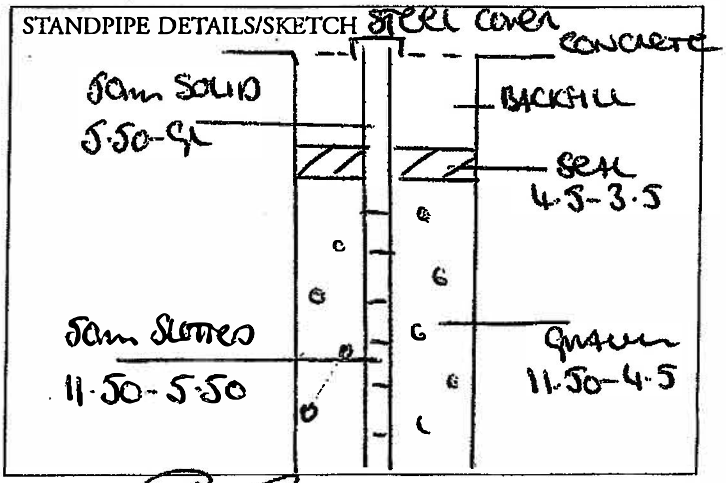
CHISELLING:

Water level at start of day 4·5 m. below G.L.

Water level at end of day m.

	1st Strike	2nd Strike	3rd Strike
Water Strike at			
er level after 20 mins.			
Was water sealed?	YES/NO	YES/NO	YES/NO
Depth sealed?			

STANDPIPE DETAILS/SKETCH



Signed - Engineer for client

Signed:

APPENDIX 7-5 BIOLOGICAL ASSESSMENT REPORTS (TMS ENVIRONMENT LTD)

tms environment ltd

Specialists in laboratory analysis,
monitoring and
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TMS Environment Ltd
53 Broomhill Drive
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Dublin 24

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BIOLOGICAL ASSESSMENT OF SURFACE WATER QUALITY

FOR

LAGAN MATERIALS LTD
AGHAMORE
CO. SLIGO

Report Ref. 27815
TMS Environment Ltd
Issued: 30 October 2020

Prepared by: Nick Owen
Senior Environmental Scientist

Approved by: Craig O'Connor

Craig O'Connor
Senior Consultant

CONTENTS **Page**

APPENDICES

1.0 Introduction

TMS Environment Ltd has been requested by Lagan Materials Ltd to carry out a biological assessment of surface water quality in the vicinity of a discharge to surface water from their quarry at Aghamore, Co. Sligo.

The survey was conducted on 29 September 2020 by TMS Environment Ltd personnel. Samples were taken from both upstream and downstream of the discharge in accordance with the EPA Q-Rating Methodology and European Communities Environmental Objectives (Surface Waters) Regulations 2009 S.I. No. 272 of 2009.

2.0 Methodology

2.1 Monitoring Locations

Assessments were performed in the Aghamore Stream at a location upstream of the effluent discharge, adjacent to a culvert (SW1 – 54.234914, -8.451404). Sampling was also carried out at a location approximately 60 metres downstream of the effluent discharge (SW2 – 54.235660, -8.451522). The locations of the macroinvertebrate surveys are illustrated in Figure 1.

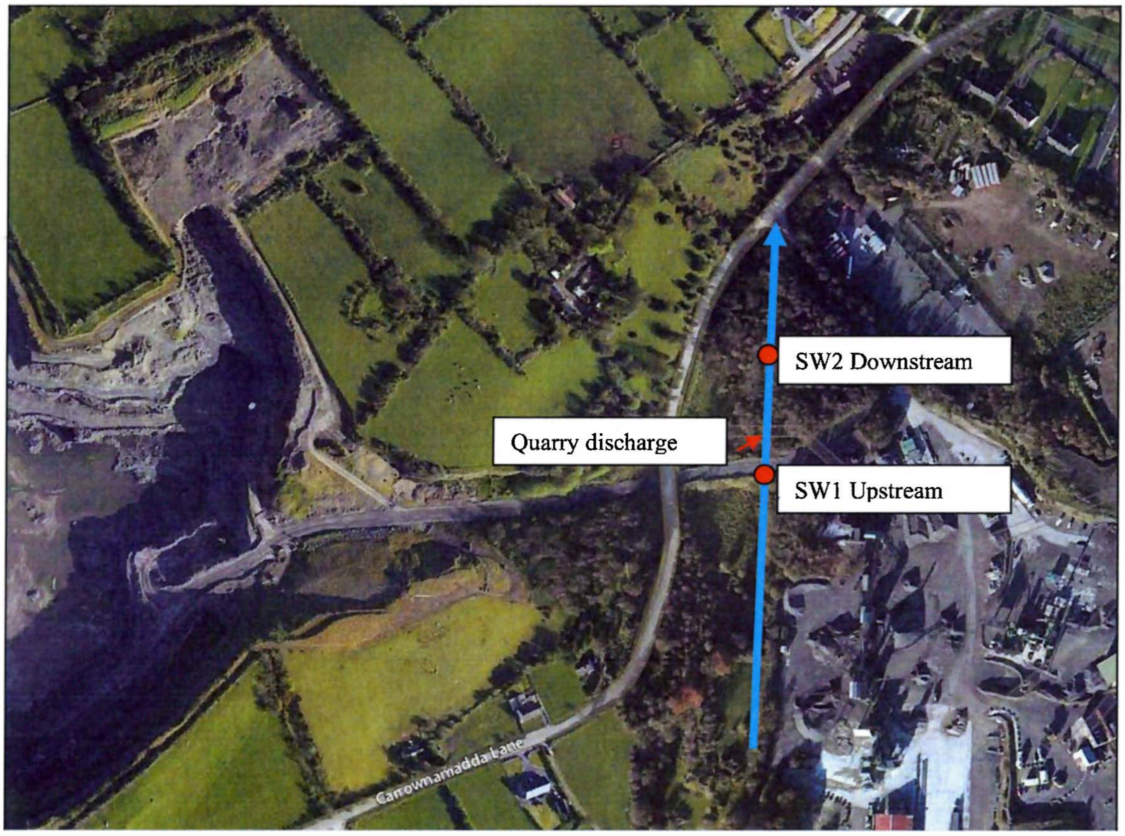

Figure 1: Location of biological assessments (SW1 and SW2) and effluent discharge, along the Aghamore Stream (denoted by blue arrow, indicating direction of flow).

The assessment locations chosen were selected on the basis of providing suitable locations to provide an adequate amount of benthic invertebrate specimens for assessment, as well as having reasonably comparable physical characteristics (substrate type, flow regime) to enable as close as possible a direct comparison between the upstream and downstream assemblages.

2.2 Sampling & Assessment

The water quality assessment was undertaken using the benthic macroinvertebrates as bioindicators. These are an excellent tool for water quality assessment as they exhibit differential responses to physical and chemical changes in their environment. Some macroinvertebrates are sensitive to pollution while others are tolerant. They provide a realistic record of the prevailing water quality conditions.

A range of physical (average depth and width, mesohabitat type and substrate composition) and chemical characteristics (dissolved oxygen, temperature, conductivity and pH) were determined on site using hand-held meters.

Two-minute kick samples and one minute stone wash samples were taken at each monitoring location. The sample nets were emptied and rinsed into a sorting tray for analysis. All macro-invertebrate specimens were isolated and identified to family or genus level in the field. Where individuals were not identifiable in the field, biological samples were taken and preserved in 70% alcohol solutions. These samples were brought to the laboratory of TMS Environment Ltd for analysis under a light microscope.

Identification of specimens was carried out to the level required for the EPA Q-Rating methodology (McGarrigle *et al.*, 2002). Based on the relative abundance of each indicator group, a biotic index (Q Value) was determined in accordance with Tables 2 to 5 and the biological assessment procedure used by the Environmental Protection Agency (McGarrigle *et al.*, 2002) and European Communities Environmental Objectives (Surface Waters) Regulations 2009 S.I. No. 272 of 2009.

3.0 Results

The sampling sites were relatively moderate flowing, clean and with little in-stream vegetation and similar water chemistries. These elements are summarised in Tables 1 and 2. The assemblages and Q-values applied are presented in Tables 3-5, with the basis for the Q-values applied included in Appendix I.

Location	Width (m)	Depth (cm)	Substrate	In-stream vegetation	Flow conditions
SW1	1.7	0.31	Gravel, sand, cobbles	None	Shallow, moderate exit slope
SW2	2.2	0.37	Gravel, cobbles, sand	None	Shallow, moderate riffle

Table 1. Physical characteristics of the two monitoring locations at the time of sampling.

Location	Temp. (°C)	DO (mg/l)	pH	EC (µS/cm @25°c)	BOD (mg/l)	Orthophos-phate (mg/l)	Total Phosphorus (mg/l)
SW1	13.6	9.20	7.18	97	1	0.02	<0.12
SW2	13.4	9.41	7.58	196	1	0.02	0.21

Table 2. Chemical characteristics of the two monitoring locations at the time of sampling.

Order / Group	Family	Genus	Q rating	SW1	SW2
Crustacea	Gammaridae	*Gammarus*	C	57	120
Trichoptera	Hydropsychidae	Indet.	C	15	5
	Rhyacophylidae	Indet.	C	10	0
Ephemeroptera	Baetidae	Indet.	B	8	0
	Heptageniidae	Indet.	A	5	6
Mollusca	Hyrobiidae	*Potamopyrgus*	C	16	12
	Lymnaeidae	Indet.	C	12	10
Hirudinea	Indet.	Indet.	C	3	1
Diptera	Simuliidae	Indet.	C	5	1
Oligochaeta	Indet.	Indet.	E	7	0

Table 3. Benthic invertebrate specimens determined for each sampling location. Indet. denotes indetermined.

Q-Value grouping	SW1	SW2
Total abundance	**138**	**155**
A	**5**	**6**
B	**8**	**0**
C	**118**	**149**
D	**0**	**0**
E	**7**	**0**
Percentage		
A	**3.6**	**3.9**
B	**5.8**	**0**
C	**85.5**	**96.1**
D	**0**	**0**
E	**5.1**	**0**
Number of Taxa		
A	**1**	**1**
B	**1**	**0**
C	**7**	**6**
D	**0**	**0**
E	**1**	**0**
Q-Rating	**3-4**	**3-4**

Table 4. The representation of each invertebrate group as separated by the Q-value system in each of the sampling sites, with assigned Q-rating at the bottom.

Biotic Index	Quality Status
Q5	Unpolluted Waters
Q4-5	
Q4	
Q3-4	Slightly Polluted Waters
Q3	Moderately Polluted Waters
Q2-3	
Q2	Seriously Polluted Waters
Q1-2	
Q1	

Table 5. Quality Standards for Rivers.

4.0 Discussion

Both of the substrates were relatively clean with cobble and coarse gravel available for invertebrates. Sites did have minor accumulations of fine sand and sediments and very few boulders were present. Flow velocity is slightly higher at the downstream location relative to the upstream site. Oxygen levels were within normal ranges (80-120%) for both locations.

The results of the macroinvertebrate surveys indicate a Q Value of 3-4, slightly polluted water (Table 5) at both SW1 and SW2. The assemblage upstream is slightly more diverse, but of a lower abundance than that observed downstream, but these variations are not significant enough to affect the Q-values applied. Specimens of the genus *Gammarus* are by far the most common organisms present, followed by Molluscs (Gastropods) and Trichopterids (Caddis flies).

The Q Value is the same upstream and downstream of the effluent discharge, therefore it can be inferred that the emissions from the quarry are not having a deleterious effect on the macroinvertebrate fauna in the Aghamore Stream. There is a slight difference in water chemistry, with the upstream site recording a slightly lower conductivity, pH, dissolved oxygen and Total Phosphorus relative to the downstream location. However, these differences do not appear to be having a significant impact on the macroinvertebrate faunal assemblage.

5.0 Conclusions

- The results of the macroinvertebrate surveys for this year (September 2020) indicate a Q Value of 3-4 for both the upstream monitoring location (SW1) and the downstream monitoring location (SW2) on the Aghamore Stream;

- As the Q Value is the same upstream and downstream of the quarry discharge, it is concluded that the discharge is not having a deleterious effect on the biological quality of the stream.

APPENDIX I

Criteria for Q-Value Application

Macroinvertebrates grouped according to their sensitivity to organic pollution

TAXA	**Group A**	**Group B**	**Group C**	**Group D**	**Group E**
	Sensitive	*Less Sensitive*	*Tolerant*	*Very Tolerant*	*Most Tolerant*
Plecoptera	All except *Leuctra* spp.	*Leuctra* spp.			
Ephemeroptera	Heptagenlidae Siphlonuridae *Ephemera danica*	Baetidae (excl. *Baetis rhodani*) Leptophlebidae	*Baetis rhodani* Caenidae Ephemerellidae		
Trichoptera		Cased spp.	Uncased spp.		
Odonata		All taxa			
Megaloptera				Sialidae	
Hemiptera		*Aphelocheirus aestivalis*	All except *A. aestivalis*		
Coleoptera			Coleoptera		
Diptera			Chironomidae (excl. *Chironomus* spp.) Simuliidae, Tipulidae		*Chironomus* spp. *Eristalis* sp.
Hydracarina			Hydracarina		
Crustacea			*Gammarus* spp. *Austropotamobius pallipes*	*Asellus* spp. *Crangonyx* spp.	
Gastropoda			Gastropoda (excl. *Lymnaea peregra* & *Physa* sp.)	*Lymnaea peregra* *Physa* sp.	
Lamellibranchiata	*Margaritifera margaritifera*		*Anodonta* spp.	Sphaeriidae	
Hirudinea			*Piscicola* sp.	All except *Piscicola* sp.	
Oligochaeta					Tubificidae
Platyhelminthes			All		

Biological Assessment of Water Quality in Eroding Reaches (Riffles & Glides) of Rivers and Streams*

Biotic Indices (Q Values) and typical associated macroinvertebrate community structure. See overleaf for details of the Faunal Groups.

Macroinvertebrate Faunal Groups**	Q5	Q4	Q3-4	Q3	Q2	Q1
Group A	At least 3 taxa well represented	At least 1 taxon in reasonable numbers	At least 1 taxon Few - Common	Absent	Absent	Absent
Group B	Few to Numerous	Few to Numerous	Few/Absent to Numerous	Few/Absent	Absent	Absent
Group C	Few	Common to Numerous *Baetis rhodani* often Abundant Others: never Excessive	Common to Excessive (usually Dominant or Excessive)	Dominant to Excessive	Few or Absent	Absent
Group D	Few or Absent	Few or Absent	Few/Absent to Common	Few/Absent to Common	Dominant to Excessive	Few or Absent
Group E	Few or Absent	Few or Absent	Few or Absent	Few or Absent	Few / Absent to Common	Dominant
Additional Qualifying Criteria						
***Cladophora* spp. Abundance**	Trace only or None	Moderate growths (if present)	May be Abundant to Excessive growths	May be Excessive growths	Few or Absent	None
Macrophytes (Typical abundance)	Normal growths or absent	Enhanced growths	May be Luxuriant growths	May be Excessive growths	Absent to Abundant	Present/Absent
Slime Growths (Sewage Fungus)	Never	Never	Trace or None	May be Abundant	May be Abundant	None
Dissolved Oxygen Saturation	Close to 100% at all times	80% - 120%	Fluctuates from < 80% to >120%	Very unstable. Potential fish-kills	Low (but > 20%)	Very low, sometimes zero
Substratum Siltation	None	May be light	May be light	May be considerable	Usually heavy	Usually very heavy and anaerobic

Note occurrence/abundance of groups in above table refers to <u>some</u> but not necessarily <u>all</u> of the constituents of the group. The Additional Qualifying Criteria apply in virtually all circumstances. Single specimens may be ignored. Seasonal and other relevant factors (i.e., drought, floods) must be taken into account.

* Macroinvertebrate criteria do not apply to rivers with mud, bedrock or sand substrata, very sluggish or torrential flow, head-water or high altitude streams and those affected by significant ground water input, excessive calcification, drainage, canalisation, culverting, marked shading etc.

** See Further Observations overleaf.

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monitoring and
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Web: www.tmsenv.ie

BIOLOGICAL ASSESSMENT OF SURFACE WATER QUALITY

FOR

LAGAN MATERIALS LTD
AGHAMORE
CO. SLIGO

Report Ref. 27960
TMS Environment Ltd
Issued: 23 December 2020

Prepared by:	Nick Owen Senior Environmental Scientist
Approved by:	Craig O'Connor Craig O'Connor Senior Consultant

CONTENTS

1.0 Introduction

TMS Environment Ltd has been requested by Lagan Materials Ltd to carry out a biological assessment of surface water quality in the vicinity of their quarry at Aghamore, Co. Sligo.

There is a licenced discharge to surface water from the quarry to the Aghamore Stream (Trade Effluent Discharge Licence DL(W)139). There is also a discharge of surface water runoff from a concrete block yard within the processing area (but outside the proposed development site boundary) to the Aghamore Stream – this connection to the stream will be blocked off when operations recommence. The objective of this assessment is to sample upstream and downstream of both of these locations and identify changes in macroinvertebrate assemblages (if any).

The survey was conducted on 24 November 2020 by TMS Environment Ltd personnel. Samples were taken from both upstream and downstream of the facility in accordance with the EPA Q-Rating Methodology and European Communities Environmental Objectives (Surface Waters) Regulations 2009 S.I. No. 272 of 2009.

2.0 Methodology

2.1 Monitoring Locations

Assessments were performed in the Aghamore Stream at five locations: upstream and downstream of the yard drainage, upstream and downstream of the effluent discharge and at a bridge approximately 150m upstream of Lough Gill. The locations of the macroinvertebrate surveys are illustrated in Figure 1.

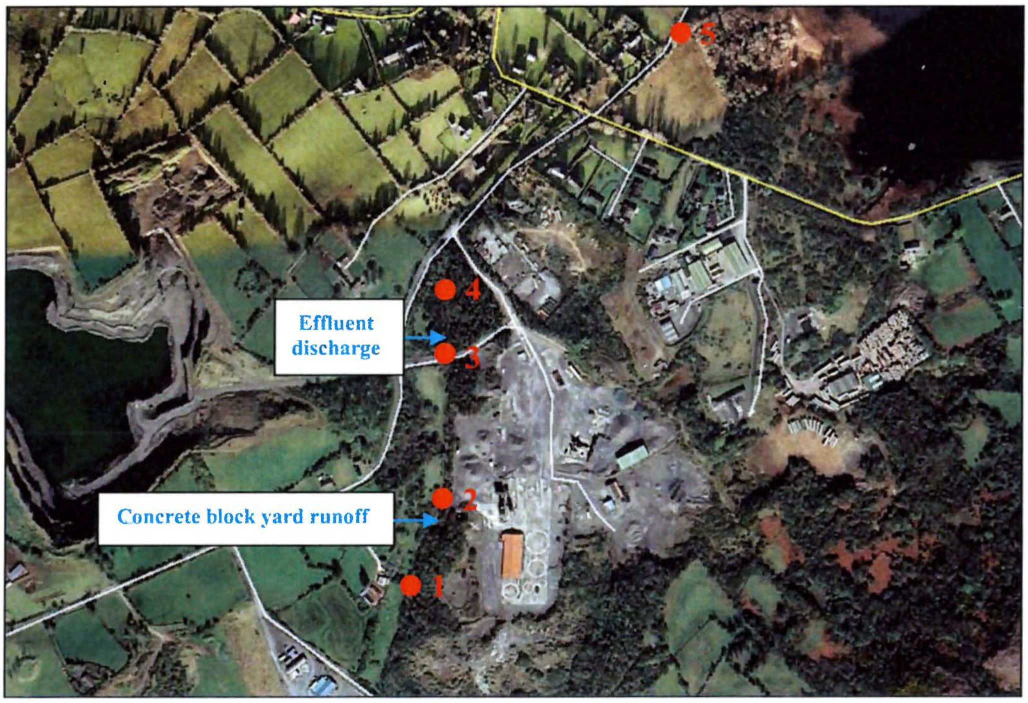

Figure 1: Location of biological assessments, yard drainage area and effluent discharge point, along the Aghamore Stream.

The assessment locations chosen were selected on the basis of providing suitable locations to provide an adequate amount of benthic invertebrate specimens for assessment, as well as having reasonably comparable physical characteristics (substrate type, flow regime) to enable as close as possible a direct comparison between the different meiofaunal assemblages.

Photographs of the selected monitoring locations are presented in Appendix I.

(It is important to note that biological assessments are normally conducted between the months of April – September, assessments conducted during the months October – March may give a less representative lower value due to the limited number of seasonal invertebrates.)

2.2 Sampling & Assessment

The water quality assessment was undertaken using the benthic macroinvertebrates as bioindicators. These are an excellent tool for water quality assessment as they exhibit differential responses to physical and chemical changes in their environment. Some macroinvertebrates are sensitive to pollution while others are tolerant. They provide a realistic record of the prevailing water quality conditions.

A range of physical (average depth and width, mesohabitat type and substrate composition) and chemical characteristics (dissolved oxygen, temperature, conductivity and pH) were determined on site using hand-held meters.

Two-minute kick samples and one-minute stone wash samples were taken at each monitoring location. The sample nets were emptied and rinsed into a sorting tray for analysis. All macro-invertebrate specimens were isolated and identified to family or genus level *in situ*. Where individuals were not identifiable in the field, biological samples were taken and preserved in 70% alcohol solutions. These samples were brought to the laboratory of TMS Environment Ltd for analysis under a light microscope.

Identification of specimens was carried out to the level required for the EPA Q-Rating methodology (McGarrigle *et al.*, 2002). Based on the relative abundance of each indicator group, a biotic index (Q Value) was determined in accordance with Tables 2 to 5 and the biological assessment procedure used by the Environmental Protection Agency (McGarrigle *et al.*, 2002) and European Communities Environmental Objectives (Surface Waters) Regulations 2009 S.I. No. 272 of 2009.

3.0 Results

The sampling sites were relatively moderate flowing, clean and with little in-stream vegetation and similar water chemistries. These elements are summarised in Tables 1-2. The assemblages and Q-values applied are presented in Tables 3-5, with the basis for the Q-values applied included in Appendix II.

Location	Width (m)	Depth (cm)	Substrate	In-stream vegetation	Flow conditions
1	2.7	0.67	Sand, silt gravel	None	Deep, slow flow, run
2	2.4	0.63	Sand, silt gravel	None	Deep, moderate flow, run
3	1.8	0.47	Gravel, sand, cobbles	None	Shallow, moderate exit slope
4	2.4	0.52	Gravel, cobbles, sand	None	Shallow, moderate riffle
5	1.9	0.55	Gravel, cobbles	None	Shallow, fast flow, riffle

Table 1. Physical characteristics of the monitoring locations at the time of sampling.

Location	Temp. (°C)	DO (mg/l)	pH	EC (µS/cm @25°c)	BOD (mg/l)	Orthophos-phate (mg/l)	Total Phosphorus (mg/l)
1	6.1	9.08	7.01	109	1.6	0.02	0.05
2	6.1	9.06	7.03	114	1.5	<0.02	0.02
3	6.3	9.17	7.05	112	1.2	<0.02	0.02
4	6.8	9.97	7.86	237	2.1	<0.02	<0.02
5	6.2	9.28	7.10	142	1.5	<0.02	<0.02

Table 2. Chemical characteristics of the monitoring locations at the time of sampling.

Order / Group	**Family**	**Genus**	**Q value**	**1**	**2**	**3**	**4**	**5**
Crustacea	Gammaridae	*Gammarus*	C	17	48	52	76	59
Trichoptera	Hydropsychidae	Indet.	C	1	6	7	4	8
	Rhyacophylidae	Indet.	C	2	1	0	2	3
Mollusca	Hyrobiidae	*Potamopyrgus*	C	15	6	7	3	11
	Lymnaeidae	Indet.	C	10	6	2	6	10
Hirudinea	Indet.	Indet.	C	5	2	3	1	1
Diptera	Simuliidae	Indet.	C	6	2	3	1	0
Oligochaeta	Indet.	Indet.	E	4	5	9	0	1

Table 3. Benthic invertebrate specimens determined for each monitoring location ('Indet.' denotes indetermined).

Q-Value grouping	**1**	**2**	**3**	**4**	**5**
Total abundance	**60**	**76**	**83**	**93**	**93**
A	**0**	**0**	**0**	**0**	**0**
B	**0**	**0**	**0**	**0**	**0**
C	**56**	**71**	**74**	**93**	**92**
D	**0**	**0**	**0**	**0**	**0**
E	**4**	**5**	**9**	**0**	**1**
Percentage					
A	**0**	**0**	**0**	**0**	**0**
B	**0**	**0**	**0**	**0**	**0**
C	**93**	**93**	**89**	**100**	**99**
D	**0**	**0**	**0**	**0**	**0**
E	**7**	**7**	**11**	**0**	**1**
Number of Taxa					
A	**0**	**0**	**0**	**0**	**0**
B	**0**	**0**	**0**	**0**	**0**
C	**7**	**7**	**6**	**7**	**6**
D	**0**	**0**	**0**	**0**	**0**
E	**1**	**1**	**1**	**0**	**1**
Q-Rating	**Q3**	**Q3**	**Q3**	**Q3**	**Q3**

Table 4. The representation of each invertebrate group as separated by the Q-value system in each of the monitoring locations, with assigned Q-rating at the bottom.

Biotic Index	**Quality Status**
Q5	Unpolluted Waters
Q4-5	
Q4	
Q3-4	Slightly Polluted Waters
Q3	Moderately Polluted Waters
Q2-3	
Q2	Seriously Polluted Waters
Q1-2	
Q1	

Table 5. Quality Standards for Rivers.

4.0 Discussion

All of the substrates were relatively clean with cobbles and / or coarse gravel available for invertebrates. Sites did have minor accumulations of fine sand and sediments and very few boulders were present. Flow velocity is higher at the downstream locations relative to the upstream sites. Oxygen levels were within normal ranges (i.e. >6.5-8mg/l) for all locations.

The results of the macroinvertebrate surveys indicate a Q Value of 3, moderately polluted water (Table 5) at all locations. The assemblages did not vary significantly between sampling locations, specimens of the genus *Gammarus* are by far the most common organisms present, followed by Molluscs (Gastropods) and Trichopterids (Caddis flies). The number of taxa present, and their diversity, is likely to be limited due to the time of year when this survey was conducted and it is probable that a survey conducted during the period April – September would produce Q ratings significantly higher than those obtained from this survey.

The Q Value applied is the same upstream and downstream of the yard drainage and the effluent discharge, therefore it can be inferred that the emissions from the quarry are not having a deleterious effect on the macroinvertebrate fauna in the Aghamore Stream.

There is a slight difference in water chemistry downstream of the effluent discharge, due to the mixing of the quarry discharge with the background stream water, however this does not appear to be having an impact on the macroinvertebrate faunal assemblage.

5.0 Conclusions

- The results of the macroinvertebrate surveys indicate a Q Value of 3 for all five monitoring locations on the Aghamore Stream (November 2020);

- The derived Q Values are most likely artificially lower than if the survey was done during April – September due to the absence of the more ephemeral components of the meiofaunal assemblage, which are unlikely to be present during the winter months;

- The derived Q Values are the same upstream and downstream of the runoff from the concrete block yard entering the stream, as well as the quarry effluent discharge entering the stream, therefore it can be inferred that the emissions from the quarry are not having a deleterious effect on the macroinvertebrate fauna in the Aghamore Stream.

APPENDIX I

Photographs of Monitoring Locations

Monitoring Location 1

Sampling Monitoring Location 1 (24/11/2020)

Monitoring Location 2

Sampling Monitoring Location 2 (24/11/2020)

Monitoring Location 3

Sampling Monitoring Location 3 (24/11/2020)

Monitoring Location 4

Sampling Monitoring Location 4 (24/11/2020)

Monitoring Location 5

Sampling Monitoring Location 5 (24/11/2020)

APPENDIX II

Criteria for Q-Value Application

Macroinvertebrates grouped according to their sensitivity to organic pollution

TAXA	Group A	Group B	Group C	Group D	Group E
	Sensitive	*Less Sensitive*	*Tolerant*	*Very Tolerant*	*Most Tolerant*
Plecoptera	All except *Leuctra* spp.	*Leuctra* spp.			
Ephemeroptera	Heptageniidae Siphlonuridae *Ephemera danica*	Baetidae (excl. *Baetis rhodani*) Leptophlebidae	*Baetis rhodani* Caenidae Ephemerellidae		
Trichoptera		Cased spp.	Uncased spp.		
Odonata		All taxa			
Megaloptera				Sialidae	
Hemiptera		*Aphelocheirus aestivalis*	All except *A. aestivalis*		
Coleoptera			Coleoptera		
Diptera			Chironomidae (excl. *Chironomus* spp.) Simuliidae, Tipulidae		*Chironomus* spp. *Eristalis* sp.
Hydracarina			Hydracarina		
Crustacea			*Gammarus* spp. *Austropotamobius pallipes*	*Asellus* spp. *Crangonyx* spp.	
Gastropoda			Gastropoda (excl. *Lymnaea peregra* & *Physa* sp.)	*Lymnaea peregra* *Physa* sp.	
Lamellibranchiata	*Margaritifera margaritifera*		*Anodonta* spp.	Sphaeriidae	
Hirudinea			*Piscicola* sp.	All except *Piscicola* sp.	
Oligochaeta					Tubificidae
Platyhelminthes			All		

Biological Assessment of Water Quality in Eroding Reaches (Riffles & Glides) of Rivers and Streams*

Biotic Indices (Q Values) and typical associated macroinvertebrate community structure. See overleaf for details of the Faunal Groups.

Macroinvertebrate Faunal Groups**	Q5	Q4	Q3-4	Q3	Q2	Q1
Group A	At least 3 taxa well represented	At least 1 taxon in reasonable numbers	At least 1 taxon Few - Common	Absent	Absent	Absent
Group B	Few to Numerous	Few to Numerous	Few/Absent to Numerous	Few/Absent	Absent	Absent
Group C	Few	Common to Numerous *Baetis rhodani* often Abundant Others: never Excessive	Common to Excessive (usually Dominant or Excessive)	Dominant to Excessive	Few or Absent	Absent
Group D	Few or Absent	Few or Absent	Few/Absent to Common	Few/Absent to Common	Dominant to Excessive	Few or Absent
Group E	Few or Absent	Few or Absent	Few or Absent	Few or Absent	Few / Absent to Common	Dominant
Additional Qualifying Criteria						
***Cladophora* spp. Abundance**	Trace only or None	Moderate growths (if present)	May be Abundant to Excessive growths	May be Excessive growths	Few or Absent	None
Macrophytes (Typical abundance)	Normal growths or absent	Enhanced growths	May be Luxuriant growths	May be Excessive growths	Absent to Abundant	Present/Absent
Slime Growths (Sewage Fungus)	Never	Never	Trace or None	May be Abundant	May be Abundant	None
Dissolved Oxygen Saturation	Close to 100% at all times	80% - 120%	Fluctuates from < 80% to > 120%	Very unstable, potential fish-kills	Low (but > 20%)	Very low, sometimes zero
Substratum Siltation	None	May be light	May be light	May be considerable	Usually heavy	Usually very heavy and anaerobic

Note occurrence/abundance of groups in above table refers to <u>some</u> but not necessarily <u>all</u> of the constituents of the group. The Additional Qualifying Criteria apply in virtually all circumstances. Single specimens may be ignored. Seasonal and other relevant factors (i.e., drought, floods) must be taken into account.

* Macroinvertebrate criteria do not apply to rivers with mud, bedrock or sand substrata, very sluggish or torrential flow, head-water or high altitude streams and those affected by significant ground water input, excessive calcification, drainage, canalisation, culverting, marked shading etc.

** See Further Observations overleaf.

APPENDIX 7-6 GEOPHYSICAL INVESTIGATION REPORT (APEX GEOPHYSICS LTD)

AGP21007_01

Report
on the
Geophysical Investigation
At
Aghamore Near, Co. Sligo
for
Lagan Asphalt

5H February 2021

apex geophysics

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PRIVATE AND CONFIDENTIAL

THE FINDINGS OF THIS REPORT ARE THE RESULT OF A GEOPHYSICAL SURVEY USING NON-INVASIVE SURVEY TECHNIQUES CARRIED OUT AT THE GROUND SURFACE. INTERPRETATIONS CONTAINED IN THIS REPORT ARE DERIVED FROM A KNOWLEDGE OF THE GROUND CONDITIONS, THE GEOPHYSICAL RESPONSES OF GROUND MATERIALS AND THE EXPERIENCE OF THE AUTHOR. APEX GEOPHYSICS LTD. HAS PREPARED THIS REPORT IN LINE WITH BEST CURRENT PRACTICE AND WITH ALL REASONABLE SKILL, CARE AND DILIGENCE IN CONSIDERATION OF THE LIMITS IMPOSED BY THE SURVEY TECHNIQUES USED AND THE RESOURCES DEVOTED TO IT BY AGREEMENT WITH THE CLIENT. THE INTERPRETATIVE BASIS OF THE CONCLUSIONS CONTAINED IN THIS REPORT SHOULD BE TAKEN INTO ACCOUNT IN ANY FUTURE USE OF THIS REPORT.

PROJECT NUMBER	AGP21007		
AUTHOR	**CHECKED**	**REPORT STATUS**	**DATE**
EURGEOL PETER O'CONNOR P.GEO., M.SC (GEOPHYSICS), DIP. EIA MGT.	TONY LOMBARD M.SC (GEOPHYSICS)	V.01	5TH FEBRUARY 2021

CONTENTS

1. EXECUTIVE SUMMARY

APEX Geophysics Limited was requested by Lagan Asphalt to carry out a geophysical investigation at Aghamore Quarry in Co. Sligo. The survey was required to assist in the hydrogeological assessment of the quarry. The objectives of the investigation were to provide information on overburden type and thickness, to map the depth to bedrock and rock type, and to provide information presence of any possible faults, fissures, or karstic zones.

The survey area consists of the existing quarry (Area A) and land to the northeast (Area B). The quarry floor at an elevation of c. 20.8 mOD is currently flooded with an average water depth of 5.4 m. The topography of the land area ranges from 17 to 32 mOD. Part of the land to the northeast has been stripped.

The Geological Survey of Ireland (GSI) 1:100k Bedrock Geology map for the area indicates that the site is underlain by dark fine-grained cherty limestone of the Dartry Limestone Formation. The Teagasc soils map for the area indicates an area of till derived from metamorphic rock. The Dartry Limestone Formation is classified on the GSI map as a 'Regionally Important Aquifer - Karstified (conduit)'. The historical 6 inch sheet for the area shows northeast-southwest striking rock with a dip of 5° to the northwest.

Previous geophysical investigations have been carried out in 2017 and 2019 for resource assessment to the northwest of the quarry have indicated between 0.7 and 3.5 m of overburden over thin weathered limestone, over limestone. No major structural or karst features were apparent on these surveys.

The land based survey to the northeast consisted of EM ground conductivity readings, 4 ERT profiles and 2 seismic refraction profiles. The over water survey in the quarry consisted of 6 ERT profiles.

The geophysical data have outlined thin overburden (0 -2m m) across most of Area B, thickening to 2-5m in local pockets. The data indicate loose predominantly clayey gravel overburden. In the northwest of the Area B the overburden thicknesses increases significantly to at least 15m and data here are indicative of a stiff gravelly clay with cobbles and boulders (Zone 1).

The bedrock in area B has been interpreted as clean thin to medium bedded limestone with an upper weathered layer, over slightly weathered to fresh limestone. At the northwest end of Area B the bedrock resistivity decreases below an elevation of around 10 mOD and similar was observed during the 2019 survey to the west. A transition to more clay mineral rich or shaley limestone may occur at depth in this area (Zone 2). A localised increase in depth to bedrock at around 85m on ERT Profile R1 may be due to a possible karst doline (Point 3).

In Area A rock resistivities are relatively constant at 1500 – 7000 Ohm-m and there are no indications of major weathered zones or structural (fault, fissure) or karst features. No changes in properties with direction of profile were apparent in either Area A or B.

Further investigation should be considered to confirm the nature of the material in Zone 1, to investigate the transition to lower resistivity material in Zone 2 and to investigate the localised feature at point 3.

The geophysical report should be reviewed after the completion of any direct investigation.

2. INTRODUCTION

APEX Geophysics Limited was requested by Lagan Asphalt to carry out a geophysical investigation at Aghamore Quarry in Co. Sligo. The survey was required to assist in the hydrogeological assessment of the quarry. Part of the survey was land based and profiles were also recorded in the currently flooded quarry area.

2.1 Survey Objectives

The objectives of the investigation were to:

- Provide information on overburden type and thickness;
- Map depth to bedrock and rock type;
- Provide information on the presence of any possible faults, fissures, or karstic zones.

2.2 Site Background

The survey area is located in the townland of Aghamore Near which is approximately 2 km south of Sligo town centre (Fig. 2.1). It consists of the existing quarry (Area A - 4.2 ha) and land to the northeast currently in pasture (Area B - 5.1 ha). The quarry floor is currently flooded with the water level at -15.4 mOD at the time of survey and with a water depth of 5.4 m. The topography of the land to the northeast ranges from 17 to 32 mOD. Part of the land to the northeast has been stripped (Fig. 2.2).

Planning permission for the site has previously been awarded but was overturned on appeal. Further information is required on the ground conditions as part of the hydrogeological assessment for a new application.

Figure 2.1. Site location indicated by red boundary.

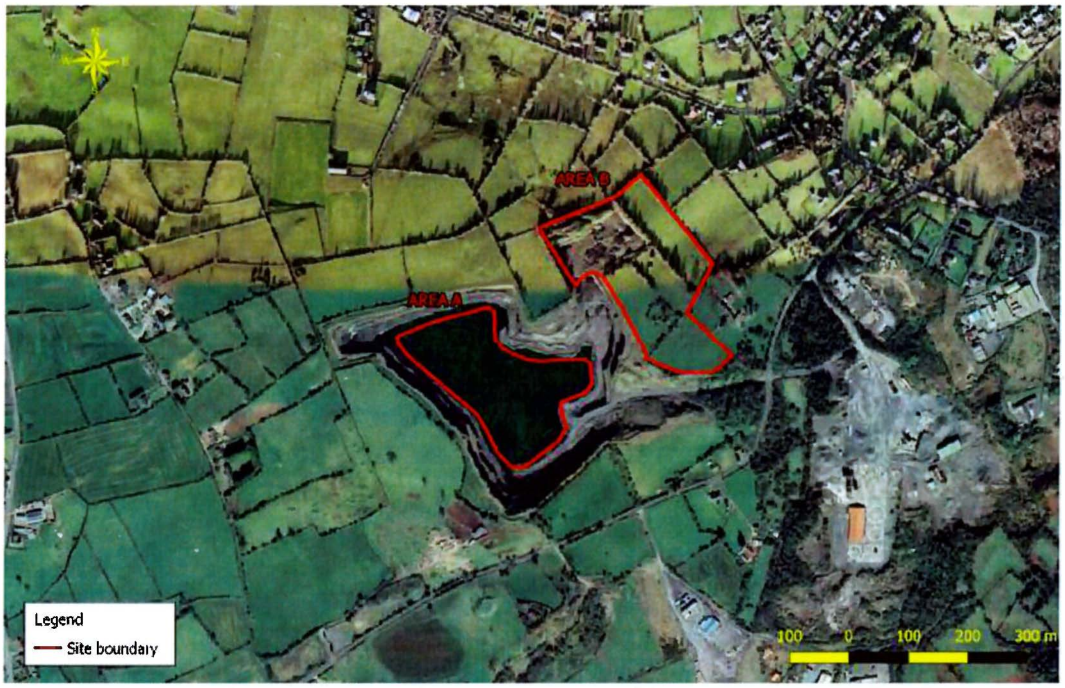

Figure 2.2. Aerial photo of site showing Area A (quarry) and Area B (land).

2.2.1 Geology

The Geological Survey of Ireland (GSI) 1:100k Bedrock Geology map for the area (Figure 2.3) indicates that the site is underlain by dark fine-grained cherty limestone of the Dartry Limestone Formation. The GSI karst database indicates a karst feature (spring) approximately 1200 m to the northeast of the site.

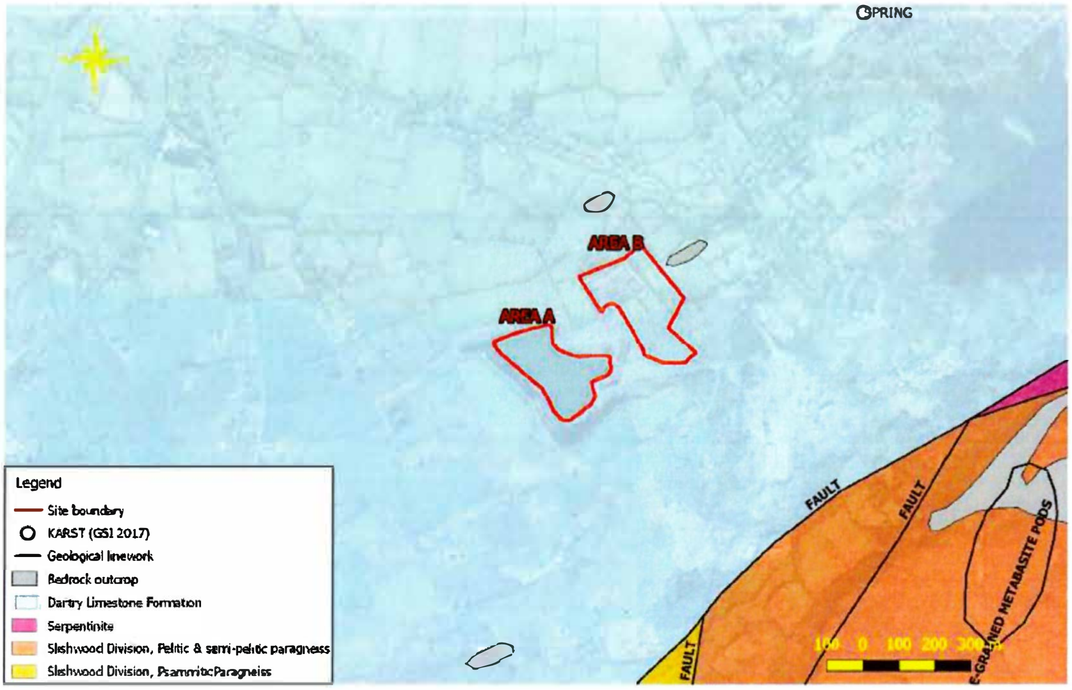

Figure 2.3. Geological map for the survey area (site marked in red).

2.2.2 Soils

The Teagasc soils map for the area (Fig. 2.4) indicates that the site is in an area of till derived from metamorphic rocks with subcropping/outcropping rock to the south and northeast of the site.

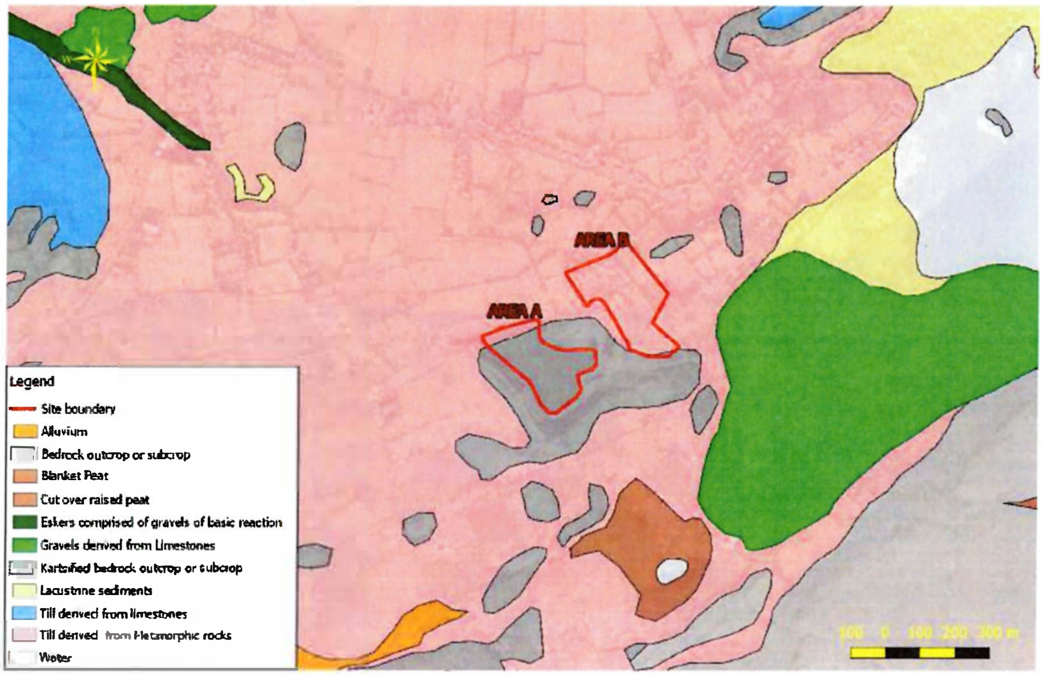

Figure 2.4: Teagasc soil map (site marked in red).

2.2.3 Groundwater

The Dartry Limestone Formation is classified as a 'Regionally Important Aquifer - Karstified (conduit)' (GSI).'

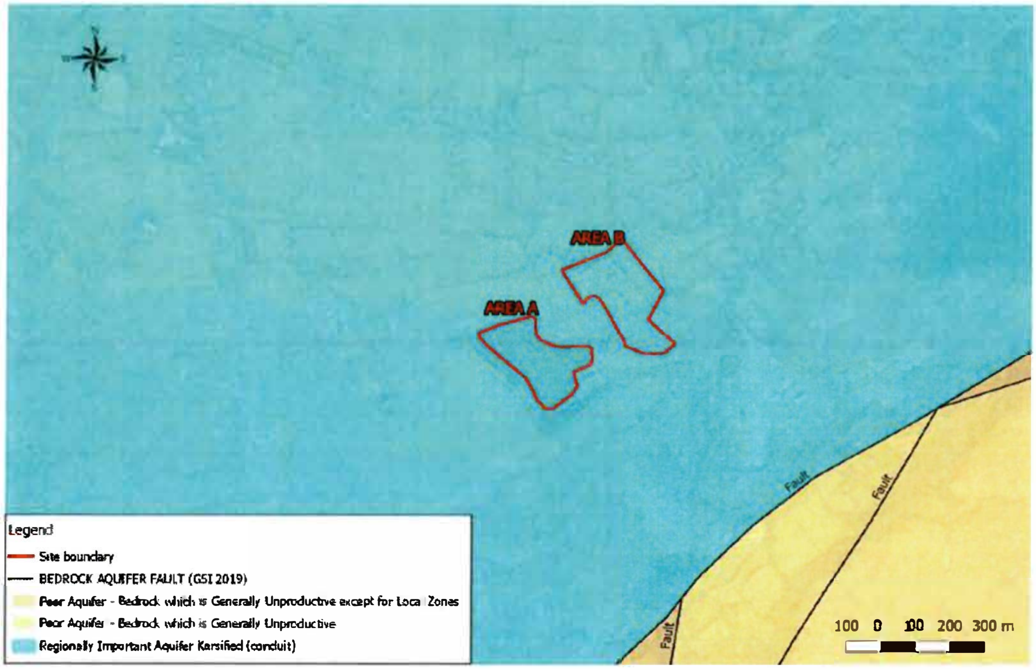

Fig 2.5: Bedrock aquifer (site marked in red).

The groundwater vulnerability rating for the site (Fig. 2.6) is classified as high to rock at surface..

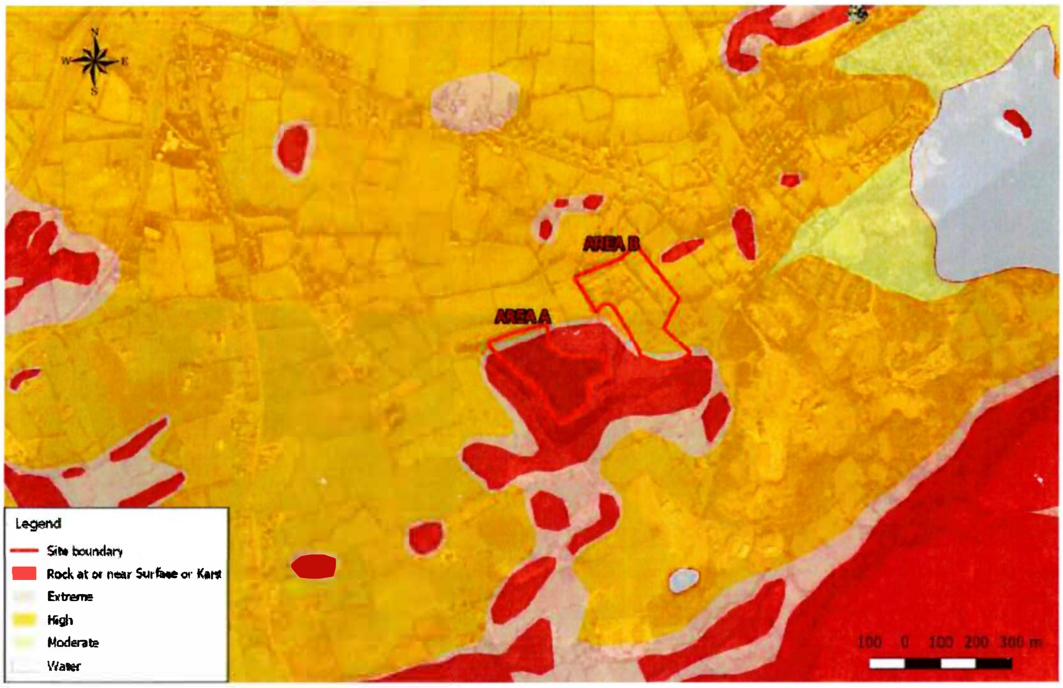

Fig 2.6. Groundwater vulnerability classification for the survey area (site marked in red).

2.2.4 Historical Data

The historical 6 inch sheet (Figure 2.7) for the area shows northeast-southwest striking rock outcropping northeast and north of the site. A geological boundary is shown running between Area A and Area B running approximately north to NNE. A dip of 5° to the northwest is shown. 'Drift' is mapped across the site.

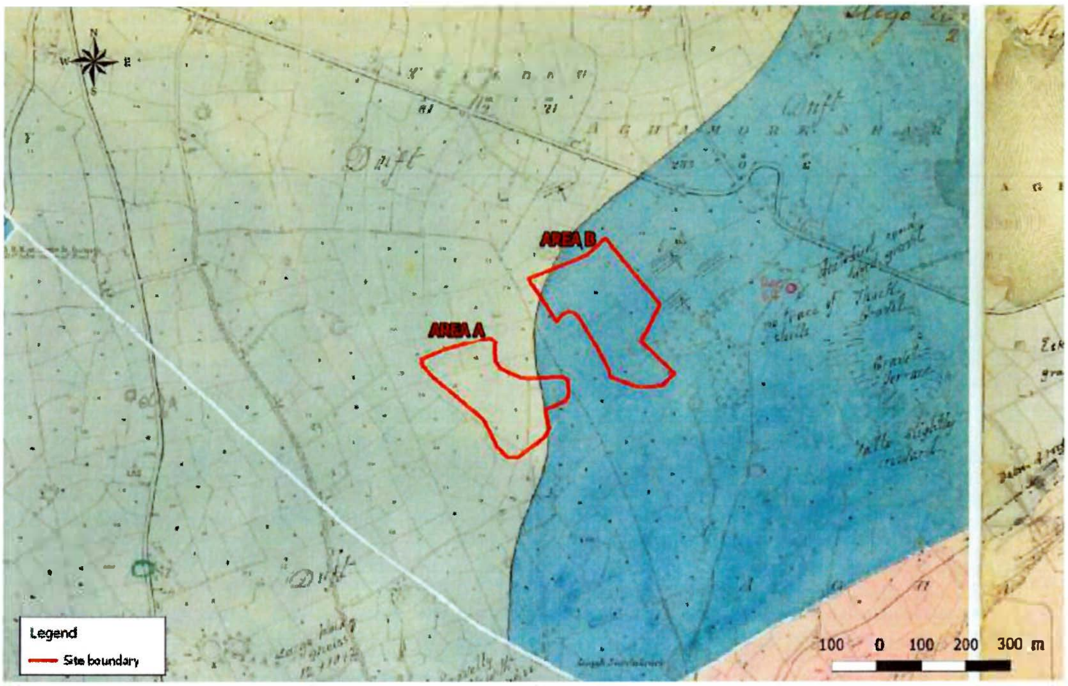

Fig2. 7: The historical 6 inch map(si te marked inred).

2.3 Previous Investigation

Previous geophysical investigations have been carried out in the lands to the northwest of the quarry in 2017 and 2019 (Apex Geoservices Ltd., 2017, 2019). The surveys indicated, between 0.7 and 3.5 m of overburden material over a thin layer of highly to moderately weathered limestone, over slightly weathered to fresh limestone to depths of at least 25m bgl (c. 5 mOD). A decrease in resistivity at around 10 mOD was noted at the eastern end of the 2019 survey.

Some monitoring well and rotary core information was also provided by the client as part of the 2019 survey.

Figure 2.8. Aerial photo of site showing 2017 and 2019 surveys

2.4 Survey Rationale

The investigation consisted of reconnaissance EM ground conductivity mapping with follow-up 2D Electrical Resistivity Tomography (ERT) and Seismic Refraction profiling:

EM ground conductivity mapping operates on the principle of inducing currents in conductive substrata and measuring the resultant secondary electro-magnetic field. The strength of this secondary EM field is calibrated to give apparent ground conductivity in milliSiemens/metre (mS/m). This technique will provide information on the shallow (0-6m below ground level) variation of the superficial deposits and outline the shallow bedrock.

ERT images the resistivity of the materials in the subsurface along a profile to produce a cross-section showing the variation in resistivity with depth, depending on the length of the profile. Each cross--section will be interpreted to determine the material type along the profile at increasing depth, based on the typical resistivities returned for Irish ground materials.

Seismic Refraction profiling measures the velocity of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher seismic velocities while soft, loose or fractured materials have lower velocities. Readings are taken using geophones connected via multi-core cable to a seismograph. This method should allow us to profile the depth to the top of the bedrock, along profiles across the site.

As with all geophysical methods the results are based on indirect readings of the subsurface properties. The effectiveness of the proposed approach will be affected by variations in the ground properties. By combining a number of techniques it is possible to provide a higher quality interpretation and reduce any ambiguities which may otherwise exist. Further information on the detailed methodology of each geophysical method employed in this investigation is given in **APPENDIX A: DETAILED GEOPHYSICAL METHODOLOGY**.

Fig. 2.9 Exposed overburden in the northwest of Area B

Fig. 2.10 Floating electrode ERT survey Area A.

3. RESULTS

The land based survey to the northeast was carried out on the 21st-22nd January 2021 involving the collection of EM ground conductivity readings, 4 ERT profiles and 2 seismic refraction profiles. The over water survey in the quarry was carried out on the 25th - 27th January 2021 and consisted of 6 ERT profiles. Profile locations were laid out as received from SLR/TMS. The Survey locations are indicated on Drawing AGP21007_01 (Appendix C).

3.1 EM Ground Conductivity Mapping

The EM ground conductivity results (Drawing AGP21007_02, Appendix C) are indicative of the bulk conductivity of the ground materials from 0-6.0m bgl. The recorded conductivity values ranged from 0.5 to 10 mS/m and have been generally interpreted in conjunction with the ERT and seismic data as follows:

Conductivity (mS/m)	Interpretation
0.5 - 2.0	Overburden thickness <2m over limestone
2.0 – 3.0	Localised pockets of overburden thickness 2-5 m
3.0 – 10.0	Thick overburden (>5m)

3.2 ERT

Ten ERT Profiles (R1 to R10) have been acquired across the site. The resistivity values have been interpreted on the following basis.

Resistivity (Ohm-m)	Interpretation
20 - 40	WATER column in quarry
150 - 500	Predominantly clayey GRAVEL overburden
50 -250	Gravelly CLAY with cobbles and boulders (Boulder Clay)
250 - 1125	Weathered LIMESTONE (subcrop), possible shaley LIMESTONE at depth
1125-7000	Slightly weathered to fresh LIMESTONE

3.3 Seismic refraction profiling

Two seismic refraction spreads were recorded across the site (S1-S2). The seismic refraction data indicated three velocity layers that have been interpreted on the following basis:

Layer	Seismic Velocity (m/s)	Average Seismic Velocity (m/s)	Interpretation	Stiffness/ Rock Quality
1	200 - 400	300	Overburden	Soft-/Loose
2	1000 -1400	1300	Highly-Moderately Weathered Rock (S1) Gravelly Silty CLAY with cobbles/boulders (S2)	Poor Stiff
3	3100-4200	3700	Slightly Weathered – fresh thinly bedded LIMESTONE	Fair - Good

3.4 Discussion

The ERT results have been interpreted in conjunction with the seismic and EM ground conductivity datasets.

Overburden – Area B

The geophysical data have outlined thin overburden (0 -2m m) across most of Area B, thickening to 2-5m in local pockets in the southwest. The resistivity and seismic values indicate loose predominantly clayey gravel with possible highly weathered/fractured rock at base.

In the northwest of the Area B the overburden thicknesses increases significantly to at least 15m and possibly greater (see Drawing AGP21007_03 and profiles R1, R3 and R4). The resistivity and seismic values here are indicative of a stiff gravelly clay and cobbles and boulders are visible where exposed (Fig. 2.9). This area has been marked **Zone** 1 on Drawing AGP21007_03 and drilling should be considered to confirm the thickness and nature of the sediment fill. Seismic spread S2 indicates a minimum thickness of 15m over possible rock but the rock level may be deeper.

Bedrock – Area B

The bedrock has been interpreted as clean (1125 – 7000 Ohm-m), thin to medium bedded limestone with an upper weathered layer 1-4m thick, over slightly weathered to fresh limestone. Seismic velocities of the bedrock are slightly lower than average at 3000 to 4200 m/s mainly due to the thin-medium bedding and some jointing.

At the northwest end of Area B the bedrock resistivity on profiles R1, R3 and R4 decreases to less than 1000 Ohm-m below a depth of around 10 mOD. This area extends around 50m southeast of Zone 1 and has been marked **Zone 2** on Drawing AGP21007_03. A similar feature was observed at the eastern end of the profiles recorded during the 2019 survey (green dashed line on Drawing AGP21007_03) and may indicate a transition to more clay mineral rich or shaley limestone at depth in this area. Alternatively it may be associated with weathering and clay infill at the edge of the thick sediment filled channel in Zone 1. Investigation to establish the nature of the material in Zone 2 is recommended.

A localised increase in depth to bedrock occurs at around 85m on ERT Profile R1 (marked point **3** on Drawing AGP21007_03) and bedrock seismic velocities in the vicinity are relatively low. This feature should be investigated to check for a possible karst doline (point 3). Resistivity values on R2 which runs approximately E-W are similar to those recorded on NW-SE trending profile R1, R3 and R4 and do not show any major change with direction.

Bedrock – Area A

The bedrock in Area A was investigated using ERT profiles recorded by the floating electrode method. Water level was -15.4 mOD and the average water depth was 5.4 m allowing bedrock resistivity to be measured between -20.8 mOD and – 60 mOD on NW-SE profiles R5, R6 and R7, and between -20.8 mOD and – 50 mOD on NE-SW profiles R8, R9 and R10).

Rock resistivities on both the NW-SE profiles (R5, R6, R7) and the NE-SW profiles (R8, R9 and R10) are relatively constant at 1500 – 7000 Ohm-m and there are no indications of major weathered zones or structural (fault, fissure) or karst features. Some lower values occur immediately beneath the water column but these are mainly due to smoothing of the sharp transition between water and rock, also associated with relaxation and near surface opening of joints on the quarry floor in the upper 1-3m.

4. RECOMMENDATIONS

Further investigation should be considered to:

- Confirm the nature of the material in Zone 1.
- Investigate the transition to lower resistivity material in Zone 2.
- Investigate the localised feature at point 3.

The geophysical report should be reviewed after the completion of any direct investigation.

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APPENDIX A: DETAILED GEOPHYSICAL METHODOLOGY

A combination of geophysical techniques was used to provide a high quality interpretation and reduce any ambiguities, which may otherwise exist.

EM Ground Conductivity Mapping

Principles

This is an electromagnetic technique used to investigate lateral variations in overburden material and to assist with the indication of the depth to bedrock. This method operates on the principle of inducing currents in conductive substrata and measuring the resultant secondary electro-magnetic field. The strength of this secondary EM field is calibrated to give apparent ground conductivity in milliSiemens/metre (mS/m). Readings over material such as organic waste and peat give high conductivity values while readings over dry materials with low clay mineral content such as gravels, limestone or quartzite give low readings. The EM31 survey technique determines the apparent conductivity of the different overburden layers from 0-6m bgl depending on the dipole mode used.

Data collection

The EM31 equipment used was a GF CMD-4 conductivity meter equipped with data logger. This instrument features a real time graphic display of the previous 20 measurement points to monitor data quality and results. Conductivity and in-phase values were recorded across the site. Local conditions and variations were recorded.

Data processing

The conductivity and in-phase field readings were downloaded, contoured and plotted using the SURFER 12 program (Golden Software, 2015). Data which was affected by metallic objects was removed. Assignation of material types and possible anomaly sources was carried out, with cross-reference to other data.

Electrical Resistivity Tomography (ERT)

Electrical Resistivity Tomography was carried out to provide information on lateral variations in the overburden material as well as on the underlying overburden and bedrock.

Principles

This surveying technique makes use of the Wenner resistivity array. The 2D-resistivity profiling method records a large number of resistivity readings in order to map lateral and vertical changes in material types. This method involves the use of electrodes connected to a resistivity meter, using computer software to control the process of data collection and storage.

Data Collection

Profiles were recorded using a Tigre resistivity meter, imaging software, two 32 takeout multicore cables and up to 64 stainless steel electrodes. Saline solution was used at the electrode/ground interface in order to gain a good electrical contact required for the technique to work effectively. The recorded data were processed and viewed immediately after surveying.

For the overwater survey floating electrodes were used with the cable anchored at either end of the line. Water depths were taken at intervals along each line.

Data Processing

The field readings were stored in computer files and inverted using the RES2DINV package (Geotomo Software, 2006) with up to 5 iterations of the measured data carried out for each profile to obtain a 2D-depth model of the resistivities. The overwater resistivity data was inverted using the standard smooth inversion with some damping of the rock resistivity values.

The inverted 2D resistivity models and corresponding interpreted geology are displayed on the accompanying drawings alongside the processed seismic sections. Profiles have been contoured using the same contour intervals and colour codes. Distance is indicated along the horizontal axis of the profiles.

Seismic Refraction Profiling

Principles

This method measures the velocity of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher seismic velocities while soft, loose or fractured materials have lower velocities.

Seismic profiling measures the p-wave velocity (Vp) of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher Vp velocities while soft, loose or fractured materials have lower Vp velocities. Readings are taken using geophones connected via multi-core cable to a seismograph.

Data Collection

A Geode high resolution 24 channel digital seismograph, 24 10HZ vertical geophones and a 10 kg hammer were used to provide first break information, with a 24 take-out cable. Equipment was carried and operated by a two-person crew.

Readings are taken using geophones connected via multi-core cable to a seismograph. The depth of resolution of soil/bedrock boundaries is determined by the length of the seismic spread, typically the depth of resolution is about one third the length of the profile (eg. 69m profile ~23m depth, 33m profile ~ 11m depth).

Data Processing

First break picking in digital format was carried out using the FIRSTPIX software program to construct p-wave (Vp) traveltime plots for each spread. Velocity phases were selected from these plots using the GREMIX software program and were used to calculate the thickness of individual velocity units. Topographic data were input. Material types were assigned and estimation made of material properties. The processed seismic data are displayed in Appendix A.

GREMIX interprets seismic refraction data as a laterally varying layered earth structure. It incorporates the slope-intercept method, parts of the Plus-Minus Method of Hagedoorn (1959), Time-Delay Method, and features the Generalized Reciprocal Method (GRM) of Palmer (1980). Up to four layers can be mapped; one deduced from direct arrivals and three deduced from refractions. Phantoming of all possible travel time pairs can be carried out by adjusting reciprocal times of off shots.

Approximate errors for Vp velocities are estimated to be +/- 10%. Errors for the calculated layer thicknesses are of the order of +/-20%. Possible errors due to the "hidden layer" and "velocity inversion" effects may also occur (Soske, 1959).

Spatial Relocation

All the geophysical investigation locations were acquired using a Trimble Geo 7X high-accuracy GNSS handheld system using the settings listed below. This system allows collection of GPS data with c.20mm accuracy.

Projection:	Irish Transverse Mercator
Datum:	Ordnance
Coordinate units:	Meters
Altitude units:	Meters
Survey altitude reference:	MSL
Geoid model:	Republic of Ireland

Water depths were measured by the sonar depth monitor on the survey boat and confirmed by manual depth sounding. The surface water level was measured using the GPS. Water depths average around 5.4 m apart from some localised areas where water depths were up to 1m shallower.

APPENDIX B: SEISMIC PLATES

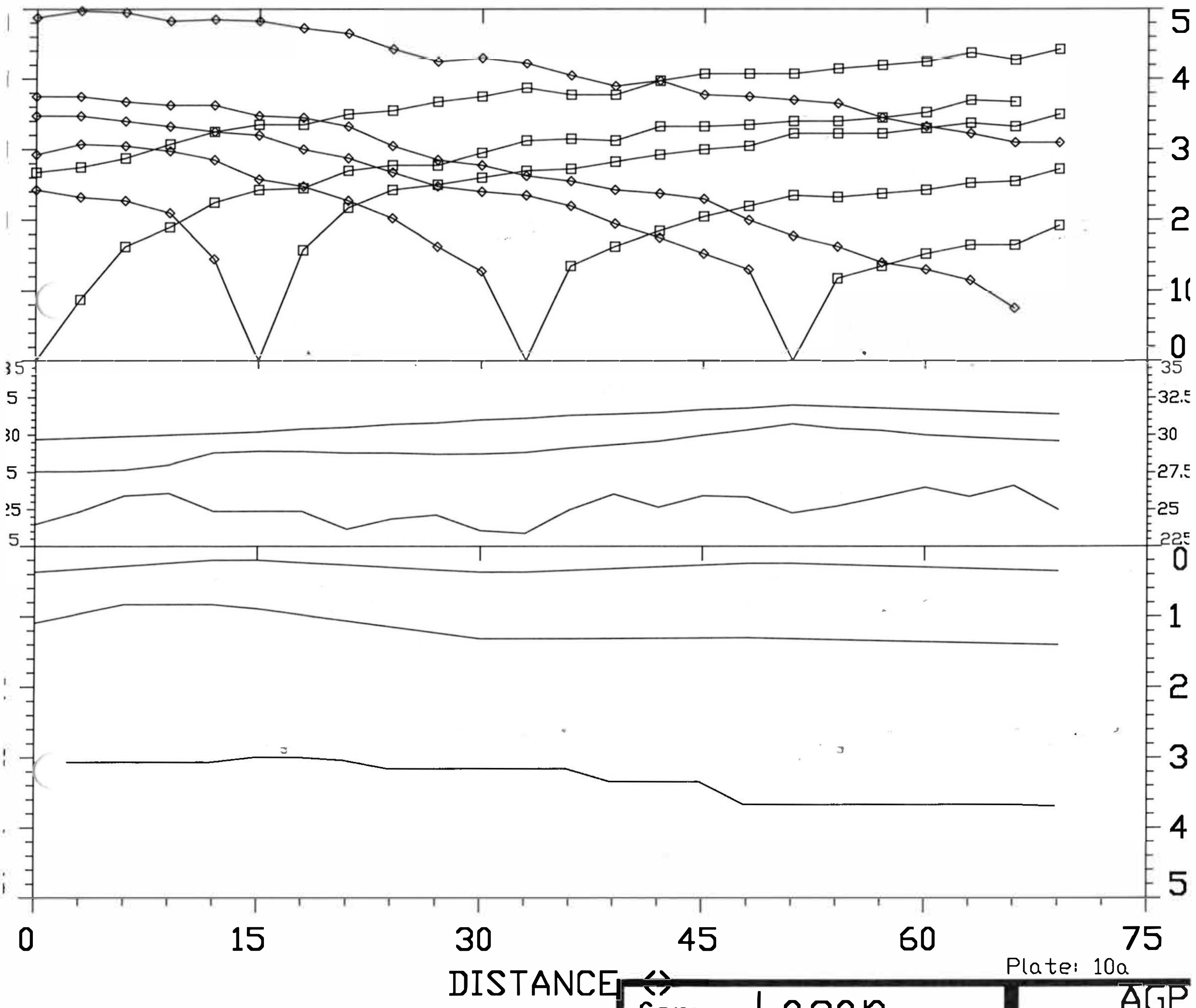

Plate: 10a

for: Lagan

by: APEX Geophysics Ltd.

Data SetS1	Date: 22\01\21
Equipment: Geode	Spread: S1

AGP

Sli

SL

Azir

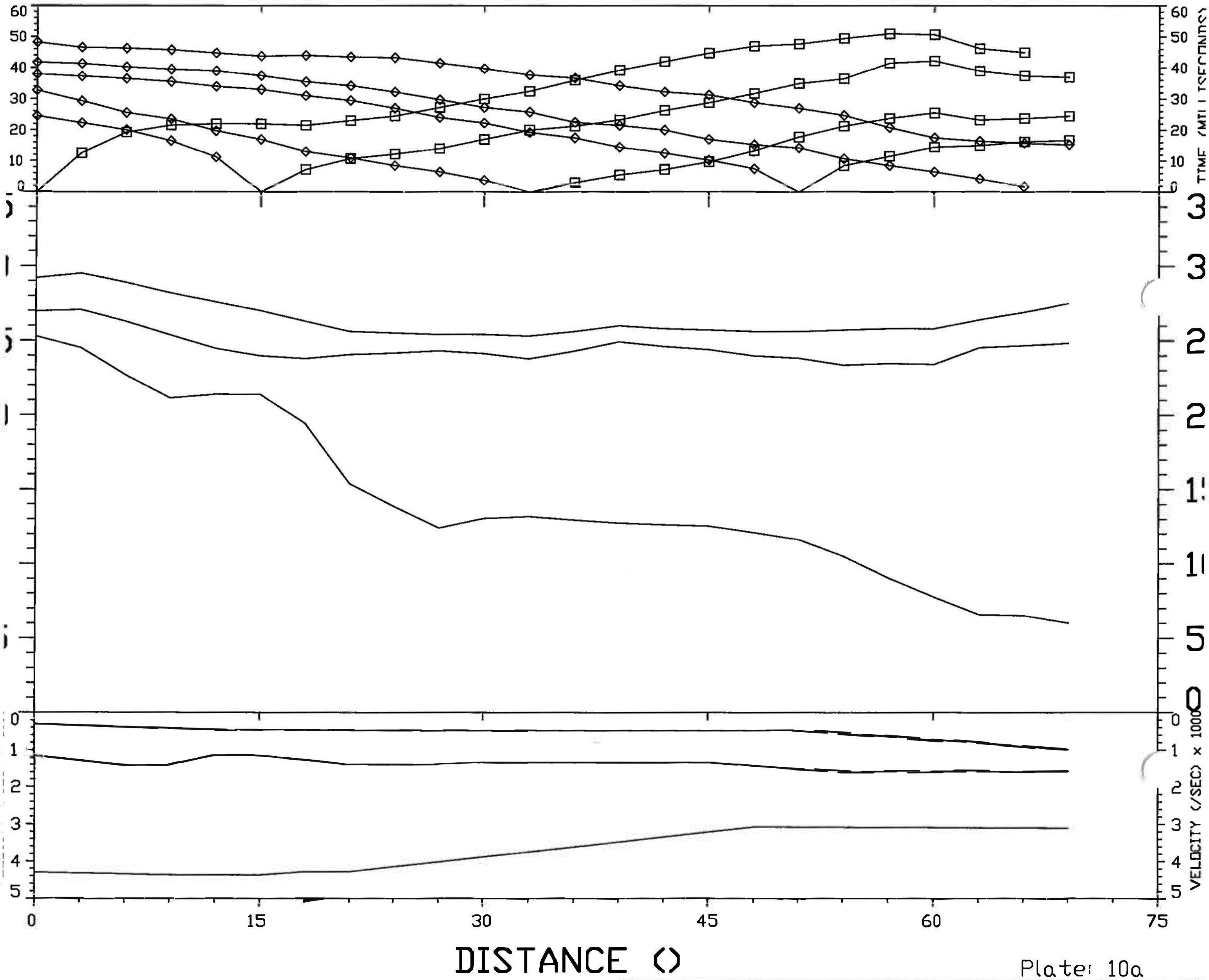

Plate: 10a

for: Lagan		AGP
by: APEX Geophysics Ltd.		Sli SL
Data SetS2	Date: 22\01\21	
Equipment: Geode	Spread: S2	Azir

APPENDIX C: DRAWINGS

The information derived from the geophysical investigation is presented in the following drawings:

AGP21007_01	Geophysical Survey Locations	1:4000	@ A4
AGP21007_02	EM Conductivity Contours (mS/m)	1:4000	@ A4
AGP21007_03	Summary Interpretation Map	1:4000	@ A4
AGP21007_R1	Results & Interpretation – ERT Profile R1 and seismic Profiles S1 and S2	1:1500	@ A4
AGP21007_R2	Results & Interpretation – ERT Profile R2	1: 1500	@ A4
AGP21007_R3	Results & Interpretation – ERT Profile R3	1: 1500	@ A4
AGP21007_R4	Results & Interpretation – ERT Profile R4	1: 1500	@ A4
AGP21007_R5	Results & Interpretation – ERT Profile R5	1: 1500	@ A4
AGP21007_R6	Results & Interpretation – ERT Profile R6	1: 1500	@ A4
AGP21007_R7	Results & Interpretation – ERT Profile R7	1: 1500	@ A4
AGP21007_R8	Results & Interpretation – ERT Profile R8	1: 1500	@ A4
AGP21007_R9	Results & Interpretation – ERT Profile R9	1: 1500	@ A4
AGP21007_R10	Results & Interpretation – ERT Profile R10	1: 1500	@ A4

:ATIONS

INDEX MAP:

LEGE ND:

🟪

R1

S1

🟨

R1

S1

R1

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PROJECT: AGI
GE(

CLIENT: LAG

DRAWING NO: AGI

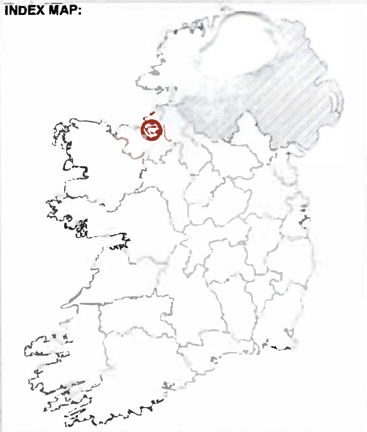
SCALE: AS

DATE: 05-(

Version:	Date:
No	05-0

GEOPHYSIC SURVEY LOCATIONS
SCALE 1:40

INDEX MAP:



LEGEND:

▭ Site
· EM conductivity/gravity station
R1 — 2D resistivity profile - 2021
S1 — Seismic refraction profile - 2021
▭ Previous Surveys
R1 — 2D resistivity profile - 2019
S1 — Seismic refraction profile - 2019
— 2D resistivity profile - 2017
— Seismic refraction profile - 2017

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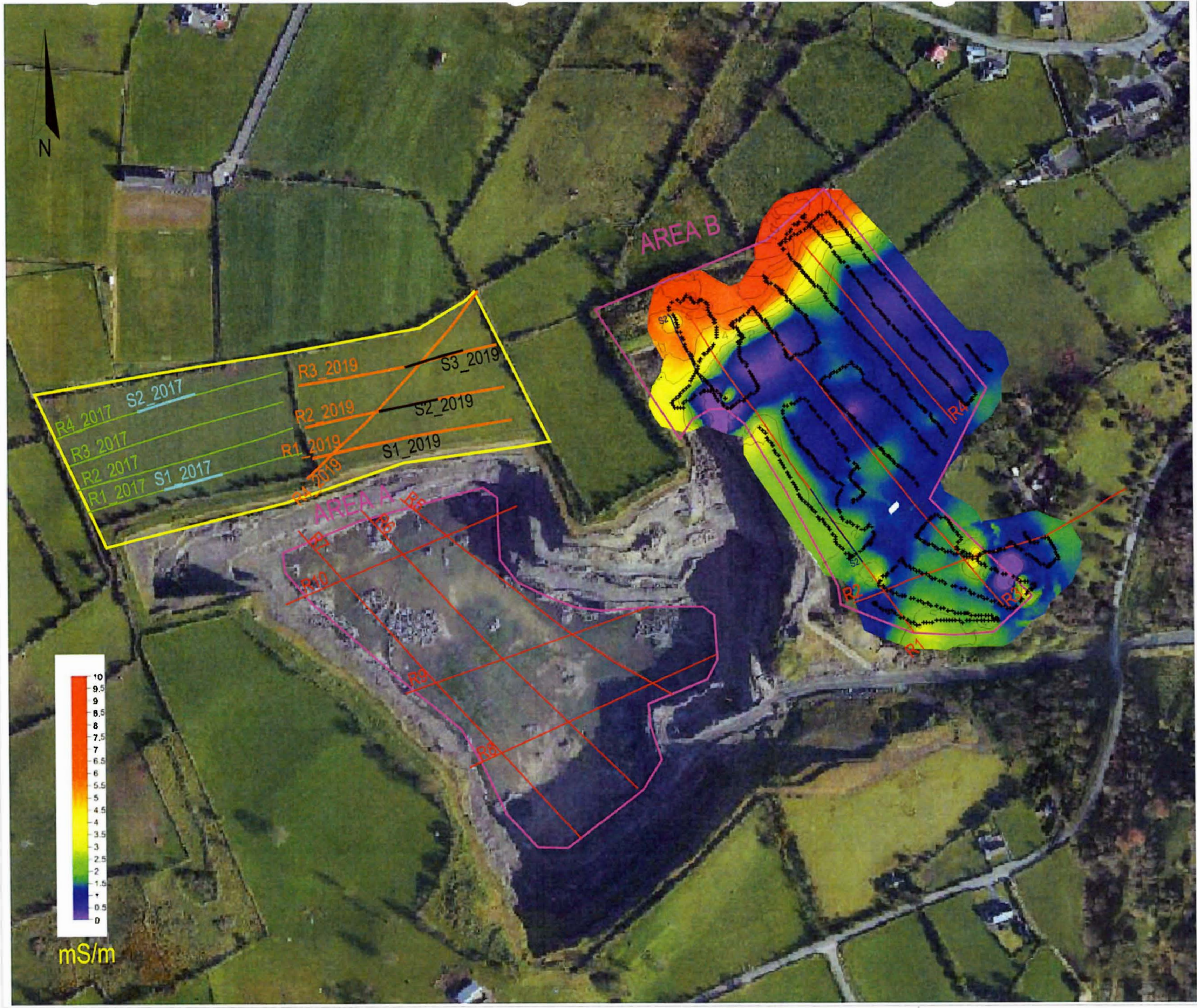
PROJECT: AGHAMORE GEOPHYSICAL SURVEY
CLIENT: LAGAN ASPHALT LTD
DRAWING NO: AGP21007_01
SCALE: AS INDICATED @ A4
DATE: 05-02-2021

Version:	Date:	Drawn By:	Checked:
No	05-02-2021	POC	TL

EM GROUND CONDUCTIVITY (mS/m)
SCALE 1:40



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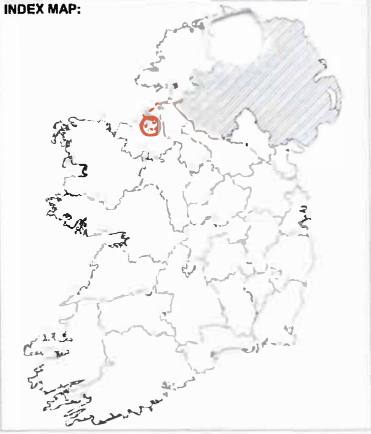

LEGEND:

▭ Site
· EM conductivity/gravity station
R1 2D resistivity profile - 2021
S1 Seismic refraction profile - 2021
R1 2D resistivity profile - 2019
S1 Seismic refraction profile - 2019
R1 2D resistivity profile - 2017
Seismic refraction profile - 2017

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PROJECT:	AGHAMORE GEOPHYSICAL SURVEY
CLIENT:	LAGAN ASPHALT LTD
DRAWING NO:	AGP21007_02
SCALE:	AS INDICATED @ A4
DATE:	05-02-2021

Version:	Date:	Drawn By:	Checked:
No	05-02-2021	POC	TL

SUMMARY I RPRETATION MAP
SCALE 1:40

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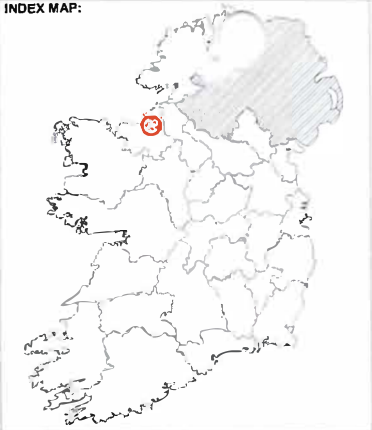

LEGEND:

▭ Survey area A and B - 2021
▨ Localised overburden thickening
▦ Fresh LIMESTONE 25 to -30 mOD
▦ Fresh LIMESTONE -20 to -60 mOD
▨ Thick Gravelly CLAY (Boulder Clay)
- - Area of low resistivity below 10 mOD
R1 2D resistivity profile - 2021
S1 Seismic refraction profile - 2021
R1 2D resistivity profile - 2019
S1 Seismic refraction profile - 2019
R1 2D resistivity profile - 2017
S1 Seismic refraction profile - 2017

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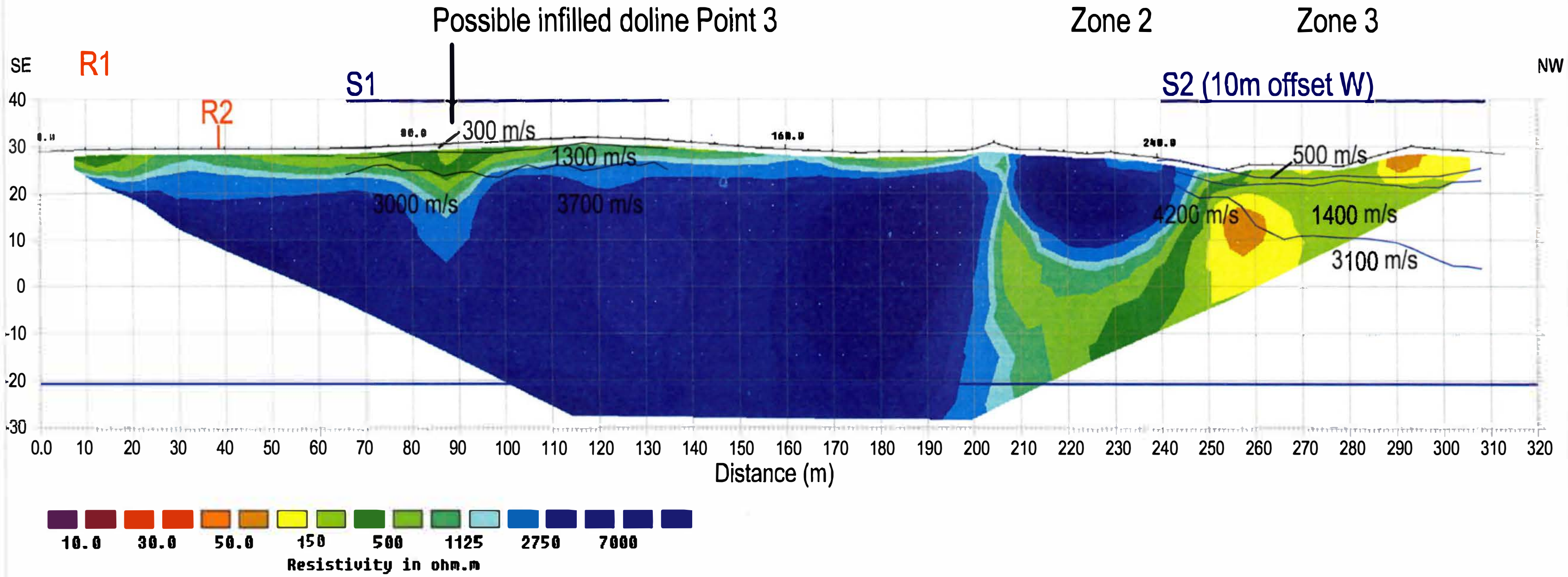
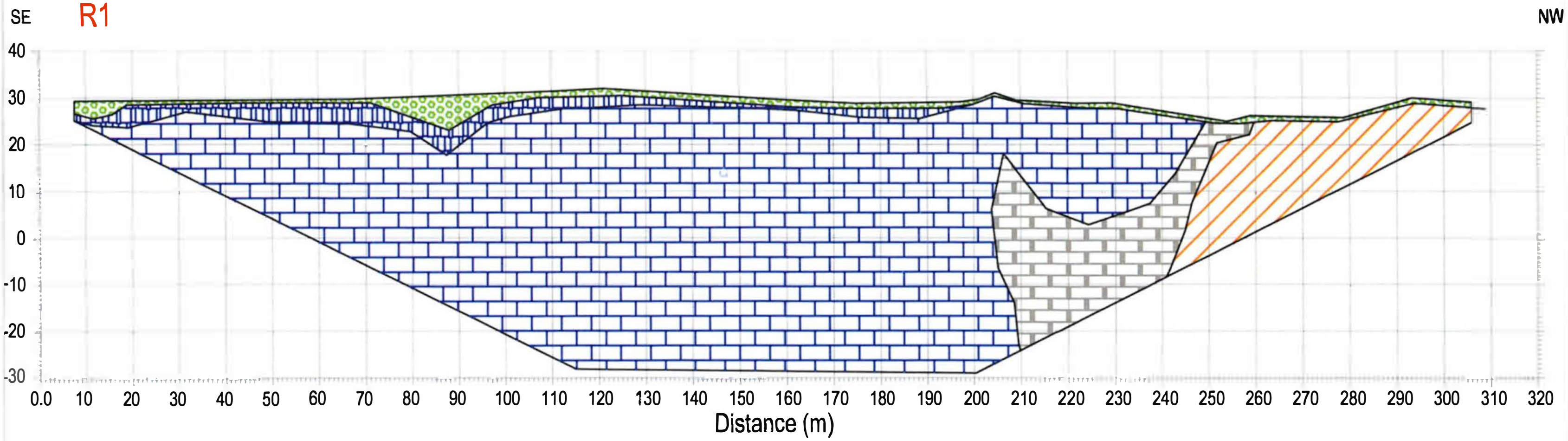
Version:	Date:	Drawn By:	Checked:
No	05-02-2021	POC	TL

ERT PROFILE R1 AND SEISMIC PROFILES S1 AND S2
SCALE 1:15





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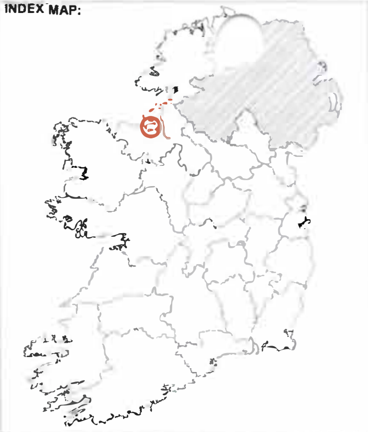

LEGEND:

- ▨ Clayey SAND/GRAVEL
- ▥ Weathered Rock
- ▦ possible shaley Limestone
- ▨ Gravelly CLAY (Boulder Clay) to >15m
- ▦ LIMESTONE (Land Survey)
- ▦ LIMESTONE (Over water survey)
- ▨ WATER COLUMN
- ▩ OPEN JOINTS
- SEISMIC LAYER, VELOCITY
- WATER LEVEL IN QUARRY (at time of survey)

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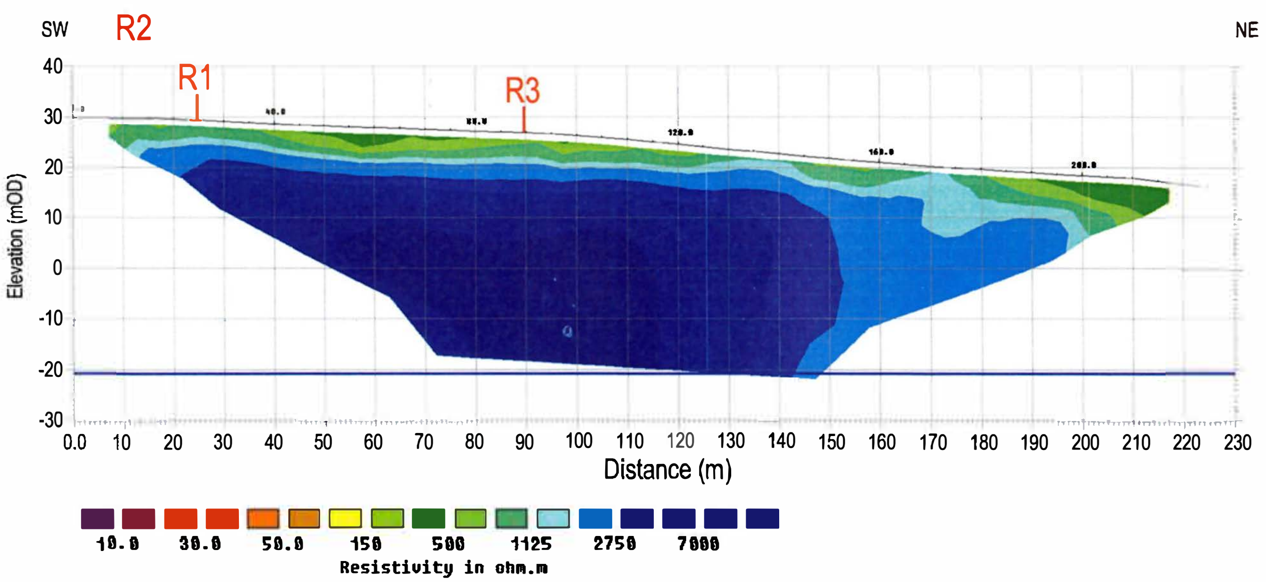
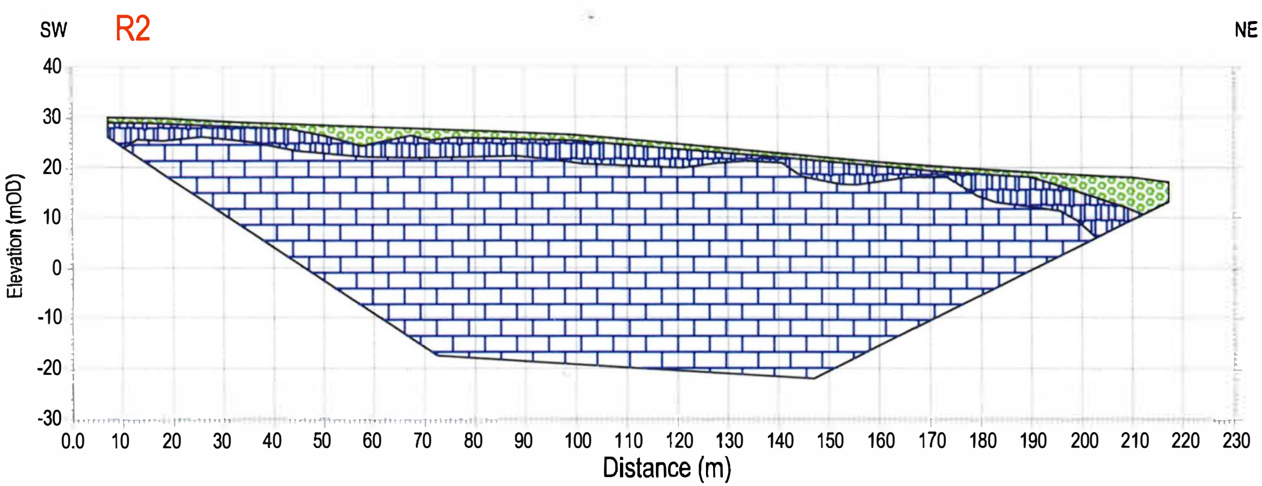
DRAWING NO:	AGP21007_R1
SCALE:	AS INDICATED @ A4
DATE:	05-02-2021

Version:	Date:	Drawn By:	Checked:
No	05-02-2021	POC	TL

ERT PROFILE R2
SCALE 1:15





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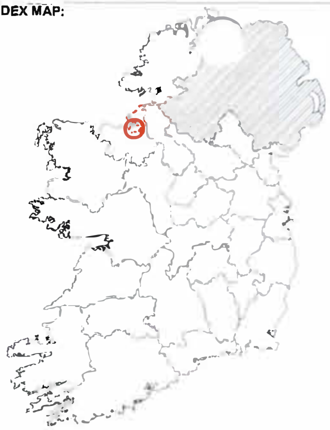

LEGEND:

- ▭ Clayey SAND/GRAVEL
- ▥ Weathered Rock
- ▦ possible shaley Limestone
- ▭ Gravelly CLAY (Boulder Clay) to >15m
- ▦ LIMESTONE (Land Survey)
- ▭ LIMESTONE (Over watersurvey)
- ▭ WATER COLUMN
- ▩ OPEN JOINTS
- 〰 SEISMIC LAYER, VELOCITY
- — WATER LEVEL IN QUARRY (at time of survey)

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ERT PROFIL 3
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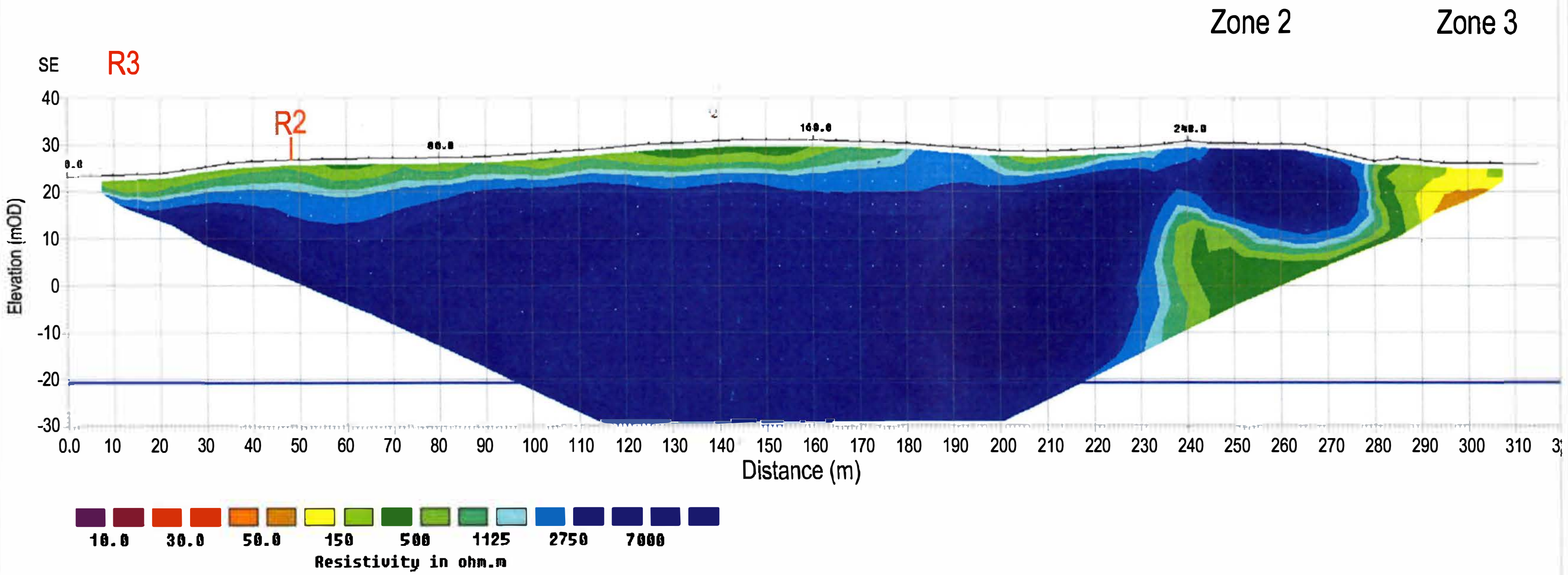

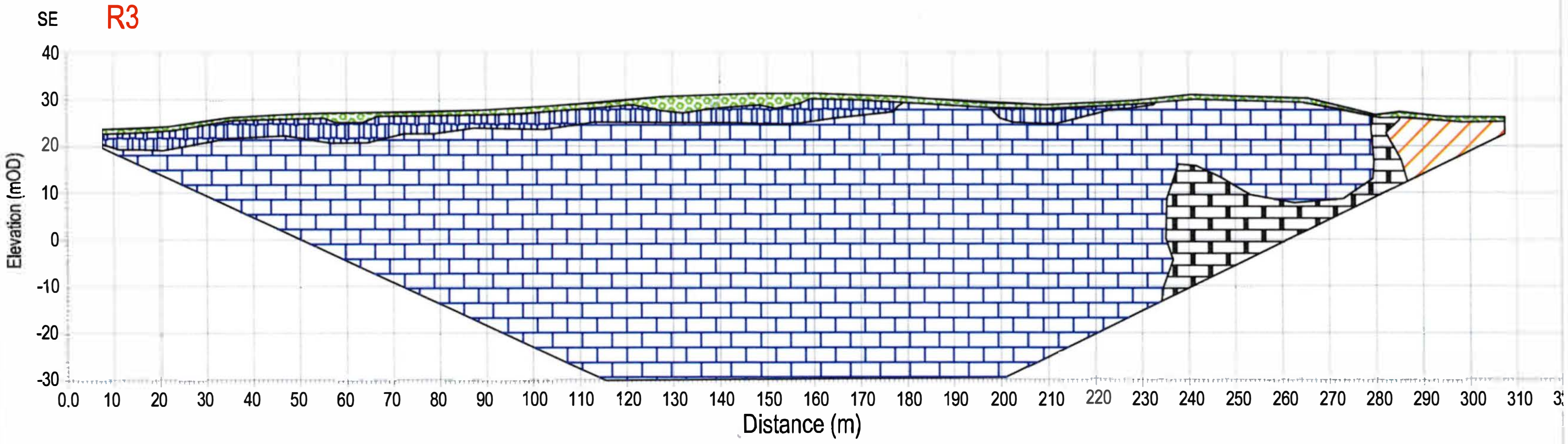

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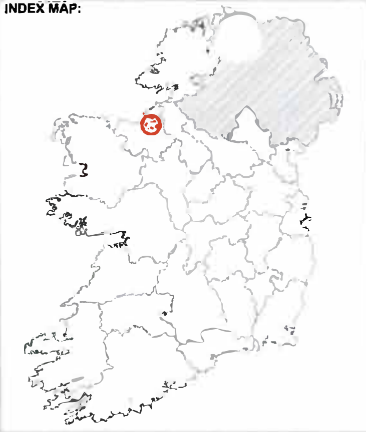

LEGEND:

- ▭ Clayey SAND/GRAVEL
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- ▦ possible shaley Limestone
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- ▦ LIMESTONE (Land Survey)
- ▭ LIMESTONE (Over water survey)
- ▨ WATER COLUMN
- ▩ OPEN JOINTS
- SEISMIC LAYER, VELOCITY
- WATER LEVEL IN QUARRY (at time of survey)

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No	05-02-2021	POC	TL

ERT PROFILE R4
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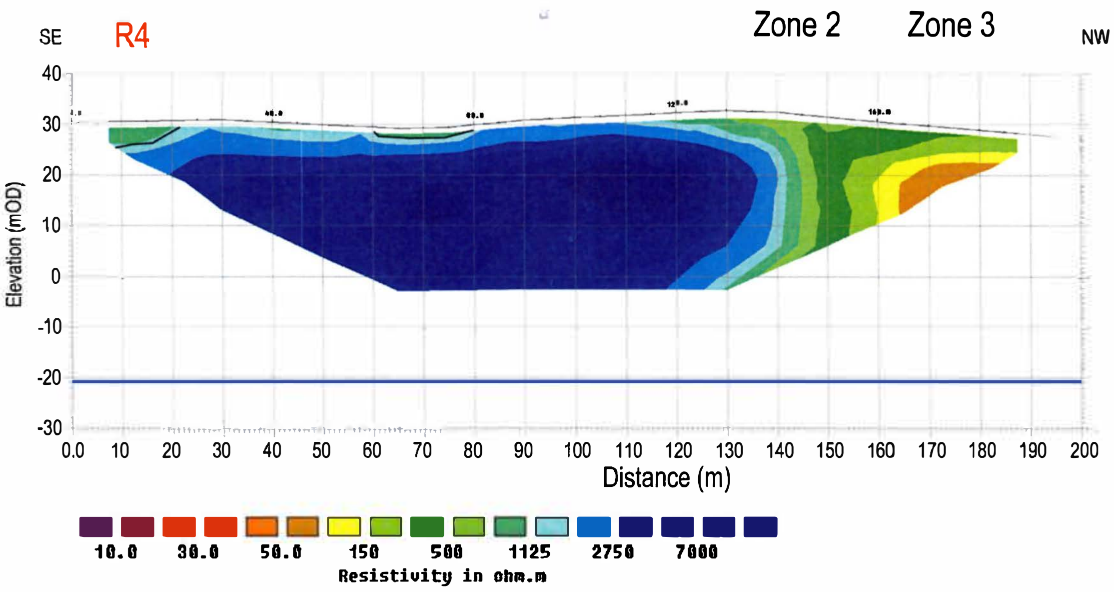

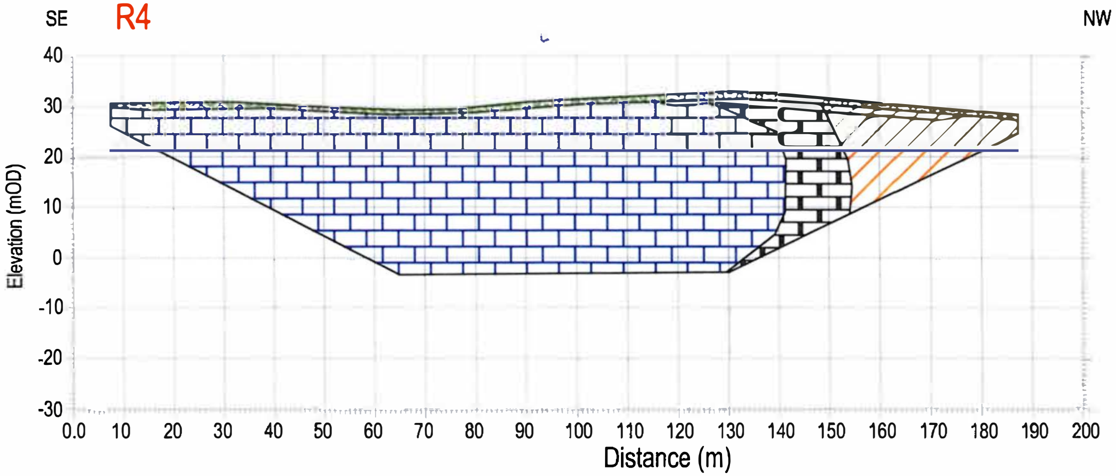

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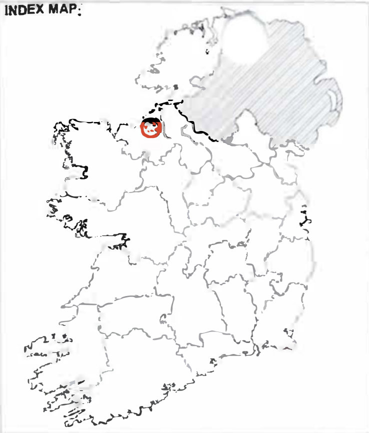

LEGEND:

- Clayey SAND/GRAVEL
- Weathered Rock
- possible shaley Limestone
- Gravelly CLAY (Boulder Clay) to >15m
- LIMESTONE (Land Survey)
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- OPEN JOINTS
- SEISMIC LAYER, VELOCITY
- WATER LEVEL IN QUARRY (at time of survey)

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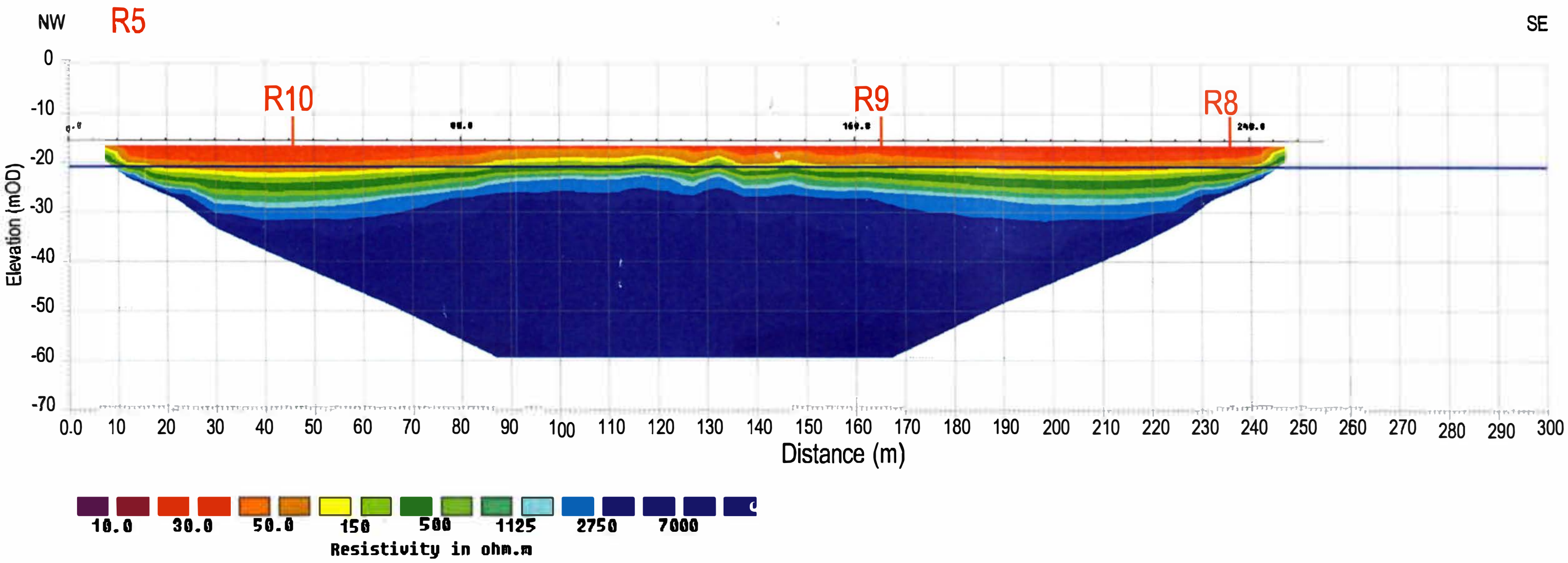
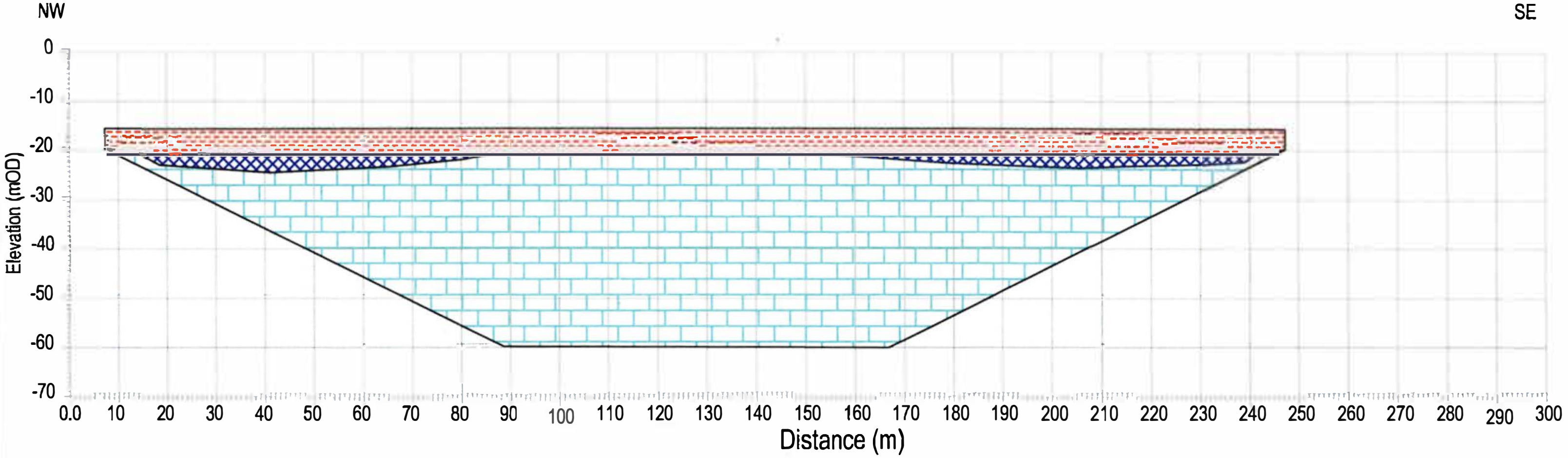
Version:	Date:	Drawn By:	Checked:
No	05-02-2021	POC	TL

ERT PROFILE R5

SCALE 1:15





INDEX MAP:

LEGEND:

- ▭ Clayey SAND/GRAVEL
- ▥ Weathered Rock
- ▨ possible shaley Limestone
- ▭ Gravelly CLAY (Boulder Clay) to >15m
- ▦ LIMESTONE (Land Survey)
- ▭ LIMESTONE (Over water survey)
- ▭ WATER COLUMN
- ▩ OPEN JOINTS
- ━ SEISMIC LAYER, VELOCITY
- ━ WATER LEVEL IN QUARRY (at time of survey)

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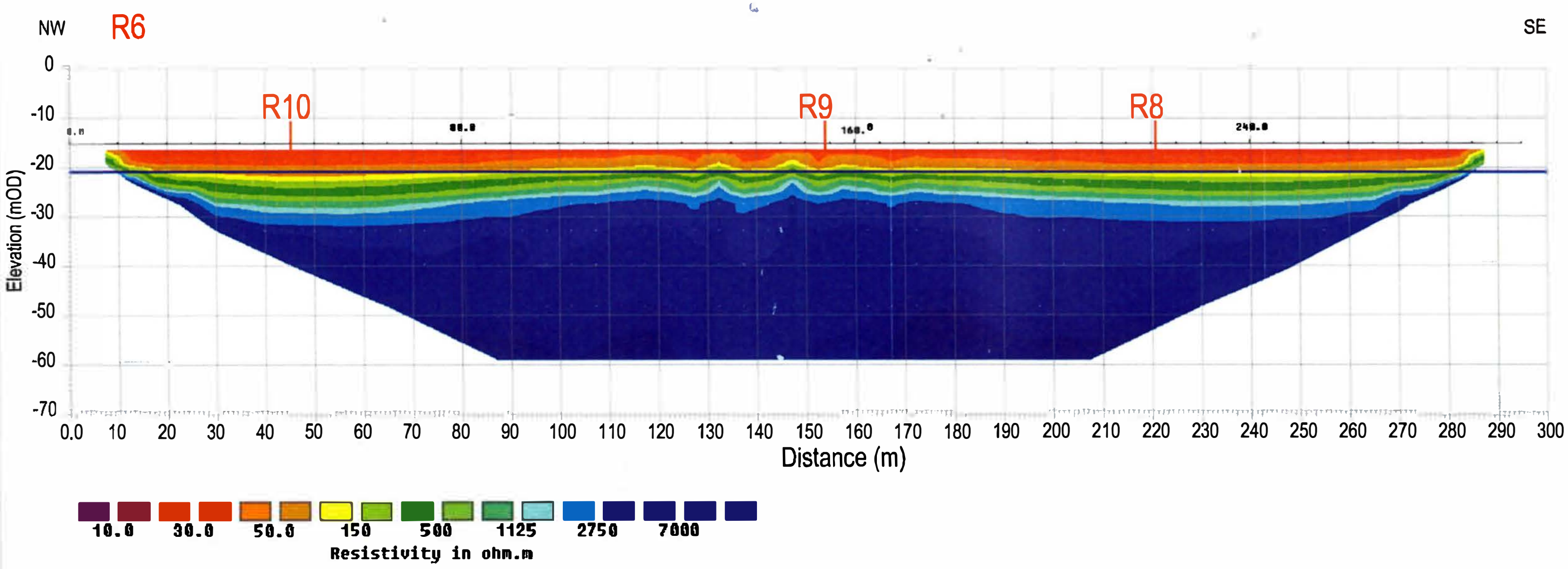

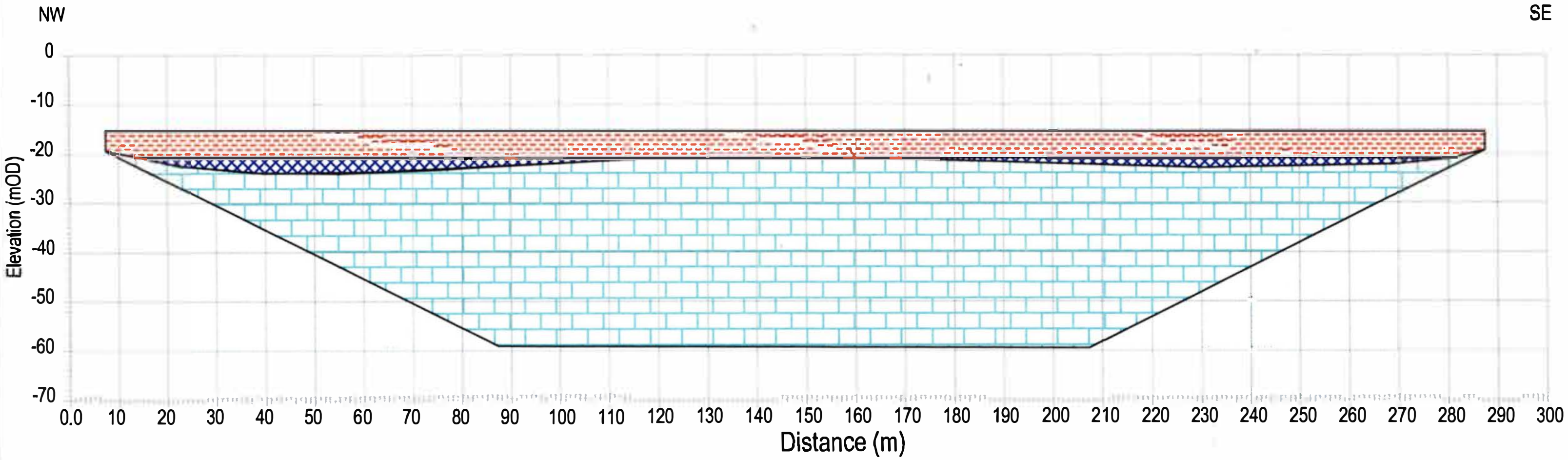

INDEX MAP:

LEGEND:

- Clayey SAND/GRAVEL
- Weathered Rock
- possible shaley Limestone
- Gravelly CLAY (Boulder Clay) to >15m
- LIMESTONE (Land Survey)
- LIMESTONE (Over water survey)
- WATER COLUMN
- OPEN JOINTS
- SEISMIC LAYER, VELOCITY
- WATER LEVEL IN QUARRY (at time of survey)

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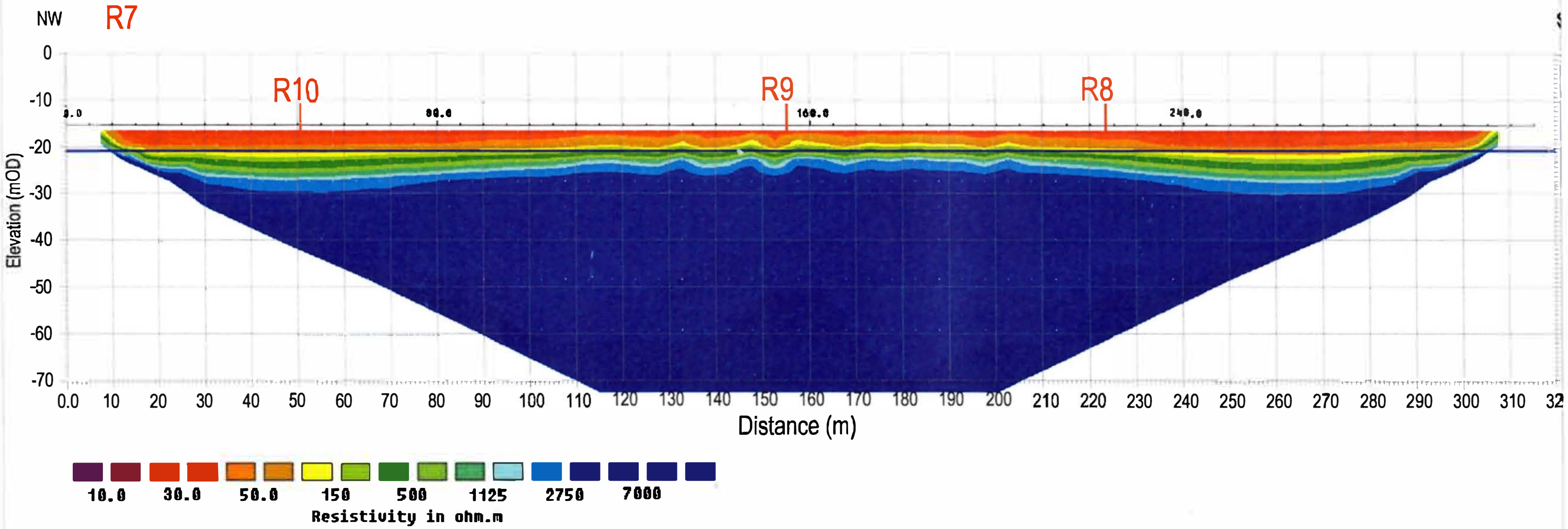
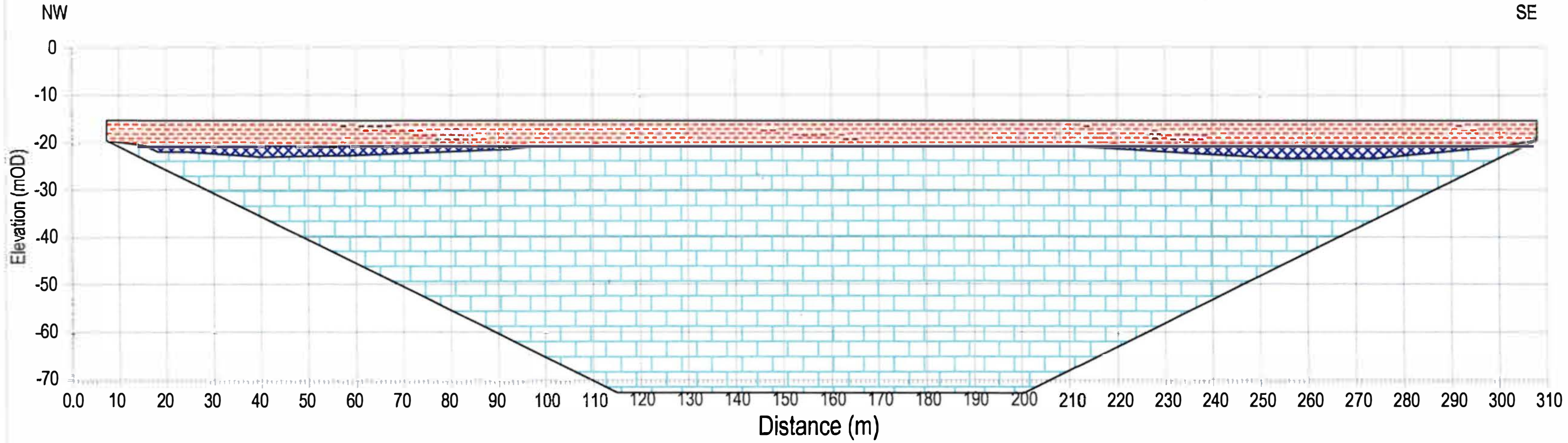
DRAWING NO: AGP21007_R6
SCALE: AS INDICATED @ A4
DATE: 05-02-2021

Version:	Date:	Drawn By:	Checked:
No	05-02-2021	POC	TL

ERT PROFILE R7
SCALE 1:15





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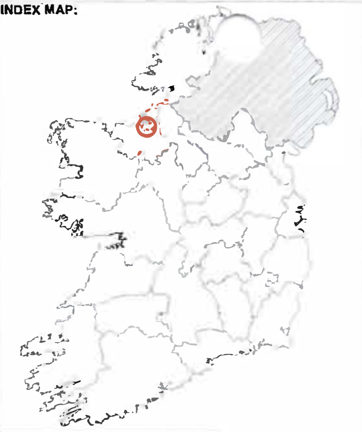

LEGEND:

- ▨ Clayey SAND/GRAVEL
- ▨ Weathered Rock
- ▨ possible shaley Limestone
- ▨ Gravelly CLAY (Boulder Cl ay) to >15m
- ▨ LIMESTONE (Land Survey)
- ▨ LIMESTONE (Over water survey)
- ▨ WATER COLUMN
- ▨ OPEN JOINTS
- SEISMIC LAYER, VELOCITY
- WATER LEVEL IN QUARRY (at time of survey)

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DRAWING NO:	AGP21007_R7
SCALE:	AS INDICATED @ A4
DATE:	05-02-2021

Version:	Date:	Drawn By:	Checked:
No	05-02-2021	POC	TL

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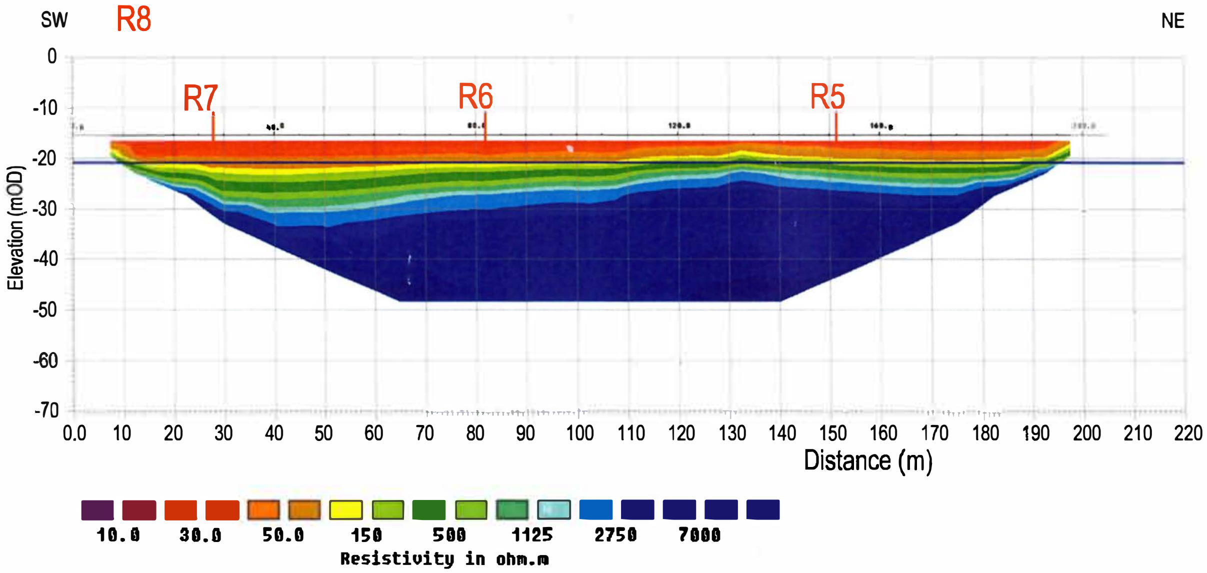

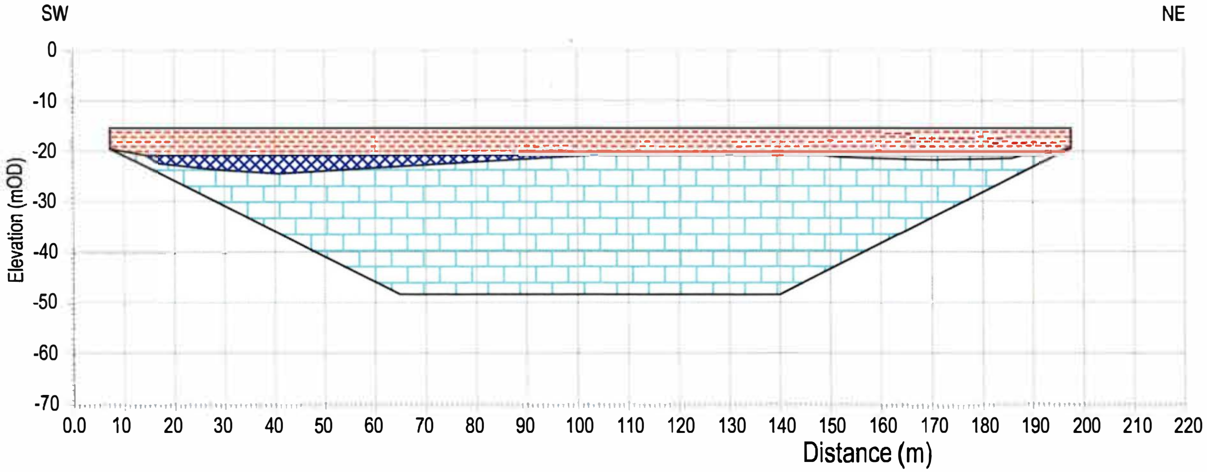

INDEX MAP:

LEGEND:

- ▭ Clayey SAND/GRAVEL
- ▥ Weathered Rock
- ▦ possible shaley Limestone
- ▭ Gravelly CLAY (Boulder Clay) to >15m
- ▦ LIMESTONE (Land Survey)
- ▭ LIMESTONE (Over water survey)
- ▨ WATER COLUMN
- ▩ OPEN JOINTS
- 3400 m/s SEISMIC LAYER, VELOCITY
- — WATER LEVEL IN QUARRY (at time of survey)

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DATE: 05-02-2021

Version:	Date:	Drawn By:	Checked:
No	05-02-2021	POC	TL

ERT PROFILE R9
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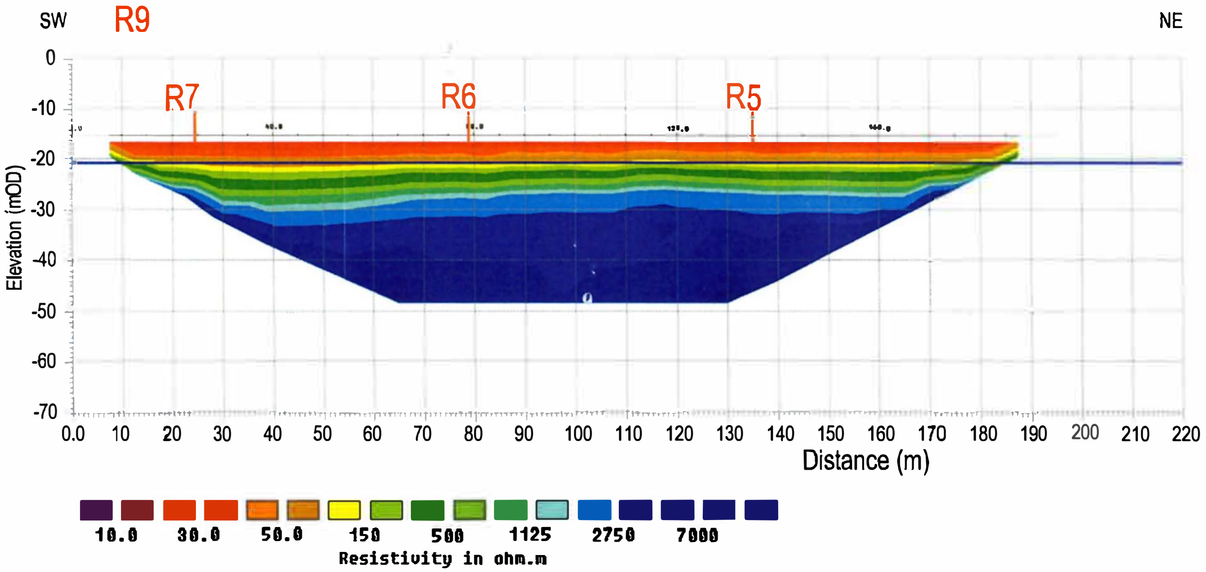

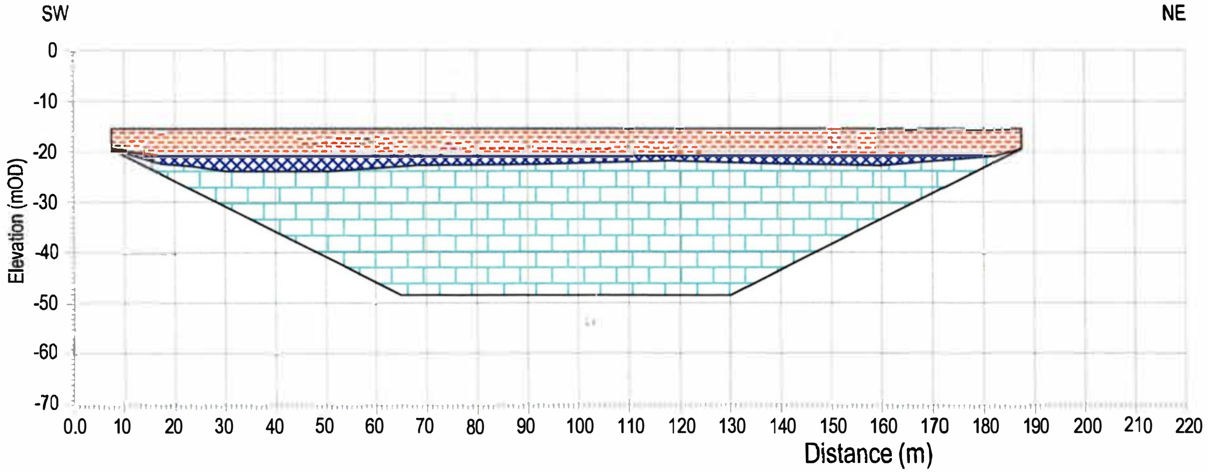

INDEX MAP:

LEGEND:

▭	Clayey SAND/GRAVEL
▥	Weathered Rock
▦	possible shaley Limestone
▭	Gravelly CLAY (Boulder Clay) to >15m
▦	LIMESTONE (Land Survey)
▭	LIMESTONE (Over water survey)
▭	WATER COLUMN
▩	OPEN JOINTS
⁀	SEISMIC LAYER, VELOCITY
—	WATER LEVEL IN QUARRY (at time of survey)

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CLIENT:
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DRAWING NO:
AGP21007_R9

SCALE:
AS INDICATED @ A4

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No	05-02-2021	POC	TL

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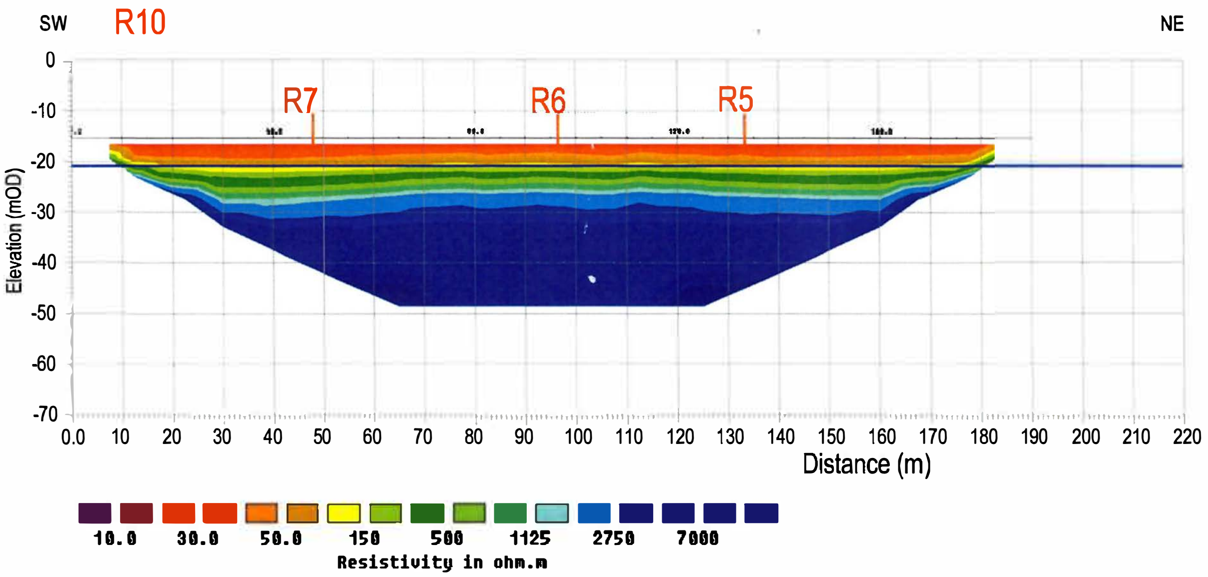

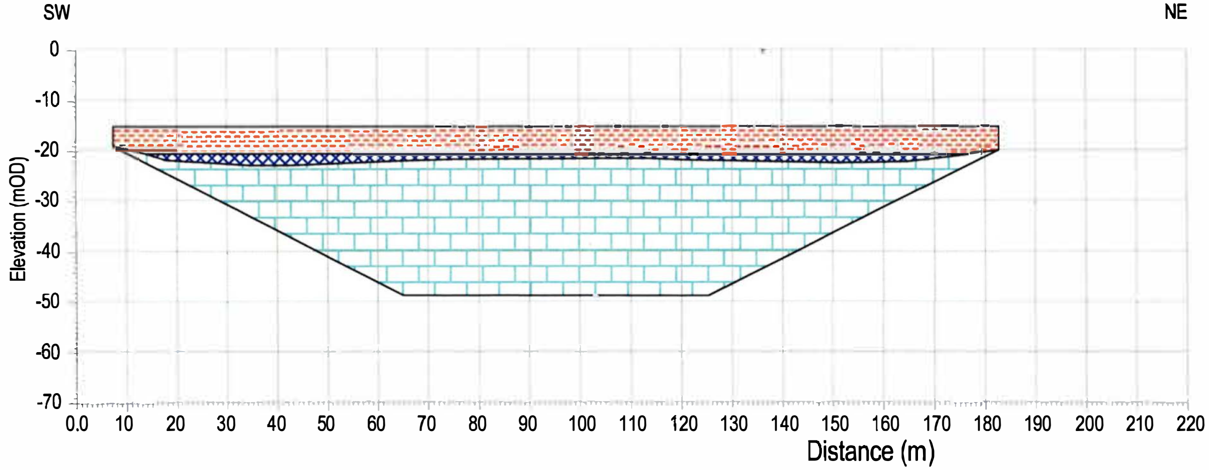

INDEX MAP:

LEGEND:

- ░ Clayey SAND/GRAVEL
- ▥ Weathered Rock
- ▦ possible shaley Limestone
- ░ Gravelly CLAY (Boulder Clay) to >15m
- ▤ LIMESTONE (Land Survey)
- ☐ LIMESTONE (Over water survey)
- ░ WATER COLUMN
- ▩ OPEN JOINTS
- SEISMIC LAYER, VELOCITY
- — WATER LEVEL IN QUARRY (at time of survey)

The information displayed here is to be used in conjunction with AGP21007_01 Report on the Geophysical Investigation at Aghamore, Sligo for Lagan Asphalt Ltd., APEX Geophysics Ltd. 5th February 2021.

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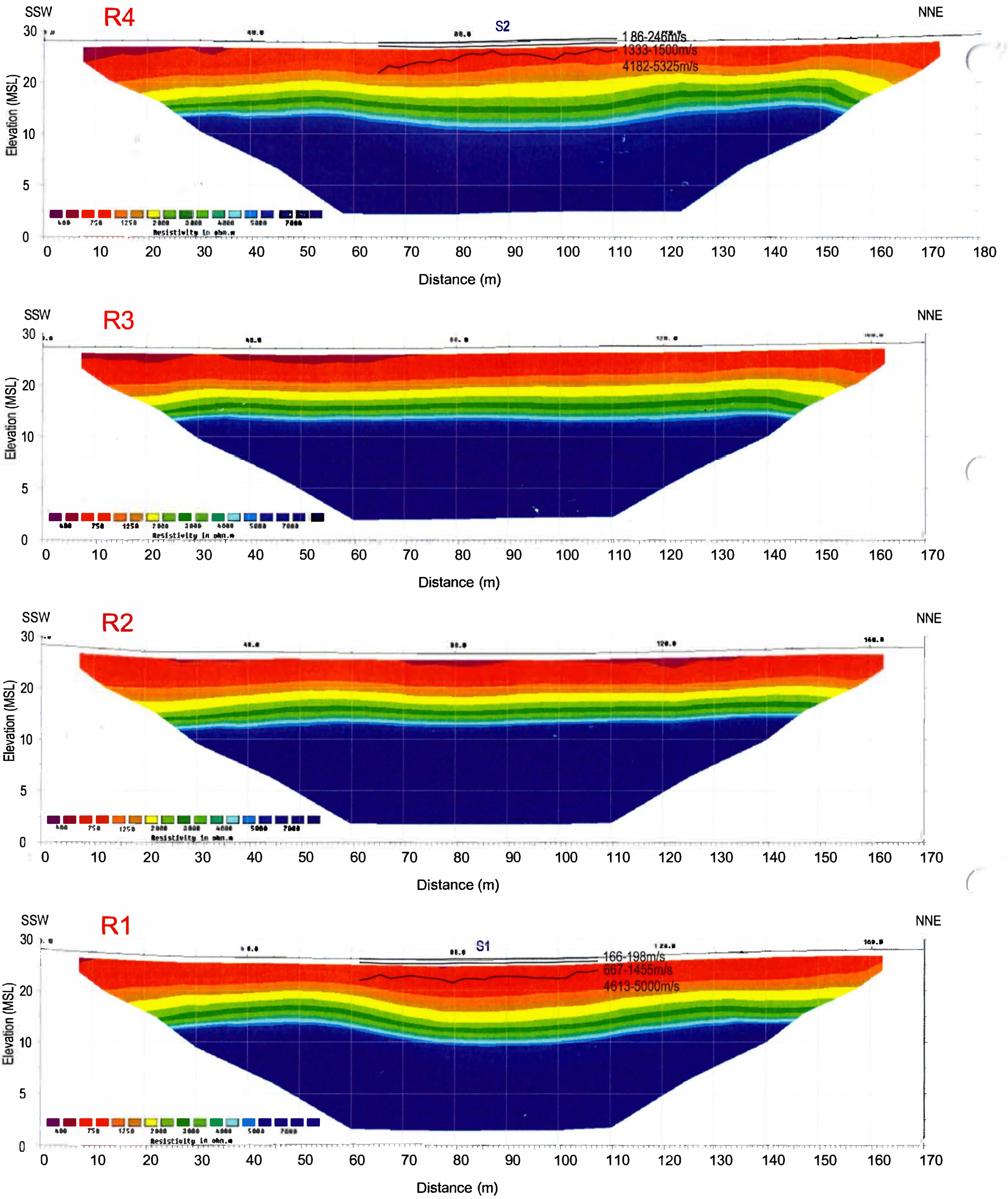
PROJECT: AGHAMORE GEOPHYSICAL SURVEY
CLIENT.: LAGAN ASPHALT LTD
DRAWING NO: AGP21007_R10
SCALE: AS INDICATED @ A4
DATE: 05-02-2021

Version:	Date:	Drawn By:	Checked:
No	05-02-2021	POC	TL

APPENDIX D: ERT PROFILES FROM 2017 SURVEY

FIGURE 1: ERT & Seismic Profile Data

SCALE 1:1000



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INDEX MAP:

LEGEND:

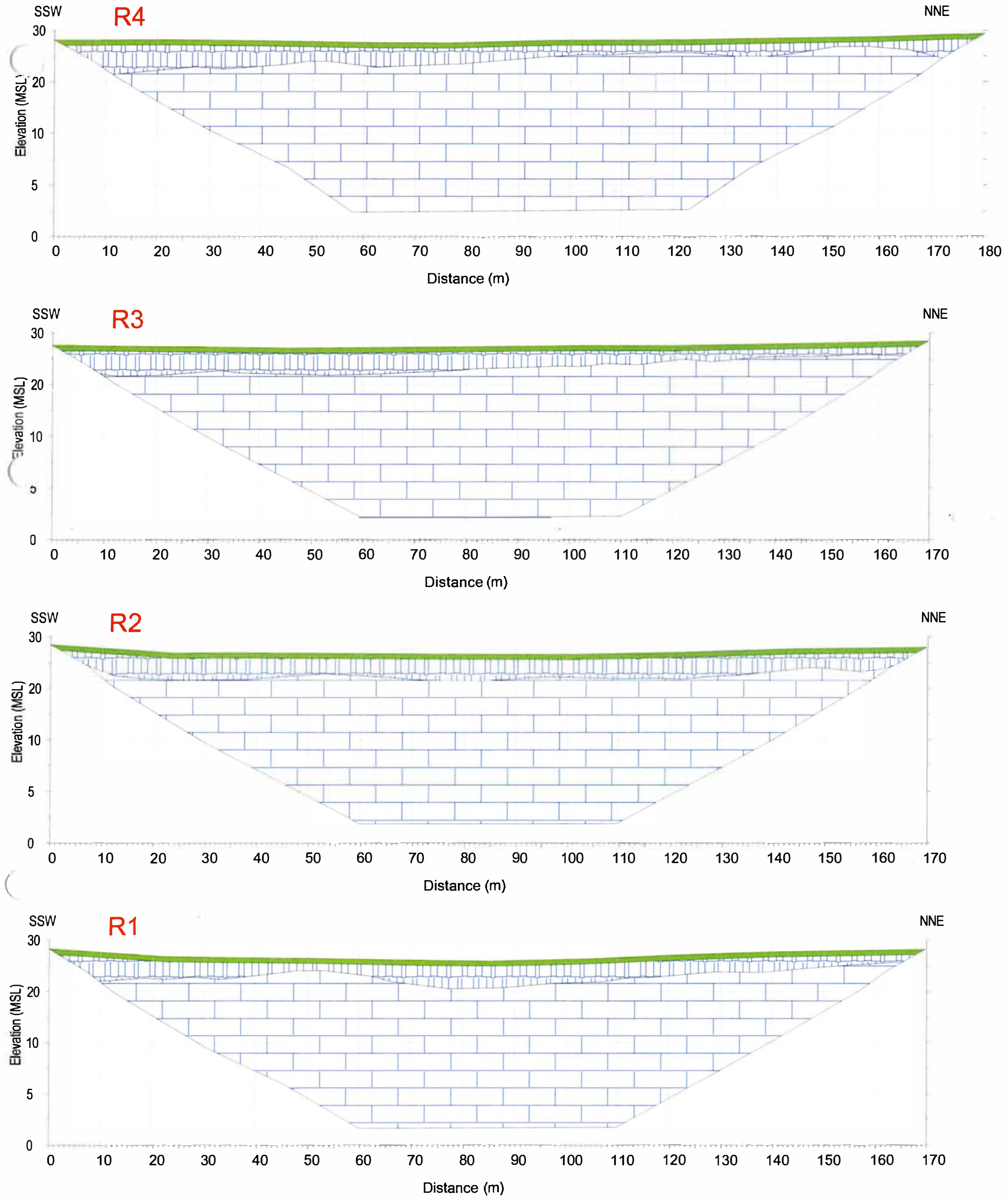
1254-1288 m/s — Seismic refraction layer with interpreted P-wave velocity
🟩 Overburden
▦ Weathered LIMESTONE
▭ LIMESTONE
PBH1 Proposed borehole
PTP1 Proposed trial pit

PROJECT: SLIGO QUARRY GEOPHYSICAL SURVEY
CLIENT: LAGAN ASPHALT
DRAWING NO: AGL1764_03
SCALE: AS INDICATED @ A1
DATE: 12-10-2017

Version.	Date:	Drawn By:	Checked:
01	12-10-2017	YOC	POC

FIGURE 1: ERT & Seismic Profile Geological Interpretation

SCALE 1:1000



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INDEX MAP:

LEGEND:

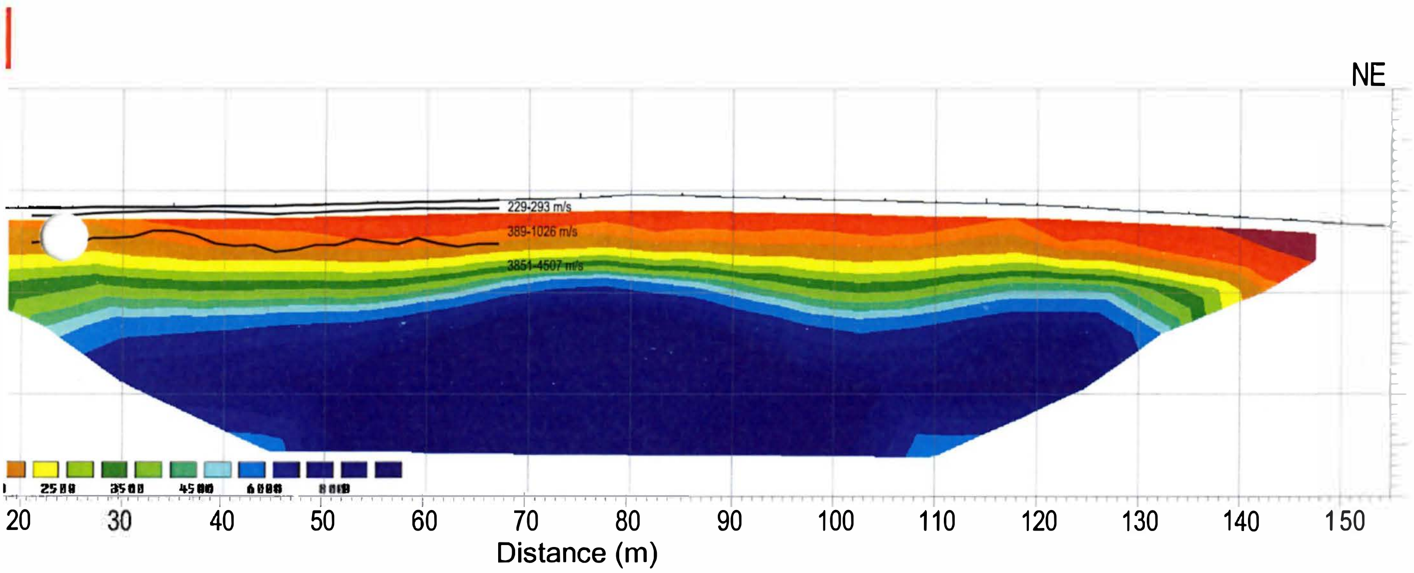
- 1254-1288 m/s Seismic refraction layer with interpreted P-wave velocity
- 🟩 Overburden
- ▦ Weathered LIMESTONE
- ▭ LIMESTONE
- PBH1 Proposed borehole
- PTP1 Proposed trial pit

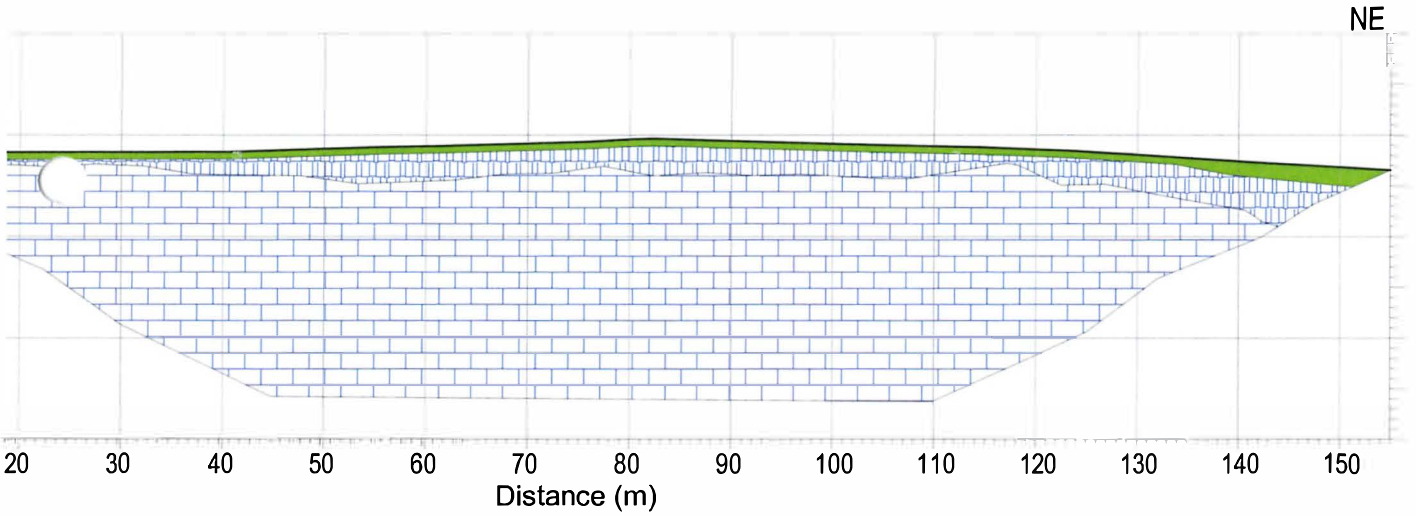
PROJECT:	SLIGO QUARRY GEOPHYSICAL SURVEY
CLIENT:	LAGAN ASPHALT
DRAWING NO:	AGL17164_04
SCALE:	AS INDICATED @ A1
DATE:	12-10-2017

Version:	Date:	Drawn By:	Checked:
01	12-10-2017	YOC	POC

APPENDIX E: ERT PROFILES FROM 2019 SURVEY

PRETATION - ERT R1 & S1





INDEX MAP:

LEGEND:

1254-1288 m/s

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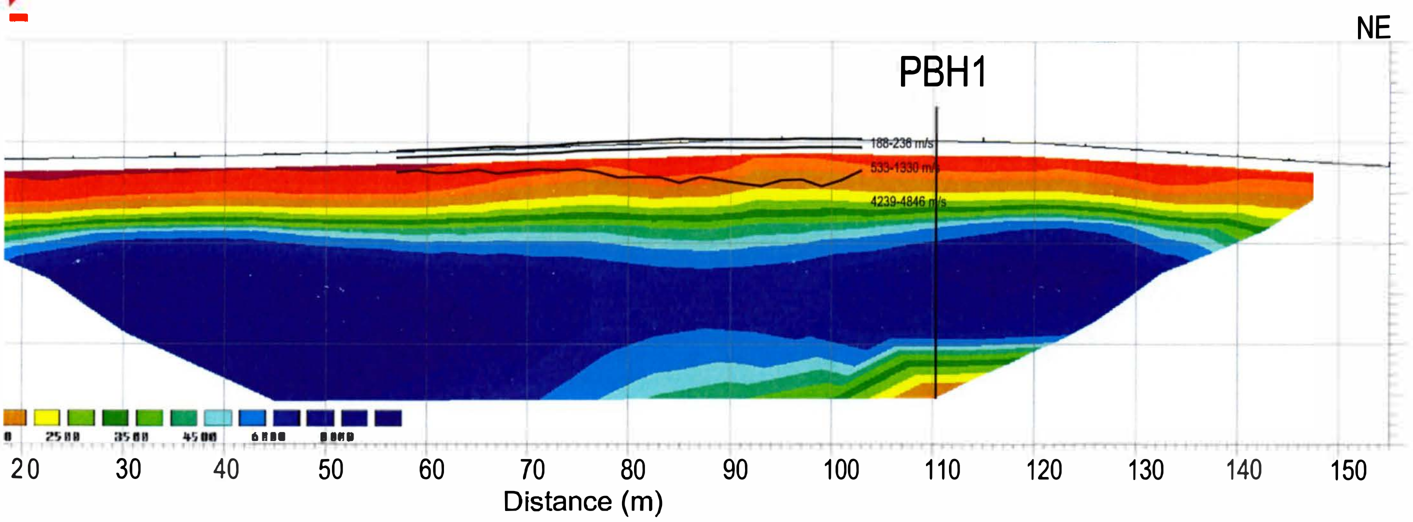
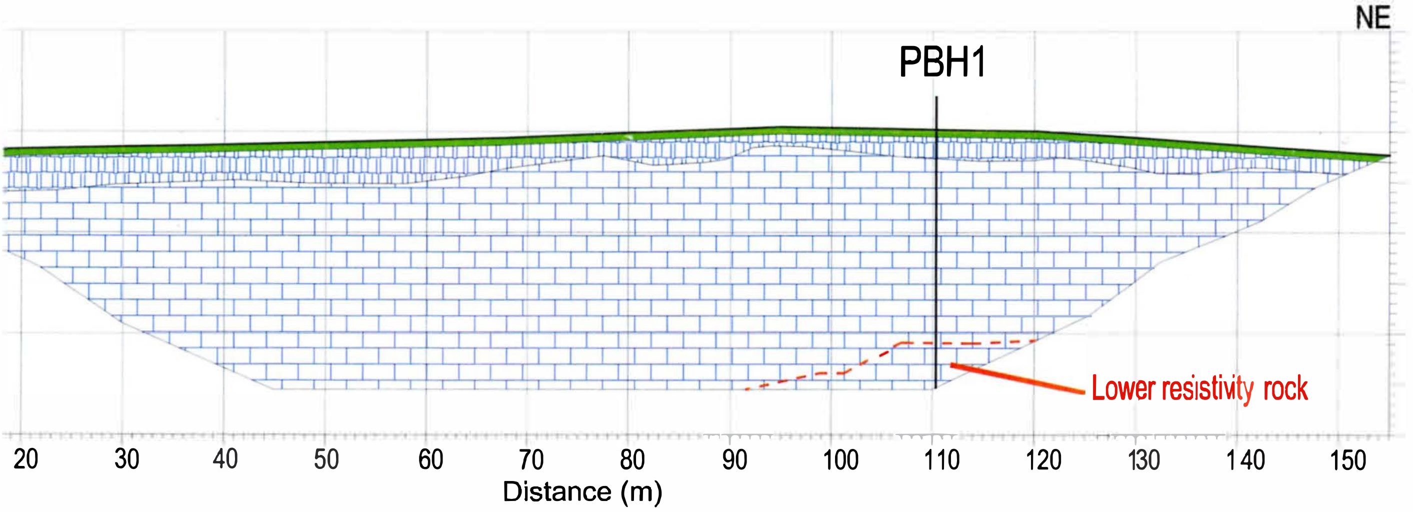
SCALE:	AS
DATE:	20-

Version:	Date:
01	20-1

RPRETATION - ERT R2 & S2

2





INDEX MAP:

LEGEND:

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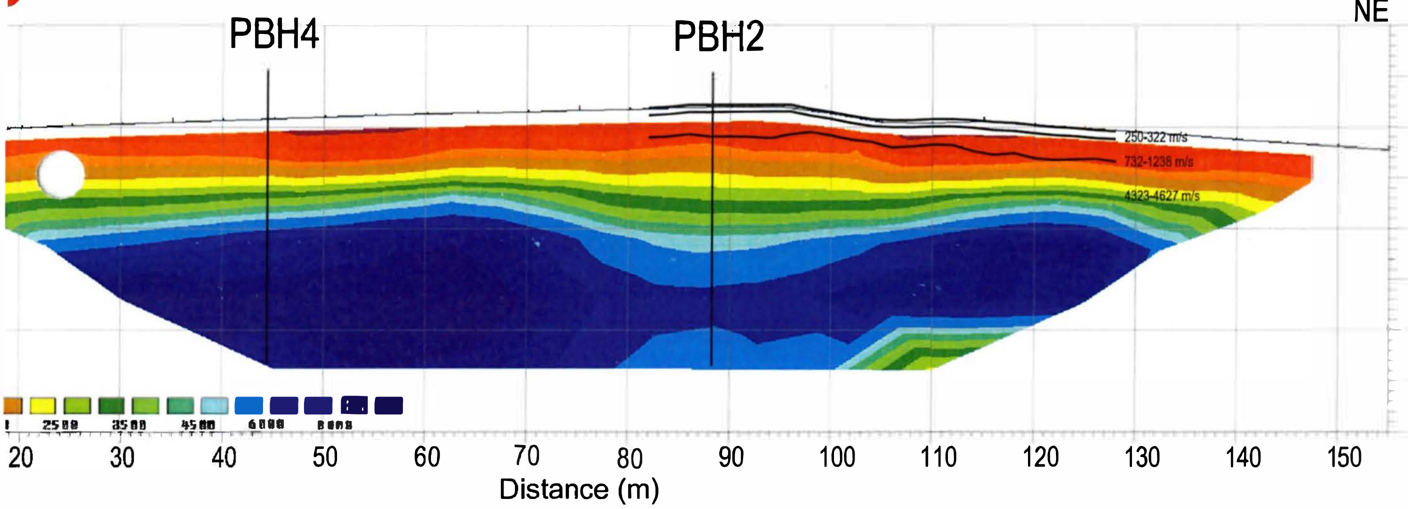
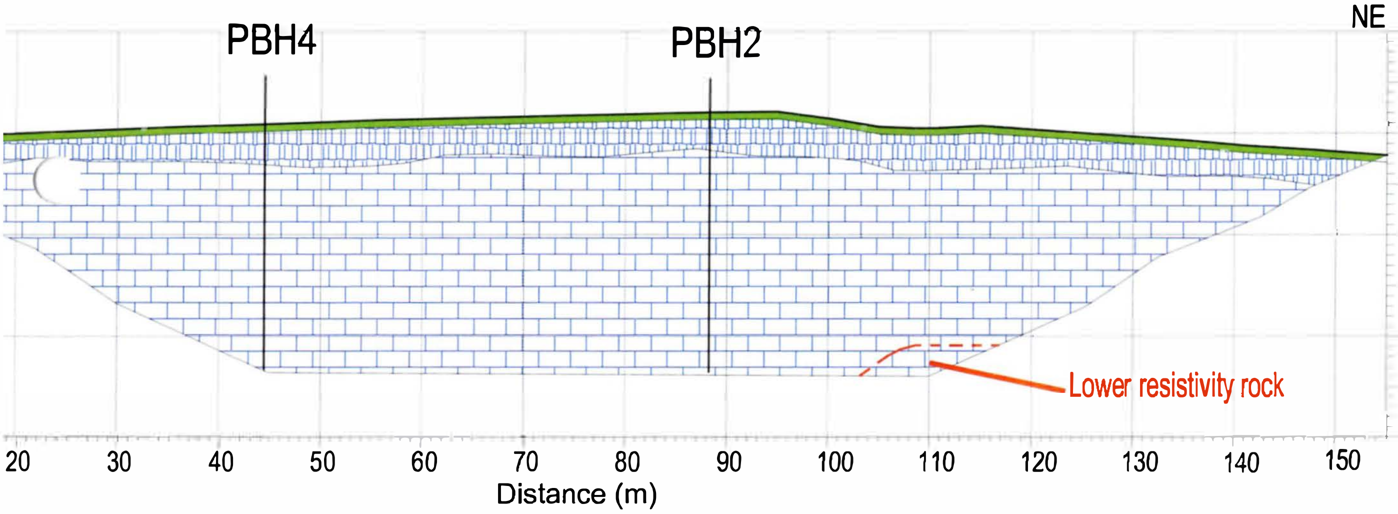
PRETATION - ERT R3 & S3





INDEX MAP:

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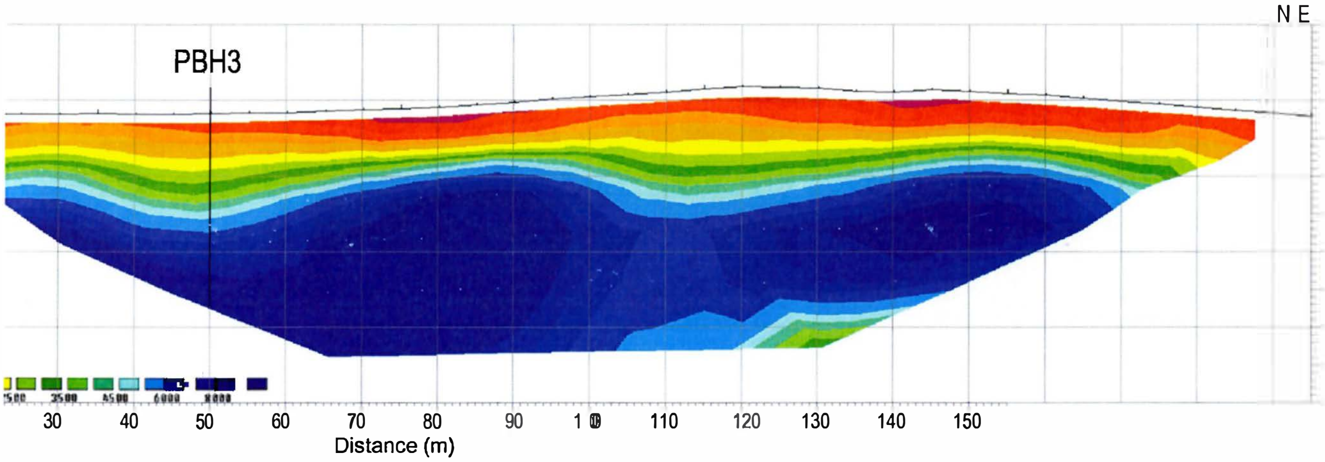
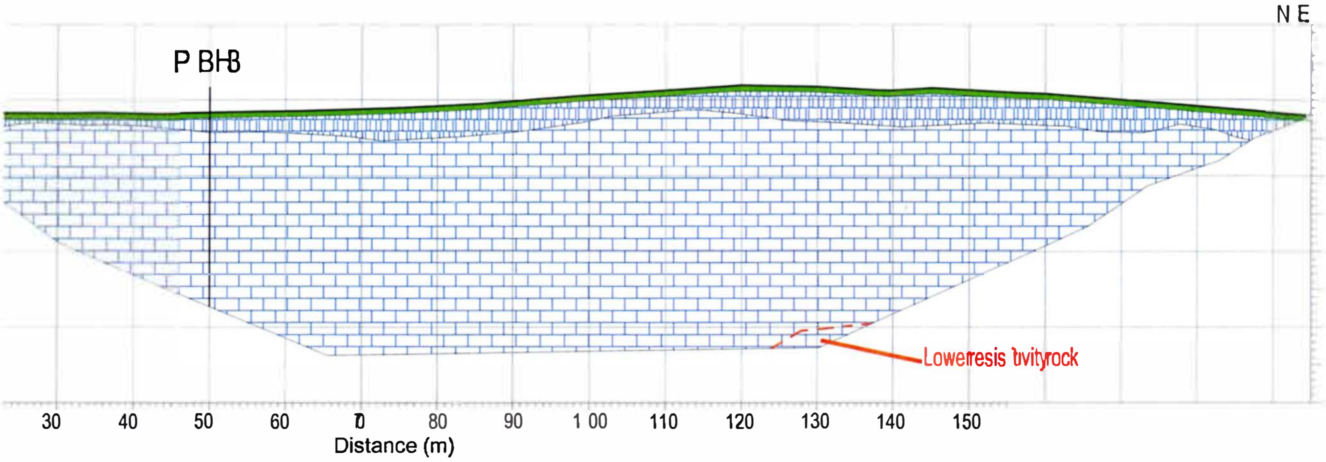
Version:	Date:
01	20-1

RPRETATION - ERT R4





INDEX MAP:

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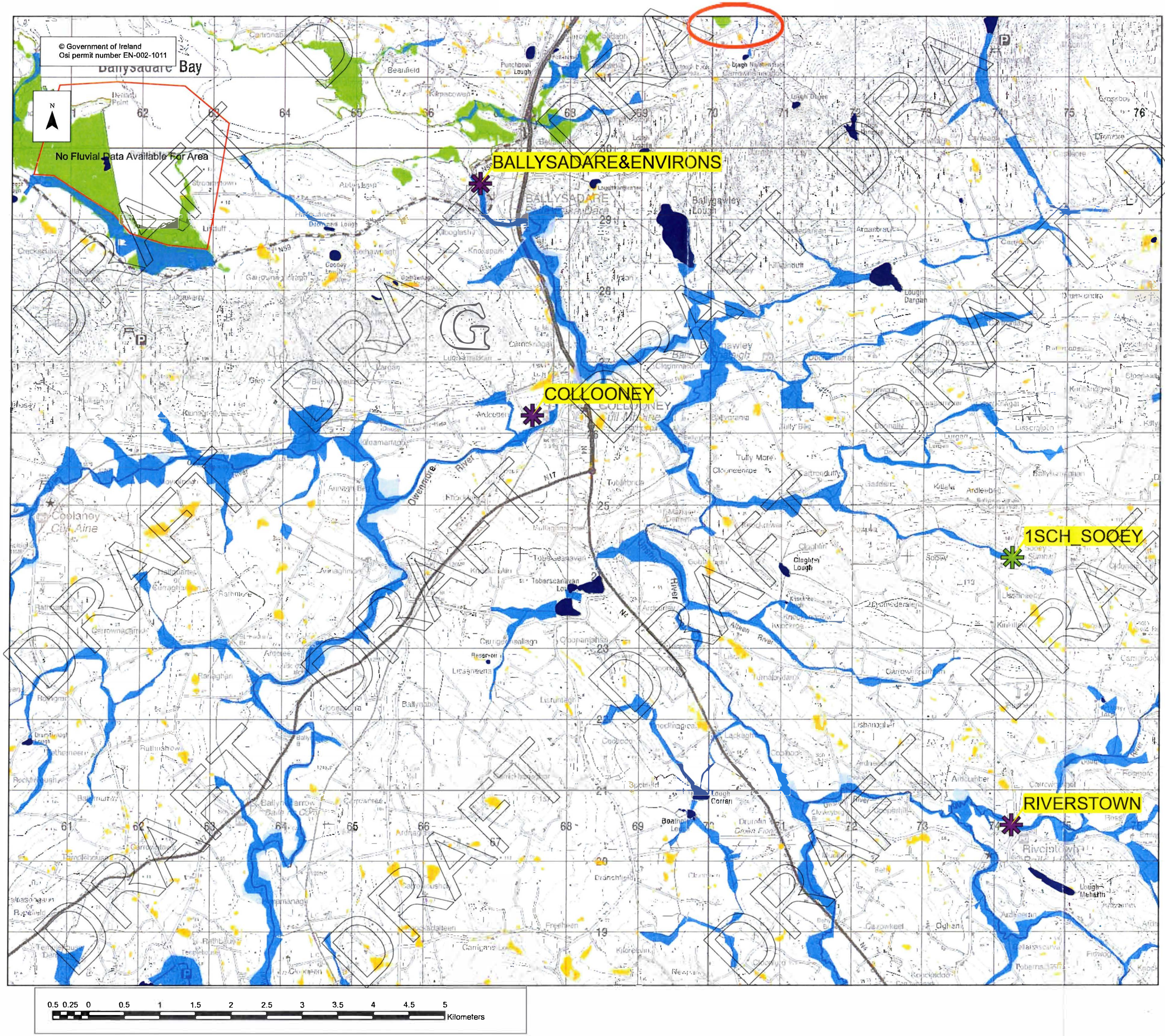
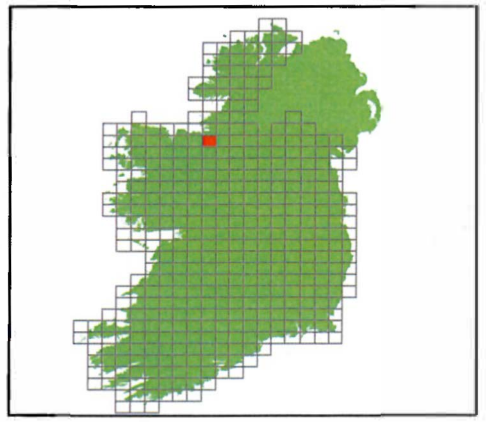
SCALE:	AS
DATE:	20-

Version:	Date:
01	20-1

APPENDIX 7-7 PRELIMINARY FLOOD RISK ASSESSMENT MAPS



Location Plan :



Legend:

Flood Extents

- 🟦 Fluvial - Indicative 1% AEP (100-yr) Event
- ▨ Fluvial - Extreme Event
- 🟩 Coastal - Indicative 0.5% AEP (200-yr) Event
- ▨ Coastal - Extreme Event
- 🟨 Pluvial - Indicative 1% AEP (100-yr) Event
- ▨ Pluvial - Extreme Event
- 🟫 Groundwater Flood Extents
- ■ Lakes / Turloughs

PFRA Outcomes

- ✱ Probable Area for Further Assesment
- ✱ Possible Area for Further Assesment

Important User Note:

The flood extents shown on these maps are based on broad-scale simple analysis and may not be accurate for a specific location. Information on the purpose, development and limitations of these maps is available in the relevant reports (see www.cfram.ie). Users should seek professional advice if they intend to rely on the maps in any way.

If you believe that the maps are inaccurate in some way please forward full details by contacting the OPW (refer to PFRA Information leaflets or 'Have Your Say' on www.cfram.ie).

Office of Public Works
Jonathon Swift Street
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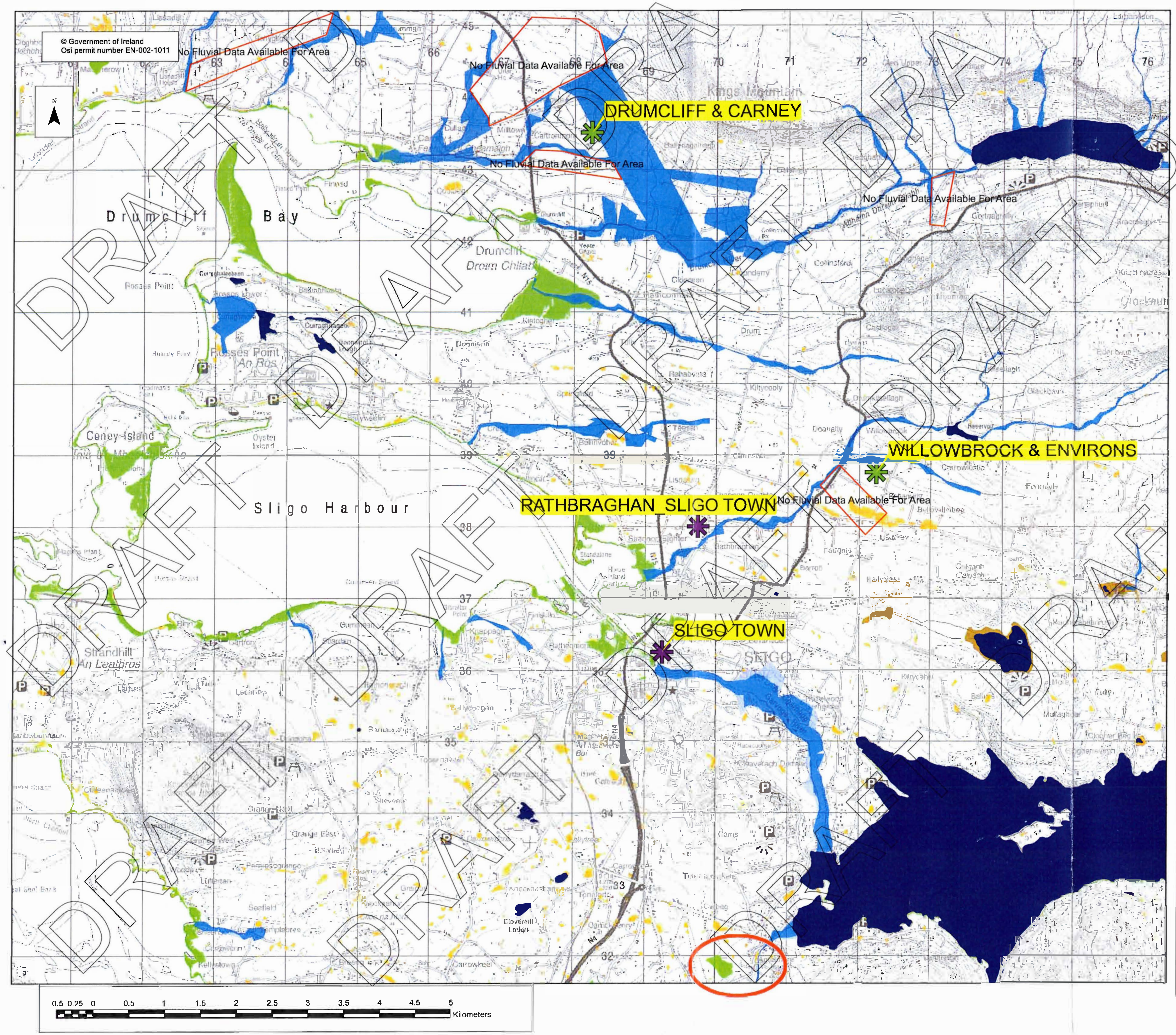
Project :
PRELIMINARY FLOOD RISK ASSESMENT (PFRA)

Map :
PFRA Indicative extents and outcomes
- Draft for Consultation

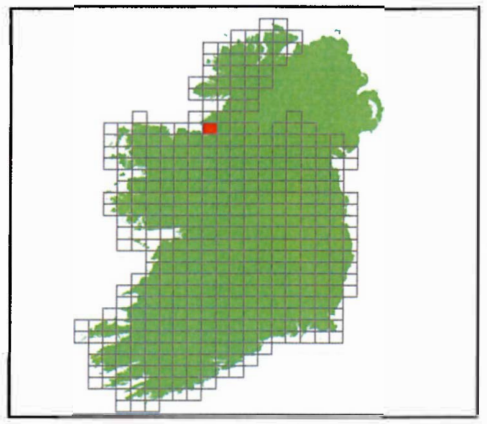
Figure By : PJW — Date : July2011
Checked By : MA — Date : July 2011

Figure No. : 2019 / MAP / 351 / A
Revision 0

Drawing Scale : 1:50,000
Plot Scale : 1:1 @ A3



Location Plan :



Legend:

Flood Extents

- 🟦 Fluvial - Indicative 1% AEP (100-yr) Event
- ▢ Fluvial - Extreme Event
- 🟩 Coastal - Indicative 0.5% AEP (200-yr) Event
- ▢ Coastal - Extreme Event
- 🟨 Pluvial - Indicative 1% AEP (100-yr) Event
- ▢ Pluvial - Extreme Event
- 🟫 Groundwater Flood Extents
- ■ Lakes / Turloughs

PFRA Outcomes

- ✳ Probable Area for Further Assesment
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Important User Note:

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Office of Public Works
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PRELIMINARY FLOOD RISK ASSESMENT (PFRA)

Map :
PFRA Indicative extents and outcomes
- Draft for Consultation

Figure By : PJW	Date : July2011
Checked By : MA	Date : July 2011
Figure No. : 2019 / MAP / 368 / A	Revision 0
Drawing Scale : 1:50,000	Plot Scale : 1:1 @ A3

APPENDIX 7-8 SITE PHOTOGRAPHS

Plate 7-1: Quarry floor dry, pumping ongoing (12/7/2017)

Plate 7-2: Quarry floor flooded, no pumping (24/5/2018)

Plate 7-3: Eastern part of application site (note ponding due to heavy rainfall)

Plate 7-4: Eastern part of application site (note ponding due to heavy rainfall)

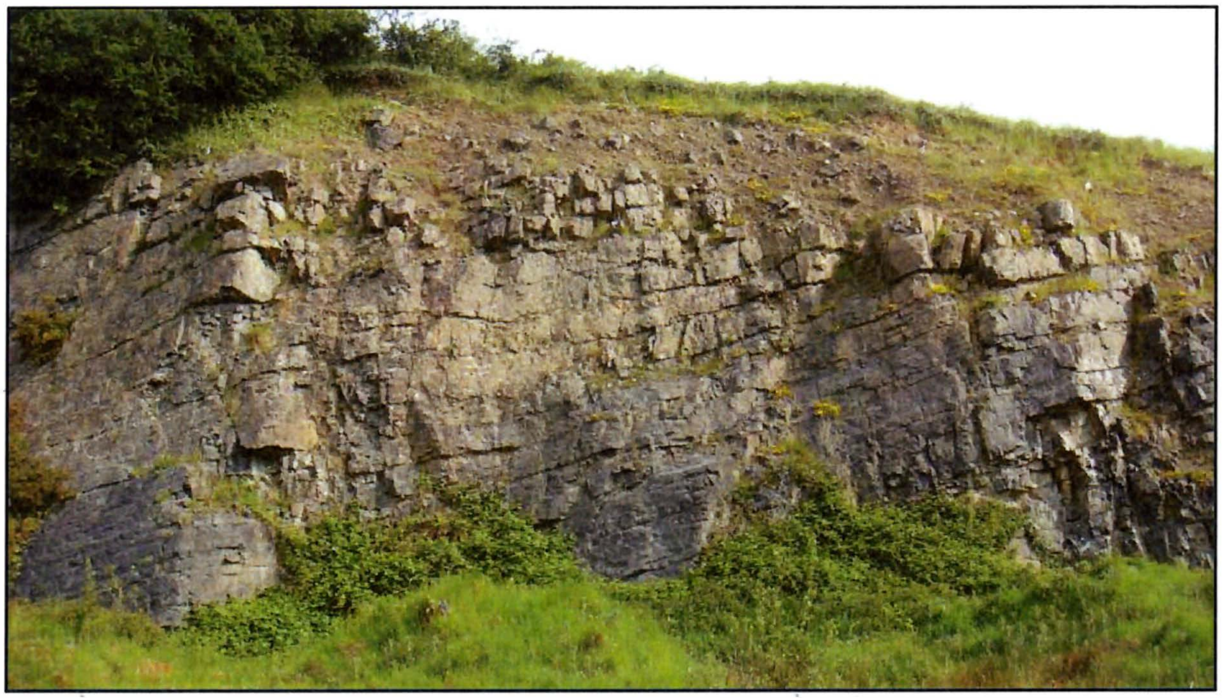

Plate 7-5: Typical profile of shallow depth to bedrock, with thin weathered zone at the top of rock (access road into quarry)

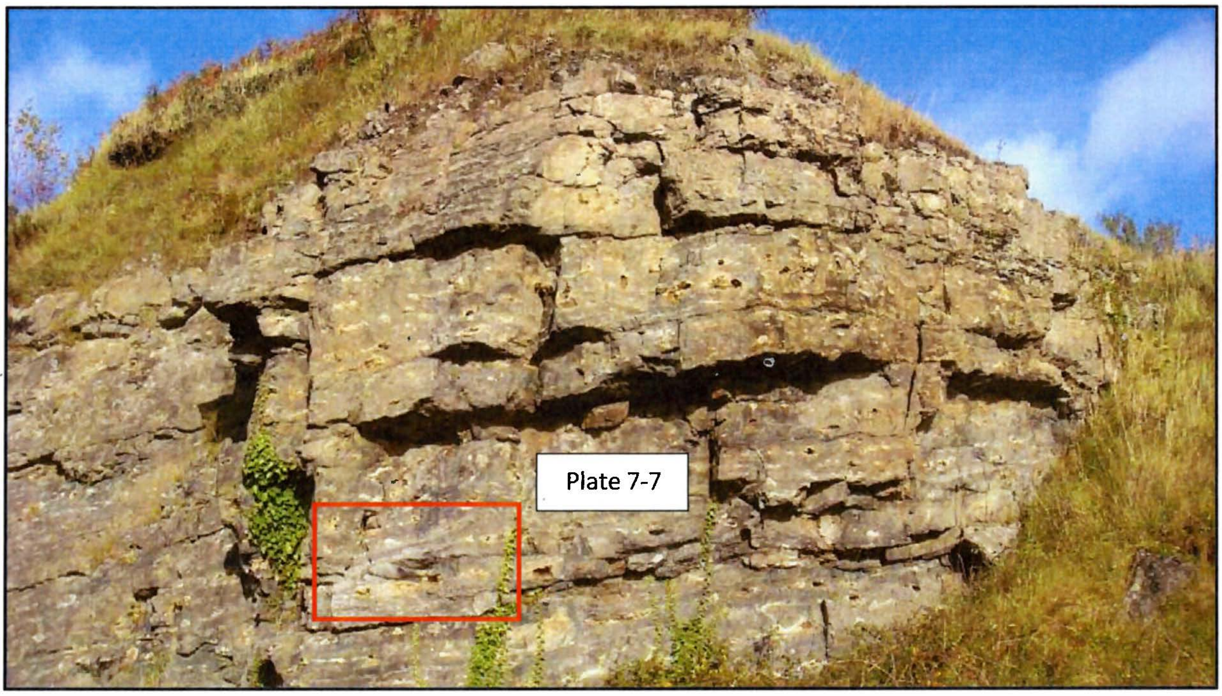

Plate 7-6: Weathered section of massive limestone beds showing infilled cavities (replaced colonial coral fossils) delineating bedding

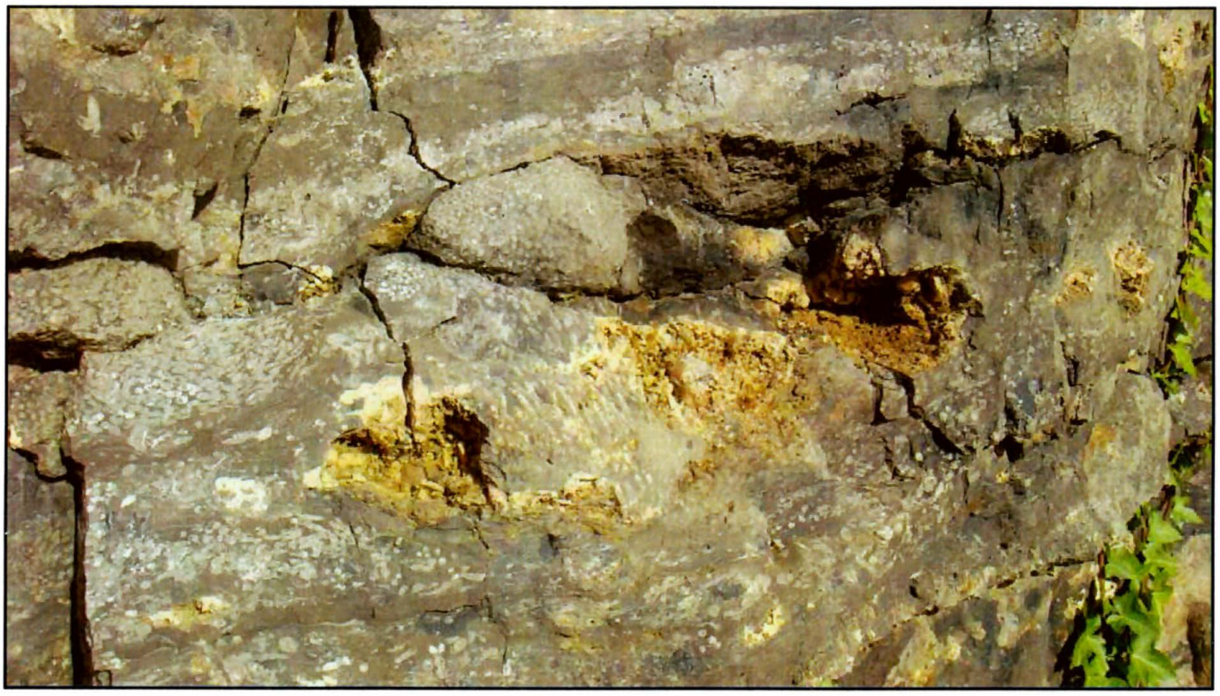

Plate 7-7: Close-up of Plate 7-6 showing colonial corals (weathered and unweathered)

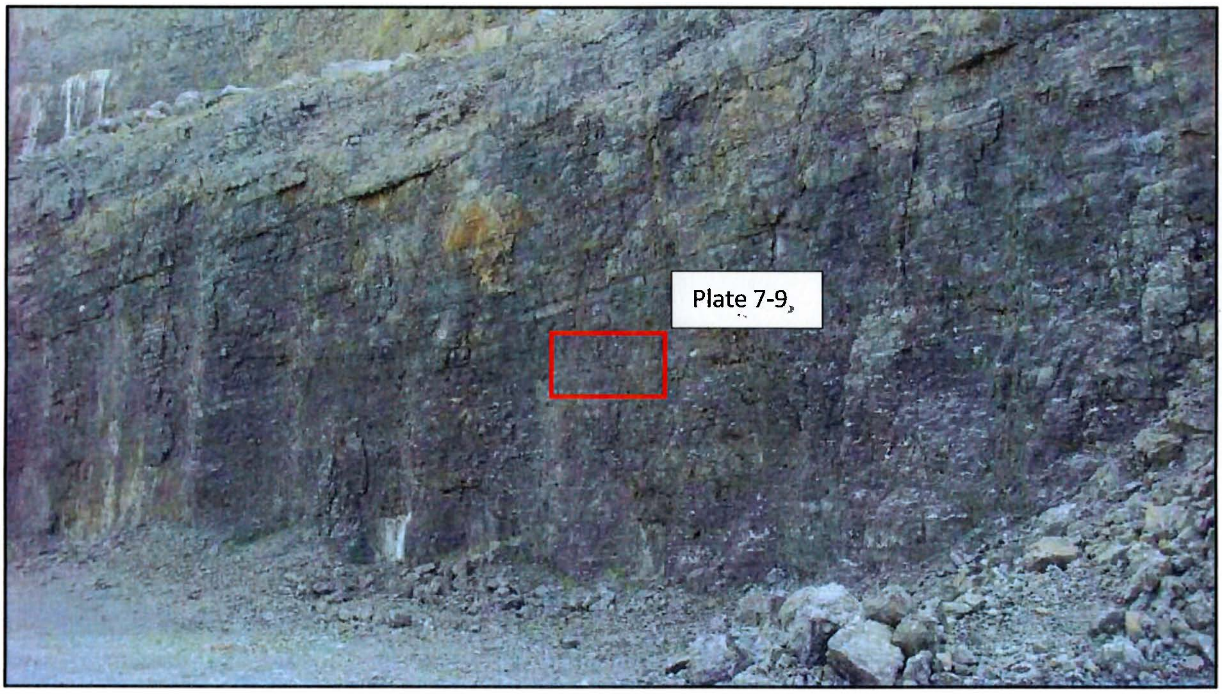

Plate 7-8: Massive limestone beds with weathered 'vuggy' cavities delineating bedding

Plate 7-9: Close-up of Plate 7-12 showing weathered 'vuggy' cavities, unconnected

Plate 7-10: Location of only deep weathered zone noted in quarry

Plate 7-11: Localised weathered zone at base of quarry, the only deep weathered zone noted, preferential weathering of particularly fossiliferous area in limestone (no conduits)

Plate 7-12: Close-up of Plate 7-11

Plate 7-13: Close-up of Plate 7-12 (note weathering of pockets of colonial coral fossils)

Plate 7-14: Large sub-vertical fault in east of quarry

Plate 7-15: Groundwater inflows at northwest corner of quarry (shallow entry but cascading down face, leaving staining/calcium-carbonate deposits)

Plate 7-16: Groundwater inflows from epikarst at northwest corner of quarry (photographed from above Plate 7-15 location)

Plate 7-17: Same location as Plate 7-16 in dry spell, inflow zones denoted by calcium-carbonate deposits

Plate 7-18: Groundwater inflows from epikarst at northeast corner of quarry

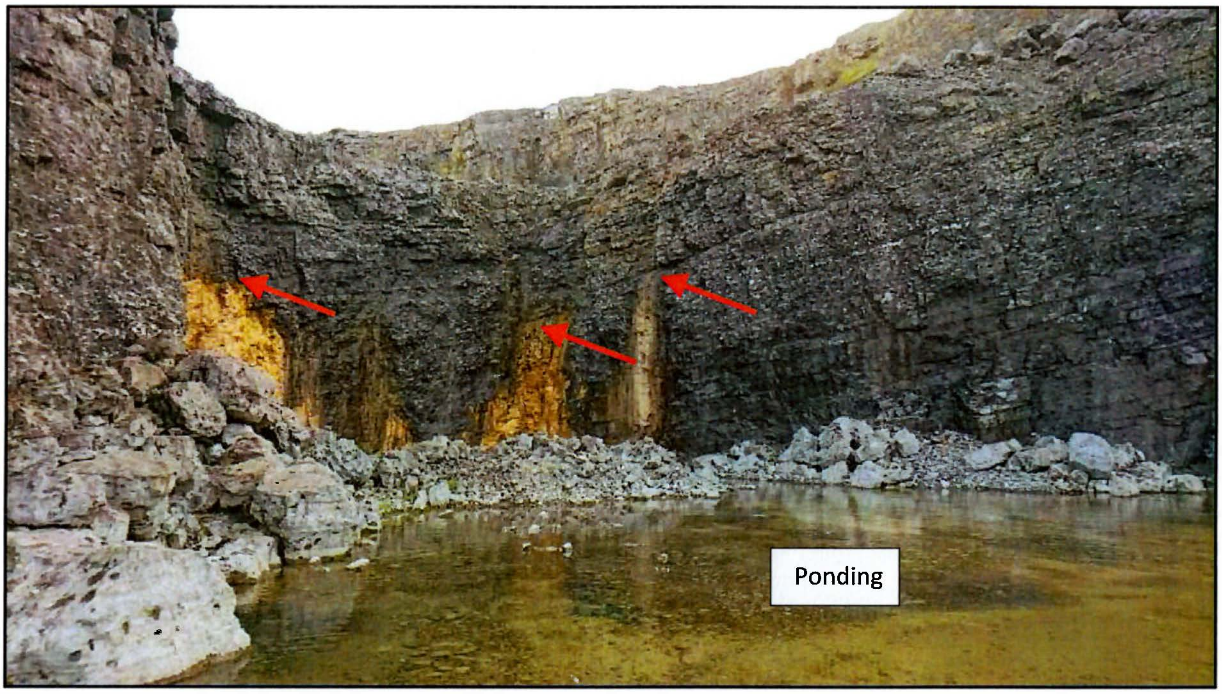

Plate 7-19: Same location as Plate 7-18 from different angle

Plate 7-20: Groundwater inflows at southwest corner of quarry (epikarst higher up face)

Plate 7-21: Groundwater inflow on quarry floor, elongate along quarry wall (rising of groundwater flow along bedding planes)

APPENDIX 7-9 DISCHARGED WATER SAMPLES

Discharged Water Samples (all available)

Cemex/Golders Samples:

	Units	Discharge	Discharge	Discharge	Discharge	Discharge	Discharge	Discharge	Discharge	Discharge	Discharge	Discharge	Discharge	Discharge			Emission Limit Value
		02/07/2007	26/08/2008	30/07/2009	31/08/2009	30/10/2009	26/02/2010	30/04/2010	31/05/2010	30/06/2010	30/07/2010	27/08/2010	02/09/2010	19/04/2011			
Temperature	°C	10.9	9.9	-	-	-	-	-	-	-	-	-	-	11.1			20
pH	-	7.2	7.7	-	-	-	-	-	-	-	-	-	8.08	8.24			6 - 9
Biological Oxygen Demand	mg/l O_2	< 2	2	4	8	1	< 1	4	4	4	2	4	2	< 1			2
Total Ammonia	mg/l N	0.049	0.008	0.008	0.008	< 0.008	< 0.008	< 0.008	0.09	0.025	0.008	< 0.008	0.33	0.02			0.1
Total Suspended Solids	mg/l	< 2	5	60	1	1.5	1.3	< 1	2.8	2	5	< 1	15	< 10			25
Molybdate Reactive Phosphorus (MRP)	mg/l P	< 0.002	0.02	< 0.01	0.07	0.1	0.03	0.12	0.08	0.07	< 0.01	0.14	< 0.019	< 0.005			0.05
Total Phosphorus	mg/l P	0.05	0.05	-	-	-	-	-	-	-	-	-	-	-			2
Sulphates	mg/l	37	24	-	-	-	-	-	-	-	-	-	51.3	47.6			200
Hydrocarbons (EPH)	mg/l	< 0.02	< 0.001	-	-	-	-	-	-	-	-	-	< 0.01	< 10			1

TMS Samples:

	Units	Discharge (W)	Discharge (E)	Discharge (W)	Discharge (E)	Discharge (W)	Discharge (E)	Discharge (W)	Discharge (E)	Discharge (W)	Discharge (E)	Discharge (W)	Discharge (E)	Discharge (W)	Discharge (W)	Discharge (W)	Emission Limit Value
		22/02/2016	22/02/2016	31/03/2016	31/03/2016	19/04/2016	19/04/2016	06/05/2016	06/05/2016	15/06/2016	15/06/2016	30/01/2018	30/01/2018	27/02/2018	27/03/2018	23/04/2018	
Temperature	°C	-	-	-	-	-	-	-	-	-	-	7.1	7.3	3.3	8.4	11.9	20
pH	-	8	8	8.1	8.1	8.14	8.18	8.12	8.19	8.23	8.24	7.96	7.9	8.39	8.18	8.03	6 - 9
Biological Oxygen Demand	mg/l O_2	< 2	< 2	< 2	< 2	2.24	< 2	3.55	3.43	21.9	11.9	< 1	< 1	< 2	< 1	< 1	2
Total Ammonia	mg/l N	0.04	0.04	0.03	0.03	0.02	0.02	< 0.41	< 0.41	< 0.41	< 0.41	< 0.02	< 0.02	< 0.02	< 0.02	0.02	0.1
Total Suspended Solids	mg/l	< 3	< 3	10.3	< 3	< 3	< 3	3.1	< 3	< 3	< 3	< 3	< 3	< 3	< 3	< 3	25
Orthophosphate	mg/l P	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.02	< 0.02	< 0.02	< 0.02	0.02	0.05
Total Phosphorus	mg/l P	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	2
Sulphates	mg/l	23.5	25.6	25.6	25.1	29	28	29.5	28.7	31.6	29.9	24	24.6	3	3.8	2.5	200
Hydrocarbons (TPH)	mg/l	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.5	< 0.5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	1

TMS Samples (cont.):

	Units	Discharge (W)	Discharge (W)	Discharge (W)	Discharge (W)	Discharge (W)	Discharge (W)	Discharge (W)	Discharge (W)	Discharge (W)	Discharge (W)	Discharge (W)	Discharge (W)				Emission Limit Value
		27/08/2018	06/11/2018	07/01/2019	28/03/2019	26/08/2020	16/09/2020	13/10/2020	03/11/2020	14/12/2020	06/01/2021	02/02/2021	10/03/2021				
Temperature	°C	14.8	8.9	8.8	9.8	13.9	13.7	13.7	12.1	6.1	4.5	4.1	9.2				20
pH	-	8.65	7.38	8.51	7.89	8.41	8.55	8.33	8.51	7.95	8.49	8.19	7.93				6 - 9
Biological Oxygen Demand	mg/l O_2	< 1	< 1	< 1	< 1	2	2	6	< 1	< 1	< 2	2.4	< 2				2
Total Ammonia	mg/l N	0.03	< 0.02	< 0.02	0.31	< 0.02	< 0.02	0.03	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02				0.1
Total Suspended Solids	mg/l	< 3	< 3	< 3	14.6	< 3	7.2	< 3	< 3	4	< 3	4.8	3.5				25
Orthophosphate	mg/l P	< 0.02	0.2	< 0.02	< 0.02	< 0.02	0.06	0.03	< 0.02	< 0.02	< 0.02	<0.02	<0.02				0.05
Total Phosphorus	mg/l P	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.02	< 0.02	< 0.05	< 0.05				2
Sulphates	mg/l	< 2	35.7	25.8	15.3	20.3	24.8	31.4	25.9	-	-	-	-				200
Hydrocarbons (TPH)	mg/l	< 0.01	< 0.01	< 0.01	-	< 0.01	0.013	< 0.01	< 0.01	-	-	-	-				1

Notes:

1. Trade Effluent Discharge Licence DL(W)139 (issued 9/12/2011)
2. All TMS Environment samples are grab samples/all previous samples assumed to be grab samples
3. Two discharge pipes at discharge point: W - West bank, E - East bank
4. Condition 2.1.3 of the licence: for discrete sampling, no grab sample shall exceed 1.2 times the Emission Limit Value (other than pH and temperature)
5. Condition 3.4 of licence: discharge will not cause receiving water to exceed limits in the Surface Water Regulations

▨ Concentration shaded where ELV exceeded

tms environment ltd

APPENDIX 7-10 GROUNDWATER SAMPLES

Groundwater Samples

			MW1					MW2					MW3					MW4					MW5		
	Parameter	Units	08/02/2018	19/04/2018	28/08/2018	05/02/2019	06/10/2020	08/02/2018	19/04/2018	28/08/2018	05/02/2019	06/10/2020	08/02/2018	19/04/2018	28/08/2018	05/02/2019	06/10/2020	08/02/2018	19/04/2018	28/08/2018	05/02/2019	06/10/2020	08/02/2018	19/04/2018	28/08/2018
Field	Temperature	°C	9.1	9.9	11.3	9.7	11.0	9.5	10.8	-	10.1	11.3	9.0	10.8	11.8	9.9	11.5	8.6	10.3	11.6	10.2	11.2	9.7	10.4	11.7
	Conductivity (field)	µS/cm @ 25°C	379	-	360	398	620	896	815	-	420	645	887	760	844	399	637	830	460	656	440	642	645	669	676
	pH	-	8.01	8.11	7.74	7.31	7.43	7.18	7.17	-	7.45	7.38	7.13	7.09	7.05	7.38	7.28	7.22	7.35	7.13	7.07	7.80	7.33	7.40	7.44
	Dissolved Oxygen [1]	% sat	88.7	90.1	86.5	98.4	89.6	66.2	70.5	-	96.3	87.2	41.0	53.6	76.5	97.2	83.9	76.8	79.7	62.5	96.7	82.9	71.4	69.7	72.1
	Dissolved Oxygen [1]	mg/l O_2	8.79	9.07	8.59	10.88	8.87	6.51	7.41	-	10.72	8.55	4.06	5.45	7.42	10.77	8.42	7.67	7.86	6.07	10.76	8.16	7.07	6.84	7.35
Whole Sample	Conductivity (lab) [2]	µS/cm @ 25°C	373	348	366	383	616	888	914	-	427	639	883	-	836	383	638	820	479	655	443	638	633	703	679
	Total Suspended Solids [3]	mg/l	50.3	114	39.9	4.9	8.4	278	78.6	-	12	< 3	149	> 200	27	23.2	7	84.8	186	43	7.6	< 3	180	70.1	93.6
	Turbidity [3]	NTU	65.3	76.8	0.4	7.1	0.65	143	101	-	0.23	3.92	22.4	14.3	0.48	0.61	1.21	140	80.3	0.42	0.22	0.78	31.9	47.3	96
	Biological Oxygen Demand	mg/l O_2	< 2	< 2	< 2	< 2	2	< 2	< 2	-	< 2	2.3	3.51	< 2	< 2	< 2	2.2	< 2	< 2	< 2	< 2	2.5	3.34	< 2	< 2
	Total Organic Carbon	mg/l	4.2	3.7	3.9	3.9	< 0.3	1.8	0.6	-	2	< 0.3	0.5	< 0.3	0.9	0.9	1.7	0.4	<0.3	1	1.2	4.2	0.7	0.5	0.8
	Total Alkalinity	mg/l $CaCO_3$	171	160	174	182	-	378	428	-	198	-	344	430	410	192	-	366	218	328	216	-	254	330	318
Major Constituents	Calcium	mg/l	55.5	53.4	57.1	51.2	87.9	149	137	-	61.3	87.5	85.7	125	134	53.8	87.2	123	75.6	120	65.9	72.9	73.4	98.5	111
	Magnesium	mg/l	12	12.5	11.7	10.6	16.7	24.1	26.4	-	10.9	16.8	24.5	24.2	25.6	11	17.6	28.1	10.8	13.5	10.6	20.2	20.5	26.7	31.9
	Sodium	mg/l	7.7	7.08	6.98	7	16.8	10	11.8	-	5.98	17.4	10.3	10.8	13.2	6.18	19.9	9.68	6.48	6.08	5.8	31.3	9.13	9.39	11.9
	Potassium	mg/l	0.59	0.62	0.84	0.72	1.12	2.17	1.65	-	0.66	1.16	2.34	1.69	2.58	0.73	1.27	0.62	1.03	1.63	0.6	1.84	1.34	0.65	1.27
	Bicarbonate	mg/l	209	195	212	222	-	461	522	-	242	-	420	525	500	234	-	447	266	400	264	-	310	403	388
	Chloride	mg/l	18.4	9.43	11.5	16.5	40	27.8	29.3	-	15.5	39.5	25.3	25.3	29	15	41	16.9	7.94	6.5	13.5	74	18.9	15.4	17.5
	Sulphate	mg/l	3.54	6.3	7.6	7.74	14.1	1.17	5.94	-	10.7	16.8	9.63	22.1	22.9	0.93	19.4	28.8	26.7	27.6	15	31.4	15.1	43.1	26.4
Minor Constituents	Fluoride	mg/l	0.09	1.27	0.19	0.08	0.19	0.07	0.23	-	0.22	0.18	0.22	0.32	0.33	0.09	0.17	0.59	0.14	0.35	0.33	0.17	0.79	0.14	0.45
	Nitrate	mg/l NO_3	1.76	3.74	1.86	2.23	< 4.43	7.66	11.2	-	1.02	< 4.43	5.5	7.97	2.58	2.08	< 4.43	7.62	2.99	3.79	< 1	< 4.43	3.58	1.83	< 1
	Nitrite	mg/l N	0.006	0.005	0.004	0.013	< 0.002	0.015	0.004	-	< 0.002	< 0.002	0.002	0.003	0.006	0.007	< 0.002	0.024	0.008	0.008	0.006	< 0.002	0.002	0.004	0.004
	Total Ammonia	mg/l N	< 0.02	0.03	< 0.02	< 0.02	< 0.02	0.09	0.02	-	< 0.02	< 0.02	< 0.02	0.04	< 0.02	< 0.02	< 0.02	< 0.02	0.03	< 0.02	< 0.02	< 0.02	< 0.02	0.02	< 0.02
	Total Nitrogen	mg/l N	< 1	< 1	2.4	2.3	< 1	< 1	2.7	-	1	< 1	< 1	1.9	2.1	2.5	< 1	< 1	< 1	3.1	2.8	< 1	< 1	< 1	0.5
	Orthophosphate	mg/l P	< 0.02	< 0.02	< 0.02	0.02	< 0.02	< 0.02	0.02	-	0.04	< 0.02	< 0.02	0.02	< 0.02	0.04	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
	Total Phosphorus	mg/l P	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	0.12	< 0.12	-	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
	Iron (Dissolved) [4]	mg/l	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	-	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
	Manganese (Dissolved) [4]	mg/l	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	0.013	0.01	-	< 0.007	< 0.007	0.046	< 0.007	0.149	< 0.007	< 0.007	< 0.007	< 0.007	0.008	< 0.007	0.007	0.012	< 0.007	0.008
Trace Metals	Aluminium (Dissolved) [4]	µg/l	< 100	< 100	< 100	< 100	< 100	< 100	< 100	-	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100
	Arsenic (Dissolved) [4]	µg/l	< 1	< 1	-	< 1	0.38	< 1	< 1	-	< 1	0.32	< 1	< 1	-	< 1	0.31	1.2	< 1	-	< 1	1.1	1.2	< 1	-
	Boron (Dissolved) [4]	µg/l	< 230	< 230	< 230	< 230	< 230	< 230	< 230	-	< 230	640	< 230	< 230	< 230	< 230	< 230	< 230	240	< 230	< 230	< 230	< 230	< 230	< 230
	Cadmium (Dissolved) [4]	µg/l	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	-	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
	Chromium (Dissolved) [4]	µg/l	< 2	< 2	< 2	< 2	< 2	< 2	< 2	-	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
	Copper (Dissolved) [4]	µg/l	< 9	< 9	< 9	< 9	10	< 9	< 9	-	< 9	11	< 9	< 9	< 9	< 9	20	< 9	< 9	< 9	< 9	< 9	15	< 9	< 9
	Lead (Dissolved) [4]	µg/l	< 6	< 6	< 6	< 6	< 6	< 6	< 6	-	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6
	Mercury (Dissolved) [4]	µg/l	< 0.01	< 0.01	0.31	< 0.2	< 0.01	< 0.01	< 0.01	-	< 0.2	< 0.01	< 0.01	< 0.01	< 0.01	< 0.2	< 0.01	< 0.01	< 0.01	0.12	< 0.2	< 0.01	< 0.01	0.01	< 0.01
	Nickel (Dissolved) [4]	µg/l	< 3	< 3	< 3	< 3	< 3	9	5	-	< 3	< 3	8	3	8	< 3	< 3	22	8	7	< 3	< 3	19	< 3	4
	Selenium (Dissolved) [4]	µg/l	< 0.8	< 0.8	< 0.8	< 0.8	< 0.6	< 0.8	< 0.8	-	1.42	< 0.6	2.8	0.86	2.41	< 0.8	< 0.6	1.71	0.99	< 0.8	1.76	0.76	< 0.8	< 0.8	< 0.8
	Zinc (Dissolved) [4]	µg/l	< 18	30	< 18	< 18	< 18	< 18	70	-	< 18	< 18	< 18	30	44	< 18	20	< 18	40	< 18	< 18	< 18	21	< 18	< 18
Hydrocarb	Total Petroleum Hydrocarbons	µg/l	< 10	< 10	< 10	< 10	< 100	< 10	< 10	-	< 10	< 10	< 10	< 10	< 10	< 10	< 100	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Volatile Organic Compounds	µg/l	< 1	< 1	< 1	< 1	< 1	< 1	< 1	-	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
	Polycyclic Aromatic Hydrocarbons	µg/l	< 0.1	< 0.1	< 0.1	< 0.1	-	< 0.1	< 0.1	-	< 0.1	-	< 0.1	< 0.1	< 0.1	< 0.1	-	< 0.1	< 0.1	< 0.1	< 0.1	-	< 0.1	< 0.1	< 0.1
Micro	Total Coliforms	mpn/100ml	166	> 2420	> 2420	79	2	0	24	-	131	12	24	104	> 2420	68	9	0	7	1414	2	162	1	36	> 2420
	Faecal Coliforms	mpn/100ml	112	687	416	88	1	6	10	-	190	6	25	89	276	108	1	1	5	921	2	83	1	96	14
	E. coli	mpn/100ml	42	4	173	25	0	0	12	-	34	1	21	5	345	30	0	0	0	1046	0	73	1	0	4

Notes:

1. Dissolved Oxygen measured in bucket, indicative only
2. Conductivity (lab) converted to 25°C reference temperature assuming 2%/°C
3. Elevated Total Suspended Solids and Turbidity related to sampling method (bailer), not representative of mobile levels
4. Iron, Manganese and Trace Metals filtered on site using 0.45µm filter and preserved with nitric acid
5. European Union Environmental Objectives (Groundwater)(Amendment) Regulations 2016 (S.I. No. 366 of 2016)
6. European Union (Drinking Water) Regulations 2014 (S.I. No. 122 of 2014)
7. Corrected to 25°C
8. No Abnormal Change
9. Converted to mg/l N

Concentration shaded where threshold/limit value exceeded

Groundwater Samples

		MW6					MW7					MW8					MW9					MW10c					
05/02/2019	06/10/2020	08/02/2018	19/04/2018	28/08/2018	05/02/2019	06/10/2020	08/02/2018	19/04/2018	28/08/2018	05/02/2019	06/10/2020	08/02/2018	19/04/2018	28/08/2018	05/02/2019	06/10/2020	08/02/2018	19/04/2018	28/08/2018	05/02/2019	07/10/2020	08/02/2018	19/04/2018	28/08/2018	05/02/2019	06/10/2020	08/02/2018
9.6	11.2	9.9	10.6	11.8	9.5	11.2	10.2	10.9	11.7	10.1	11.1	9.5	10.4	11.2	10.0	11.0	9.3	10.1	11.2	10.4	11.6	10.0	10.8	11.4	9.9	11.0	9.6
594	655	641	643	684	620	661	1142	397	688	640	673	676	481	795	455	660	756	663	786	707	762	576	373	542	666	663	910
7.51	7.19	7.40	7.42	7.37	7.60	7.65	7.11	7.02	7.39	7.55	7.57	7.15	7.21	7.23	7.11	7.80	7.31	7.39	7.23	7.01	8.01	7.35	7.38	7.21	7.39	7.09	7.17
93.7	84.1	68.7	70.3	75.4	86.5	85.7	80.6	85.8	68.5	82.1	83.1	66.1	72.5	73.6	87.5	84.7	58.2	55.4	90.6	44.2	90.3	77.5	82.6	55.2	65.7	92.4	80.2
10.44	8.25	6.92	7.02	7.48	9.70	8.38	7.99	8.64	6.82	9.08	8.32	6.42	7.50	7.45	9.78	8.52	5.72	5.53	8.97	4.97	8.91	7.62	8.31	5.17	7.43	9.07	8.18
630	645	635	575	684	-	646	1122	450	691	638	648	671	507	739	443	642	792	754	749	733	756	572	391	548	634	649	869
81.5	<3	313	>200	491	10.9	7.7	227	35	560	144	<3	83.6	49.7	237	<3	4.8	101	32.6	1921	22.5	151	<3	35	654	70	4.3	228
2.5	1.58	104	7.3	369	0.57	8.23	77.1	101.4	340	1.05	1.66	87.4	92.3	311	0.4	0.36	59.4	62.7	718	3.21	5.33	1.74	1.34	296	2.9	0.1	563
<2	<2	3.98	<1	2.2	2.31	<2	<2	<2	<2	10.32	<2	1.93	<2	<2	<2	2.3	2.85	<2	4.22	<2	9.1	<2	<2	<2	9.9	<2	<2
0.6	3.3	0.8	1.2	0.6	0.7	<0.3	1.2	1.5	1.5	1	<0.3	1.15	0.9	1.2	<0.3	3.2	2.7	3.8	2.2	2.4	8.4	<0.3	<0.3	<0.3	<0.3	5.1	1.4
294	-	274	296	322	370	-	330	218	322	308	-	304	244	336	214	-	286	328	332	326	-	286	178	262	302	-	336
90.5	111	115	101	159	100	117	200	72.2	172	89.5	114	123	83.2	139	67.1	83.1	117	109	378	109	116	95.7	58.2	193	88.4	114	135
18.2	15.3	28.9	27.6	58.7	20.9	15.9	61.5	10.6	64.3	20.2	15.7	15	11.8	29	10.8	23.3	20.5	20.3	39	19.8	18.6	11.5	11.3	52	20.2	15.6	22.9
9.24	5.82	6.56	9.44	10.7	9.3	5.84	12.2	6.5	4.9	10.2	5.16	1.67	7.01	12.6	5.7	35.9	27.7	21.5	29	17	16.9	1.37	1.08	9.51	9.96	5.78	18.4
1.48	0.64	0.78	0.68	1.53	3.65	0.67	0.8	0.83	1	5.84	0.66	1.17	1.1	1.41	0.58	2.12	5.11	3.15	4.32	1.07	7.19	0.53	0.74	1.16	1.34	0.66	1.59
359	-	334	361	393	451	-	403	266	393	376	-	371	298	412	261	-	349	400	405	359	-	349	217	320	332	-	410
15.5	16.5	15.4	14.9	21	14	16.5	15.9	9.93	18	17.5	15.5	18.4	8.93	19	14.5	71	54.1	41.2	38.5	30	50	17.4	12.9	17.7	16.5	16	45.2
18.3	7.16	18	33.5	34.7	23.5	5.68	308	18.3	50.6	2.55	3.48	10.7	25.9	45.8	9.5	33.6	19.5	29	51.3	8.43	47.9	<2.0	17.2	18.2	19	7.99	16.8
0.85	0.16	0.15	0.26	0.17	0.87	0.16	0.06	0.32	0.12	0.71	0.16	0.18	0.54	1	0.35	0.15	0.10	0.11	0.18	0.05	0.12	0.15	0.17	0.23	0.69	0.18	0.09
4.78	<4.43	<1	2.99	<1	4.73	<4.43	<1	4.97	<1	3.76	<4.43	2.56	4.67	1.12	3.85	<4.43	9.46	4.9	3.53	1.75	<4.43	2.3	3.35	4.28	4.21	<4.43	1.34
0.011	<0.002	0.002	0.006	0.003	0.022	<0.002	0.006	0.008	0.002	0.031	<0.002	0.014	0.005	0.005	0.02	<0.002	0.006	0.004	0.004	0.022	<0.002	0.002	0.005	0.002	0.027	<0.002	0.032
0.09	<0.02	0.04	0.03	<0.02	0.09	<0.02	<0.02	0.03	<0.02	0.16	0.03	0.26	0.04	<0.02	<0.02	<0.02	<0.02	0.05	0.15	<0.02	0.3	<0.02	0.03	<0.01	0.08	<0.02	0.06
1.3	<1	<1	<1	2.3	4.1	<1	<1	1.2	1.3	2.9	<1	<1	1.1	1	1.9	<1	<1	1.2	2.1	2.4	1.09	<1	<1	2.5	3	<1	<1
<0.02	0.02	<0.01	0.04	<0.02	0.05	0.02	<0.02	0.03	<0.02	0.05	<0.02	<0.02	0.03	<0.02	0.02	0.02	<0.02	<0.02	<0.02	0.02	0.29	<0.02	<0.01	<0.01	0.04	0.03	<0.02
<0.12	<0.12	<0.12	<0.12	0.29	<0.12	<0.12	<0.12	<0.12	0.13	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	<0.12	0.20	<0.12	<1.2	<0.12	0.26	<0.12	<0.12	0.3	<0.12	<0.12	0.27
<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	0.67	<0.23	0.35	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23
<0.007	<0.007	0.027	0.01	0.007	0.008	<0.007	0.513	<0.007	0.056	0.017	<0.007	0.008	<0.007	<0.007	<0.007	0.01	<0.007	0.335	0.463	0.435	<0.007	<0.007	<0.007	<0.007	0.019	<0.007	0.058
<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
1.3	0.37	<1	6.2	-	1.8	0.3	4.3	<1	-	2.6	0.32	<1	<1	-	<1	1.1	<1	<1	-	<1	0.32	<1	<1	-	2.6	0.32	1.3
<230	<230	<230	<230	<230	<230	<230	<230	<230	<230	<230	<230	<230	<230	<230	<230	470	<230	<230	<230	<230	<230	<230	<230	<230	<230	410	<230
<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2	<2	<2	<2	<2	<2
<9	10	<9	<9	<9	<9	9	<9	<9	<9	<9	10	<9	<9	<9	<9	<9	<9	<9	<9	<9	19	<9	<9	<9	<9	10	<9
<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6
<0.2	<0.01	<0.01	<0.01	<0.01	<0.2	<0.01	<0.01	<0.01	<0.01	<0.2	<0.01	<0.01	<0.01	0.03	<0.2	<0.01	0.01	<0.01	<0.01	<0.2	0.03	<0.01	<0.01	0.04	<0.2	<0.01	0.04
16	<3	12	11	10	15	<3	127	<3	4	14	<3	8	7	16	3	4	7	11	12	12	<3	5	4	11	14	<3	7
<0.8	<0.6	<0.8	<0.6	<0.8	<0.8	<0.6	<0.8	<0.8	<0.8	<0.8	<0.6	<0.8	<0.8	1.07	2.48	0.89	<0.8	<0.8	<0.8	<0.8	<0.6	<0.8	<0.8	0.88	<0.8	<0.6	1.26
<18	<18	<18	60	<18	<18	<18	<18	<18	<18	<18	<18	<18	30	<18	<18	<18	60	70	<18	<18	<18	<18	30	<18	<18	<18	<18
<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
<0.1	-	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	-	<0.1
0	6	29	40	689	1	13	0	114	>2420	57	4	4	0	3	1	98	10	0	1	43	548	0	122	214	25	8	57
0	5	21	47	133	0	3	2	276	>2420	46	5	15	2	1	2	53	4	0	0	56	5	0	138	5	25	0	29
0	1	4	0	73	1	0	0	0	0	10	0	4	0	3	0	41	5	0	0	24	3	0	1	1	12	3	13

Groundwater Samples

MW11				MW12	MW13	MW14	MW15	MW16	MW17	MW18	MW19	MW20	MW21	MW22	MW23	MW24	MW25	Old Well	Groundwater Threshold Values [5]	Drinking Water Parametric Values [6]
19/04/2018	28/08/2018	05/02/2019	06/10/2020	06/10/2020	06/10/2020	06/10/2020	07/10/2020	07/10/2020	07/10/2020	06/10/2020	06/10/2020	07/10/2020	07/10/2020	07/10/2020	07/10/2020	07/10/2020	07/10/2020	07/10/2020		
10.3	11.7	11.0	11.1	11.4	11.6	11.3	11.6	11.5	11.5	11.0	11.3	11.3	11.5	11.6	11.6	11.4	11.5	11.2	-	-
315	823	440	641	632	609	634	335	352	373	644	652	702	551	761	344	502	274	738	800 - 1875	2750 [7]
7.22	7.25	7.27	7.33	7.08	7.16	7.14	7.12	7.08	7.33	7.31	7.23	7.24	7.17	7.14	7.18	7.18	7.21	7.46	-	≥ 6.5 and ≤ 9.5
83.8	58.2	87.7	86.8	80.8	80.7	81.2	81.5	80.5	79.3	76.8	76.6	83.3	81.9	82.9	79.3	75.5	73.3	91.2	-	-
8.37	5.71	9.74	8.72	8.02	8.02	8.14	8.18	8.02	7.96	7.62	7.59	8.26	8.13	8.17	7.19	7.18	7.22	9.07	-	-
348	813	397	638	638	616	639	310	311	352	636	639	684	542	743	344	504	274	735	800 - 1875	2750 [7]
20.1	393	78.4	8.4	5.2	64.7	6	2490	127	12021	< 3	< 3	1632	850	5072	14219	9067	392	36.7	-	-
415	657	16.9	0.82	1.68	1.76	0.98	177	47.4	198	1.9	2.42	103	29.4	24.9	283	140	128	7.71	-	NAC [8]
< 2	< 2	< 2	2.5	2.4	2.1	2	2.3	< 2	< 2	< 2	< 2	9.5	11	< 2	2.4	2.3	< 2	3.1	-	-
2	1.7	1.2	3.8	4.8	2.8	6.6	5.1	4.5	9.3	4.5	7.3	2.9	17	6.8	4.7	< 0.3	0.3	1.1	-	NAC [8]
158	382	174	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50.2	129	57.9	92.4	69	72.4	71.6	-	36.7	-	112	84.7	-	97.2	102	-	-	101	109	-	-
10.7	28.4	10.8	17.4	19.2	20.1	19.9	-	9	-	15.4	18.3	-	25.4	28.3	-	-	19.2	19.7	-	-
6.6	13.2	6.5	17.7	30	31.6	30.8	22.8	30.7	29.6	6.04	22.1	12.9	13.6	22.4	36.4	< 6.0	6.88	20.6	-	200
0.58	1.45	0.67	1.17	1.75	1.83	1.8	6.67	9.94	-	0.64	1.38	6.78	-	-	-	-	2.75	4.29	-	-
193	466	191	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13.4	30	16.2	51	64	65	60.5	39	19.5	21	16	25.5	26	26	18	18.7	28.5	13.5	44.5	24 - 187.5	250
5.48	40	13.72	22.9	26.4	31.7	29.2	14.2	64.5	-	5.55	10.4	47.1	10.9	-	-	20.6	19.4	27.5	187.5	250
0.12	0.3	0.17	0.17	0.17	0.34	0.2	0.24	0.17	0.2	0.16	0.14	0.14	0.15	0.14	0.17	0.14	0.18	0.16	-	1.5
1.77	1.35	1.56	< 4.43	< 4.43	< 4.43	< 4.43	< 4.43	< 4.43	< 4.43	< 4.43	< 4.43	< 4.43	< 4.43	< 4.43	< 4.43	< 4.43	< 4.43	< 4.43	37.5	50
0.003	0.002	0.009	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.41	0.23	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.21	< 0.002	< 0.002	< 0.002	0.114 [9]	0.152 [9]
0.04	< 0.02	0.02	< 0.02	< 0.02	< 0.02	0.02	0.29	0.1	0.18	< 0.02	< 0.02	0.06	4.1	0.04	0.17	0.04	0.04	0.16	0.065 - 0.175	0.23 [9]
< 1	0.8	1.4	< 1	< 1	< 1	< 1	< 1	< 1	3.81	< 1	< 1	< 1	5.62	1.03	1.16	< 1	< 1	< 1	-	-
< 0.02	0.04	0.09	< 0.02	0.02	< 0.02	< 0.02	1.48	0.1	1.49	0.03	< 0.02	0.43	1.03	3.2	9.3	6.6	0.19	0.07	0.035	-
< 0.12	0.8	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	1.53	< 0.12	< 0.12	< 0.12	< 0.12	2.19	0.2	0.23	3.81	3.67	0.17	< 0.12	-	-
< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	-	0.2
< 0.007	< 0.007	< 0.007	< 0.007	0.01	< 0.007	0.009	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007	-	0.05
< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	150	200
< 1	-	< 1	0.32	1.1	1.1	1.2	0.33	0.32	0.36	0.29	0.3	0.31	0.31	0.32	0.33	0.35	0.36	0.36	7.5	10
< 230	< 230	< 230	< 230	< 230	840	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	-	1000
< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	-	5
< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	37.5	50
< 9	< 9	< 9	19	< 9	< 9	< 9	19	19	19	14	10	20	19	18	18	21	19	19	-	2000
< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	< 6	7.5	10
< 0.01	< 0.01	< 0.2	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.15	0.01	< 0.01	0.75	1
< 3	3	< 3	< 3	4	4	4	< 3	< 3	< 3	< 3	< 3	< 3	< 3	< 3	< 3	< 3	< 3	< 3	-	20
< 0.8	< 0.8	1.03	< 0.6	0.84	0.94	0.83	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	-	10
< 18	< 18	< 18	20	< 18	< 18	< 18	20	20	20	< 18	< 18	< 18	20	20	< 18	20	< 18	18	75	-
< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 40	< 10	< 10	< 10	< 10	< 20	7.5	-
< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	-	-
< 0.1	< 0.1	< 0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.075	0.1
205	313	228	30	65	50	93	> 2420	435	80	6	3	> 2420	0	1986	> 2420	1203	13	122	-	0
99	120	172	1	10	11	15	12	26	31	0	0	649	0	76	29	3	3	5	-	-
0	240	61	6	4	7	8	6	24	31	1	0	117	0	96	981	0	0	1	-	0

tms environment ltd

APPENDIX 7-11 SURFACE WATER SAMPLES

Surface Water Samples

	Parameter	Units	Upstream of Infilled Area (Off-Site)[16]				Downstream of Infilled Area (Off-Site)[16]				Upstream											
			26/08/2020	16/09/2020	13/10/2020	03/11/2020	26/08/2020	16/09/2020	13/10/2020	03/11/2020	30/01/2018	27/02/2018	27/03/2018	23/04/2018	27/08/2018	06/11/2018	07/01/2019	28/03/2019	26/08/2020	16/09/2020	29/09/2020	13/10/2020
Field	Temperature	°C	14.3	15.2	13	8.1	14.4	15.3	13.1	8.2	6.3	3.9	8.7	11.6	13	9.1	8.7	10.2	14.5	15.6	13.6	12.9
	Conductivity (field)	µS/cm @ 25°C	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	557	212	209	151	231	232	421	ND[3]	ND[3]	ND[3]	ND[3]
	pH	-	7.26	7.19	7.01	7.01	7.21	7.17	7.06	7.02	7.72	8.21	7.32	7.81	7.24	7.62	7.31	7.65	7.2	7.25	7.18	7.06
	Dissolved Oxygen	% sat	92.1	99.6	91.7	93.7	92.3	99.4	92	94.1	93.8	102.5	95.7	95.6	91.7	92.6	65.1	89.3	91.8	92.3	97.2	92.6
	Dissolved Oxygen	mg/l O_2	9.21	9.76	9.06	9.34	9.25	9.7	9.08	9.42	11.57	13.15	11.14	11.78	9.08	9.07	6.68	10.06	9.15	9.27	9.2	9.2
Whole Sample	Conductivity (lab)[1]	µS/cm @ 25°C	54	143	228	244	51	139	228	237	405	551	209	299	158	240	235	428	179	330	-	226
	Total Suspended Solids	mg/l	< 3	3.9	3.7	4	< 3	4.9	5.9	< 3	< 3	< 3	3.1	< 3	< 3	24.5	< 3	< 3	< 3	3.8	-	< 3
	Turbidity	NTU	0.68	0.98	1.46	0.66	0.98	1.03	1.18	0.36	1.4	1	0.98	2.09	0.98	5.38	1.88	0.87	1.52	1.26	-	3.41
	Biological Oxygen Demand	mg/l O_2	3	1	3	< 1	4	2	3	< 1	1	< 2	4	< 1	2	< 1	< 1	< 1	4	1	1	3
	Total Organic Carbon	mg/l	20	1.9	1.5	5.8	2.1	14.5	2.6	13.4	0.45	4	8.4	6.2	2.6	11.7	6.3	3.5	2.1	1.1	-	10.8
	Total Hardness	mg/l $CaCO_3$	-	-	-	-	-	-	-	-	169	217	66.5	112	54.8	85.8	88.1	199	-	-	-	-
Major Constit	Calcium	mg/l	-	-	-	-	-	-	-	-	50.9	68.2	19.7	34.7	17.5	27.1	27.7	62.8	-	-	-	-
	Magnesium	mg/l	-	-	-	-	-	-	-	-	10.2	11.4	4.2	6.1	2.7	4.4	4.6	10.3	-	-	-	-
	Chloride	mg/l	8.5	13.5	32	22	8	14.5	31	20	33.2	41.2	24	23.5	13	24.5	19	30.5	10.5	18.5	-	31
	Sulphate	mg/l	9.8	8.9	< 2	3.6	11.8	8.7	< 2	2.6	3.05	< 2	< 2	< 2	5.9	5.6	4.3	< 2	8.4	9.9	-	< 2
Minor Constituents	Nitrate	mg/l NO_3	< 4.43	< 4.43	< 4.43	< 4.43	< 4.43	< 4.43	< 4.43	< 4.43	4.76	5.38	3.69	3	1.1	2.6	< 3.10	25.52	5.4	4.56	-	< 4.43
	Nitrite	mg/l N	0.008	0.004	< 0.002	< 0.002	0.008	0.003	< 0.002	< 0.002	0.006	0.008	0.004	0.003	0.008	0.004	< 0.08	< 0.08	0.003	0.005	-	< 0.002
	Total Ammonia	mg/l N	< 0.02	< 0.02	0.04	< 0.02	0.04	< 0.02	0.05	< 0.02	0.03	0.03	0.03	0.05	0.05	< 0.02	0.03	0.34	0.04	0.05	-	0.04
	Total Nitrogen	mg/l N	0.29	0.16	< 1	< 0.5	0.37	0.21	1.03	< 0.5	1.4	< 1	< 1	< 1	1.2	< 1	3.5	0.7	0.11	0.29	-	< 1
	Orthophosphate	mg/l P	< 0.02	0.05	0.02	< 0.02	< 0.02	0.04	0.03	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.05	< 0.02	0.04	< 0.02	0.06	0.02	0.02
	Total Phosphorus	mg/l P	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
Trace Metals	Aluminium (Total)	µg/l	400	200	100	< 100	400	200	100	< 100	< 100	< 100	< 100	< 100	200	100	100	< 100	200	100	-	100
	Arsenic (Total)	µg/l	0.4	0.39	0.48	0.35	0.36	0.36	0.47	0.34	< 1	< 1	< 2	< 1	< 1	< 1	< 1	< 1	0.68	0.73	-	0.45
	Boron (Total)	µg/l	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	330	< 230	< 230	< 230	< 230	< 230	< 230	< 230	-	< 230
	Cadmium (Dissolved)[2]	µg/l	< 0.02	< 0.02	< 0.02	< 0.6	< 0.02	< 0.02	< 0.02	< 0.6	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.02	< 0.02	-	< 0.02
	Chromium (Total)	µg/l	< 2	4	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	4	-	< 2
	Copper (Total)	µg/l	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	10	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	-	< 9
	Lead (Dissolved)[2]	µg/l	0.52	< 0.3	< 0.3	< 0.3	0.63	< 0.3	< 0.3	< 0.3	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 0.3	< 0.3	-	< 0.3
	Mercury (Dissolved)[2]	µg/l	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	-	< 0.01
	Nickel (Dissolved)[2]	µg/l	< 3	< 3	< 3	< 3	< 3	5	< 3	< 3	< 3	< 3	17	< 3	< 3	< 3	< 3	< 3	< 3	< 3	-	< 3
	Selenium (Total)	µg/l	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.6	< 0.6	-	< 0.6
	Zinc (Total)	µg/l	< 18	20	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	-	< 18
Hydrocarb	Total Petroleum Hydrocarbons	µg/l	< 40	< 100	< 40	< 40	< 40	< 100	< 40	< 40	< 10	< 10	< 10	< 10	< 10	< 10	< 10	-	< 40	< 40	-	< 40
	Volatile OrganicCompounds	µg/l	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	-	< 1
	Polycyclic Aromatic Hydrocarbons	µg/l	-	-	-	-	-	-	-	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.02	-	-	-	-
Micro	Total Coliforms	mpn/100ml	-	-	-	-	-	-	-	-	345	238	50 cfu/100ml	167	> 2420	921	2420	59	-	-	-	-
	Faecal Coliforms	mpn/100ml	602	88	308	> 2420	1300	82	308	> 2420	64	40	172	129	411	131	1203	36	1733	328	-	1120
	E. coli	mpn/100ml	214	3	133	488	185	14	361	411	32	26	50 cfu/100ml	119	214	115	106	21	411	365	-	411

Notes:

1. Conductivity (lab) converted to 25°C reference temperature assuming 2%/°C
2. Surface Water EQS's for Cadmium, Lead, Mercury and Nickel refer to dissolved concentrations
3. Not Detected (fieldmeter malfunction)
4. Discharge from the West stream bank (W) or East stream bank (E); note discharge from east bank ceased after January 2018 so only one sample taken
5. European Communities Environmental Objective (Surface Waters) Regulations 2009 (S.I. No. 272 of 2009), European Union Environmental Objectives (Surface Waters)(Amendment) Regulation 2015 (S.I. No. 386 of 2015)
6. European Communities (Quality of Salmonid Waters) Regulations 1988 (S.I. No. 293 of 1988)
7. European Union (Drinking Water) Regulations 2014 (S.I. No. 122 of 2014)
8. Surface Water EQS for 'Good' status
9. For Cadmium, EQS depends on water hardness
10. Annual Average (AA) and Maximum Allowable Concentration (MAC)
11. For Copper and Zinc, lower value applies for water hardness <100mg/l $CaCO_3$ and higher value applies for water hardness >100mg/l $CaCO_3$
12. Temperature must also not exceed 21.5°C, or 10°C from 1 November to 30 April where species which need cold water for reproduction are present
13. Converted to mg/l N
14. Corrected to 25°C
15. No Abnormal Change
16. Infilled area (now developed) surrounding Lough Nameenbrack upstream of site and operated by third party
17. Sampling locations provided on Figure 7-2

Concentration shaded where standard/limit value exceeded

Surface Water Samples

						Discharge (W)[4]																Discharge (E)[4]	
03/11/2020	24/11/2020	14/12/2020	06/01/2021	02/02/2021	10/03/2021	30/01/2018	27/02/2018	27/03/2018	23/04/2018	27/08/2018	06/11/2018	07/01/2019	28/03/2019	26/08/2020	16/09/2020	13/10/2020	03/11/2020	14/12/2020	06/01/2021	02/02/2021	10/03/2021	30/01/2018	30/01/2018
9.7	6.3	6.9	4.3	6.2	7.2	7.1	3.3	8.4	11.9	14.8	8.9	8.8	9.8	13.9	13.7	13.7	12.1	6.1	4.5	4.1	9.2	7.3	6.8
ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	ND[3]	630	654	697	548	711	686	763	585	507	551	651	672	582	667	731	692	660	430
7.01	7.05	7.1	7.03	7.09	7.12	7.96	8.39	8.18	8.03	8.65	7.38	8.51	7.89	8.41	8.55	8.33	8.51	7.95	8.49	8.19	7.93	7.9	7.78
93.6	91.7	-	-	-	98.4	99.3	109.5	101	100.7	99.7	98.7	98.6	103.4	101.6	102.7	102.6	102.6	-	-	-	103.6	100.2	94.6
9.42	9.17	-	-	-	9.97	12.03	14.71	11.92	12.16	9.82	9.91	9.79	11.74	10.15	10.23	10.29	10.32	-	-	-	11.71	12.06	11.52
265	-	-	-	-	-	591	614	580	662	662	669	693	584	620	649	634	626	-	-	-	-	648	425
23.9	-	7.1	4	14	13	< 3	< 3	< 3	< 3	< 3	< 3	< 3	14.6	< 3	7.2	< 3	< 3	4	< 3	4.8	3.5	< 3	3.5
11.8	-	-	-	-	-	0.53	0.84	0.72	1.02	0.21	0.35	0.63	0.74	0.57	0.44	0.58	0.68	-	-	-	-	0.32	0.87
< 1	1.2	< 1	< 2	2.2	2	< 1	< 2	< 1	< 1	< 1	< 1	< 1	< 1	2	2	6	< 1	< 1	< 2	2.4	< 2	< 1	< 1
0.5	-	-	-	-	-	< 0.3	3	< 0.3	< 0.3	1	2.2	4.3	1.9	2.1	3.3	1.1	3.7	-	-	-	-	< 0.3	0.4
-	-	-	-	-	-	248	277	285	259	251	275	288	263	-	-	-	-	-	-	-	-	278	174
-	-	-	-	-	-	72.5	81.7	80.6	71.4	66.4	77.8	82	76.5	-	-	-	-	-	-	-	-	80.9	52.2
-	-	-	-	-	-	16.4	17.8	20.4	19.6	20.7	19.6	20.3	17.5	-	-	-	-	-	-	-	-	18.4	10.7
23	-	-	-	-	-	38.7	43.7	56.5	59	16.5	4.5	57.5	47.5	59	58.5	60.5	47	-	-	-	-	41.2	30.8
4.1	-	-	-	-	-	24	3	3.8	2.5	< 2	35.7	25.8	15.3	20.3	24.8	31.4	25.9	-	-	-	-	24.6	4.34
< 4.43	-	-	-	-	-	6.53	6.54	7.05	2.84	1.87	2.87	3.1	12.05	< 4.43	< 4.43	< 4.43	< 4.43	-	-	-	-	6.98	4.89
< 0.002	-	< 0.002	< 0.002	< 0.002	0.01	0.007	0.003	0.003	0.005	0.006	0.004	< 0.08	< 0.08	< 0.002	0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.003	0.006
0.06	-	0.06	0.06	< 0.02	0.03	< 0.02	< 0.02	< 0.02	0.02	0.03	< 0.02	< 0.02	0.31	< 0.02	< 0.02	0.03	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.02
0.7	-	-	-	-	-	1	< 1	1.5	< 1.0	1.1	< 1	1.45	1	< 0.1	0.16	< 1	< 0.5	-	-	-	-	1	< 1
< 0.02	< 0.02	< 0.02	< 0.02	0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.02	< 0.02	0.2	< 0.02	< 0.02	< 0.02	0.06	0.03	< 0.02	< 0.02	< 0.02	<0.02	<0.02	< 0.02	< 0.02
< 0.12	0.02	< 0.02	0.2	0.05	< 0.05	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.02	< 0.02	< 0.05	< 0.05	< 0.12	< 0.12
100	-	-	-	-	-	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	-	-	-	-	< 100	< 100
0.41	-	-	-	-	-	< 1	< 1	< 1	< 1	1.6	< 1	< 1	< 1	1.1	0.99	1.1	0.76	-	-	-	-	< 1	< 1
< 230	-	-	-	-	-	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	-	-	-	-	< 230	< 230
< 0.6	-	-	-	-	-	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.02	< 0.02	< 0.02	< 0.6	-	-	-	-	< 0.5	< 0.5
< 2	-	-	-	-	-	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	-	-	-	-	< 2	< 2
< 9	-	-	-	-	-	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	-	-	-	-	< 9	< 9
< 1	-	-	-	-	-	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 0.3	< 0.3	< 0.3	< 0.3	-	-	-	-	< 1	< 1
< 0.01	-	-	-	-	-	0.015	< 0.01	< 0.01	< 0.01	< 0.01	0.077	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	-	-	-	-	< 0.01	< 0.01
< 3	-	-	-	-	-	5	6	6	4	5	< 3	4	8	3	3	10	5	-	-	-	-	7	< 3
< 0.6	-	-	-	-	-	1.45	1.2	1.21	1.3	1.26	1.1	1.37	1.05	1.1	1.2	0.88	1.4	-	-	-	-	1.07	< 0.8
< 18	-	-	-	-	-	< 18	< 18	< 18	< 18	< 18	40	< 18	< 18	< 18	< 18	< 18	< 18	-	-	-	-	< 18	< 18
< 40	-	-	-	-	-	< 10	< 10	< 10	< 10	< 10	< 10	< 10	-	< 10	13	< 10	< 10	-	-	-	-	< 10	< 10
< 1	-	-	-	-	-	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	-	-	-	-	< 1	< 1
-	-	-	-	-	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.01	-	-	-	-	-	-	-	-	< 0.1	< 0.1
-	-	-	-	-	-	17	178	0 cfu/100ml	15	231	63	173	8	-	-	-	-	-	-	-	-	20	132
201	-	-	-	-	-	3	32	0	3	19	9	1	6	36	0	20	3	-	-	-	-	3	23
88	-	-	-	-	-	1	82	0 cfu/100ml	1	6	4	0	1	4	1	4	5	-	-	-	-	1	24

Surface Water Samples

Downstream																	Bridge before Lough						
27/02/2018	27/03/2018	23/04/2018	27/08/2018	06/11/2018	07/01/2019	28/03/2019	26/08/2020	16/09/2020	29/09/2020	13/10/2020	03/11/2020	24/11/2020	14/12/2020	06/01/2021	02/02/2021	10/03/2021	30/01/2018	27/02/2018	27/03/2018	23/04/2018	27/08/2018	06/11/2018	07/01/2019
3.5	8.8	11.8	13.3	8.6	9	10.1	14.1	15.8	13.4	13.2	8.7	6.8	6.5	4.4	5.7	7.8	6.8	4	8.3	11.7	13.6	8.9	9
630	441	415	272	421	490	544	ND^{3}	ND^{3}	ND^{3}	ND^{3}	ND^{3}	ND^{3}	ND^{3}	ND^{3}	ND^{3}	ND^{3}	427	638	449	499	295	438	ND^{3}
8.23	7.96	7.85	7.79	7.31	7.62	7.79	7.65	7.72	7.58	7.39	7.5	7.86	7.26	7.72	7.38	7.37	7.74	8.21	8.1	7.87	8.15	7.38	7.7
102.1	99	95.7	95.6	93.6	87.8	99.3	96.1	97.7	98.7	95.8	95.9	98.6	-	-	-	99.6	96.2	114	97.3	97	96.7	91.7	85.8
13.35	11.51	11.91	9.27	9.41	8.69	11.18	9.35	9.48	9.41	9.41	9.62	9.97	-	-	-	10.31	11.7	15.36	11.41	11.99	9.72	9.16	8.62
620	436	559	271	436	488	542	254	525	-	330	326	-	-	-	-	-	424	629	458	551	282	432	491
3	3.5	3.2	< 3	5.5	< 3	< 3	3.1	6.9	-	< 3	11.5	-	7	5.1	4.4	9.3	< 3	3	4.4	3.7	< 3	< 3	< 3
0.66	0.91	2.48	0.73	0.79	1.38	0.86	1.68	1.58	-	1.28	20.1	-	-	-	-	-	1.59	0.66	1.21	1.65	0.34	1.35	3.24
< 2	< 1	< 1	< 1	1	< 1	< 1	2	3	1	1	< 1	2.1	< 1	< 2	2.1	2	< 1	< 2	2	< 1	< 1	< 1	< 1
2.6	5.9	3.2	1.9	9.4	4.7	1.5	10.4	2.7	-	2.2	< 0.3	-	-	-	-	-	0.8	2.4	6	3.9	2	7.4	5.2
261	161	215	95.3	162	188	243	-	-	-	-	-	-	-	-	-	-	165	267	167	211	92.9	170	206
77 8	46.2	60.5	27.3	47.6	54.2	71.8	-	-	-	-	-	-	-	-	-	-	49.8	80.2	47.9	59.6	26.8	50.3	59.8
16.1	11.2	15.6	6.6	10.6	12.7	15.4	-	-	-	-	-	-	-	-	-	-	9.9	16.3	11.6	15.2	6.3	10.8	13.7
44.2	39	47.5	26	43	42.2	41	24	44.5	-	45	27	-	-	-	-	-	30.8	43.7	42.7	45.9	27.5	43	42.5
28.4	24.3	22.7	4.5	3.3	2.6	9.6	13.3	25.4	-	10.3	8.75	-	-	-	-	-	5.75	30	27.3	24.2	4	3.9	4.7
6.34	7.11	4.07	1.25	2	< 3.10	17.19	< 4.43	4.7	-	< 4.43	< 4.43	-	-	-	-	-	5.08	6.26	7.01	4.05	1.54	2.2	< 3.10
0.004	0.003	0.003	0.007	0.006	< 0.08	< 0.08	0.006	0.012	-	< 0.002	< 0.002	-	< 0.002	< 0.002	< 0.002	< 0.002	0.008	0.005	0.005	0.004	0.008	0.008	< 0.08
< 0.02	0.02	0.04	0.03	< 0.02	< 0.02	0.34	0.03	0.05	-	0.03	0.04	-	0.06	0.02	< 0.02	0.03	0.02	0.2	0.04	0.03	0.03	< 0.02	< 0.02
5.1	4.6	3.2	< 1	< 1	0.5	1	0.79	0.53	-	< 1	0.66	-	-	-	-	-	2.1	< 1	1.5	< 1	< 1	< 1	1.3
< 0.02	< 0.02	0.02	< 0.02	0.06	< 0.02	< 0.02	< 0.02	0.02	0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.02	0.03	< 0.02	0.07	< 0.02
< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	0.21	< 0.12	< 0.12	< 0.02	0.05	< 0.02	< 0.05	< 0.05	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
< 100	< 100	< 100	200	< 100	< 100	< 100	300	100	-	100	100	-	-	-	-	-	< 100	< 100	< 100	< 100	200	< 100	< 100
< 1	< 2	< 1	< 1	< 1	< 1	< 1	0.9	1.2	-	0.61	0.45	-	-	-	-	-	< 1	< 1	< 2	< 1	< 1	< 1	< 1
< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	-	< 230	< 230	-	-	-	-	-	< 230	< 230	< 230	< 230	< 230	< 230	< 230
< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.02	< 0.02	-	< 0.02	< 0.6	-	-	-	-	-	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
< 2	< 2	< 2	< 2	< 2	2	2	< 2	< 2	-	< 2	< 2	-	-	-	-	-	< 2	< 2	< 2	< 2	< 2	< 2	< 2
< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	-	< 9	< 9	-	-	-	-	-	< 9	< 9	< 9	< 9	< 9	< 9	< 9
< 1	< 1	< 1	< 1	< 1	< 1	< 1	0.4	< 0.3	-	< 0.3	< 0.3	-	-	-	-	-	< 1	< 1	< 1	< 1	< 1	< 1	< 1
< 0.01	< 0.01	< 0.01	< 0.01	0.2	< 0.01	< 0.01	< 0.01	< 0.01	-	< 0.01	< 0.01	-	-	-	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
< 3	< 3	6	< 3	4	125	< 3	< 3	3	-	< 3	< 3	-	-	-	-	-	< 3	3	< 3	5	4	< 3	4
< 0.8	< 0.8	1.07	< 0.8	< 0.8	0.92	< 0.8	< 0.6	0.84	-	< 0.6	< 0.6	-	-	-	-	-	< 0.8	1.09	1.22	1.06	< 0.8	< 0.8	0.96
< 18	< 18	< 18	< 18	< 18	< 18	50	30	90	-	< 18	< 18	-	-	-	-	-	< 18	< 18	< 18	< 18	< 18	< 18	< 18
< 10	< 10	< 10	< 10	< 10	< 10	-	< 40	< 40	-	< 40	< 40	-	-	-	-	-	< 10	< 10	< 10	< 10	< 10	< 10	< 10
< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	-	< 1	< 1	-	-	-	-	-	< 1	< 1	< 1	< 1	< 1	< 1	< 1
< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.02	-	-	-	-	-	-	-	-	-	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
68	60 cfu/100ml	67	> 2420	435	579	19	-	-	-	-	-	-	-	-	-	-	240	68	30 cfu/100ml	137	792	461	> 2420
21	70	40	249	135	192	20	2420	344	-	184	238	-	-	-	-	-	39	21	46	22	249	86	579
15	60 cfu/100ml	58	144	74	27	4	770	317	-	121	50	-	-	-	-	-	32	13	30 cfu/100ml	43	10^{1}	44	55

Surface Water Samples

Gill						Lough Gill (Dooney Rock)												Surface Water Environmental Quality Standards [5]	Salmonid Water Quality Standard [6]	Drinking Water Parametric Value [7]
28/03/2019	26/08/2020	16/09/2020	13/10/2020	03/11/2020	24/11/2020	30/01/2018	27/02/2018	27/03/2018	23/04/2018	27/08/2018	06/11/2018	07/01/2019	28/03/2019	26/08/2020	16/09/2020	13/10/2020	03/11/2020			
10.2	14.3	15.5	13	7.8	6.2	6.3	4.2	6.9	9.9	14.7	8.7	6.3	9.5	14.6	15.5	13.3	10.1	≤ 1.5 rise outside mixing zone	≤ 1.5 rise outside mixing zone [12]	-
516	ND [3]	ND [3]	ND [3]	ND [3]	ND [3]	177.6	210	201	205	201	ND [3]	227	209	ND [3]	ND [3]	ND [3]	ND [3]	-	-	2750 [14]
7.91	7.3	7.29	7.25	7.04	7.1	7.81	8.17	8.11	7.9	8.18	8.22	8.09	7.77	8.11	8.2	8.07	8.07	> 6 and < 9 (hard water)	≥ 6 and ≤ 9	≥ 6.5 and ≤ 9.5
101	94.2	95.7	93.8	95.1	93.3	95	110.1	102.8	96	95.2	94.1	91.6	100.1	97.1	97.5	98.9	96.7	> 80% and < 120% (95%ile)	-	-
11.35	9.37	9.32	9.27	9.6	9.28	11.76	13.05	12.45	11.83	9.43	9.47	9.07	11.45	9.68	9.72	9.72	9.72	-	50% ≥ 9	-
540	272	542	349	334	-	180	210	195	209	194	141	204	210	235	218	221	211	-	-	2750 [14]
< 3	< 3	3	< 3	3.2	-	< 3	< 3	13.4	< 3	< 3	< 3	< 3	< 3	< 3	3.8	< 3	6	-	≤ 25	-
0.88	1.24	0.72	3.82	0.56	-	0.86	0.65	0.98	0.81	0.28	0.59	2.25	0.91	0.98	0.93	0.29	0.42	-	-	NAC [15]
< 1	13	2	2	< 1	1.5	< 1	< 2	< 1	< 1	< 1	2	< 1	< 1	3	1	1	< 1	≤ 1.5 (mean) or ≤ 2.6 (95%ile) [8]	≤ 5	-
1.8	3.4	8	1.3	< 0.3	-	1.1	6.8	8.7	6.2	4.2	12.4	5.9	6.9	< 0.3	13.1	0.5	< 0.3	-	-	NAC [15]
251	-	-	-	-	-	57.1	78.2	70.9	77.6	67.5	43.8	71.8	87.1	-	-	-	-	-	-	-
74.6	-	-	-	-	-	18.1	25.7	23.1	25.3	21.9	13.4	23.3	28.6	-	-	-	-	-	-	-
15.8	-	-	-	-	-	2.9	3.4	3.2	3.5	3.1	2.5	3.3	3.8	-	-	-	-	-	-	-
43	24	47.5	42	29	-	20.8	17.4	19	19.5	15.8	22	18	22.5	17.5	15.5	30	14	-	-	250
< 2	3.9	35.5	10.8	8.8	-	< 2	5.4	< 2	< 2	< 2	2.3	4	3.1	2.3	5.2	3.2	4.4	-	-	250
18.69	< 4.43	< 4.43	< 4.43	< 4.43	-	4.43	2.78	5.27	2.95	1.62	1.2	< 3.10	< 4.43	4.65	6.51	< 4.43	< 4.43	-	-	50
< 0.08	0.005	< 0.002	< 0.002	< 0.002	-	0.002	0.006	0.004	0.004	0.004	0.01	< 0.08	< 0.08	< 0.002	0.003	< 0.002	< 0.002	-	0.015 [13]	0.152 [13]
0.32	0.03	0.02	0.05	0.03	-	< 0.02	< 0.02	0.02	0.03	0.02	< 0.02	< 0.02	0.29	0.02	< 0.02	0.03	< 0.02	≤ 0.065 (mean) or ≤ 0.14 (95%ile) [8]	0.778 [13]	0.23 [13]
1	0.6	0.11	< 1	< 0.5	-	1.7	< 1	1.2	< 1	< 1	< 1	1	0.6	0.43	0.76	< 1	< 0.5	-	-	-
0.02	< 0.02	0.04	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.03	< 0.02	< 0.02	< 0.02	0.03	< 0.02	< 0.02	≤ 0.035 (mean) or ≤ 0.075 (95%ile) [8]	-	-
< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.02	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	-	-	-
< 100	200	< 100	< 100	< 100	-	< 100	< 100	< 100	< 100	< 100	100	100	< 100	< 100	< 100	< 100	< 100	-	-	200
< 1	0.75	1	0.55	0.47	-	< 1	< 1	< 2	< 1	< 1	< 1	< 1	< 1	0.46	0.36	0.35	0.39	25 (AA)	-	10
< 230	< 230	< 230	< 230	< 230	-	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	-	-	1000
< 0.5	< 0.02	< 0.02	< 0.02	< 0.6	-	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.02	< 0.02	< 0.02	< 0.6	0.09 - 0.25 (AA), 0.6 - 1.5 (MAC) [9]	-	5
< 2	< 2	< 2	< 2	< 2	-	< 2	< 2	< 2	< 2	< 2	< 2	5	3	< 2	< 2	< 2	< 2	4.7 (AA), 32 (MAC) [10]	-	50
< 9	< 9	< 9	< 9	< 9	-	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	< 9	5 or 30 [11]	22 or 40 [11]	2000
< 1	0.31	< 0.3	< 0.3	< 0.3	-	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 0.3	< 0.3	< 0.3	< 0.3	14 (MAC)	-	10
< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	-	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.05 (AA), 0.07 (MAC)	-	1
5	< 3	< 3	< 3	< 3	-	< 3	< 3	6	< 3	< 3	< 3	< 3	< 3	< 3	4	< 3	< 3	20 (AA)	-	20
< 0.8	< 0.6	0.67	< 0.6	< 0.6	-	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.6	< 0.6	< 0.6	< 0.6	-	-	10
30	< 18	< 18	< 18	< 18	-	< 18	< 18	< 18	< 18	< 18	< 16	< 18	< 18	< 18	< 18	< 18	< 18	50 or 100 [11]	200 or 300 [11]	-
-	< 40	< 20	< 40	< 40	-	< 10	< 10	< 10	< 10	< 10	< 10	< 10	-	< 20	< 20	< 40	< 40	-	-	-
< 1	< 1	< 1	< 1	< 1	-	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	-	-	-
< 0.02	-	-	-	-	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.04	-	-	-	-	-	-	0.1
91	-	-	-	-	-	57	41	0 cfu/100ml	21	> 2420	1414	378	4	-	-	-	-	-	-	0
27	1300	214	206	214	-	22	9	0	9	459	25	4	3	33	12	31	16	-	-	-
17	411	96	108	44	-	5	4	0 cfu/100ml	12	26	24	4	1	16	5	8	4	-	-	0

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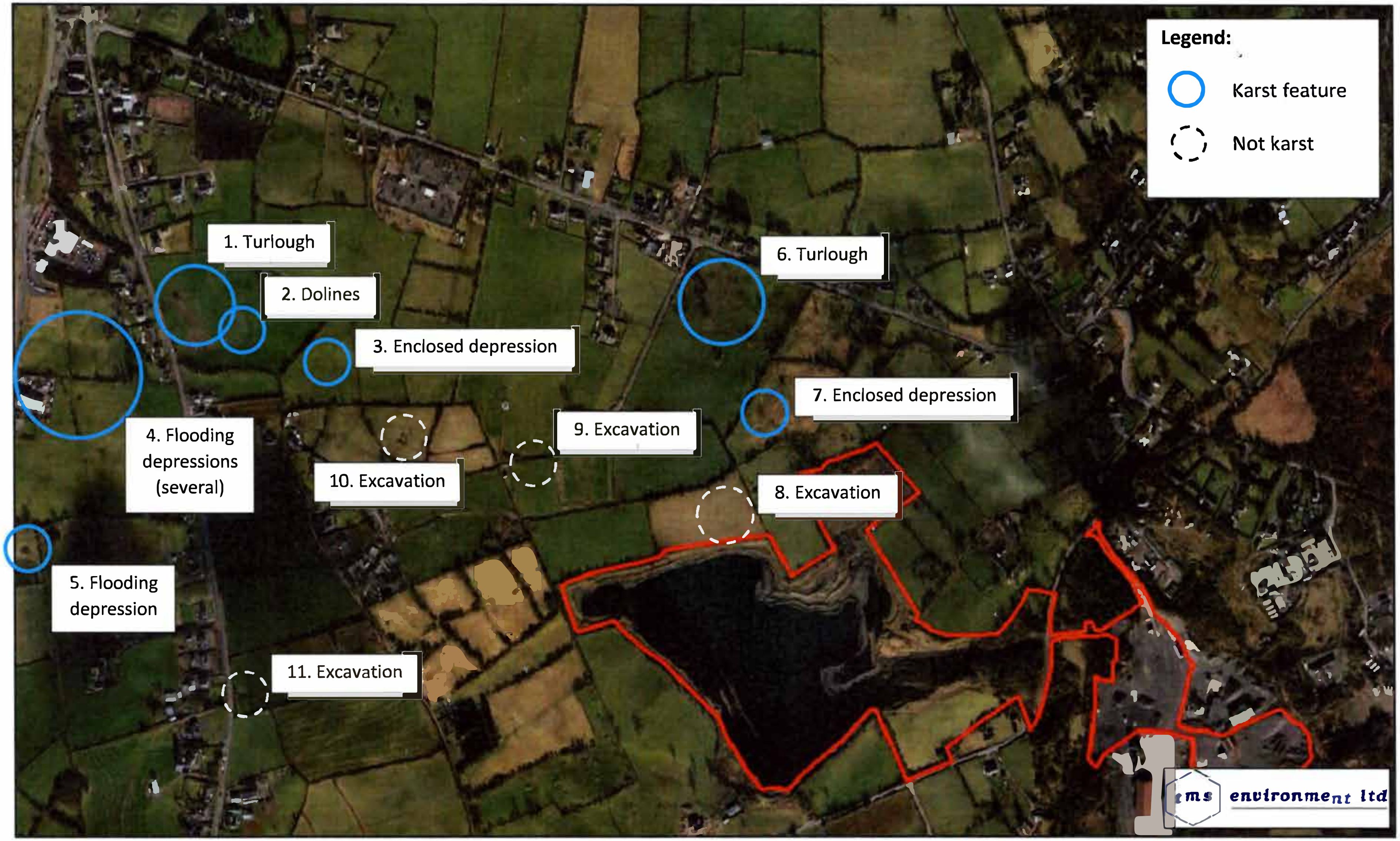
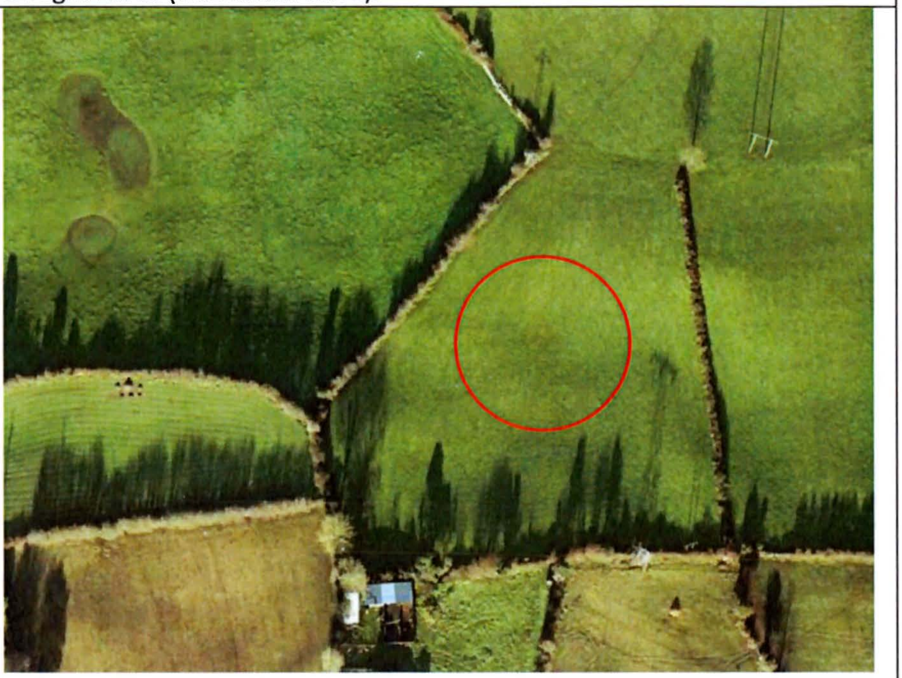
APPENDIX 7-12 KARST FEATURE SURVEY

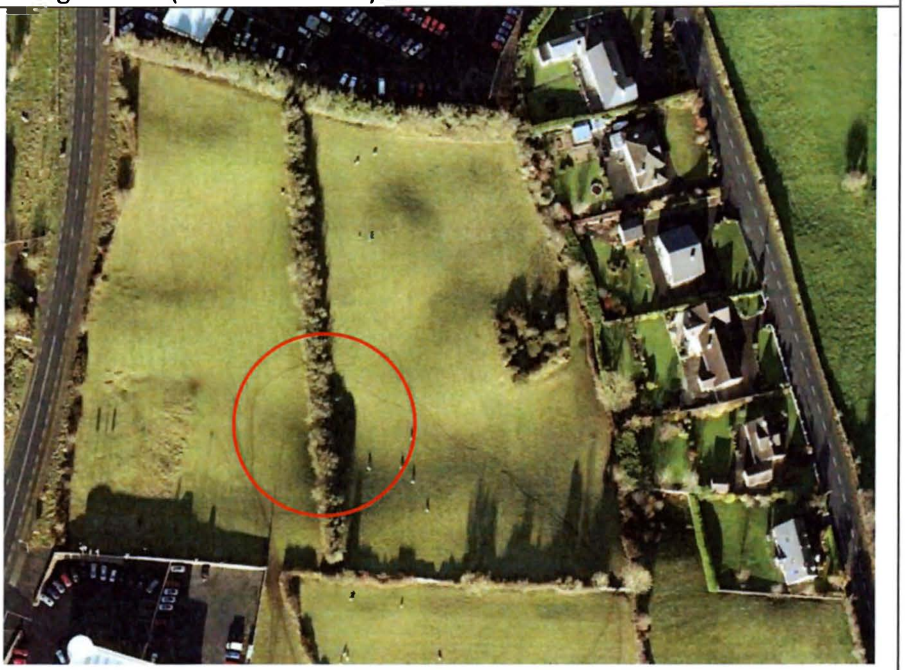


Karst Feature Survey Map (Google Earth)

Feature No.	1
Feature Type	Turlough (probable)
ITM Coordinates	569255, 832372
Source	Google Earth (December 2006):
	
	Google Earth (March 2020):
	
Additional Information	Area identified in GSI Groundwater Flooding Data Viewer as historically flooded by groundwater, subject of recent study by SCC/OPW

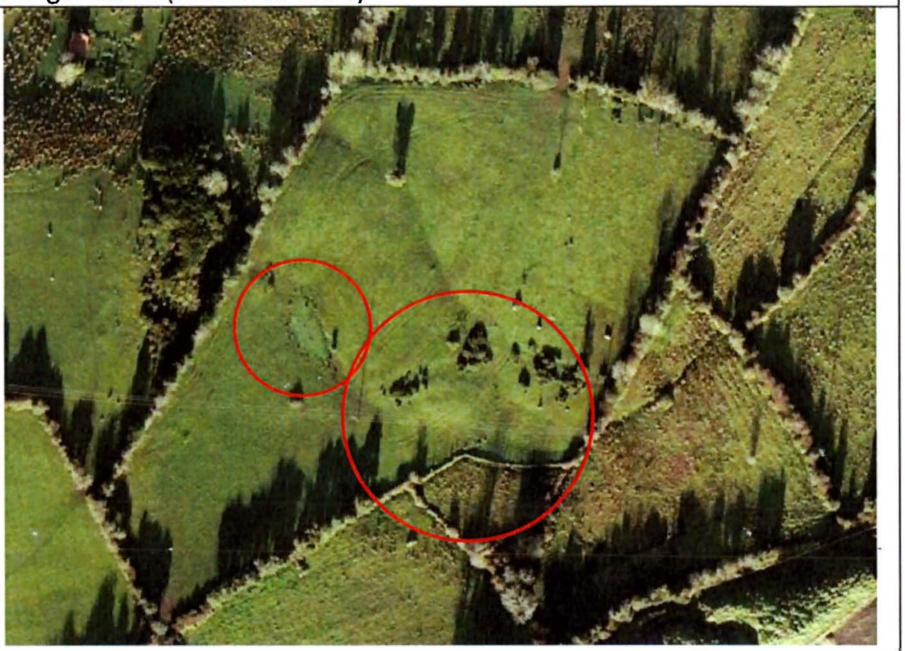
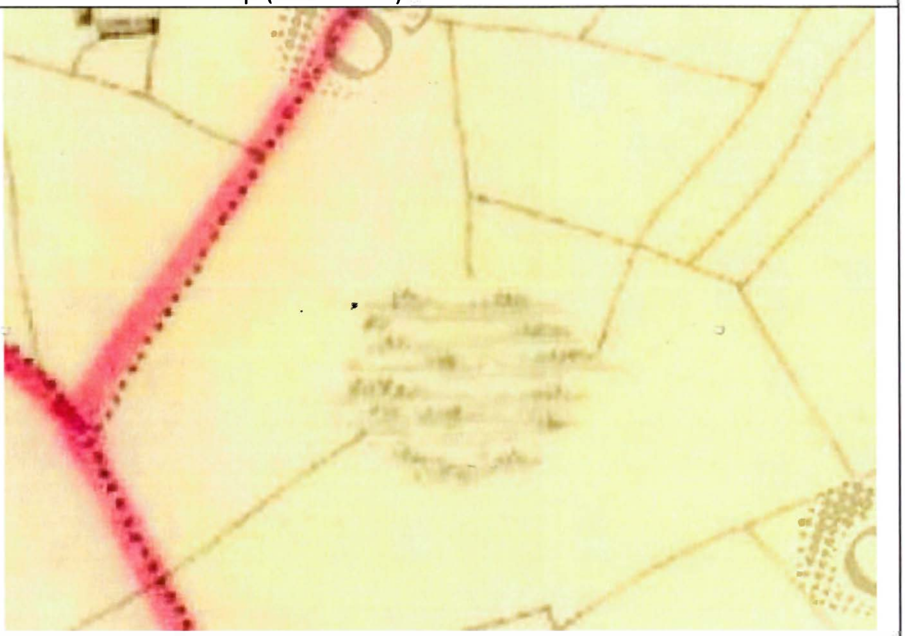
Feature No.	2
Feature Type	Dolines
ITM Coordinates	569255, 832371
Source	Google Earth (December 2006):
	
	Google Earth (March 2020):
	
Additional Information	Dolines flooded, connect to turlough when in flood

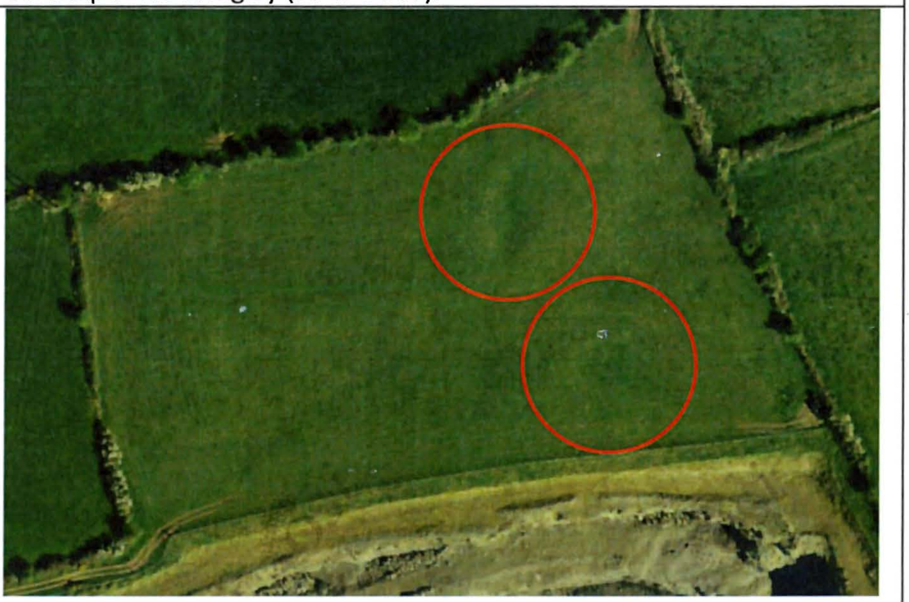
Feature No.	3
Feature Type	Enclosed depression
ITM Coordinates	569384, 832315
Source	Google Earth (December 2006):
	
	Google Earth (March 2020):
	
Additional Information	Small circular surface depression visible in aerial photographs, surface water ponding (or groundwater) when wet

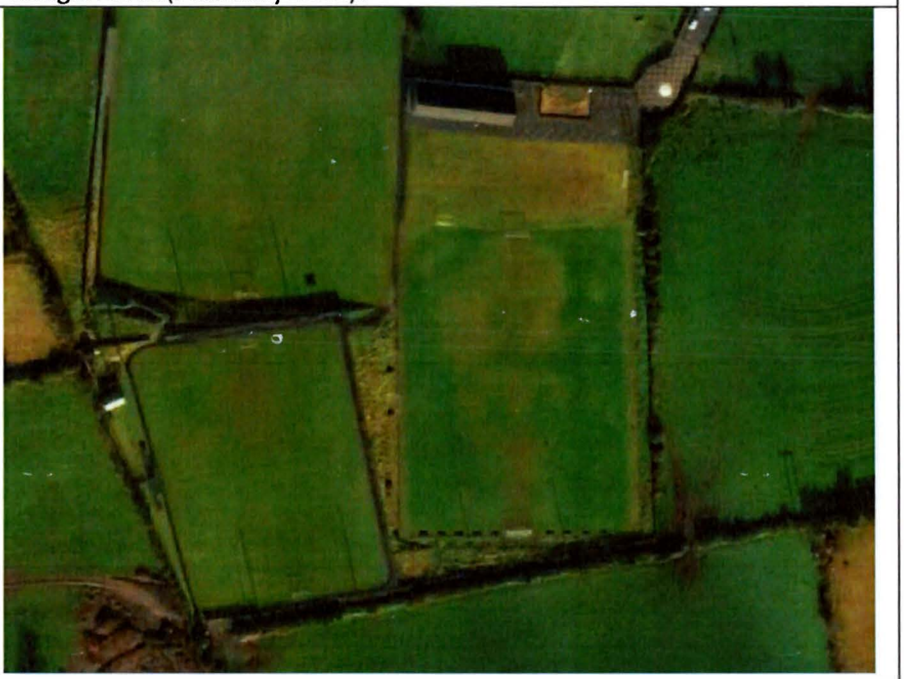
Feature No.	4
Feature Type	Flooding depressions (several – one example highlighted)
ITM Coordinates	568978, 832326
Source	Google Earth (December 2006):
	
	Google Earth (March 2020):
	
Additional Information	Several circular/oval depressions in this low-lying area, surface water ponding (or groundwater) when wet, subject of recent study by SCC/OPW

Feature No.	5
Feature Type	Flooding depression
ITM Coordinates	568906 ,832030
Source	Google Earth (February 2021):
	
	
Additional Information	Small circular surface depression visible in aerial photographs, surface water ponding (or groundwater) when wet, suggestion from aerial photographs of central hole (estavelle?)

Feature No.	6
Feature Type	Turlough (probable)
ITM Coordinates	570007, 832404
Source	Google Earth (December 2006):
	
	Google Earth (March 2020):
	
Additional Information	Area identified in GSI Groundwater Flooding Data Viewer as historically flooded by groundwater, subject of recent study by SCC/OPW

Feature No.	7
Feature Type	Enclosed depression
ITM Coordinates	57007 4,832235
Source	Google Earth (December 2006)·.
	
	OSI Historical 6" Map (1837-1842):
	
Additional Information	Small elongate depression visible in aerial photographs, c. 25m x 10m, surface water ponding (or groundwater) when wet, possible ephemeral spring draining to low-lying wet area (artificially drained)

Feature No.	8
Feature Type	Excavation (assumed)
ITM Coordinates	569990, 832089
Source	Google Earth (December 2006):
	
	OSI MapGenie Imagery (2013-2018):
	
Additional Information	Two small surface depressions visible in aerial photographs, one elongate (c. 28m x 15m), one circular (c. 17m diameter), geophysical surveying across this field did not identify features in bedrock therefore assumed to be shallow excavations in overburden (not karst related)

Feature No.	9
Feature Type	Excavation (assumed)
ITM Coordinates	569716, 832144
Source	Google Earth (December 2006):
	
	Google Earth (February 2021):
	
Additional Information	Small surface depression visible in aerial photographs, elongate (c. 26m x 15m), assumed to be shallow excavation in overburden (not karst related), now covered with new GAA pitch

Feature No.	10
Feature Type	Excavation (assumed)
ITM Coordinates	569506, 832195
Source	Google Earth (December 2006):
	
	Google Earth (February 2021):
	
Additional Information	Small surface depression visible in aerial photographs, circular (c. 25m diameter), assumed to be shallow excavation in overburden (not karst related)

Feature No.	11
Feature Type	Excavation (assumed)
ITM Coordinates	569254,831800
Source	OSI Digital Globe 2011-2013:
	
	OSI MapGenie Imagery (2013-2018):
	
	Google Earth (February 2021):
	
Additional Information	Small surface depression visible in aerial photographs, elongate (c. 38m x 18m), assumed to be shallow excavation in overburden (not karst related)

APPENDIX 7-13 GROUNDWATER BODY DESCRIPTIONS (GSI)

Carrowmore East GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
35 Sligo/Leitrim Co. Co.'s.	**Rivers**: Bonet, Garavoge, Diffreen **Lakes**:, Gill, Anelteen, Doon, Colgagh, Black, Keelogyboy, Stramore	Cummeen Strand / Drumcliff Bay (000627), Colgagh Lough (001658), Lough Gill (001976).	58

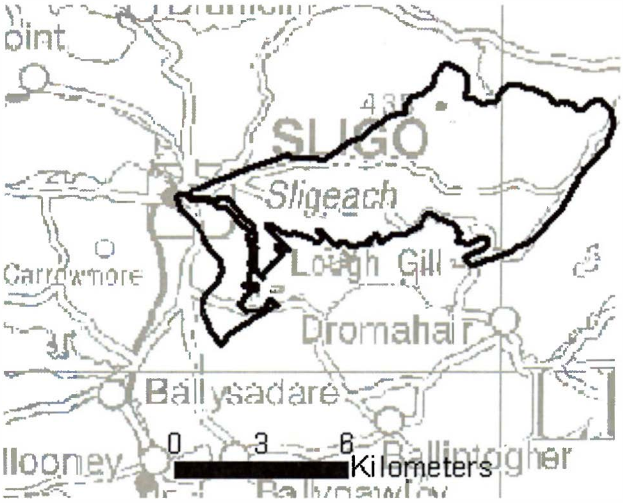
Topography		The GWB occupies an area around L. Gill. The land surface is characterised by an upland area to the east which slopes toward L. Gill and the coast. Elevations range from 10-435 mAOD. The GWB is bounded to the south and east by the Dromahair GWB and L. Gill. The northern and western boundaries are topographic highs which act as surface water catchment divides. Figure 1 illustrates the location and boundaries.
Geology and Aquifers	**Aquifer categories**	**Rk^c:** Regionally important karstified aquifer dominated by conduit flow. The 'c' signifies conduit flow.
	Main aquifer lithologies	Dinantian Pure Bedded Limestones
	Key structures	The GWB is located to the north of the Ox Mountain Inlier. A major NE-SW trending fault (Ox Mountains-Pettigoe Fault) bounds the southern side of the GWB. A syncline runs through the GWB with the rocks on both limbs dipping approximately 5°. A steep normal fault trending almost E-W belonging to the Cuilcagh-Manorhamilton-Rosses point fault zone cuts into the GWB just north of the Sligo-Manohamilton road.
	Key properties	Karstification is widespread throughout, and recorded features include swallow holes, caves and springs. Caves are particularly prevalent north of L. Gill. Yield data are sparse, there is 1 "good" (100-400 m^3/d) well present. Drilling carried out in the early 1970's by the GSI to locate high yielding wells was unsuccessful (Daly, 1975). Transmissivities are expected to variable, ranging from 1 to greater than 2000 m^2/d. Storativity is likely to be low - approximately 0.01-0.02. A tracer test was carried out in the neighbouring Carrowmore West GWB (Higgins, 1987). No groundwater velocities are reported but are expected to be in the order of 20-50 m/hr. General flow directions are likely to be to the west and north west under hydraulic gradients that are expected to be greater than 0.0005 on the low lying areas and greater than 0.005 on the upland areas.
	Thickness	Most groundwater flow is likely to be 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.
Overlying Strata	**Lithologies**	Data are available for the western 2/3 of the GWB. Till is the dominant subsoil type.
	Thickness	Data are sparse, with thickness between 0-10 m. Rock outcrops are distributed on the upland areas.
	% area aquifer near surface	*[Information to be added at a later date]*
	Vulnerability	*[Information to be added at a later date]*
Recharge	**Main recharge mechanisms**	Both point and diffuse recharge occur. Diffuse recharge occurs via rainfall percolating through permeable subsoil and rock outcrops. Point recharge to the underlying aquifer occurs by means of swallow holes and caves. There are no surface outlets from the smaller lakes within the GWB, and it is assumed that there is recharge to the underlying aquifer.
	Est. recharge rates	*[Information to be added at a later date]*
Discharge	**Large springs and high yielding wells (m^3/d)**	None identified
	Main discharge mechanisms	The main discharges are to springs, streams, rivers and lakes.
	Hydrochemical Signature	The groundwater is likely to have $CaHCO_3$ signature. Data from the adjoining Carrowmore West GWB is given below for six samples. Alkalinity (mg/l as $CaCO_3$): 113-163. Total Hardness (mg/l): 302-430. Conductivity (μS/cm): 580-725.

Groundwater Flow Paths	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. Groundwater can flow across surface water catchment divides and beneath surface water channels as evidenced by a tracer test carried out in the Carrowmore area by Higgins (1987). Flow velocities can be rapid and variable, both spatially and temporally. Rapid groundwater flow velocities indicate that a large proportion of groundwater flow takes place in enlarged conduit systems. Overall groundwater flow will be towards L. Gill, but the karstified nature of the bedrock means that locally, groundwater flow directions can be highly variable.
Groundwater & Surface water interactions	Generally, there is a high degree of interconnection between groundwater and surface water in karstified limestone areas. The karst features represent the close interaction between surface water and groundwater. Any contamination of surface water is rapidly transported into the groundwater system, and vice versa.
Conceptual model	• The GWB occupies an area around L. Gill. The land surface is characterised by an upland area to the east which slopes toward L. Gill and the coast. Elevations range from 10-435 mAOD. • The GWB is bounded to the south and east by the Dromahair GWB and L. Gill. The northern and western boundaries are topographic highs which act as surface water catchment divides. • The aquifer is a Regionally important karstified aquifer (**Rk^c**). • Several karst features are recorded, most notably caves. • Transmissivities are expected to be variable, ranging from 1 to greater than 2000 m^2/d. Storativity is likely to be in the range of 1-2%. • Most groundwater flux is likely to be in the upper part of the aquifer. • Till is the dominant subsoil type. • Recharge occurs via point and diffuse mechanisms. Point recharge to the underlying aquifer occurs by means of swallow holes. • The main discharges are to springs, streams, rivers and lakes. • The groundwater has a calcium bicarbonate signature. • There is a high degree of interconnection between groundwater and surface water.
Attachments	Table 1 and Figure 1.
Instrumentation	**Stream gauge:** None **EPA Water Level Monitoring boreholes:** None **EPA Representative Monitoring points:** None
Information Sources	Daly, E. (1975) *Report on the groundwater potential of the area around Sligo town.* Geological Survey of Ireland. Higgins, T. (1987) *An Assessment of the Impact of Human activity on groundwater quality in th eCarrowmore area of County Sligo.* BSc thesis. Sligo Regional Technical College. MacDermot, C.V. Long C.B. and Harney S.J (1996) *Geology of Sligo-Leitrim: A geological description of Sligo, Leitrim and adjoining parts of Cavan, Fermanagh, Mayo and Roscommon, to accompany bedrock geology 1:100,000 scale map, Sheet 7, Sligo - Leitrim.* With contributions from K. Carlingbold, G. Stanley, D. Daly and R. Meehan. Geological Survey of Ireland, 100pp. Thorn, R., Drew, D. and Coxon, C. (1990). *The Hydrology and Caves of the Geevagh and Bricklieve Karsts, Co. Sligo. Irish Geography* 23(2) (1990) 120-135. Geographical Society of Ireland, Dublin. Thorn, R. (1987). The Geevagh Karst. *Irish Speleology.* Journal of the Speleological Union of Ireland. Vol. 4 No. 1 1987. Thorn, R., Doyle, M., Henry, H. (1986). *The Groundwater Resources of South County Sligo – A Preliminary App raisal.* Sligo Regional Techincal College. Report Number 86/1. ISBN 0 948870 01 X.
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae.

Table 1. List of Rock units in GWB

Abbeytown Limestone (BSab)	Crinoidal Calcarenite	Dinantian Pure Bedded Limestones	Rkc
Ballyshannon Limestone Formation (BS)	Pale grey calcarenite limestone	Dinantian Pure Bedded Limestones	Rkc
Dartry Limestone Formation (DA)	Dark fine-grained cherty limestone	Dinantian Pure Bedded Limestone	Rkc

Figure 1 Location and boundaries of GWB.



Carrowmore West GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
35 Sligo Co. Co.	**Rivers**: Ballysodare. **Lakes**: Pollanima, Punchbowl, Cloverhill, Corhawnagh, Cooney, Doonyneill.	Ballysadare Bay (000622), Corhawnagh Lough (001902)	37

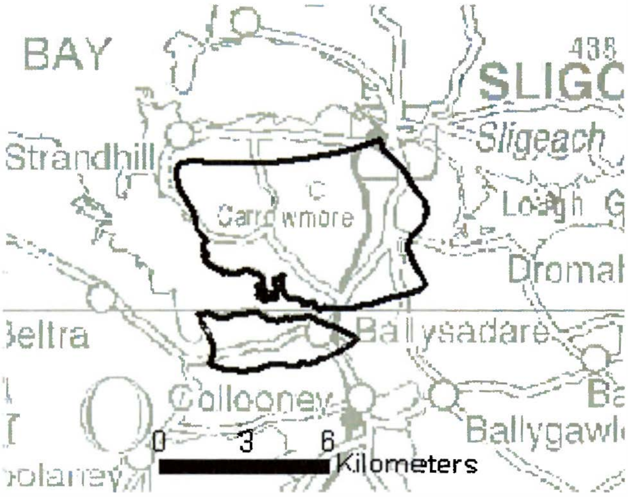
Topography	The GWB occupies an area on the eastern side of Ballysadare Bay. The GWB includes an area that includes Ballysadare due its proximity and similar aquifer properties. The land surface is generally low lying apart from Knocknarea, a hill on the northwestern side of the GWB. Elevations range from 0-327 mAOD. The GWB is bounded to the west by the coast. The northern and southern boundaries are the poor aquifers of the Collooney and Strandhill GWB's. Figure 1 illustrates the location and boundaries. Surface drainage is minimal, with some streams located to the southern side of the GWB.	
Geology and Aquifers	**Aquifer categories**	**Rk^c:** Regionally important karstified aquifer dominated by conduit flow. The 'c' signifies conduit flow.
	Main aquifer lithologies	Dinantian Pure Bedded Limestones, Dinantian Pure Unbedded Limestones.
	Key structures	The GWB is located to the north of the Ox Mountain Inlier. A major NE-SW trending fault (Ox Mountains-Pettigoe Fault) bounds the southern side of the GWB. A syncline runs through the GWB with the rocks on both limbs dipping approximately 5°.
	Key properties	Karstification is widespread, and recorded features include swallow holes and springs. Drilling carried out in the early 1970's by the GSI to locate high yielding wells was unsuccessful (Daly, 1975). However, spring yields (Tobernaveen and Carrowgobadh) are estimated to be in the order of 30,000 m^3/d in total (Higgins, 1987). Transmissivities are expected to be variable, ranging from 1 to greater than 2000 m^2/d. Storativity is expected to be low - approximately 0.01-0.02. Positive traces are reported between the Tonesfortes sink and the Tobernaveen and Carrowgobadh springs (Higgins, 1987). However, no groundwater velocities are reported but are expected to be in the order of 20-50 m/hr. General flow directions are likely to be to the north and west under hydraulic gradients that are expected to be greater than 0.0005.
	Thickness	Most groundwater is likely to be 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.
Overlying Strata	**Lithologies**	Till is the dominant subsoil type.
	Thickness	Data are sparse (n=3) and indicate that the thickness are less than 3 m.
	% area aquifer near surface	*[Information to be added at a later date]*
	Vulnerability	*[Information to be added at a later date]*
Recharge	**Main recharge mechanisms**	Both point and diffuse recharge occur. Diffuse recharge occurs via rainfall percolating through permeable subsoil and rock outcrops. Point recharge to the underlying aquifer occurs by means of swallow holes.
	Est. recharge rates	*[Information to be added at a later date]*
Discharge	**Large springs and high yielding wells (m^3/d)**	Tobernaveen and Carrowgobadh springs are estimated to yield in the order of 30,000 m^3/d (Higgins, 1987).
	Main discharge mechanisms	The main discharges are to springs, streams, rivers and lakes.
	Hydrochemical Signature	The groundwater is very hard and has $CaHCO_3$ signature. Higgins (1987) carried out water sampling and the results for selected parameters are given below for six samples. Elevated chloride indicate that the groundwater is brackish (Higgins, 1987). Alkalinity (mg/l as $CaCO_3$): 113-163. Total Hardness (mg/l): 302-430. Conductivity (μS/cm): 580-725. Chloride (mg/l): 24-35.

Groundwater Flow Paths	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. Groundwater can flow across surface water catchment divides and beneath surface water channels. A tracer test carried out by Higgins (1987) illustrates that the positive trace from Tonafortes sink to Carrowgobadh spring crosses a surface water catchment. Flow velocities can be rapid and variable, both spatially and temporally. Rapid groundwater flow velocities indicate that a large proportion of groundwater flow takes place in enlarged conduit systems. Flow path lengths can be up to a several kilometres in length. Overall groundwater flow will be towards the rivers and lakes, generally to the west toward L. Gill, but the karstified nature of the bedrock means that locally, groundwater flow directions can be highly variable.
Groundwater & Surface water interactions	Generally, there is a high degree of interconnection between groundwater and surface water in karstified limestone areas. The karst features represent the close interaction between surface water and groundwater. Any contamination of surface water is rapidly transported into the groundwater system, and vice versa.
Conceptual model	• The GWB occupies an area on the eastern side of Ballysadare Bay. The GWB includes an area that includes Ballysadare due its proximity and similar aquifer properties. The land surface is generally low lying apart from Knocknarea, a hill on the northwestern side of the GWB. Elevations range from 0-327 mAOD. • The GWB is bounded to the west by the coast. The northern and southern boundaries are the poor aquifers of the Collooney and Strandhill GWB's. • The aquifer is a Regionally important karstified aquifer (**Rk^c**). • Several karst features are recorded. • Transmissivities are expected to be variable, ranging from 1 to greater than 2000 m^2/d. Storativity is likely to be in the range of 1-2%. • Most groundwater flux is likely to be in the upper part of the aquifer. • Till is the dominant subsoil type. • Recharge occurs via point and diffuse mechanisms. Point recharge to the underlying aquifer occurs by means of swallow holes. • The main discharges are to springs, streams, rivers and lakes. • The groundwater has a calcium bicarbonate signature. • There is a high degree of interconnection between groundwater and surface water.
Attachments	Table 1 and Figure 1.
Instrumentation	**Stream gauge:** 35039,35040,35041. **EPA Water Level Monitoring boreholes:** None **EPA Representative Monitoring points:** None
Information Sources	Daly, E. (1975) *Report on the groundwater potential of the area around Sligo town.* Geological Survey of Ireland. Higgins, T. (1987) *An Assessment of the Impact of Human activity on groundwater quality in the Carrowmore area of County Sligo.* BSc thesis. Sligo Regional Technical College. MacDermot, C.V. Long C.B. and Harney S.J (1996) *Geology of Sligo-Leitrim: A geological description of Sligo, Leitrim and adjoining parts of Cavan, Fermanagh, Mayo and Roscommon, to accompany bedrock geology 1:100,000 scale map, Sheet 7, Sligo - Leitrim.* With contributions from K. Carlingbold, G. Stanley, D. Daly and R. Meehan. Geological Survey of Ireland, 100pp. Thorn, R., Drew, D. and Coxon, C. (1990). *The Hydrology and Caves of the Geevagh and Bricklieve Karsts, Co. Sligo. Irish Geography* 23(2) (1990) 120-135. Geographical Society of Ireland, Dublin. Thorn, R. (1987). The Geevagh Karst. *Irish Speleology.* Journal of the Speleological Union of Ireland. Vol. 4 No. 1 1987. Thorn, R., Doyle, M., Henry, H. (1986). *The Groundwater Resources of South County Sligo – A Preliminary Appraisal.* Sligo Regional Techincal College. Report Number 86/1. ISBN 0 948870 01 X.
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae.

Table 1. Rock units in GWB.

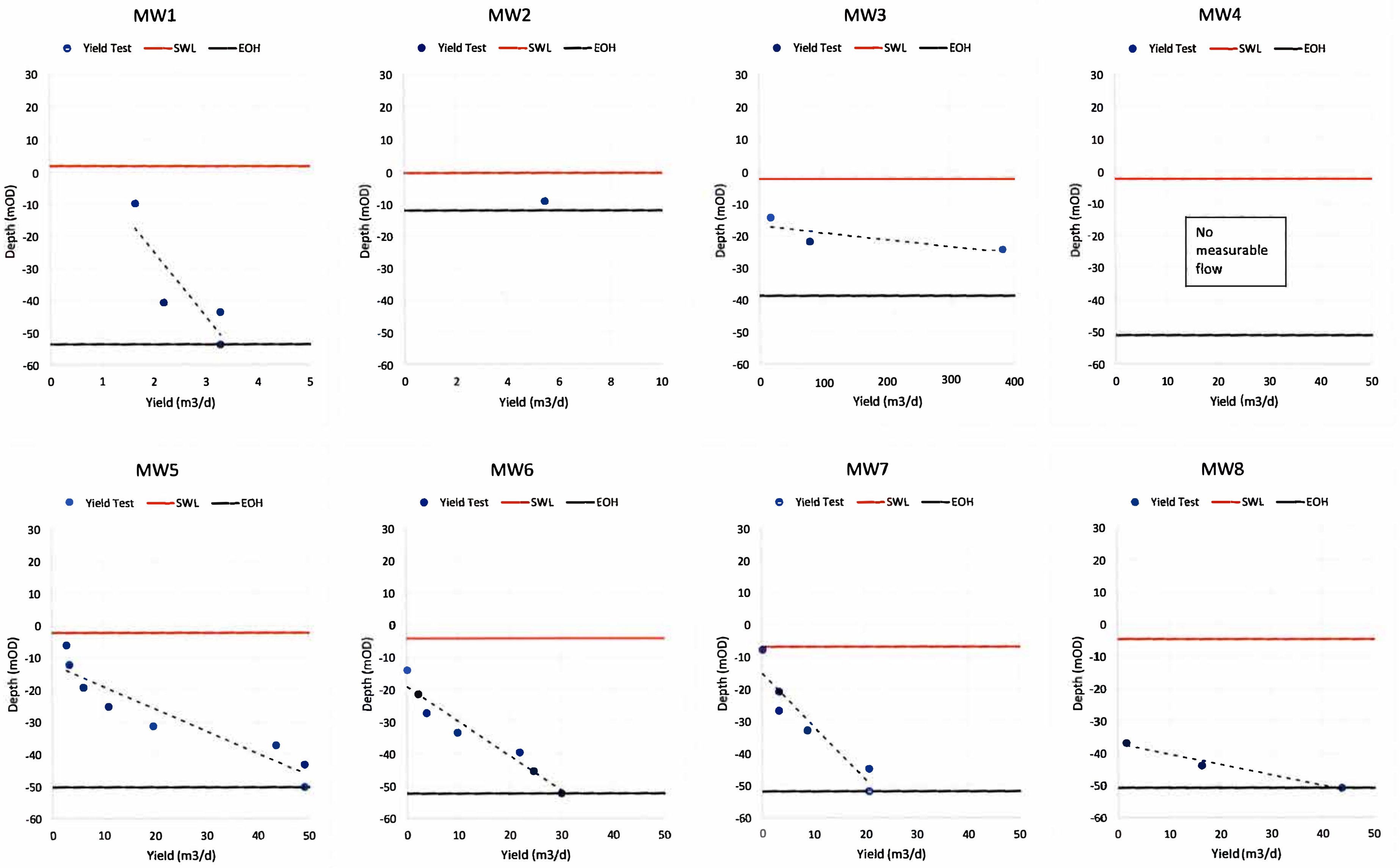
Rock unit name and code	Description	Rock unit group	Aquifer Classification
Dartry Limestone Formation (DA)	Dark fine-grained cherty limestone	Dinantian Pure Bedded Limestone	Rkc
Dartry Limestone Formation and Mudbank Limestone	Dark fine-grained cherty limestone	Dinantian Pure Unbedded Limestone	Rkc

Figure 1 Location and Boundaries of GWB.



APPENDIX 7-14 YIELD TEST RESULTS

Yield Test Results



SWL - Static Water Level
EOH - End of Hole

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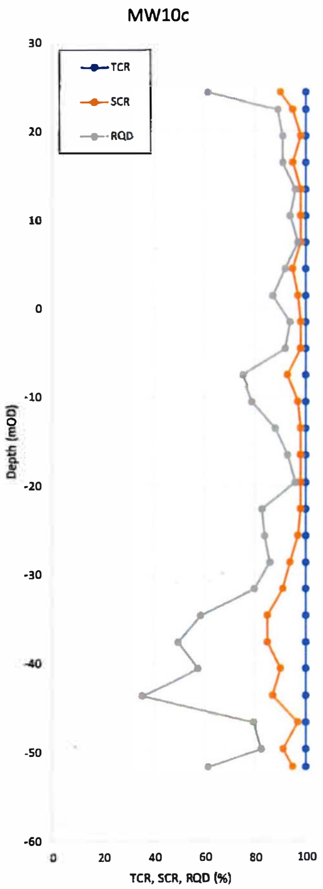
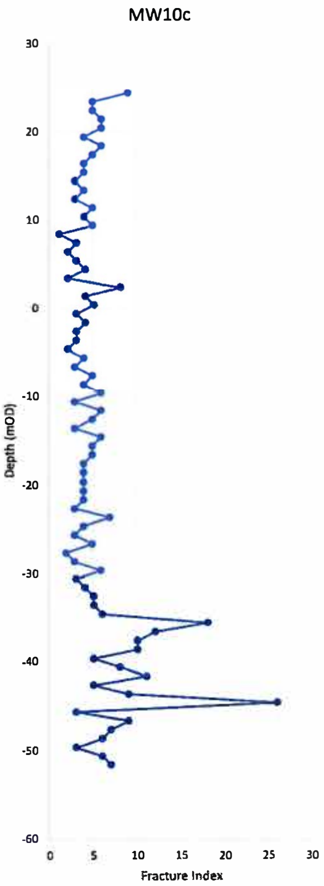
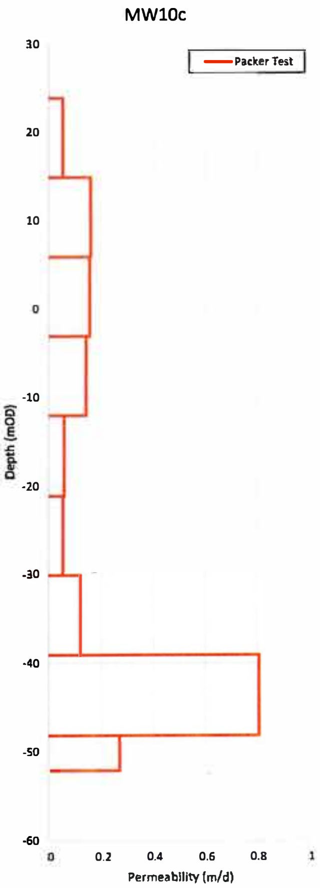
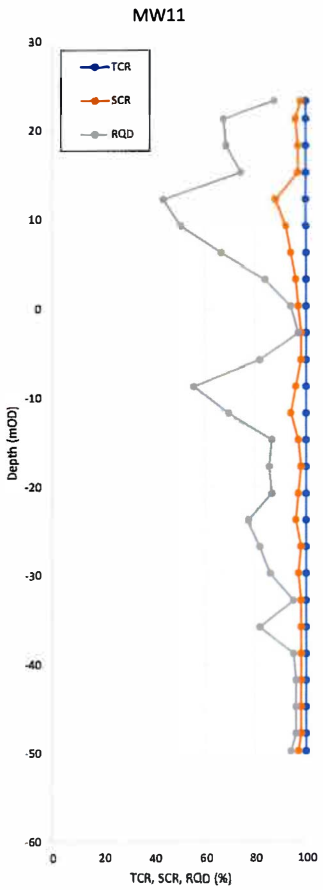
APPENDIX 7-15 COREHOLE RESULTS

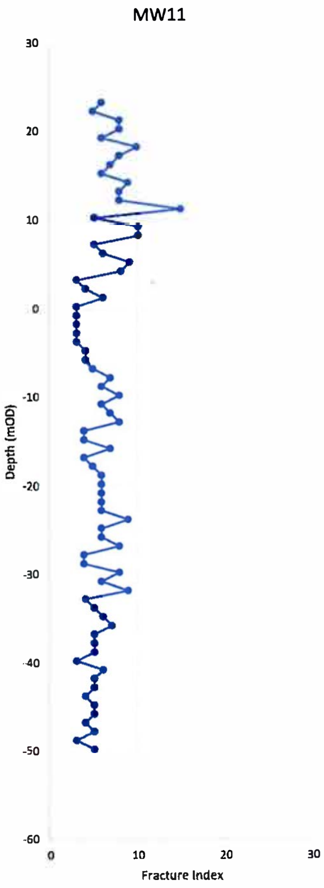
Corehole Results

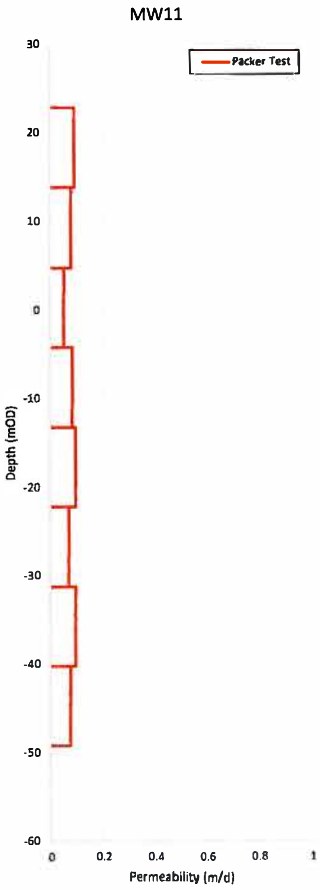












PACKER TEST RESULTS

Contract: Aghamore
Client: Lagan
Engineer: TMS Environmental
Borehole: MW 10c
Bh. size: NQ
Date: 18/07/2017
Packer Type: Single

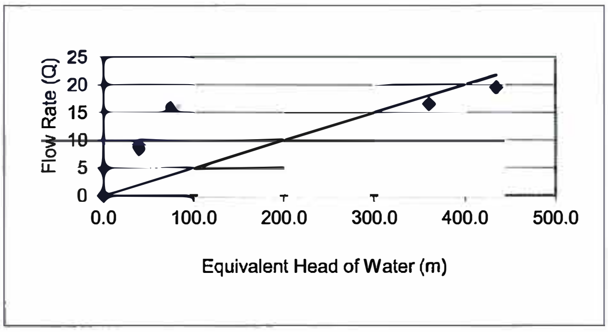
Top of test section (m bgl)	4
Bottom of test section (m bgl)	13
Centre of test section (m bgl)	8.5
Length of test section (m bgl)	9
Pressure gauge height (m agl)	0.2
Initial depth to G.W. (m bgl)	3.7
Packer inflation pressure (psi)	290

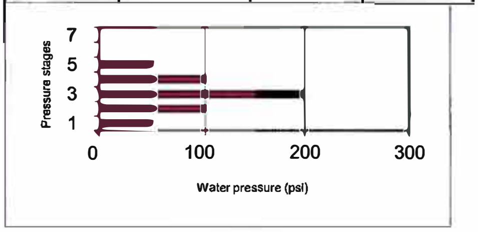
1. Site Records

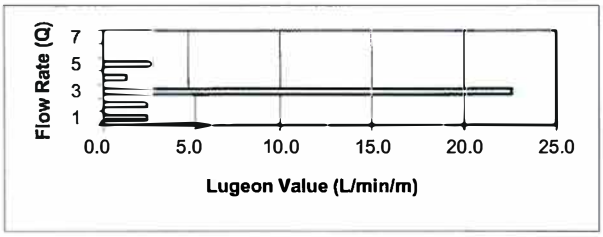
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (litres)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min litres
1	50	8375	8415	8458	8500	40	43	42	125
2	100	8521	8599	8679	8760	78	80	81	239
3	200	8676	8773	8872	8970	97	99	98	294
4	100	8982	9065	9147	9230	83	82	83	248
5	50	9241	9286	9333	9380	45	47	47	139

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Stage Lugeon Value l/min/m
1	39.1	8.3	*2.4*
2	74.3	15.9	*2.4*
3	434.5	19.6	*22.6*
4	360.4	16.5	*1.2*
5	39.1	9.3	*2.6*
6	0	0	0







3. Permeability (k) analysis

Mean Lugeon Value Used:	6.24L
k (m/sec)	6.24E-07

PACKER TEST RESULTS

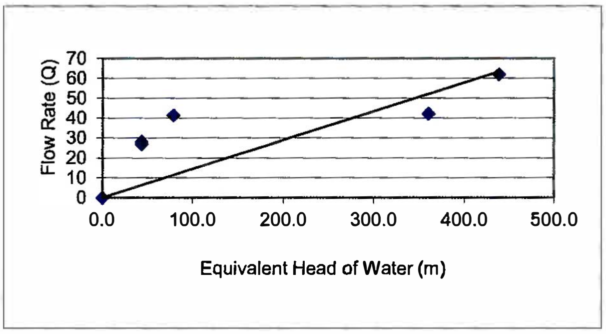
Contract:	Aghamore	Top of test section (m bgl)	13
Client:	Lagan	Bottom of test section (m bgl)	22
Engineer:	TMS Environmental	Centre of test section (m bgl)	17.5
Borehole:	**MW 10c**	Length of test section (m bgl)	9
Bh. size:	NQ	Pressure gauge height (m agl)	0.2
Date:	19/07/2017	Initial depth to G.W. (m bgl)	7.8
Packer Type:	Single	Packer inflation pressure (psi)	290

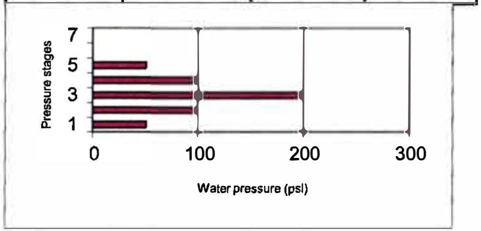
1. Site Records

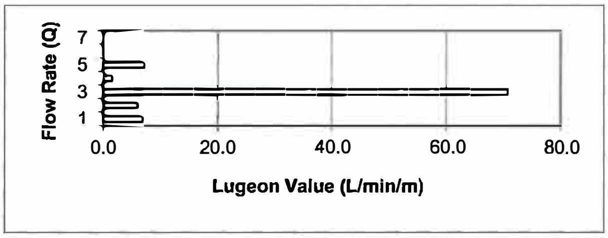
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (litres)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min litres
1	50	400	532	667	804	132	135	137	404
2	100	820	1025	1233	1443	205	208	210	623
3	200	1460	1767	2080	2391	307	313	311	931
4	100	2410	2621	2831	3042	211	210	211	632
5	50	3060	3202	3342	3482	142	140	140	422

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Stage Lugeon Value l/min/m
1	43.2	26.9	*6.9*
2	78.4	41.5	*5.9*
3	438.6	62.1	*70.8*
4	360.4	42.1	*1.5*
5	43.2	28.1	*7.2*
6	0	0	0







3. Permeability (k) analysis

Mean Lugeon Value Used: 18.46L

k (m/sec) 1.85E-06

PACKER TEST RESULTS

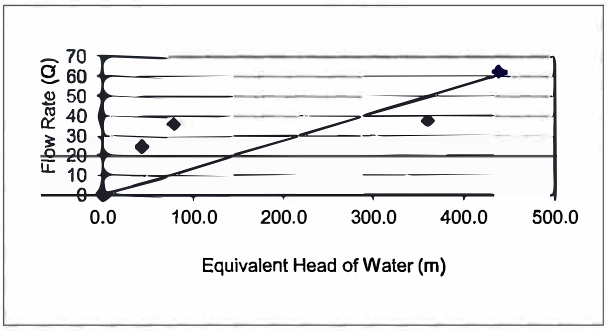
Contract:	Aghamore	Top of test section (m bgl)	22
Client:	Lagan	Bottom of test section (m bgl)	31
Engineer:	TMS Environmental	Centre of test section (m bgl)	26.5
Borehole:	**MW 10c**	Length of test section (m bgl)	9
Bh. size:	NQ	Pressure gauge height (m agl)	0.2
Date:	19/07/2017	Initial depth to G.W. (m bgl)	7.8
Packer Type:	Single	Packer inflation pressure (psi)	290

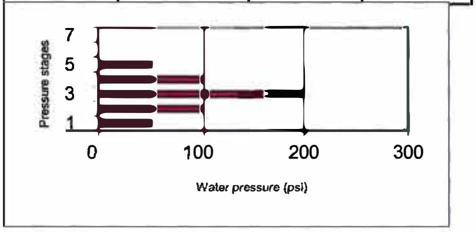
1. Site Records

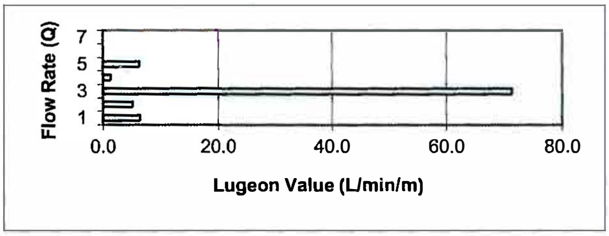
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (litres)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min litres
1	50	390	510	633	766	120	123	133	376
2	100	790	972	1153	1335	182	181	182	545
3	200	1350	1660	1975	2288	310	315	313	938
4	100	2300	2488	2678	2867	188	190	189	567
5	50	2880	3003	3126	3248	123	123	122	368

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Stage Lugeon Value l/min/m
1	43.2	25.1	*6.4*
2	78.4	36.3	*5.1*
3	438.6	62.5	*71.3*
4	360.4	37.8	*1.3*
5	43.2	24.5	*6.3*
6	0	0	0







3. Permeability (k) analysis

Mean Lugeon Value Used: 18.08L

k (m/sec) 1.81E-06

PACKER TEST RESULTS

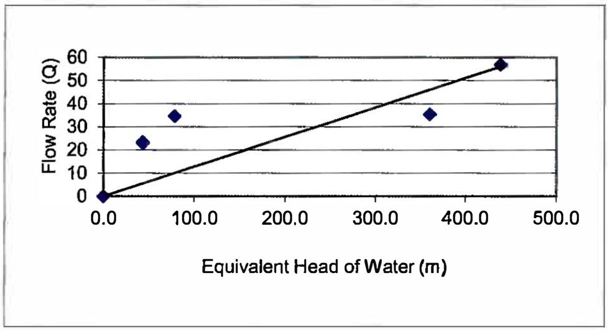
Contract:	Aghamore	Top of test section (m bgl)	31
Client:	Lagan	Bottom of test section (m bgl)	40
Engineer:	TMS Environmental	Centre of test section (m bgl)	35.5
Borehole:	**MW 10c**	Length of test section (m bgl)	9
Bh. size:	NQ	Pressure gauge height (m agl)	0.2
Date:	20/07/2017	Initial depth to G.W. (m bgl)	7.8
Packer Type:	Single	Packer inflation pressure (psi)	290

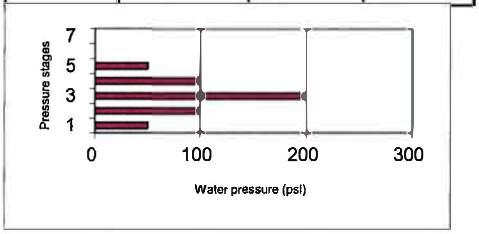
1. Site Records

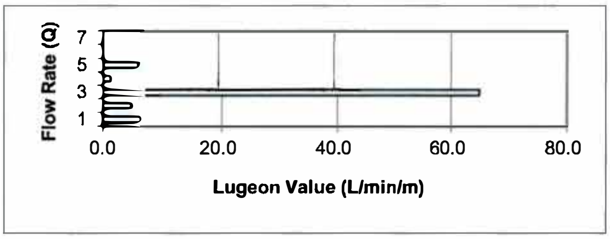
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (litres)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min litres
1	50	3260	3372	3487	3603	112	115	116	343
2	100	3615	3787	3962	4136	172	175	174	521
3	200	4145	4428	4714	4999	283	286	285	854
4	100	5010	5185	5364	5542	175	179	178	532
5	50	5550	5669	5786	5903	119	117	117	353

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Stage Lugeon Value l/min/m
1	43.2	22.9	*5.9*
2	78.4	34.7	*4.9*
3	438.6	56.9	*64.9*
4	360.4	35.5	*1.3*
5	43.2	23.5	*6.1*
6	0	0	0







3. Permeability (k) analysis

Mean Lugeon Value Used:	16.62L
k (m/sec)	1.66E-06

PACKER TEST RESULTS

Contract: Aghamore
Client: Lagan
Engineer: TMS Environmental
Borehole: MW 10c
Bh. size: NQ
Date: 20/07/2017
Packer Type: Single

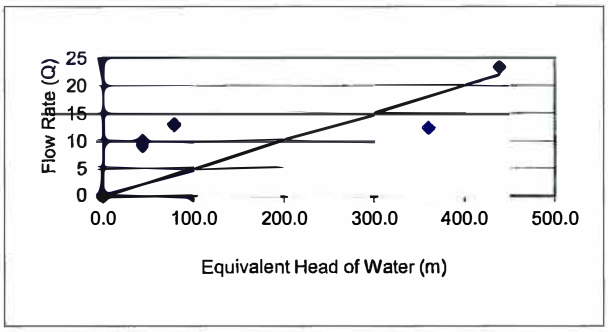
Top of test section (m bgl)	40
Bottom of test section (m bgl)	49
Centre of test section (m bgl)	44.5
Length of test section (m bgl)	9
Pressure gauge height (m agl)	0.2
Initial depth to G.W. (m bgl)	7.8
Packer inflation pressure (psi)	290

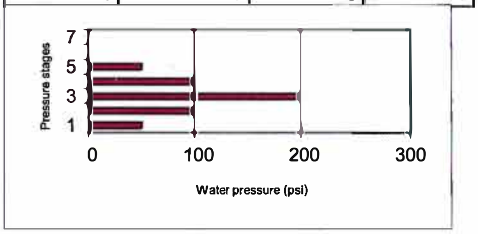
1. Site Records

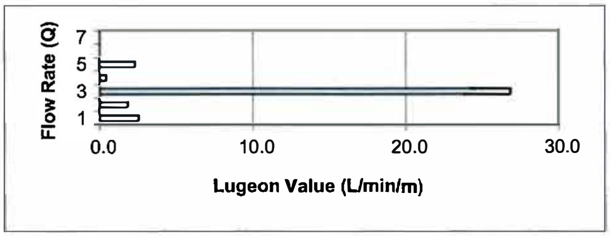
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (litres)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min litres
1	50	5920	5970	6021	6071	50	51	50	151
2	100	6080	6147	6212	6277	67	65	65	197
3	200	6285	6401	6519	6635	116	118	116	350
4	100	6640	6704	6766	6827	64	62	61	187
5	50	6835	6881	6926	6971	46	45	45	136

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Stage Lugeon Value l/min/m
1	43.2	10.1	*2.6*
2	78.4	13.1	*1.9*
3	438.6	23.3	*26.6*
4	360.4	12.5	*0.4*
5	43.2	9.1	*2.3*
6	0	0	0







3. Permeability (k) analysis

Mean Lugeon Value Used:	6.76L
k (m/sec)	6.76E-07

PACKER TEST RESULTS

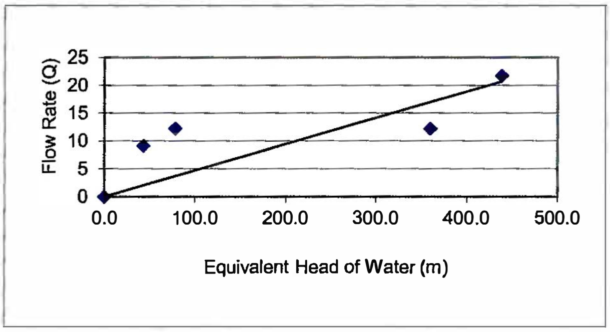
Contract:	Aghamore	Top of test section (m bgl)	49
Client:	Lagan	Bottom of test section (m bgl)	58
Engineer:	TMS Environmental	Centre of test section (m bgl)	53.5
Borehole:	**MW 10c**	Length of test section (m bgl)	9
Bh. size:	NQ	Pressure gauge height (m agl)	0.2
Date:	20/07/2017	Initial depth to G.W. (m bgl)	7.8
Packer Type:	Single	Packer inflation pressure (psi)	290

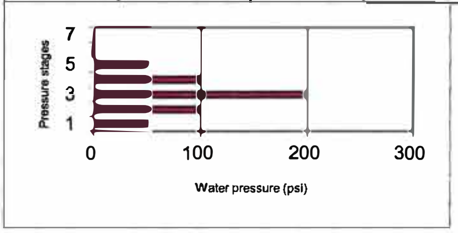
1. Site Records

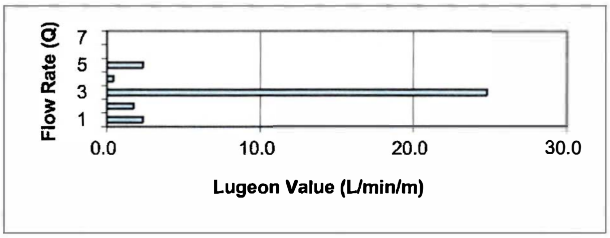
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (litres)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min litres
1	50	6990	7037	7082	7127	47	45	45	137
2	100	7140	7203	7264	7324	63	61	60	184
3	200	7350	7457	7567	7676	107	110	109	326
4	100	7690	7751	7813	7873	61	62	60	183
5	50	7890	7936	7981	8027	46	45	46	137

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Stage Lugeon Value l/min/m
1	43.2	9.1	*2.3*
2	78.4	12.3	*1.7*
3	438.6	21.7	*24.8*
4	360.4	12.2	*0.4*
5	43.2	9.1	*2.3*
6	0	0	0







3. Permeability (k) analysis

Mean Lugeon Value Used:	6.30L
k (m/sec)	6.30E-07

PACKER TEST RESULTS

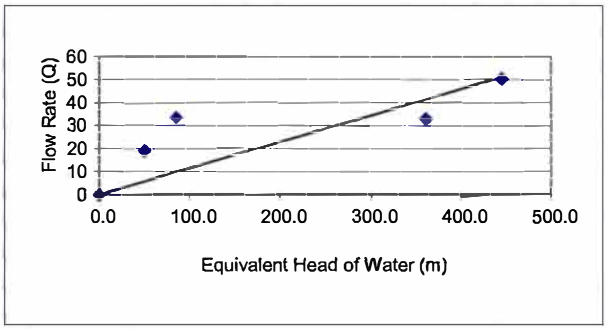
Contract:	Aghamore	Top of test section (m bgl)	58
Client:	Lagan	Bottom of test section (m bgl)	67
Engineer:	TMS Environmental	Centre of test section (m bgl)	62.4
Borehole:	**MW 10c**	Length of test section (m bgl)	9
Bh. size:	NQ	Pressure gauge height (m agl)	0.2
Date:	21/07/2017	Initial depth to G.W. (m bgl)	14.7
Packer Type:	Single	Packer inflation pressure (psi)	290

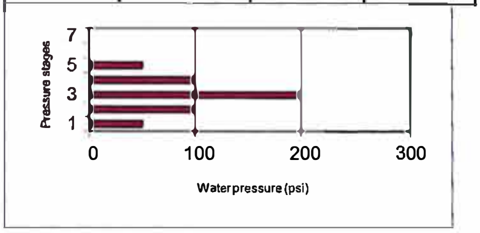
1. Site Records

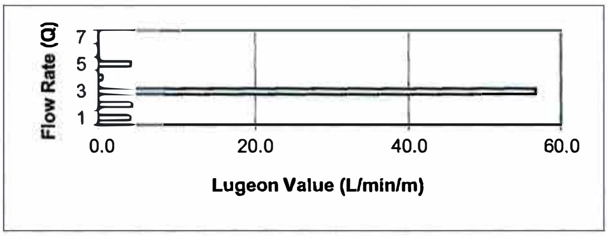
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (litres)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min litres
1	50	8050	8146	8241	8336	96	95	95	286
2	100	8345	8515	8683	8850	170	168	167	505
3	200	8870	9121	9374	9627	251	253	253	757
4	100	9640	9805	9971	10135	165	166	164	495
5	50	80140	80234	80331	80427	94	97	96	287

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Stage Lugeon Value l/min/m
1	50.1	19.1	*4.2*
2	85.3	33.7	*4.4*
3	445.5	50.5	*56.6*
4	360.4	33.0	*0.6*
5	50.1	19.1	*4.2*
6	0	0	0







3. Permeability (k) analysis

Mean Lugeon Value Used:	14.00L
k (m/sec)	1.40E-06

PACKER TEST RESULTS

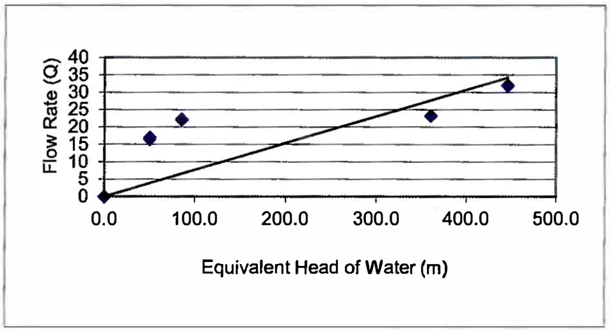
Contract:	Aghamore	Top of test section (m bgl)	67
Client:	Lagan	Bottom of test section (m bgl)	76
Engineer:	TMS Environmental	Centre of test section (m bgl)	71.5
Borehole:	**MW 10c**	Length of test section (m bgl)	9
Bh. size:	NQ	Pressure gauge height (m agl)	0.2
Date:	21/07/2017	Initial depth to G.W. (m bgl)	14.7
Packer Type:	Single	Packer inflation pressure (psi)	290

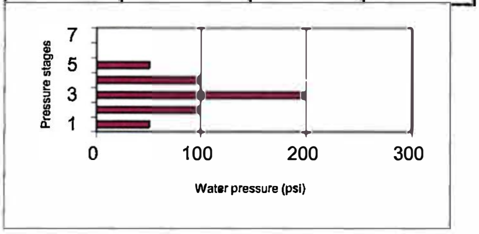
1. Site Records

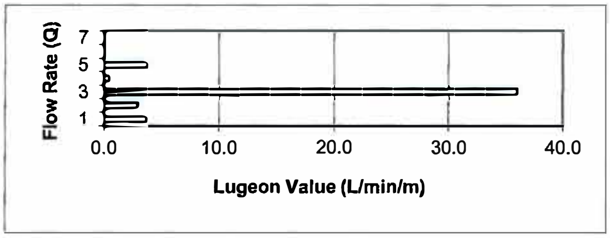
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (litres)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min litres
1	50	520	603	684	767	83	81	83	247
2	100	770	879	990	1103	109	111	113	333
3	200	1120	1277	1437	1600	157	160	163	480
4	100	1620	1737	1852	1968	117	115	116	348
5	50	1980	2065	2149	2234	85	84	85	254

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Stage Lugeon Value l/min/m
1	50.1	16.5	*3.7*
2	85.3	22.2	*2.9*
3	445.5	32.0	*35.9*
4	360.4	23.2	*0.4*
5	50.1	16.9	*3.8*
6	0	0	0







3. Permeability (k) analysis

Mean Lugeon Value Used: 9.34L

k (m/sec) 9.34E-06

PACKER TEST RESULTS

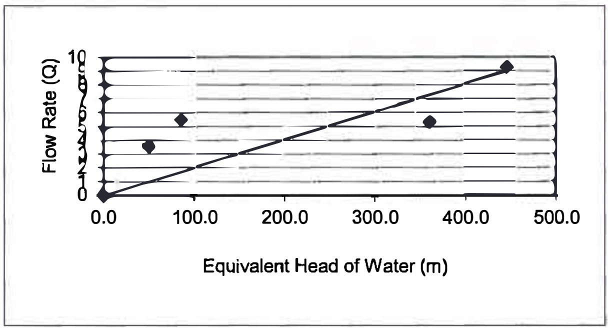
Contract:	Aghamore	Top of test section (m bgl)	76
Client:	Lagan	Bottom of test section (m bgl)	80
Engineer:	TMS Environmental	Centre of test section (m bgl)	78
Borehole:	**MW 10c**	Length of test section (m bgl)	4
Bh. size:	NQ	Pressure gauge height (m agl)	0.2
Date:	21/07/2017	Initial depth to G.W. (m bgl)	14.7
Packer Type:	Single	Packer inflation pressure (psi)	290

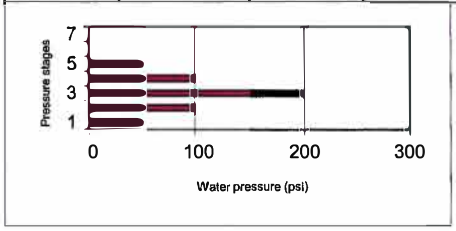
1. Site Records

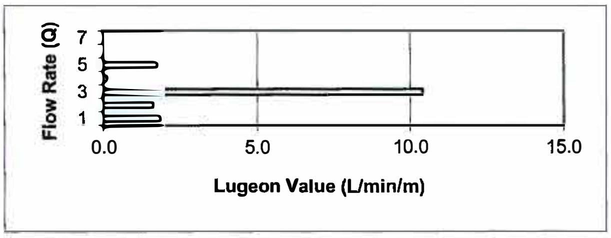
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (litres)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min litres
1	50	2250	2267	2286	2305	17	19	19	55
2	100	2310	2338	2365	2393	28	27	28	83
3	200	2400	2445	2492	2539	45	47	47	139
4	100	2550	2577	2603	2630	27	26	27	80
5	50	2640	2658	2675	2692	18	17	17	52

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Stage Lugeon Value l/min/m
1	50.1	3.7	*1.8*
2	85.3	5.5	*1.6*
3	445.5	9.3	*10.4*
4	360.4	5.3	*0.1*
5	50.1	3.5	*1.7*
6	0	0	0







3. Permeability (k) analysis

Mean Lugeon Value Used: 3.12L

k (m/sec) 3.12E-06

PACKER TEST RESULTS

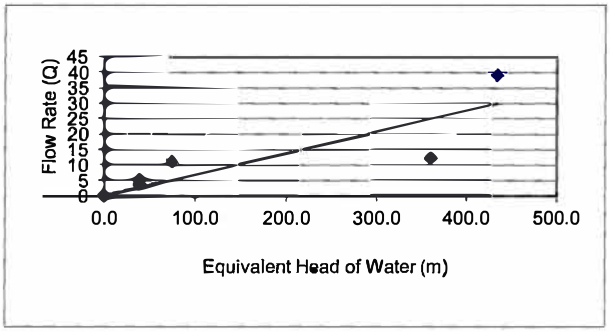
Contract:	Aghamore	Top of test section (m bgl)	7
Client:	Lagan	Bottom of test section (m bgl)	16
Engineer:	TMS Environmental	Centre of test section (m bgl)	11.5
Borehole:	**MW 11**	Length of test section (m bgl)	9
Bh. size:	NQ	Pressure gauge height (m agl)	0.2
Date:	10/08/2017	Initial depth to G.W. (m bgl)	3.8
Packer Type:	Single	Packer inflation pressure (psi)	290

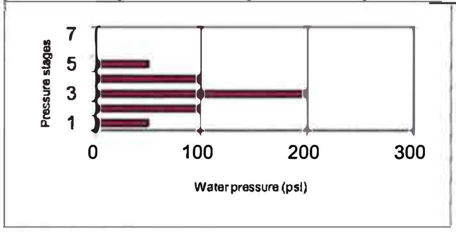
1. Site Records

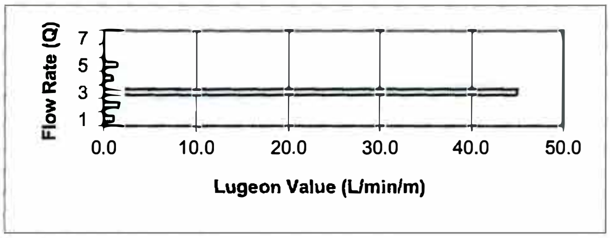
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (litres)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min litres
1	50	2700	2719	2737	2756	19	18	19	56
2	100	2760	2816	2873	2929	56	57	56	169
3	200	2940	3137	3332	3527	197	195	195	587
4	100	3535	3596	3656	3717	61	60	61	182
5	50	3730	3757	3782	3807	27	25	25	77

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Stage Lugeon Value l/min/m
1	39.2	3.7	*1.1*
2	74.4	11.3	*1.7*
3	434.6	39.1	*45.0*
4	360.4	12.1	*0.9*
5	39.2	5.1	*1.5*
6	0	0	0







3. Permeability (k) analysis

Mean Lugeon Value Used: 10.04L

k (m/sec) 1.00E-06

PACKER TEST RESULTS

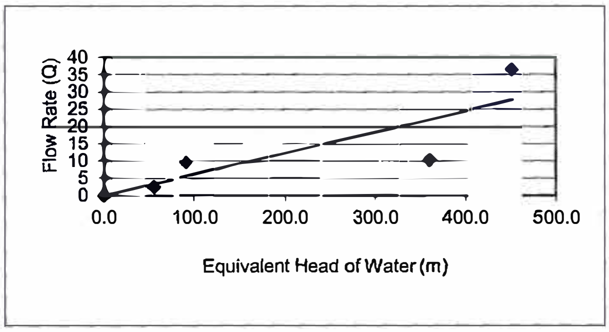
Contract:	Aghamore	Top of test section (m bgl)	16
Client:	Lagan	Bottom of test section (m bgl)	25
Engineer:	TMS Environmental	Centre of test section (m bgl)	20.5
Borehole:	**MW 11**	Length of test section (m bgl)	9
Bh. size:	NQ	Pressure gauge height (m agl)	0.2
Date:	10/08/2017	Initial depth to G.W. (m bgl)	21
Packer Type:	Single	Packer inflation pressure (psi)	290

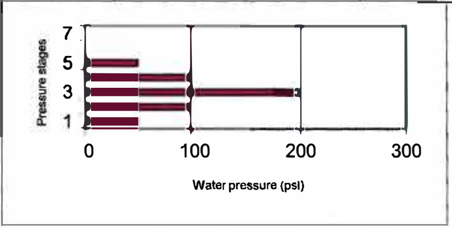
1. Site Records

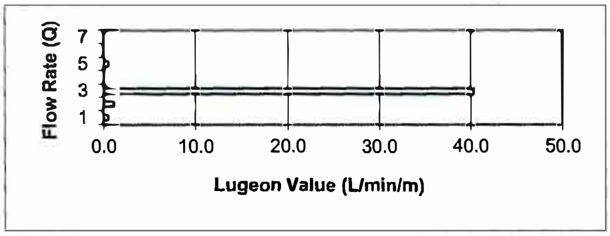
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (litres)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min litres
1	50	3830	3842	3855	3868	12	13	13	38
2	100	3880	3927	3976	4024	47	49	48	144
3	200	4035	4218	4400	4582	183	182	182	547
4	100	4595	4644	4692	4751	49	48	59	156
5	50	4760	4774	4788	4801	14	14	13	41

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Stage Lugeon Value l/min/m
1	56.4	2.5	*0.5*
2	91.6	9.6	*1.2*
3	451.8	36.5	*40.4*
4	360.4	10.4	*0.1*
5	56.4	2.7	*0.5*
6	0	0	0







3. Permeability (k) analysis

Mean Lugeon Value Used: 8.54L

k (m/sec) 8.54E-07

PACKER TEST RESULTS

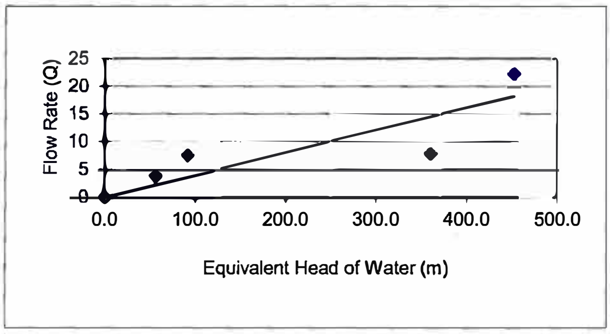
Contract:	Aghamore	Top of test section (m bgl)	25
Client:	Lagan	Bottom of test section (m bgl)	34
Engineer:	TMS Environmental	Centre of test section (m bgl)	29.5
Borehole:	**MW 11**	Length of test section (m bgl)	9
Bh. size:	NQ	Pressure gauge height (m agl)	0.2
Date:	11/08/2017	Initial depth to G.W. (m bgl)	21
Packer Type:	Single	Packer inflation pressure (psi)	290

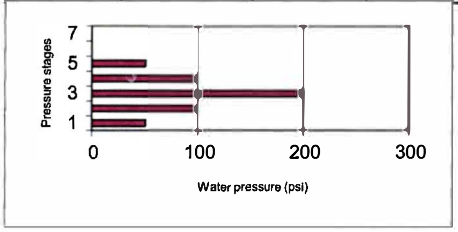
1. Site Records

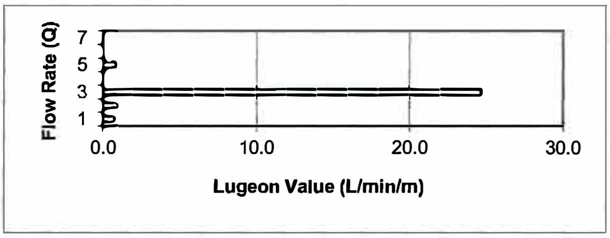
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (litres)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min litres
1	50	4830	4848	4867	4886	18	19	19	56
2	100	4895	4933	4971	5010	38	38	39	115
3	200	5020	5130	5241	5354	110	111	113	334
4	100	5360	5399	5439	5478	39	40	39	118
5	50	5480	5499	5520	5541	19	21	21	61

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Stage Lugeon Value l/min/m
1	56.4	3.7	*0.7*
2	91.6	7.7	*0.9*
3	451.8	22.3	*24.6*
4	360.4	7.9	*0.1*
5	56.4	4.1	*0.8*
6	0	0	0







3. Permeability (k) analysis

Mean Lugeon Value Used:	5.42L
k (m/sec)	5.42E-07

PACKER TEST RESULTS

Contract: Aghamore
Client: Lagan
Engineer: TMS Environmental
Borehole: MW 11
Bh. size: NQ
Date: 11/08/2017
Packer Type: Single

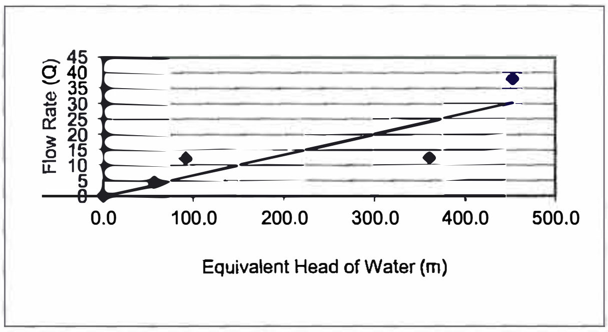
Top of test section (m bgl)	34
Bottom of test section (m bgl)	43
Centre of test section (m bgl)	38.5
Length of test section (m bgl)	9
Pressure gauge height (m agl)	0.2
Initial depth to G.W. (m bgl)	21.2
Packer inflation pressure (psi)	290

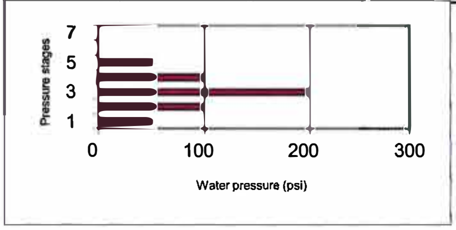
1. Site Records

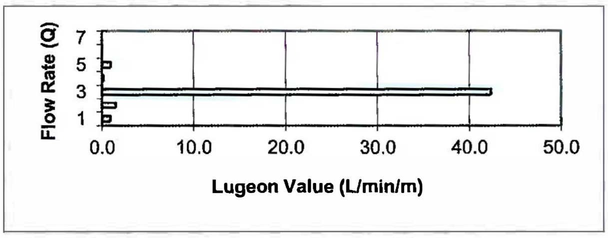
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (litres)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min litres
1	50	5560	5581	5604	5628	21	23	24	68
2	100	5640	5699	5760	5823	59	61	63	183
3	200	5835	6032	6221	6409	197	189	188	574
4	100	6420	6481	6543	6605	61	62	62	185
5	50	6620	6643	6668	6692	23	25	24	72

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Stage Lugeon Value l/min/m
1	56.6	4.5	*0.9*
2	91.8	12.2	*1.5*
3	452.0	38.3	*42.3*
4	360.4	12.3	*0.2*
5	56.6	4.8	*0.9*
6	0	0	0







3. Permeability (k) analysis

Mean Lugeon Value Used:	9.16L
k (m/sec)	9.16E-07

PACKER TEST RESULTS

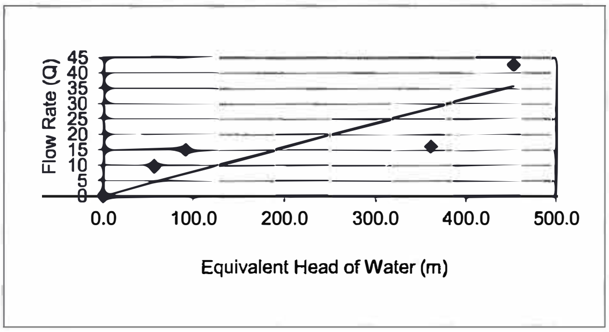
Contract:	Aghamore	Top of test section (m bgl)	43
Client:	Lagan	Bottom of test section (m bgl)	52
Engineer:.	TMS Environmental	Centre of test section (m bgl)	47.5
Borehole:	**MW 11**	Length of test section (m bgl)	9
Bh. size:	NQ	Pressure gauge height (m agl)	0.2
Date:	14/08/2017	Initial depth to G.W. (m bgl)	21
Packer Type:	Single	Packer inflation pressure (psi)	290

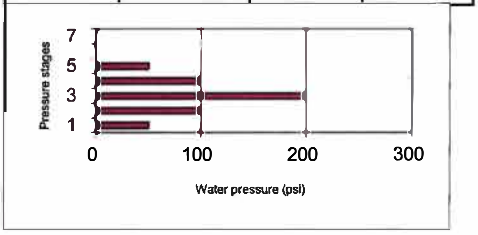
1. Site Records

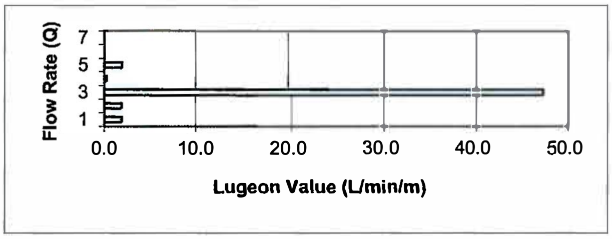
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (litres)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min litres
1	50	6705	6751	6799	6846	46	48	47	141
2	100	6855	6928	7003	7081	73	75	78	226
3	200	7100	7312	7526	7741	212	214	215	641
4	100	7750	7831	7919	7994	81	88	75	244
5	50	8005	8054	8102	8151	49	48	49	146

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Stage Lugeon Value l/min/m
1	56.4	9.4	*1.9*
2	91.6	15.1	*1.8*
3	451.8	42.7	*47.3*
4	360.4	16.3	*0.2*
5	56.4	9.7	*1.9*
6	0	0	0







3. Permeability (k) analysis

Mean Lugeon Value Used:	10.62L
k (m/sec)	1.06E-06

PACKER TEST RESULTS

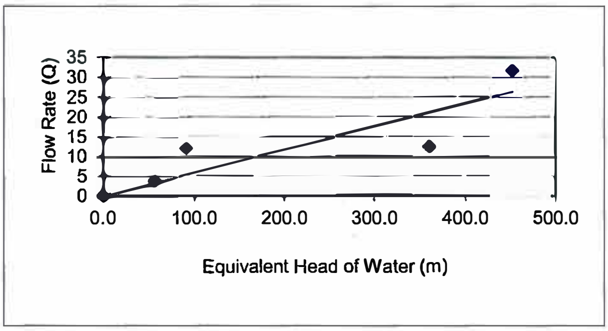
Contract:	Aghamore	Top of test section (m bgl)	52
Client:	Lagan	Bottom of test section (m bgl)	61
Engineer:	TMS Environmental	Centre of test section (m bgl)	56.5
Borehole:	**MW 11**	Length of test section (m bgl)	9
Bh. size:	NQ	Pressure gauge height (m agl)	0.2
Date:	14/08/2017	Initial depth to G.W. (m bgl)	21
Packer Type:	Single	Packer inflation pressure (psi)	290

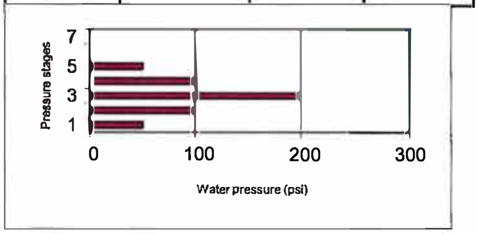
1. Site Records

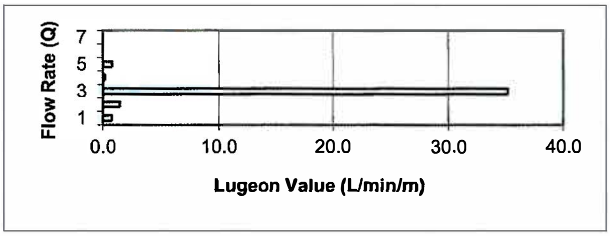
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (litres)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min litres
1	50	8170	8189	8209	8228	19	20	19	58
2	100	8240	8299	8359	8419	59	60	60	179
3	200	8430	8587	8746	8906	157	159	160	476
4	100	8920	8983	9045	9107	63	62	62	187
5	50	9130	9151	9171	9191	21	20	20	61

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Stage Lugeon Value l/min/m
1	56.4	3.9	*0.8*
2	91.6	11.9	*1.4*
3	451.8	31.7	*35.1*
4	360.4	12.5	*0.2*
5	56.4	4.1	*0.8*
6	0	0	0







3. Permeability (k) analysis

Mean Lugeon Value Used:	7.66L
k (m/sec)	7.66E-07

PACKER TEST RESULTS

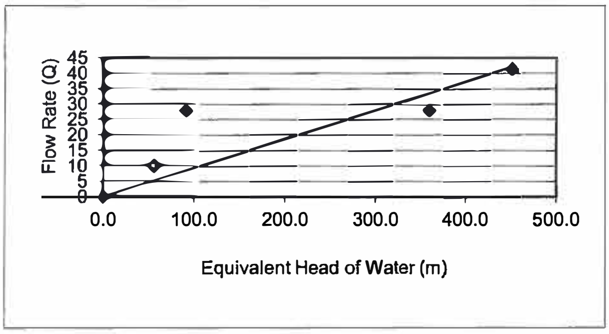
Contract:	Aghamore	Top of test section (m bgl)	61
Client:	Lagan	Bottom of test section (m bgl)	70
Engineer:	TMS Environmental	Centre of test section (m bgl)	65.5
Borehole:	**MW 11**	Length of test section (m bgl)	9
Bh. size:	NQ	Pressure gauge height (m agl)	0.2
Date:	15/08/2017	Initial depth to G.W. (m bgl)	21
Packer Type:	Single	Packer inflation pressure (psi)	290

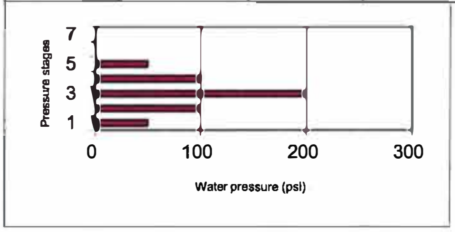
1. Site Records

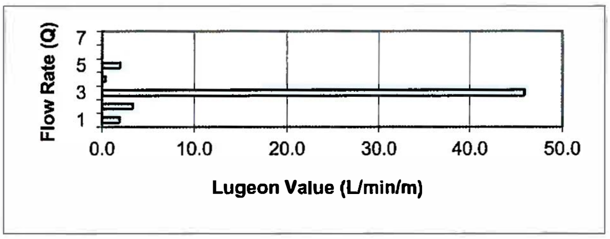
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (litres)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min litres
1	50	9200	9248	9297	9348	48	49	51	148
2	100	9360	9497	9636	9776	137	139	140	416
3	200	9785	9991	10200	10408	206	209	208	623
4	100	90418	90559	90701	90842	141	142	141	424
5	50	90730	90780	90831	90882	50	51	51	152

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Stage Lugeon Value l/min/m
1	56.4	9.9	*1.9*
2	91.6	27.7	*3.4*
3	451.8	41.5	*46.0*
4	360.4	28.3	*0.4*
5	56.4	10.1	*2.0*
6	0	0	0







3. Permeability (k) analysis

Mean Lugeon Value Used:	10.74L
k (m/sec)	1.07E-06

PACKER TEST RESULTS

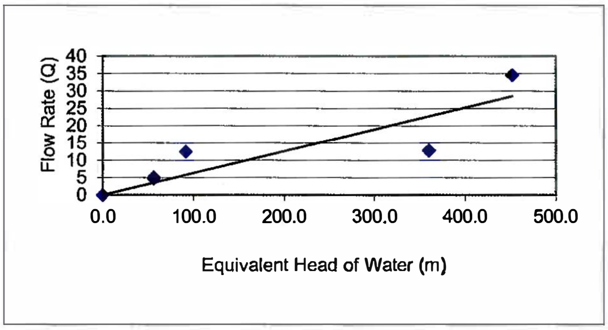
Contract:	Aghamore	Top of test section (m bgl)	70
Client:	Lagan	Bottom of test section (m bgl)	79
Engineer:	TMS Environmental	Centre of test section (m bgl)	74.5
Borehole:	**MW 11**	Length of test section (m bgl)	9
Bh. size:	NQ	Pressure gauge height (m agl)	0.2
Date:	15/08/2017	Initial depth to G.W. (m bgl)	21
Packer Type:	Single	Packer inflation pressure (psi)	290

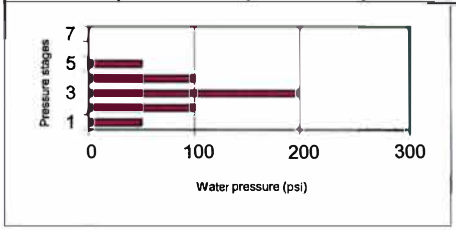
1. Site Records

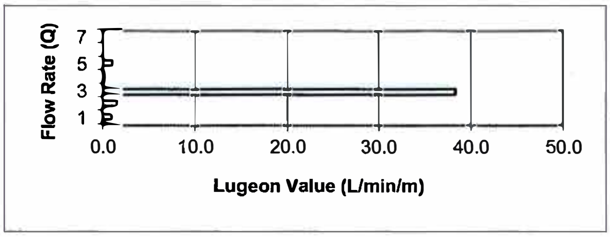
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (litres)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min litres
1	50	895	918	942	966	23	24	24	71
2	100	980	1043	1105	1168	63	62	63	188
3	200	1180	1352	1526	1699	172	174	173	519
4	100	1710	1775	1839	1903	65	64	64	193
5	50	1920	1946	1971	1996	26	25	25	76

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Stage Lugeon Value l/min/m
1	56.4	4.7	*0.9*
2	91.6	12.5	*1.5*
3	451.8	34.6	*38.3*
4	360.4	12.9	*0.2*
5	56.4	5.1	*1.0*
6	0	0	0







3. Permeability (k) analysis

Mean Lugeon Value Used:	8.38L
k (m/sec)	8.38E-07

APPENDIX 7-16 WATER BALANCE

Quarry Water Balance - January to April 2021

Quarry Water Balance:

Start Date	26/01/2021	
End Date	09/04/2021	
Days	73	
Water Level 26/01/2021 (mOD)	-15.4	Water level measured by APEX Geophysics
Water Level 09/04/2021 (mOD)	-18.9	Water level measured by Hydro-G
Fall (m)	3.5	
Rainfall (mm)	256.8	Markree data
Potential Evapotranspiration (mm)	72.3	Finner data
Evaporation (mm)	104	Finner data
Pumping Rate (m3/d)	2,722	Assumed average of 31.5l/s
Stormwater Catchment to Quarry (m2)	125,000	Estimated
Quarry Lake Area Only (m2)	46,000	Estimated
Epikarst Drainage Area to Quarry (m2)	116,300	Estimated
Deeper Groundwater Inflows (m3/d)	*56.5*	*Estimated by iteration*

Inputs:

Rainfall on Quarry Lake (m3)	11,813	
Runoff to Quarry Lake (m3)	17,244	Assumed runoff coefficient of 0.85
Epikarst Drainage to Quarry Lake (m3)	7,876	
Deeper Groundwater Inflows (m3)	4,125	
Total Inputs (m3)	41,057	Estimated by above

Outputs:

Pumping (m3)	198,706	
Evaporation from quarry lake (m3)	3,349	Evaporation from lake at 70% of pan data
Total Outputs (m3)	202,055	

Change in Storage:

Decrease (m3)	161,000	

Outputs - Storage = Inputs

Total Outputs (m3)	202,055	
Decrease in Storage (m3)	161,000	
Total Inputs (m3)	41,055	Calculated from Outputs minus Storage

Recharge to Epikarst:

Rainfall (mm)	256.8	
Potential Evapotranspiration (mm)	72.3	
Actual Evapotranspiration (mm)	68.685	Assumed 95% of PE
Effective Rainfall (mm)	188.115	
Recharge Coefficient (%)	40	High Vulnerability: moderate permeability subsoils overlain by poorly drained soils
Recharge (mm)	75.246	
Recharge - deeper percolation (mm)	67.7214	Assumed 10% of recharge percolates deeper

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APPENDIX 7-17 GROUNDWATER LEVELS

Groundwater Levels - Manual Measurement

mbtoc:

	12/07/2017	23/08/2017	28/08/2017	07/09/2017	08/02/2018	26/03/2018	30/03/2018	11/04/2018	19/04/2018	16/05/2018	29/05/2018	01/06/2018	10/07/2018	07/11/2018	29/01/2019	02/05/2019	23/08/2019	22/07/2020	06/10/2020
MW1	34.410	18.610	23.350	25.140	17.220	25.040	24.950	23.515	21.485	24.800	25.285	25.390	26.515	16.365	16.670	-	25.870	9.230	8.990
MW2	27.600	c. 12.58 - 13.18	c. 15.00	c. 17.00 - 25.00	c. 14.99	Dry	Dry	26.715	26.320	27.215	Dry	Dry	Dry	21.450	21.300	25.710	24.340	21.225	22.670
MW3	30.495	30.455	30.470	30.470	30.475	30.500	30.500	30.510	30.565	30.315	30.525	30.545	30.505	30.505	30.560	29.985	30.615	28.420	29.550
MW4	35.040	30.000	30.465	31.730	29.550	34.340	33.110	30.350	30.320	33.595	34.225	34.390	35.340	30.010	33.265	34.560	35.380	32.055	35.170
MW5	35.335	34.660	34.455	34.530	29.990	32.495	32.580	32.800	33.945	33.105	33.155	33.190	34.040	33.475	32.350	33.555	35.755	33.295	34.770
MW6	34.680	33.650	33.660	33.935	26.255	31.310	31.470	31.860	32.005	32.240	32.255	32.315	33.235	32.570	30.695	32.750	32.855	32.415	32.540
MW7	38.555	37.415	37.500	37.810	32.355	35.495	35.560	35.760	35.935	36.075	36.055	36.075	36.895	36.505	35.350	35.350	37.210	35.900	35.680
MW8	35.520	31.140	31.280	32.430	30.625	33.920	33.760	31.065	31.090	34.050	34.625	34.885	35.675	29.055	30.795	35.390	36.100	33.105	35.850
MW9	14.880	14.580	14.655	14.680	14.070	14.670	14.640	14.640	14.610	14.700	14.710	14.745	14.655	11.315	14.315	14.485	15.015	14.655	-
MW10c	-	c. 7.21	c. 7.99	36.070	c. 12.27	33.960	34.015	33.870	15.565	34.565	34.560	34.550	34.975	28.500	21.740	33.980	35.200	33.450	35.150
MW11	-	c. 13.58	c. 14.50	c. 19.00	c. 13.20	35.565	c. 26.00	c. 27.00	35.650	35.560	35.545	35.570	35.565	35.470	35.385	35.105	35.650	32.210	35.320
Old Well	-	-	4.170	4.520	5.975	7.210	6.580	4.195	6.120	6.305	6.400	6.950	Dry	4.145	4.280	5.660	7.985	5.450	-
MW12																			15.060
MW13																			5.740
MW14																			7.240
MW15																			-
MW16																			-
MW17																			-
MW18																			34.750
MW19																			21.400
MW20																			-
MW21																			-
MW22																			-
MW23																			-
MW24																			-
MW25																			-

mOD:

	12/07/2017	23/08/2017	28/08/2017	07/09/2017	08/02/2018	26/03/2018	30/03/2018	11/04/2018	19/04/2018	16/05/2018	29/05/2018	01/06/2018	10/07/2018	07/11/2018	29/01/2019	02/05/2019	23/08/2019	22/07/2020	06/10/2020
MW1	-6.888	8.912	4.172	2.382	10.302	2.482	2.572	4.007	6.037	2.722	2.237	2.132	1.007	11.157	10.852	-	1.652	18.292	18.532
MW2	0.590	-	-	-	-	Dry	Dry	1.475	1.870	0.975	Dry	Dry	Dry	6.740	6.890	2.480	3.850	6.965	5.520
MW3	-1.937	-1.897	-1.912	-1.912	-1.917	-1.942	-1.942	-1.952	-2.007	-1.757	-1.967	-1.987	-1.947	-1.947	-2.002	-1.427	-2.057	0.138	-0.992
MW4	-5.758	-0.718	-1.183	-2.448	-0.268	-5.058	-3.828	-1.068	-1.038	-4.313	-4.943	-5.108	-6.058	-0.728	-3.983	-5.278	-6.098	-2.773	-5.888
MW5	-4.190	-3.515	-3.310	-3.385	1.155	-1.350	-1.435	-1.655	-2.800	-1.960	-2.010	-2.045	-2.895	-2.330	-1.205	-2.410	-4.610	-2.150	-3.625
MW6	-6.670	-5.640	-5.650	-5.925	1.755	-3.300	-3.460	-3.850	-3.995	-4.230	-4.245	-4.305	-5.225	-4.560	-2.685	-4.740	-4.845	-4.405	-4.530
MW7	-9.142	-8.002	-8.087	-8.397	-2.942	-6.082	-6.147	-6.347	-6.522	-6.662	-6.642	-6.662	-7.482	-7.092	-5.937	-5.937	-7.797	-6.487	-6.267
MW8	-5.268	-0.888	-1.028	-2.178	-0.373	-3.668	-3.508	-0.813	-0.838	-3.798	-4.373	-4.633	-5.423	1.197	-0.543	-5.138	-5.848	-2.853	-5.598
MW9	-1.372	-1.072	-1.147	-1.172	-0.562	-1.162	-1.132	-1.132	-1.102	-1.192	-1.202	-1.237	-1.147	2.193	-0.807	-0.977	-1.507	-1.147	-
MW10c	-	-	-	-7.085	-	-4.975	-5.030	-4.885	13.420	-5.580	-5.575	-5.565	-5.990	0.485	7.245	-4.995	-6.215	-4.465	-6.165
MW11	-	-	-	-	-	-4.716	-	-	-4.801	-4.711	-4.696	-4.721	-4.716	-4.621	-4.536	-4.256	-4.801	-1.361	-4.471
Old Well	-	-	8.004	7.654	6.199	4.964	5.594	7.979	6.054	5.869	5.774	5.224	Dry	8.029	7.894	6.514	4.189	6.724	-
MW12																			-3.758
MW13																			6.968
MW14																			5.052
MW15																			-
MW16																			-
MW17																			-
MW18																			-4.842
MW19																			8.471
MW20																			-
MW21																			-
MW22																			-
MW23																			-
MW24																			-
MW25																			-

Groundwater Levels - Manual Measurement

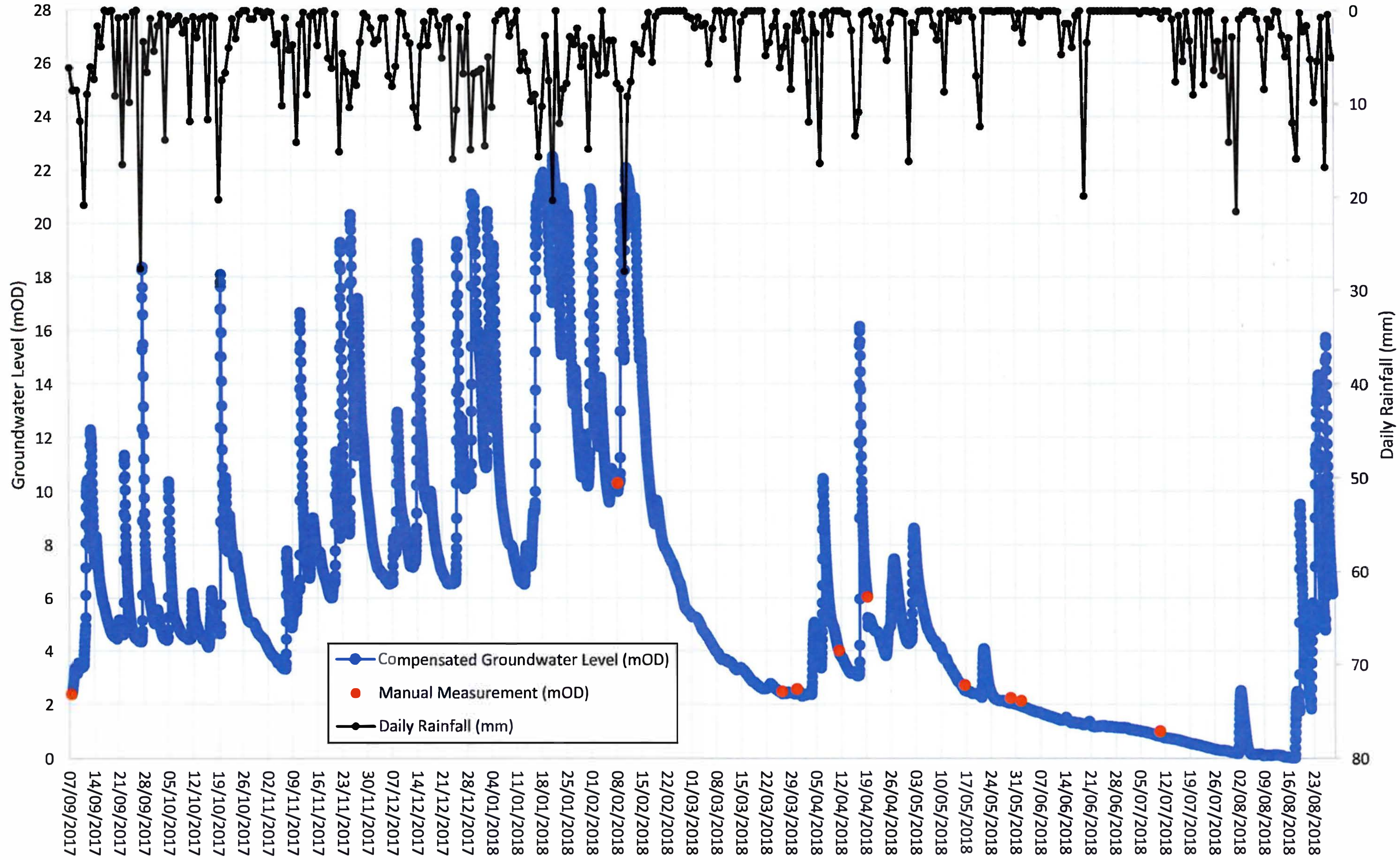
mbtoc:

	07/10/2020	15/10/2020	23/10/2020	30/10/2020	13/11/2020	30/11/2020	04/12/2020	21/12/2020	09/03/2021
MW1	-	8.960	-	6.305	6.380	-	-	8.870	8.865
MW2	-	22.450	-	-	-	19.180	21.360	20.935	24.350
MW3	-	29.380	-	30.470	30.470	30.505	31.785	28.345	30.600
MW4	-	29.940	-	28.520	29.025	29.690	29.120	33.790	29.915
MW5	-	31.700	-	30.030	29.300	29.050	30.855	30.230	30.140
MW6	-	29.830	-	25.410	24.445	27.075	29.135	27.935	27.445
MW7	-	34.460	-	32.195	31.530	31.490	31.545	33.555	32.635
MW8	-	35.620	-	30.015	30.010	30.335	29.865	35.790	30.745
MW9	14.950	14.310	-	13.550	13.505	13.835	13.990	14.030	14.530
MW10c	-	21.290	-	-	11.160	-	-	19.585	31.215
MW11	-	35.270	-	-	33.560	33.180	34.425	33.870	34.620
Old Well	7.460	4.170	4.160	4.160	4.160	4.225	4.105	4.150	-
MW12	-	13.520	12.990	12.910	12.395	12.280	13.480	12.155	12.530
MW13	-	8.770	6.300	5.520	5.480	5.565	5.515	5.515	6.475
MW14	-	4.970	3.540	3.660	3.675	4.320	3.580	3.700	5.925
MW15	5.100	5.960	-	4.750	4.390	4.570	4.880	5.000	5.500
MW16	4.980	4.610	-	3.590	3.330	3.330	3.575	3.745	4.505
MW17	5.560	-	-	6.100	5.690	5.515	5.550	5.580	-
MW18	-	34.450	-	31.780	31.105	31.150	31.280	33.950	32.475
MW19	-	21.040	-	15.050	16.870	18.980	20.535	19.765	21.355
MW20	4.180	4.140	-	3.575	3.190	3.070	3.135	3.210	3.630
MW21	2.320	2.180	-	1.590	1.355	1.280	1.270	1.355	2.030
MW22	7.720	7.620	-	6.530	6.425	6.505	6.795	6.945	-
MW23	1.570	1.720	-	1.260	0.930	0.735	0.700	0.610	0.630
MW24	3.660	3.470	-	2.540	2.200	2.275	2.390	2.560	3.150
MW25	4.910	3.750	-	3.120	2.790	2.680	2.765	2.820	3.330

mOD:

	07/10/2020	15/10/2020	23/10/2020	30/10/2020	13/11/2020	30/11/2020	04/12/2020	21/12/2020	09/03/2021
MW1	-	18.562	-	21.217	21.142	-	-	18.652	18.657
MW2	-	5.740	-	-	-	9.010	6.830	7.255	3.840
MW3	-	-0.822	-	-1.912	-1.912	-1.947	-3.227	0.213	-2.042
MW4	-	-0.658	-	0.762	0.257	-0.408	0.162	-4.508	-0.633
MW5	-	-0.555	-	1.115	1.845	2.095	0.290	0.915	1.005
MW6	-	-1.820	-	2.600	3.565	0.935	-1.125	0.075	0.565
MW7	-	-5.047	-	-2.782	-2.117	-2.077	-2.132	-4.142	-3.222
MW8	-	-5.368	-	0.237	0.242	-0.083	0.387	-5.538	-0.493
MW9	-1.442	-0.802	-	-0.042	0.003	-0.327	-0.482	-0.522	-1.022
MW10c	-	7.695	-	-	17.825	-	-	9.400	-2.230
MW11	-	-4.421	-	-	-2.711	-2.331	-3.576	-3.021	-3.771
Old Well	4.714	8.004	8.014	8.014	8.014	7.949	8.069	8.024	-
MW12	-	-2.218	-1.688	-1.608	-1.093	-0.978	-2.178	-0.853	-1.228
MW13	-	3.938	6.408	7.188	7.228	7.143	7.193	7.193	6.233
MW14	-	7.322	8.752	8.632	8.617	7.972	8.712	8.592	6.367
MW15	9.153	8.293	-	9.503	9.863	9.683	9.373	9.253	8.753
MW16	8.459	8.829	-	9.849	10.109	10.109	9.864	9.694	8.934
MW17	11.808	-	-	11.268	11.678	11.853	11.818	11.788	-
MW18	-	-4.542	-	-1.872	-1.197	-1.242	-1.372	-4.042	-2.567
MW19	-	8.831	-	14.821	13.001	10.891	9.336	10.106	8.516
MW20	8.204	8.244	-	8.809	9.194	9.314	9.249	9.174	8.754
MW21	8.942	9.082	-	9.672	9.907	9.982	9.992	9.907	9.232
MW22	9.317	9.417	-	10.507	10.612	10.532	10.242	10.092	-
MW23	9.994	9.844	-	10.304	10.634	10.829	10.864	10.954	10.934
MW24	7.782	7.972	-	8.902	9.242	9.167	9.052	8.882	8.292
MW25	7.092	8.252	-	8.882	9.212	9.322	9.237	9.182	8.672

MW1


Groundwater Level (mOD)
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)
07/09/2017
14/09/2017
21/09/2017
28/09/2017
05/10/2017
12/10/2017
19/10/2017
26/10/2017
02/11/2017
09/11/2017
16/11/2017
23/11/2017
30/11/2017
07/12/2017
14/12/2017
21/12/2017
28/12/2017
04/01/2018
11/01/2018
18/01/2018
25/01/2018
01/02/2018
08/02/2018
15/02/2018
22/02/2018
01/03/2018
08/03/2018
15/03/2018
22/03/2018
29/03/2018
05/04/2018
12/04/2018
19/04/2018
26/04/2018
03/05/2018
10/05/2018
17/05/2018
24/05/2018
31/05/2018
07/06/2018
14/06/2018
21/06/2018
28/06/2018
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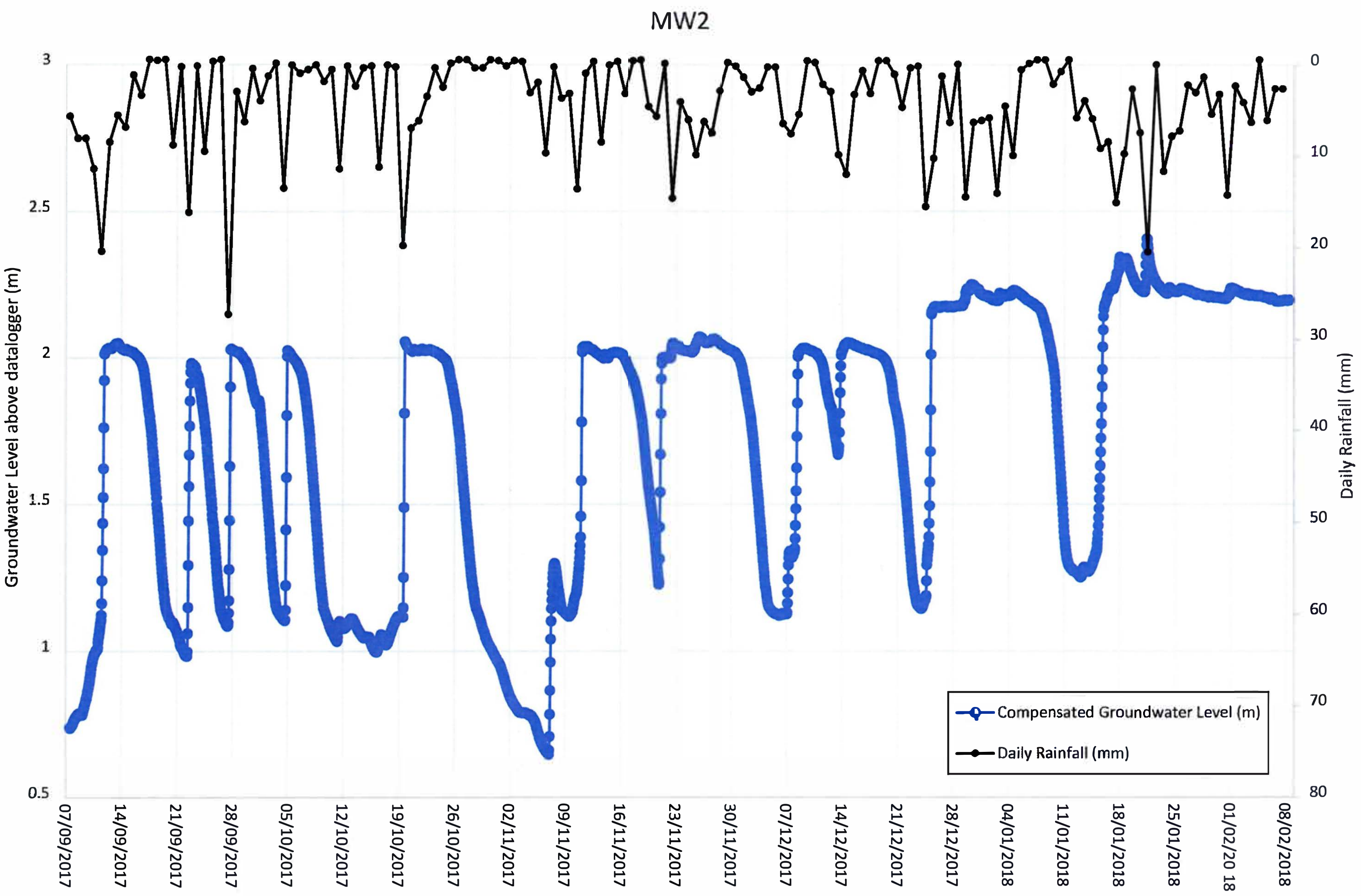
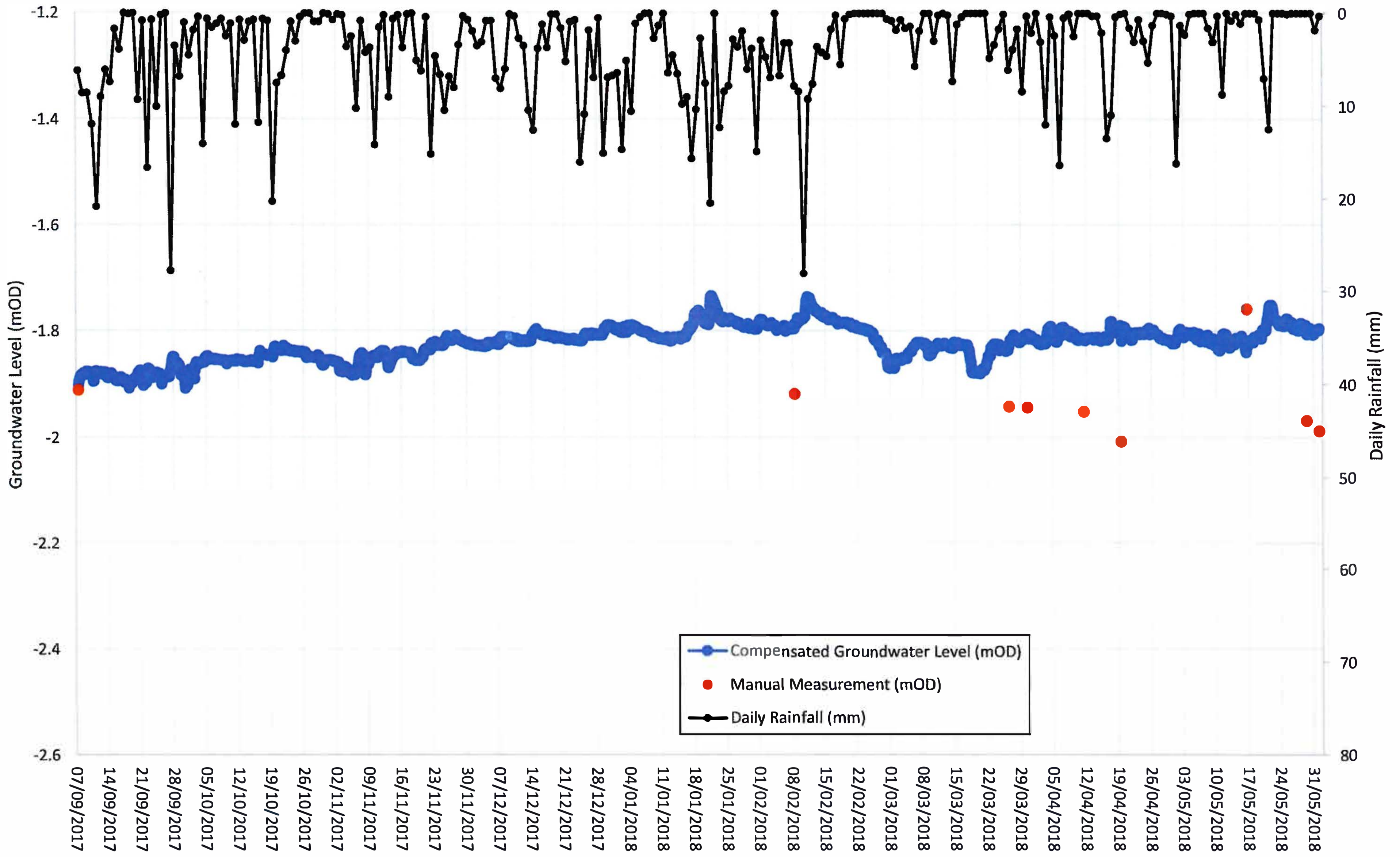
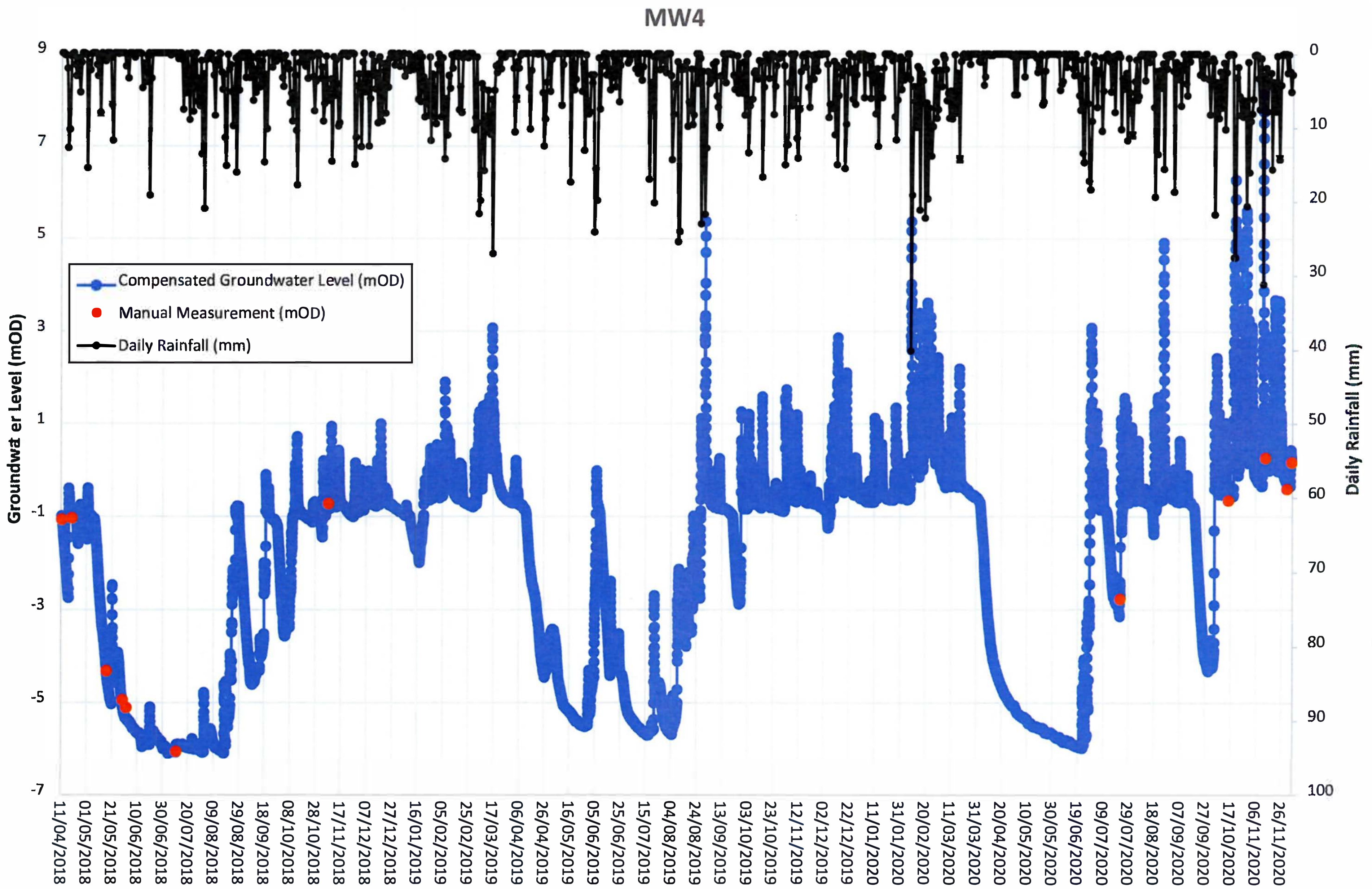
12/07/2018
19/07/2018
26/07/2018
02/08/2018
09/08/2018
16/08/2018
23/08/2018

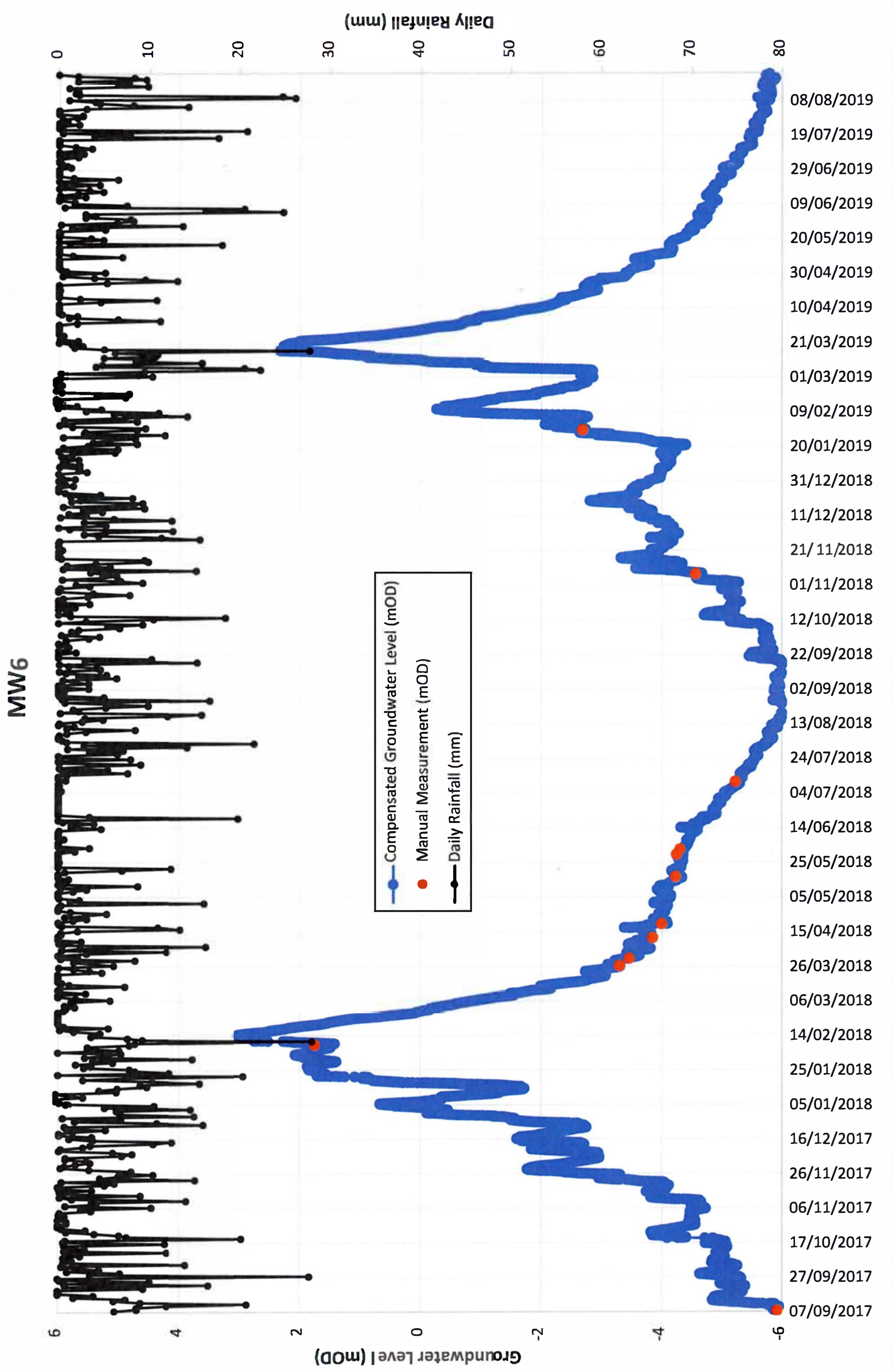

MW2
Groundwater Level above datalogger (m)
3
2.5
2
1.5
1
0.5
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
Compensated Groundwater Level (m)
Daily Rainfall (mm)
07/09/2017
14/09/2017
21/09/2017
28/09/2017
05/10/2017
12/10/2017
19/10/2017
26/10/2017
02/11/2017
09/11/2017
16/11/2017
23/11/2017
30/11/2017
07/12/2017
14/12/2017
21/12/2017
28/12/2017
04/01/2018
11/01/2018
18/01/2018
25/01/2018
01/02/20 18
08/02/2018

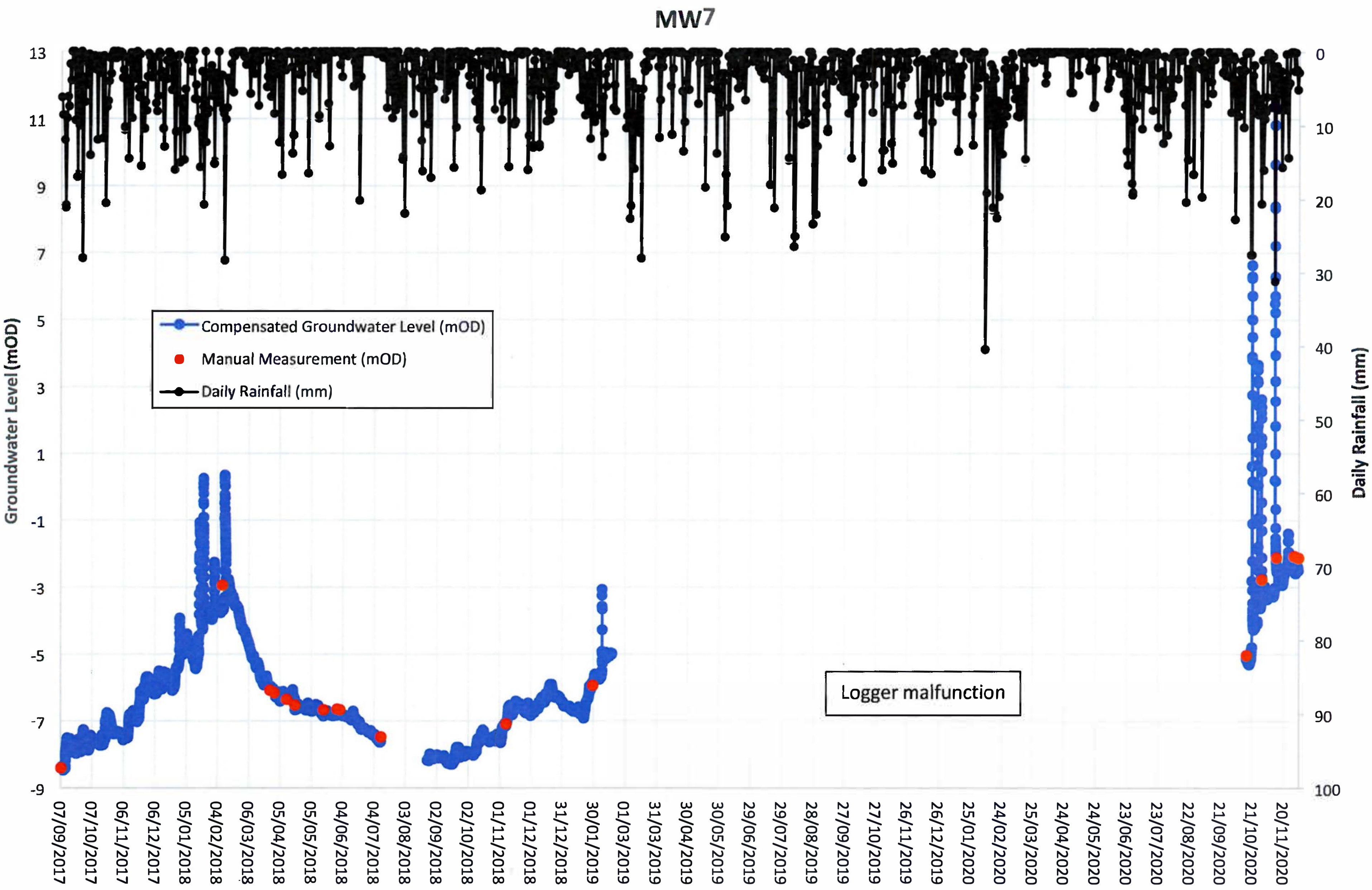
MW3



Groundwater Level (mOD)
-1.2
-1.4
-1.6
-1.8
-2
-2.2
-2.4
-2.6
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
07/09/2017
14/09/2017
21/09/2017
28/09/2017
05/10/2017
12/10/2017
19/10/2017
26/10/2017
02/11/2017
09/11/2017
16/11/2017
23/11/2017
30/11/2017
07/12/2017
14/12/2017
21/12/2017
28/12/2017
04/01/2018
11/01/2018
18/01/2018
25/01/2018
01/02/2018
08/02/2018
15/02/2018
22/02/2018
01/03/2018
08/03/2018
15/03/2018
22/03/2018
29/03/2018
05/04/2018
12/04/2018
19/04/2018
26/04/2018
03/05/2018
10/05/2018
17/05/2018
24/05/2018
31/05/2018
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)


MW4
Groundwa er Level (mOD)
9
7
5
3
1
-1
-3
-5
-7
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
90
100
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)
11/04/2018
01/05/2018
21/05/2018
10/06/2018
30/06/2018
20/07/2018
09/08/2018
29/08/2018
18/09/2018
08/10/2018
28/10/2018
17/11/2018
07/12/2018
27/12/2018
16/01/2019
05/02/2019
25/02/2019
17/03/2019
06/04/2019
26/04/2019
16/05/2019
05/06/2019
25/06/2019
15/07/2019
04/08/2019
24/08/2019
13/09/2019
03/10/2019
23/10/2019
12/11/2019
02/12/2019
22/12/2019
11/01/2020
31/01/2020
20/02/2020
11/03/2020
31/03/2020
20/04/2020
10/05/2020
30/05/2020
19/06/2020
09/07/2020
29/07/2020
18/08/2020
07/09/2020
27/09/2020
17/10/2020
06/11/2020
26/11/2020


MW6
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
Groundwater Level (mOD)
6
4
2
0
-2
-4
-6
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)
08/08/2019
19/07/2019
29/06/2019
09/06/2019
20/05/2019
30/04/2019
10/04/2019
21/03/2019
01/03/2019
09/02/2019
20/01/2019
31/12/2018
11/12/2018
21/11/2018
01/11/2018
12/10/2018
22/09/2018
02/09/2018
13/08/2018
24/07/2018
04/07/2018
14/06/2018
25/05/2018
05/05/2018
15/04/2018
26/03/2018
06/03/2018
14/02/2018
25/01/2018
05/01/2018
16/12/2017
26/11/2017
06/11/2017
17/10/2017
27/09/2017
07/09/2017


MW7
Groundwater Level (mOD)
13
11
9
7
5
3
1
-1
-3
-5
-7
-9
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
90
100
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)
Logger malfunction
07/09/2017
07/10/2017
06/11/2017
06/12/2017
05/01/2018
04/02/2018
06/03/2018
05/04/2018
05/05/2018
04/06/2018
04/07/2018
03/08/2018
02/09/2018
02/10/2018
01/11/2018
01/12/2018
31/12/2018
30/01/2019
01/03/2019
31/03/2019
30/04/2019
30/05/2019
29/06/2019
29/07/2019
28/08/2019
27/09/2019
27/10/2019
26/11/2019
26/12/2019
25/01/2020
24/02/2020
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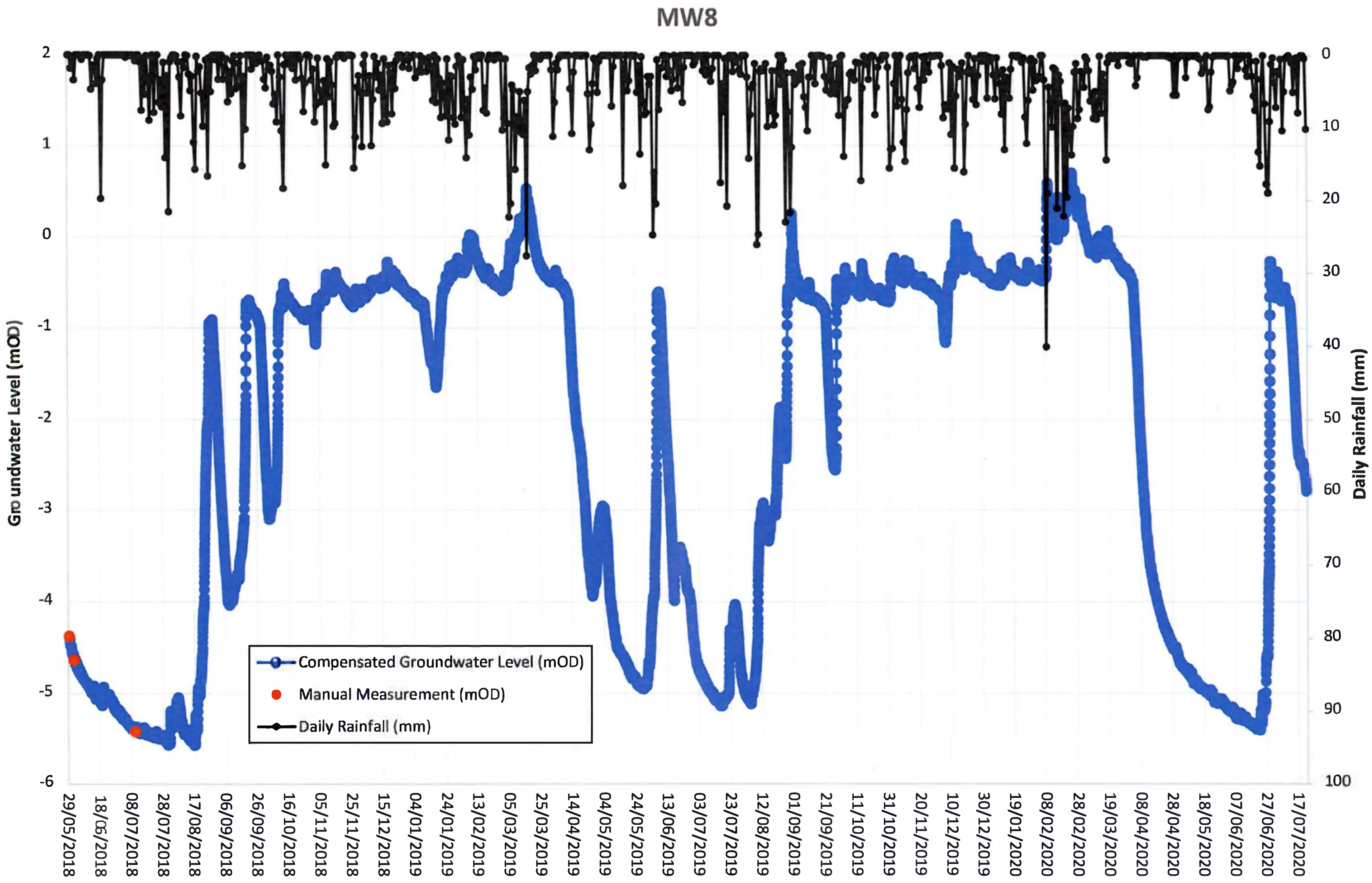
21/10/2020
20/11/2020


MW8
Gro undwater Level (mOD)
2
1
0
-1
-2
-3
-4
-5
-6
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
90
100
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)
29/05/2018
18/06/2018
08/07/2018
28/07/2018
17/08/2018
06/09/2018
26/09/2018
16/10/2018
05/11/2018
25/11/2018
15/12/2018
04/01/2019
24/01/2019
13/02/2019
05/03/2019
25/03/2019
14/04/2019
04/05/2019
24/05/2019
13/06/2019
03/07/2019
23/07/2019
12/08/2019
01/09/2019
21/09/2019
11/10/2019
31/10/2019
20/11/2019
10/12/2019
30/12/2019
19/01/2020
08/02/2020
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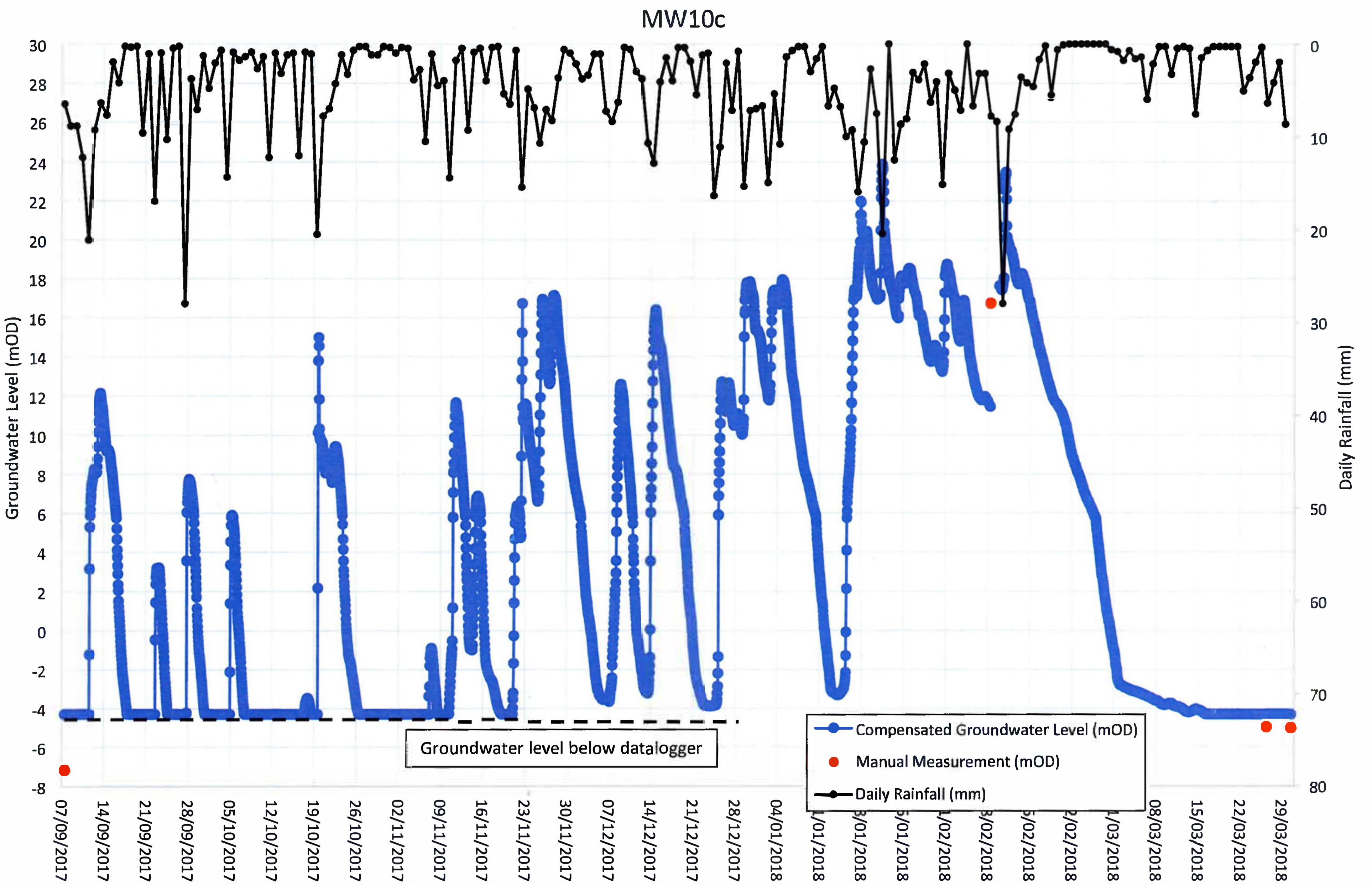
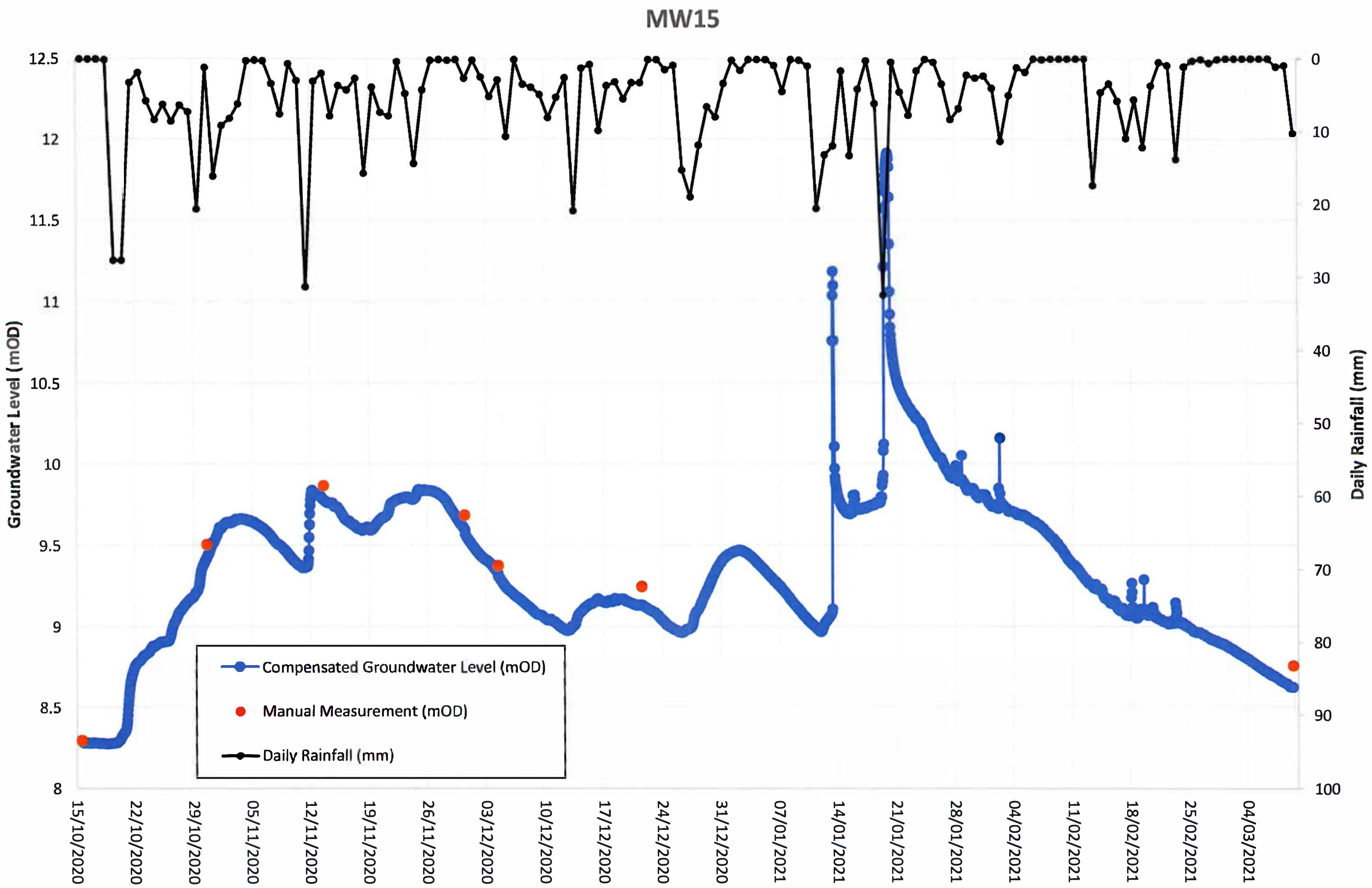
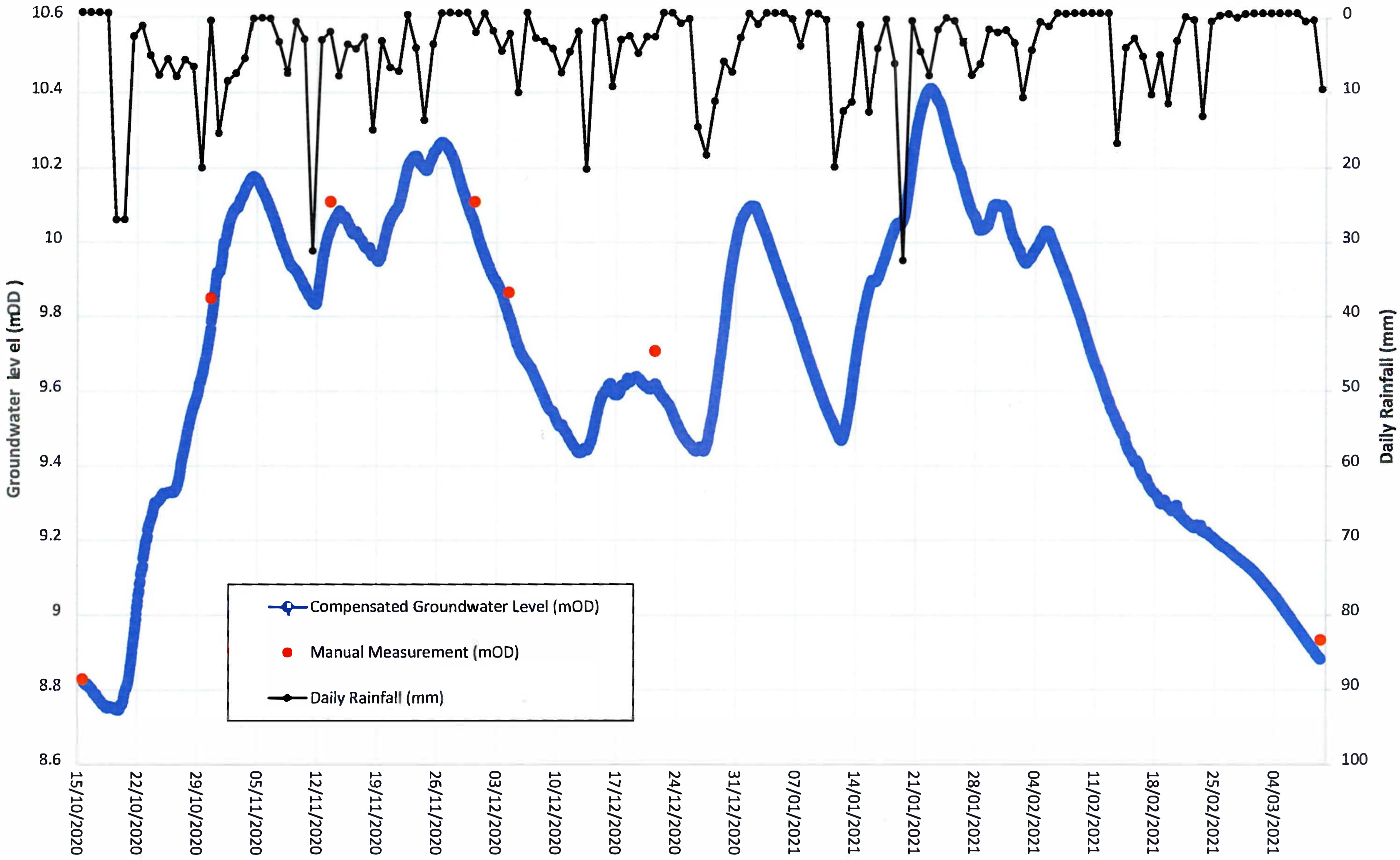
08/04/2020
28/04/2020
18/05/2020
07/06/2020
27/06/2020
17/07/2020


MW10c
Groundwater Level (mOD)
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
07/09/2017
14/09/2017
21/09/2017
28/09/2017
05/10/2017
12/10/2017
19/10/2017
26/10/2017
02/11/2017
09/11/2017
16/11/2017
23/11/2017
30/11/2017
07/12/2017
14/12/2017
21/12/2017
28/12/2017
04/01/2018
1/01/2018
3/01/2018
5/01/2018
1/02/2018
3/02/2018
5/02/2018
2/02/2018
1/03/2018
08/03/2018
15/03/2018
22/03/2018
29/03/2018
Groundwater level below datalogger
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)

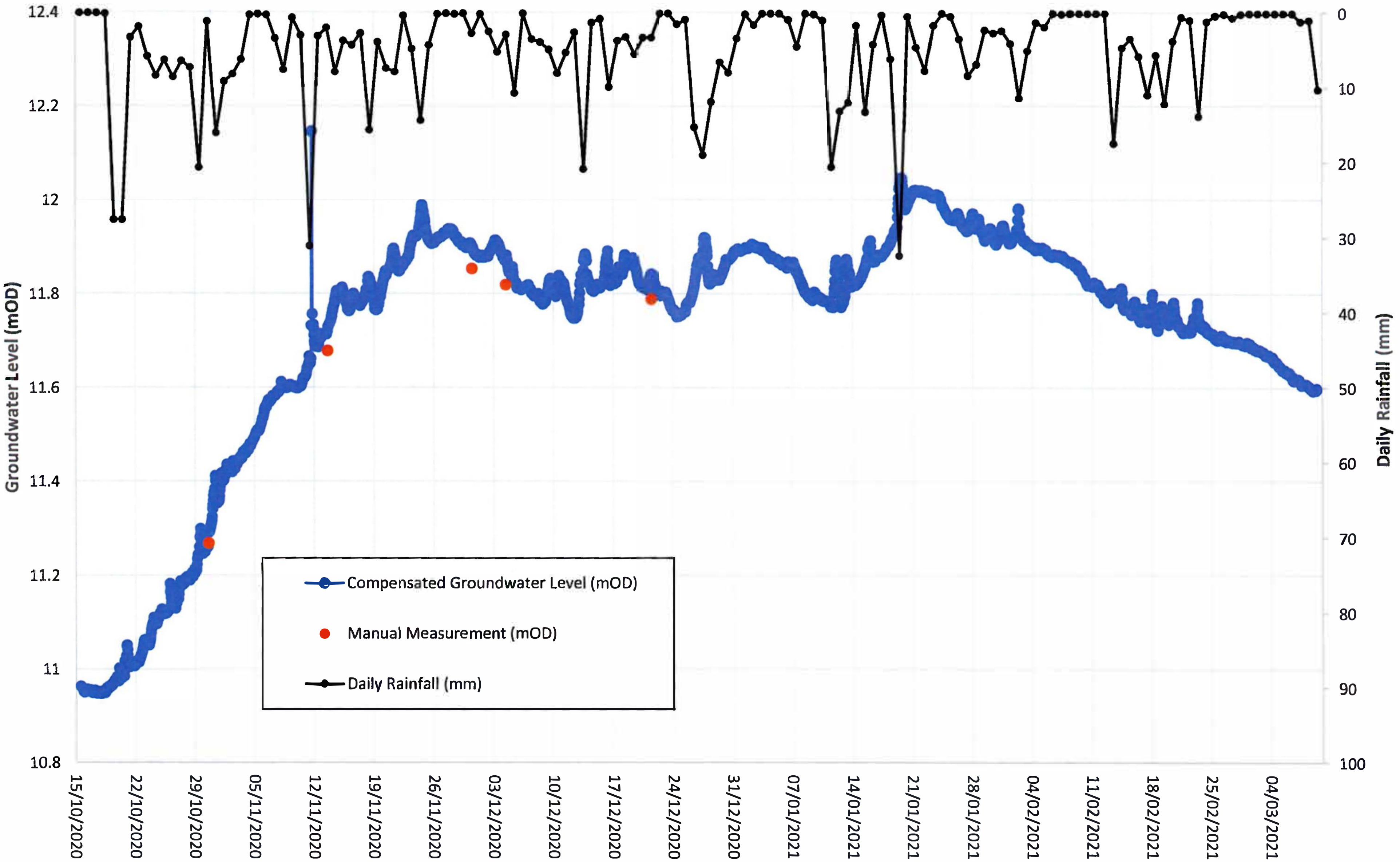

MW15
Groundwater Level (mOD)
12.5
12
11.5
11
10.5
10
9.5
9
8.5
8
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
90
100
15/10/2020
22/10/2020
29/10/2020
05/11/2020
12/11/2020
19/11/2020
26/11/2020
03/12/2020
10/12/2020
17/12/2020
24/12/2020
31/12/2020
07/01/2021
14/01/2021
21/01/2021
28/01/2021
04/02/2021
11/02/2021
18/02/2021
25/02/2021
04/03/2021
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)

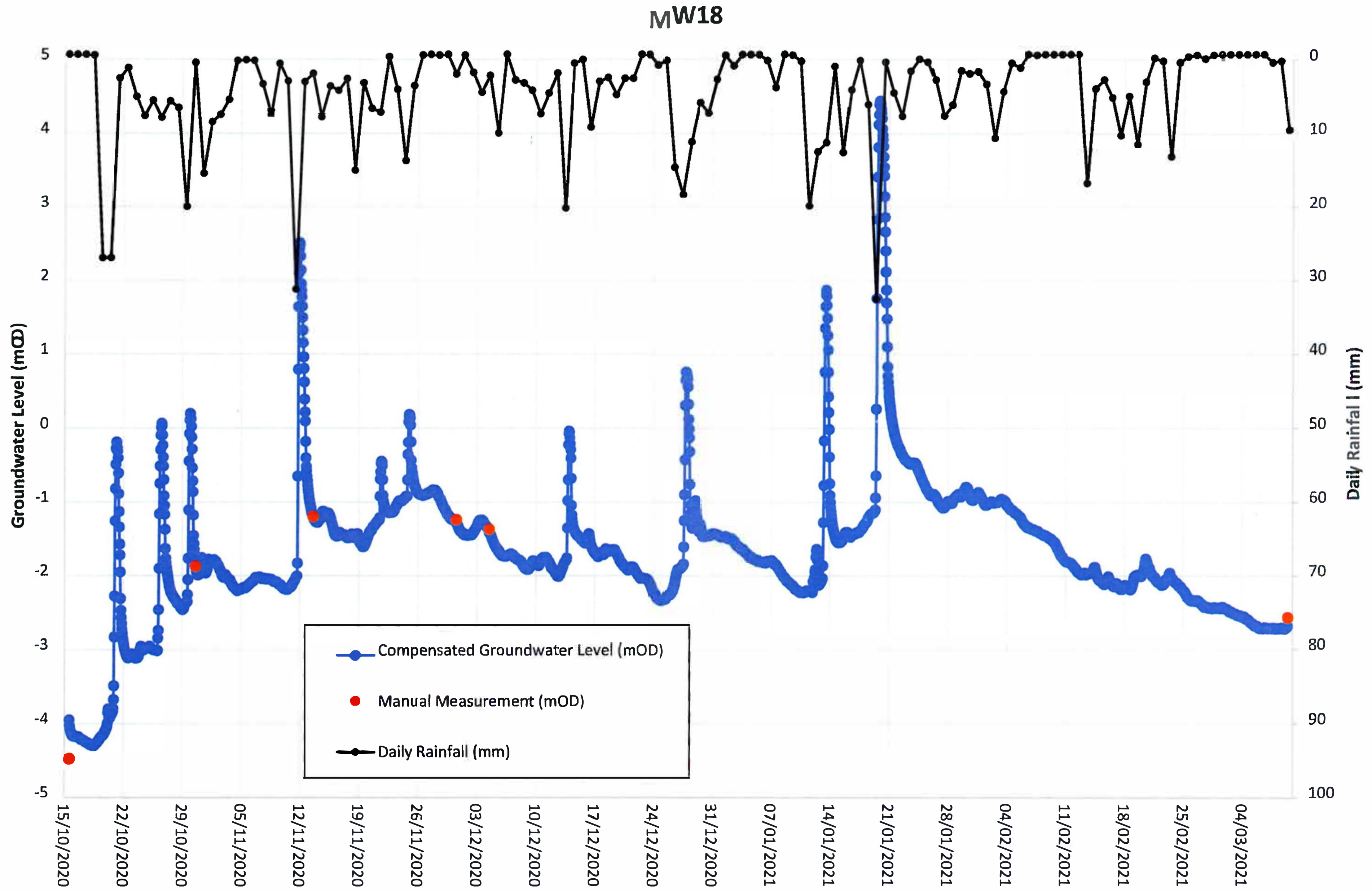
MW16

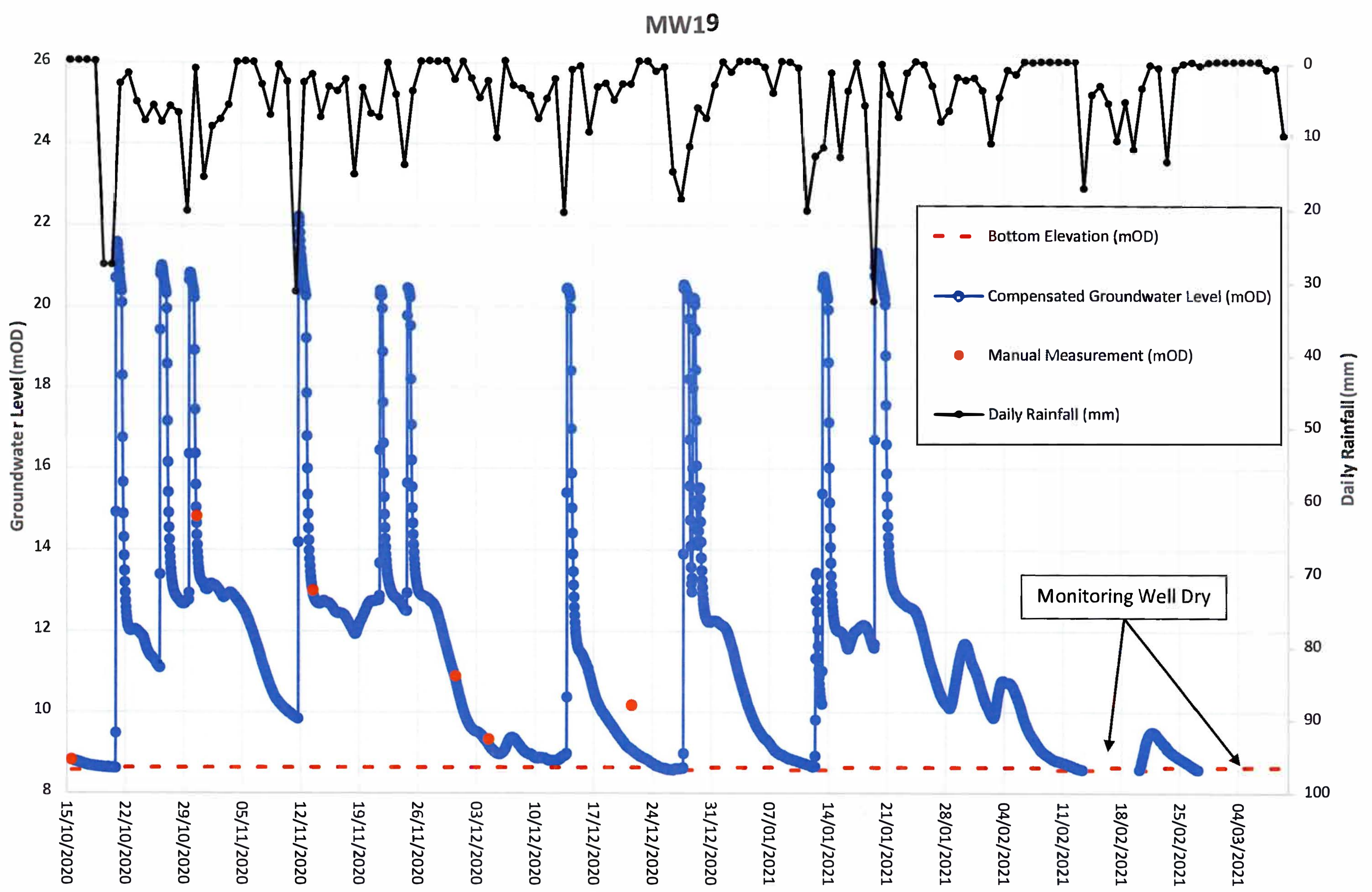


Groundwater lev el (mOD)
10.6
10.4
10.2
10
9.8
9.6
9.4
9.2
9
8.8
8.6
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
90
100
15/10/2020
22/10/2020
29/10/2020
05/11/2020
12/11/2020
19/11/2020
26/11/2020
03/12/2020
10/12/2020
17/12/2020
24/12/2020
31/12/2020
07/01/2021
14/01/2021
21/01/2021
28/01/2021
04/02/2021
11/02/2021
18/02/2021
25/02/2021
04/03/2021
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)

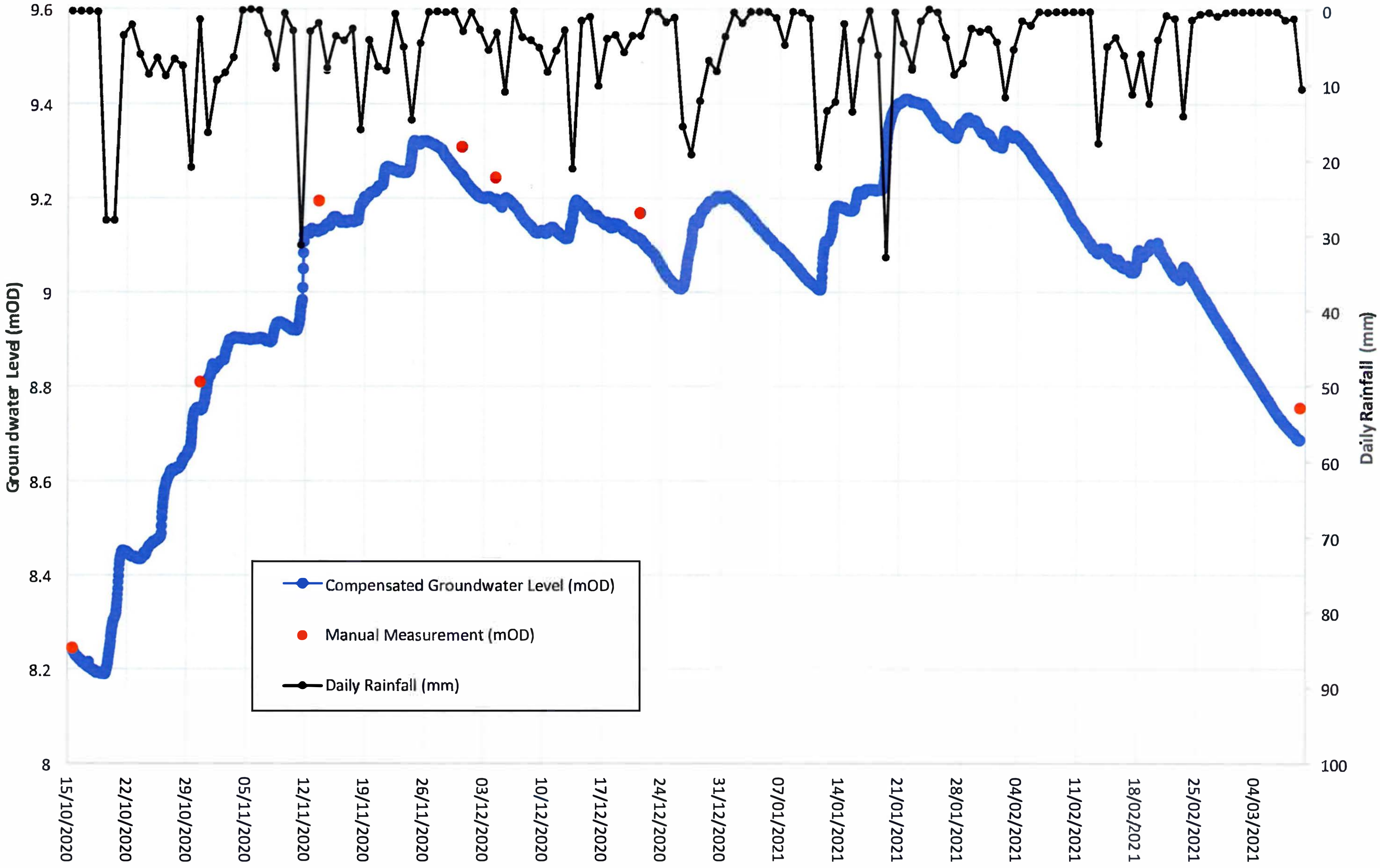
MW17

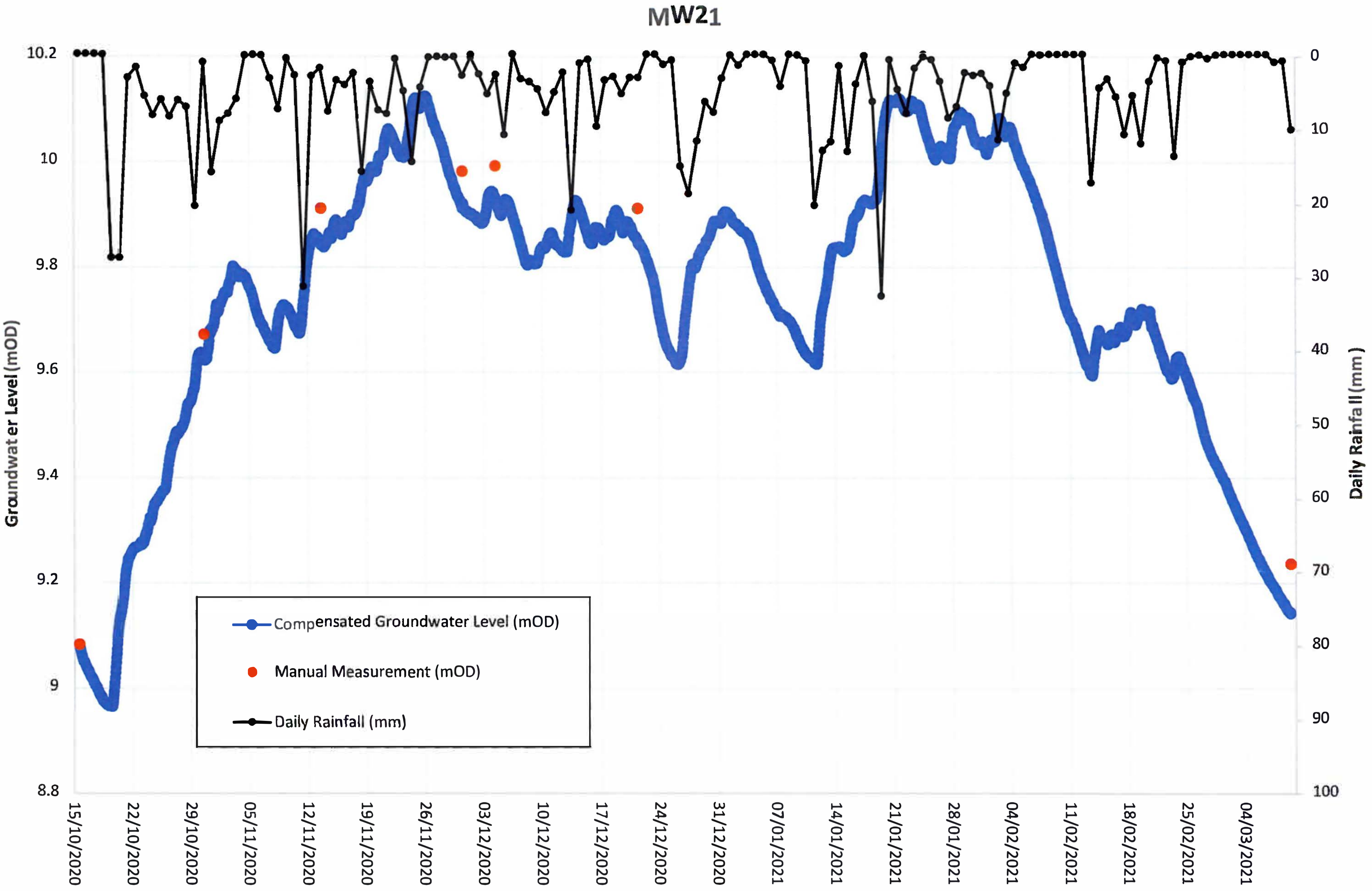

Groundwater Level (mOD)
12.4
12.2
12
11.8
11.6
11.4
11.2
11
10.8
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
90
100
15/10/2020
22/10/2020
29/10/2020
05/11/2020
12/11/2020
19/11/2020
26/11/2020
03/12/2020
10/12/2020
17/12/2020
24/12/2020
31/12/2020
07/01/2021
14/01/2021
21/01/2021
28/01/2021
04/02/2021
11/02/2021
18/02/2021
25/02/2021
04/03/2021
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)

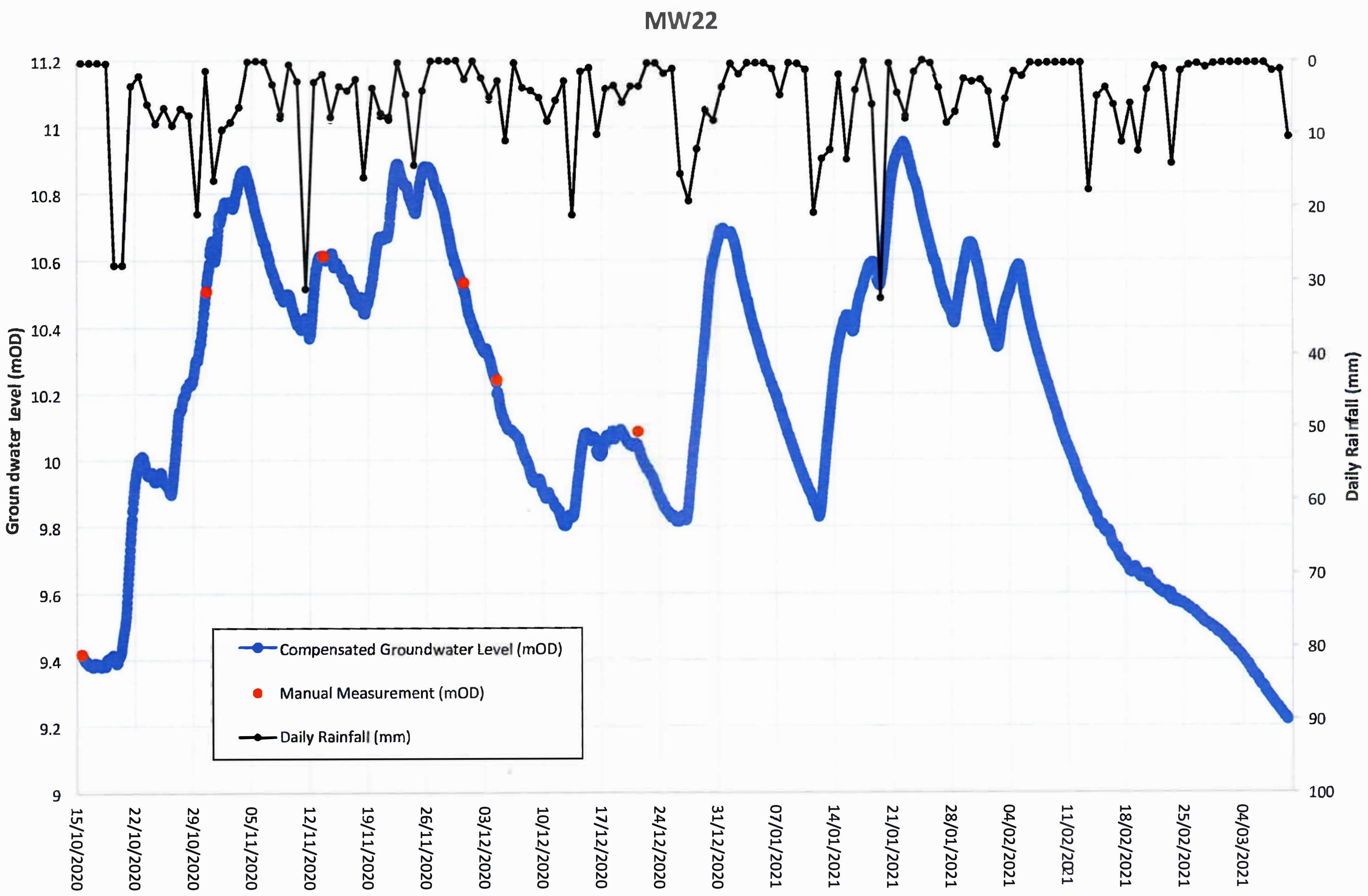

MW18
Groundwater Level (mOD)
5
4
3
2
1
0
-1
-2
-3
-4
-5
Daily Rainfall l (mm)
0
10
20
30
40
50
60
70
80
90
100
15/10/2020
22/10/2020
29/10/2020
05/11/2020
12/11/2020
19/11/2020
26/11/2020
03/12/2020
10/12/2020
17/12/2020
24/12/2020
31/12/2020
07/01/2021
14/01/2021
21/01/2021
28/01/2021
04/02/2021
11/02/2021
18/02/2021
25/02/2021
04/03/2021
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)


MW19
Groundwate r Level (mOD)
26
24
22
20
18
16
14
12
10
8
Dai ly Rainfall (mm)
0
10
20
30
40
50
60
70
80
90
100
15/10/2020
22/10/2020
29/10/2020
05/11/2020
12/11/2020
19/11/2020
26/11/2020
03/12/2020
10/12/2020
17/12/2020
24/12/2020
31/12/2020
07/01/2021
14/01/2021
21/01/2021
28/01/2021
04/02/2021
11/02/2021
18/02/2021
25/02/2021
04/03/2021
Bottom Elevation (mOD)
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)
Monitoring Well Dry

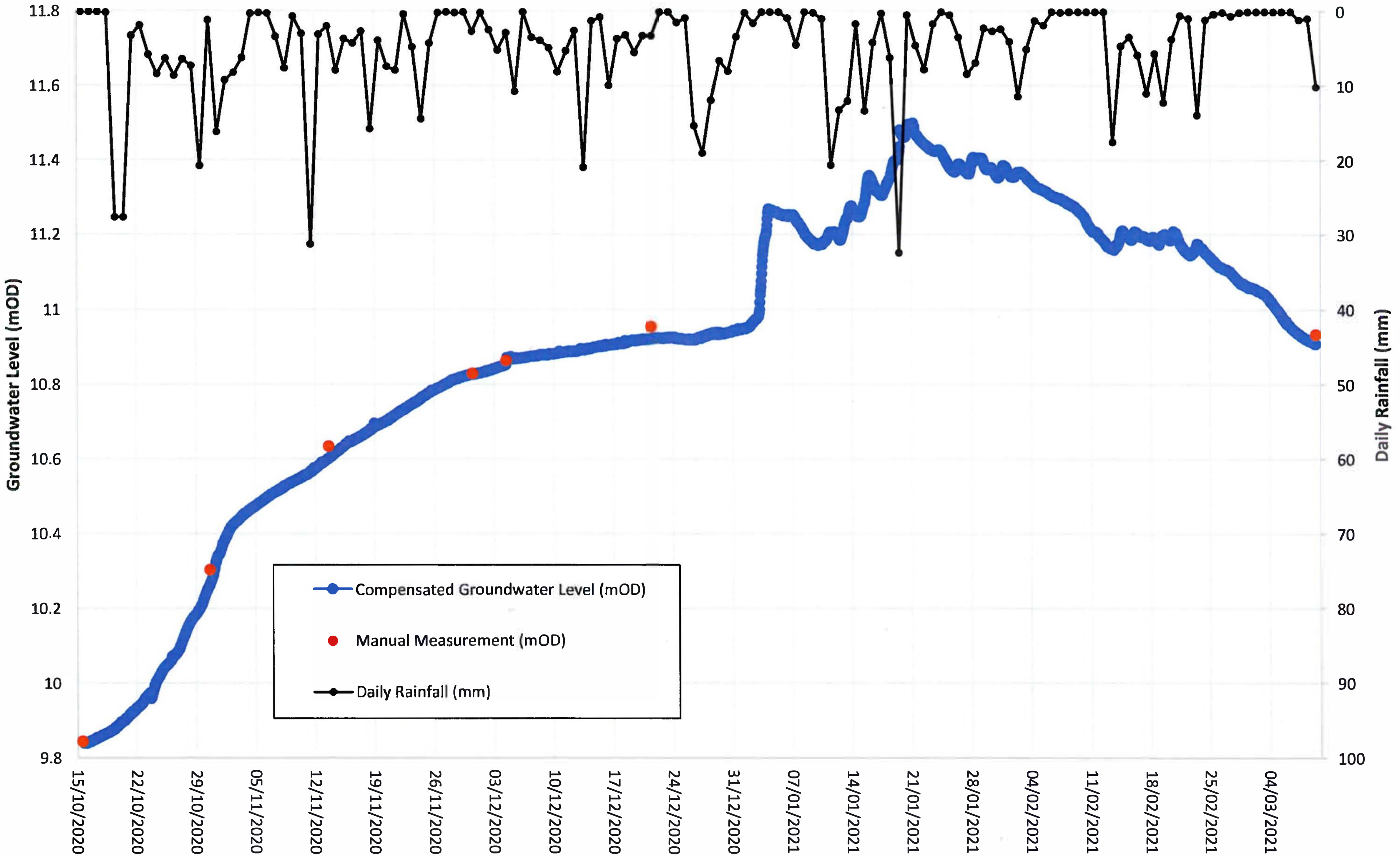
MW20


Groundwater Level (mOD)
9.6
9.4
9.2
9
8.8
8.6
8.4
8.2
8
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
90
100
15/10/2020
22/10/2020
29/10/2020
05/11/2020
12/11/2020
19/11/2020
26/11/2020
03/12/2020
10/12/2020
17/12/2020
24/12/2020
31/12/2020
07/01/2021
14/01/2021
21/01/2021
28/01/2021
04/02/2021
11/02/2021
18/02/2021
25/02/2021
04/03/2021
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)

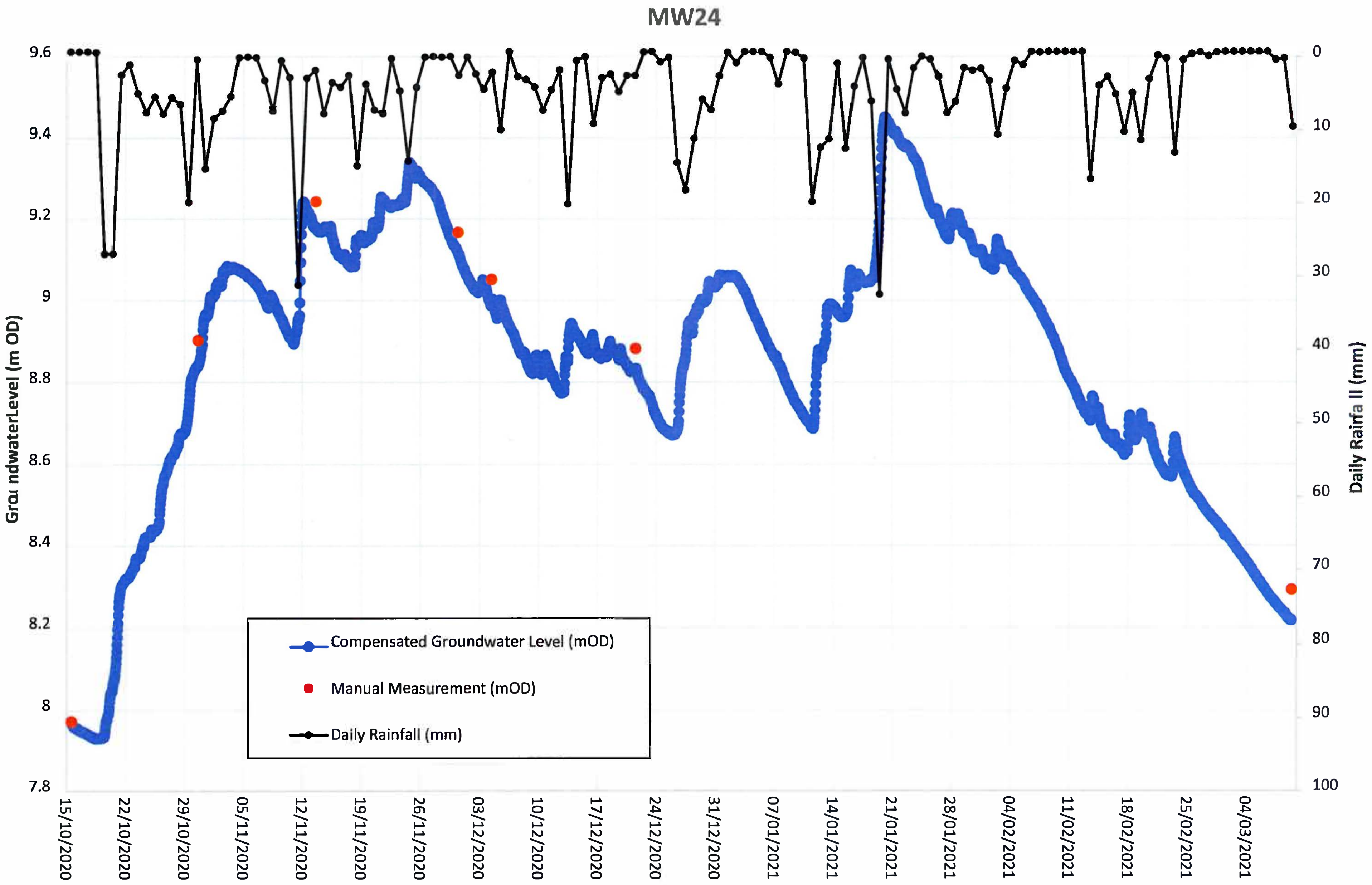

MW21
Groundwater Level (mOD)
10.2
10
9.8
9.6
9.4
9.2
9
8.8
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
90
100
15/10/2020
22/10/2020
29/10/2020
05/11/2020
12/11/2020
19/11/2020
26/11/2020
03/12/2020
10/12/2020
17/12/2020
24/12/2020
31/12/2020
07/01/2021
14/01/2021
21/01/2021
28/01/2021
04/02/2021
11/02/2021
18/02/2021
25/02/2021
04/03/2021
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)

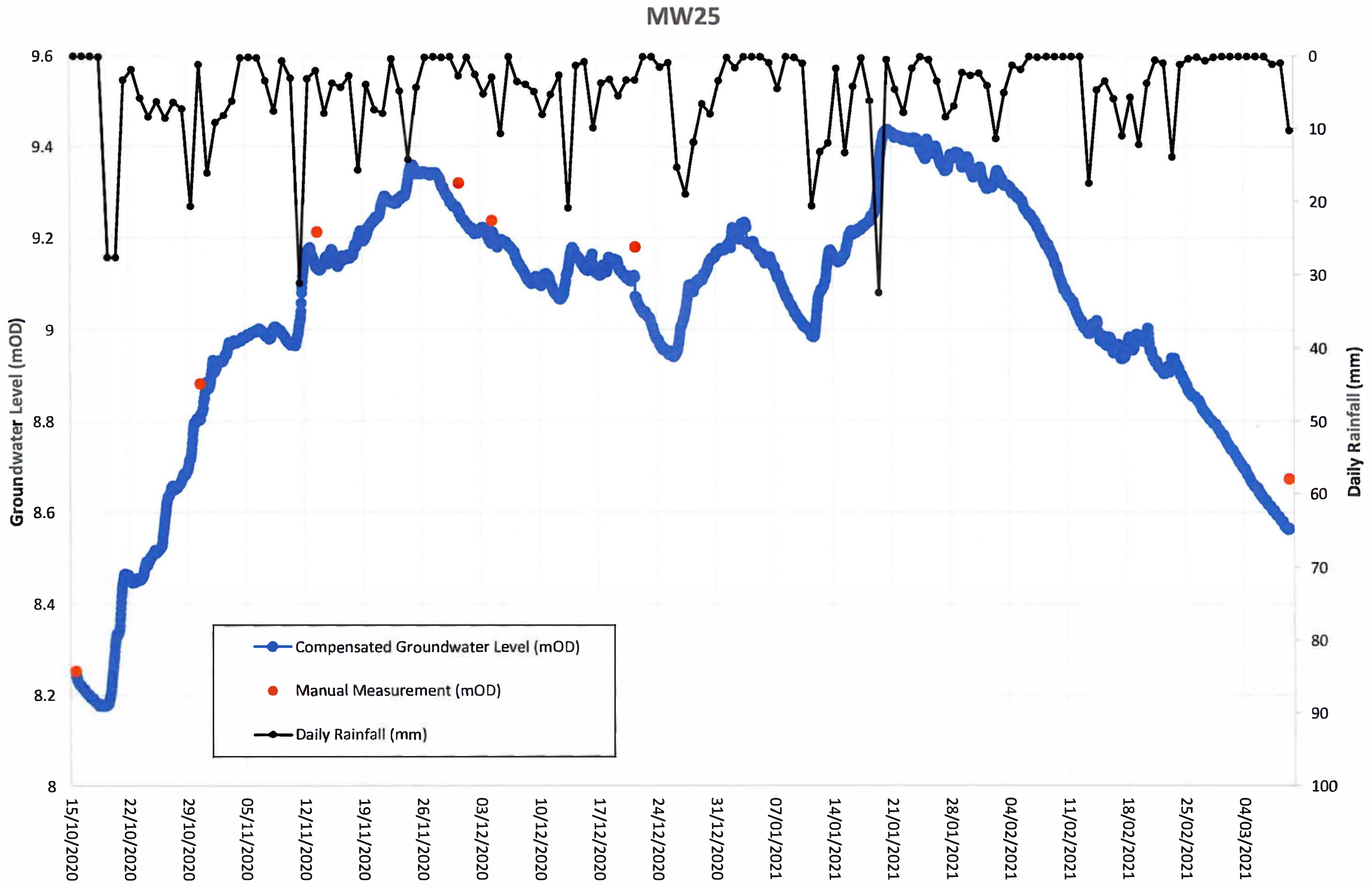

MW22
Groun dwater Level (mOD)
11.2
11
10.8
10.6
10.4
10.2
10
9.8
9.6
9.4
9.2
9
Daily Rai nfall (mm)
0
10
20
30
40
50
60
70
80
90
100
15/10/2020
22/10/2020
29/10/2020
05/11/2020
12/11/2020
19/11/2020
26/11/2020
03/12/2020
10/12/2020
17/12/2020
24/12/2020
31/12/2020
07/01/2021
14/01/2021
21/01/2021
28/01/2021
04/02/2021
11/02/2021
18/02/2021
25/02/2021
04/03/2021
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)

MW23



Groundwater Level (mOD)
11.8
11.6
11.4
11.2
11
10.8
10.6
10.4
10.2
10
9.8
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
90
100
15/10/2020
22/10/2020
29/10/2020
05/11/2020
12/11/2020
19/11/2020
26/11/2020
03/12/2020
10/12/2020
17/12/2020
24/12/2020
31/12/2020
07/01/2021
14/01/2021
21/01/2021
28/01/2021
04/02/2021
11/02/2021
18/02/2021
25/02/2021
04/03/2021
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)


MW24
Gra ndwaterLevel (m OD)
9.6
9.4
9.2
9
8.8
8.6
8.4
8.2
8
7.8
Daily Rainfa ll (mm)
0
10
20
30
40
50
60
70
80
90
100
15/10/2020
22/10/2020
29/10/2020
05/11/2020
12/11/2020
19/11/2020
26/11/2020
03/12/2020
10/12/2020
17/12/2020
24/12/2020
31/12/2020
07/01/2021
14/01/2021
21/01/2021
28/01/2021
04/02/2021
11/02/2021
18/02/2021
25/02/2021
04/03/2021
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)


MW25
Groundwater Level (mOD)
9.6
9.4
9.2
9
8.8
8.6
8.4
8.2
8
Daily Rainfall (mm)
0
10
20
30
40
50
60
70
80
90
100
15/10/2020
22/10/2020
29/10/2020
05/11/2020
12/11/2020
19/11/2020
26/11/2020
03/12/2020
10/12/2020
17/12/2020
24/12/2020
31/12/2020
07/01/2021
14/01/2021
21/01/2021
28/01/2021
04/02/2021
11/02/2021
18/02/2021
25/02/2021
04/03/2021
Compensated Groundwater Level (mOD)
Manual Measurement (mOD)
Daily Rainfall (mm)

APPENDIX 7-18 ASSESSMENT TABLES (EPA & NRA)

The EPA (2017) descriptive criteria integrated into the impact assessment presented are presented in Table 7-1 to Table 7-5, below.

Table 7-1

Quality of Effects EPA (2017)

Quality	Description
Positive	A change which improves the quality of the environment
Neutral	No change, or a change that is imperceptible (within normal bounds of variation or within the margin of forecasting error)
Negative/Adverse	A change which reduces the quality of the environment

Table 7-2

Extent & Context of Effects EPA (2017)

Extent & Context	Description
Extent	Describe the size of the area, the number of sites, and the proportion of a population affected by an effect
Context	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions

Table 7-3

Probability of Effects EPA (2017)

Probability	Description
Likely	The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented
Unlikely	The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented

Table 7-4

Duration & Frequency of Effects EPA (2017)

Duration & Frequency	Description
Momentary	Effects lasting from seconds to minutes

Brief	Effects lasting less than a day
Temporary	Effects lasting less than a year
Short-term	Effects lasting one to seven years
Medium-term	Effects lasting seven to fifteen years
Long-term	Effects lasting fifteen to sixty years
Permanent	Effects lasting over sixty years
Reversible	Effects that can be undone, for example through remediation or restoration
Frequency	Describe how often the effect will occur (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)

Table 7-5

Types of Effects EPA (2017)

Type	Description
Indirect (Secondary)	Impacts on the environment which are not a direct result of the project, often produced away from the project site or because of a complex path
Cumulative	The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects
'Do-Nothing'	The environment as it would be in the future should the project not be carried out
'Worst-Case'	The effects arising from a project in the case where mitigation measures substantially fail
Indeterminable	When the full consequences of a change in the environment cannot be described
Irreversible	When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost
Residual	The degree of environmental change that will occur after the proposed mitigation measures have taken effect
Synergistic	Where the resultant effect is of greater significance than the sum of its constituents

The assessment of the significance of potential effects on the water environment follows the guidelines provided by the Institute of Geologists of Ireland (2013), which recommend the approach taken by the National Roads Authority (NRA, 2008). Tables 7-6 to 7-10 present the NRA (2008) Framework Tables.

Table 7-6

Importance of Hydrological Features (NRA, 2008)

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation (e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very High	Attribute has a high quality or value on a regional or national scale	River, wetland or surface water body ecosystem protected by national legislation (e.g. NHA status). Regionally important potable water source supplying >2,500 homes. Quality Class A (Biotic Index Q4, Q5). Flood plain protecting more than 50 residential or commercial properties from flooding. Nationally important amenity site for 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 >1,000 homes. Quality Class B (Biotic Index Q3-4). 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 7-7

Importance of Hydrogeological Features (NRA, 2008)

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation (e.g. SAC or SPA status).
Very High	Attribute has a high quality or value on a regional or national scale	Regionally Important Aquifer with multiple wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation (e.g. NHA status). Regionally important potable water source supplying >2,500 homes. Inner source protection area for regionally important potable 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 >1,000 homes. Outer source protection area for regionally important potable 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 7-8

Magnitude of Impact on Hydrological Features (NRA, 2008)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and/or quality and integrity of attribute	Loss or extensive change to a waterbody or water dependent habitat. Increase in predicted peak flood level >100mm. Extensive loss of fishery. Calculated risk of serious pollution incident >2% annually. Extensive reduction in amenity value.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Increase in predicted peak flood level >50mm. Partial loss of fishery. Calculated risk of serious pollution incident >1% annually. Partial reduction in amenity value.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Increase in predicted peak flood level of >10mm. Minor loss of fishery. Calculated risk of serious pollution incident >0.5% annually. Slight reduction in amenity value.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Negligible change in predicted peak flood level. Calculated risk of serious pollution incident <0.5% annually.
Minor Beneficial	Results in minor improvement of attribute quality	Reduction in predicted peak flood level >10mm. Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually.
Moderate Beneficial	Results in moderate improvement of attribute quality	Reduction in predicted peak flood level >50mm. Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually.
Major Beneficial	Results in major improvement of attribute quality	Reduction in predicted peak flood level >100mm.

Table 7-9

Magnitude of Impact on Hydrogeological Features (NRA, 2008)

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 runoff. Calculated risk of serious pollution incident >2% annually.
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 runoff. Calculated risk of serious pollution incident >1% annually.
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 existing water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine runoff. Calculated risk of serious pollution incident >0.5% annually.
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.

Table 7-10

Significance of Impact on Hydrological/Hydrogeological Features (NRA, 2008)

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

APPENDIX 7-19 SETTLEMENT LAGOON DETAILS

Settlement Lagoon Details

1. Design Settling Velocity

Parameter	Symbol	Value	Units	Notes
Diameter of particle	d	4.0×10^{-6}	m	Mid-range for fine silt
Density of settling particle	ϱ_p	2600	kg/m^3	
Density of water	ϱ_w	1000	kg/m^3	
Dynamic viscosity of water	μ	1.307×10^{-3}	kg/m.s	At 10 degrees Celcius
Acceleration due to gravity	g	9.81	m/s^2	

Settling Velocity (from Stokes Law)	V_s	$1\ 067 \times 10^{-5}$	m/s	
Design Settling Velocity	V_s	1.0×10^{-5}	m/s	

Stokes Law:

$$V_s = \frac{g(\rho_s - \rho_w)d^2}{18\mu}$$

where

V_s = terminal settling velocity of the solid particle

g = gravitational acceleration

ρ_s = density of settling particle

ρ_w = density of water

d = diameter of particle

μ = dynamic viscosity

2. Design Flow Rate

Parameter	Symbol	Value	Units	Notes
Maximum discharge rate	Q	0.0405	m^3/s	As per discharge licence
Groundwater inflows	Q	0.0122	m^3/s	At final quarry depth of -50moD
Maximum excess discharge rate	Q	0.0283	m^3/s	Maximum rate available for storm water pumping
Design Flow Rate	Q_{max}	0.0283	m^3/s	

3. Surface Area Required

Parameter	Symbol	Value	Units	Notes
Surface Area	A	2830	m^2	Surface Area Required = Design Flow Rate/Settling Velocity

Notes:

1. Settlement lagoon to have standing water depth of 1.5m
2. Settlement lagoon to have freeboard of 0.5m
3. Settlement lagoon base/sides to be lined to prevent leakage

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APPENDIX 7-20 RADIUS OF INFLUENCE & GROUNDWATER INFLOWS ESTIMATES

Estimated Radius of Influence

Sichardt's Empirical Equation:

Sichardt's Empirical Equation:

$$\boxed{R_o = C(H - h_w)\sqrt{(k)}}$$

Where:

C is a constant (usually 3000)

H-h_w is drawdown at the excavation (m)

k is permeability (m/s)

Equivalent Well radius is 160m (match on aerial photo for lower bench)

1. Existing Situation (floor at -21mOD)

			Notes:
C	3000	-	Constant
H-h_w	27.5	m	Annual average
k	1.25 E-6	m/s	Packer tests
R_0 (beyond Equivalent Well)	92	m	Excludes Equivalent Well radius
R_0	**252**	m	Includes Equivalent Well radius

2. Bench at -34.5mOD

			Notes:
C	3000	-	Constant
H-h_w	41	m	Annual average
k	1.25 E-6	m/s	Packer tests
R_0 (beyond Equivalent Well)	138	m	Excludes Equivalent Well radius
R_0	**298**	m	Includes Equivalent Well radius

3. Bench at -50mOD

			Notes:
C	3000	-	Constant
H-h_w	56.5	m	Annual average
k	1.25 E-6	m/s	Packer tests
R_0 (beyond Equivalent Well)	190	m	Excludes Equivalent Well radius
R_0	350	m	Includes Equivalent Well radius

Radius of Influence and Groundwater Inflows

Iterative Method (Combined Thiem-Dupuit Equation & Rate-ofRecharge Method):

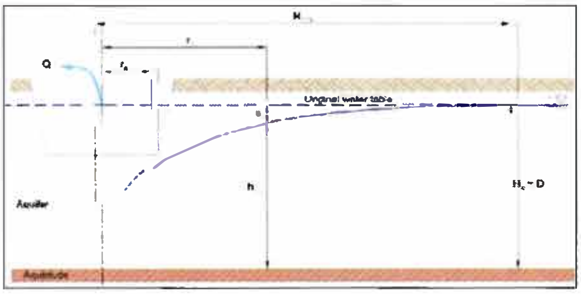
Existing Situation (floor at -21mOD):

1. Recharge Estimate:

			Notes:
Annual Rainfall (AR)	1,260	mm/yr	Annual mean at Markree Castle (Met Eireann)
Potential Evapotranspiration (PE)	509	mm/yr	Average ofannualmean at Finner Camp and KnockAirport (Met Eireann)
Actual Evapotranspiration (AE)	484	mm/yr	Takenas 95% of PE
Effective Rainfall (ER)	776	mm/yr	AR - AE
Recharge Coefficient (rc)	90	%	Upperend estimate for thinmoderately permeable overburden
Recharge (R)	698	mm/yr	ER x rc

2. Inputs:

			Notes:
k	0.108	m/d	Packer tests
H	27.5	m	Groundwater headabove quarry floor outside zone of influence (annual average)
h_w	0	m	Groundwater headabove quarry floorat quarry face
r_e	160	m	Equivalent Well radius, visualmatchon aerial photo for lower bench
R	0 0019123	m/d	Recharge per day (annual average)



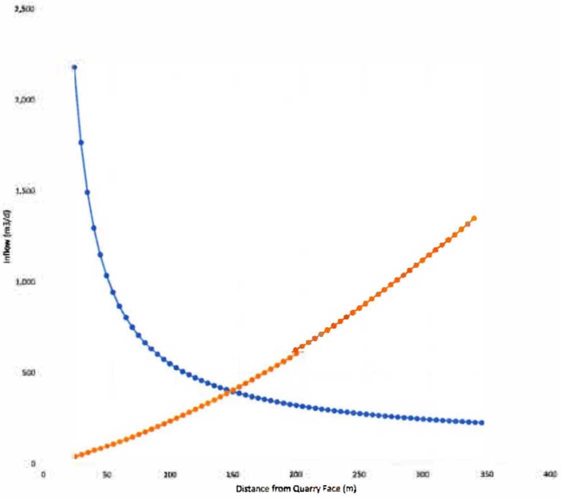
Thiem-Dupuit Equation:

$$Q = \frac{\pi k\left(H^2 - h_w^2\right)}{\ln\left[R_o/r_e\right]}$$

Assumptions:
- the aquifer is unconfined
- the aquifer hasinfinite arealextent
- the aquifer is homogeneous, and of uniform thickness
- there is only a smallwater table gradient
- groundwater flowls horizontal
- the pumping rate is constant
- the aquiferis fully penetrated
- the flow is insteady state
- the Dupuitassumptions are satisfied

3. Radius of Influence & Groundwater Inflows Estimate:

Distance from Quarry Face (m)	R_0 (m)	$Q_{groundwater\ inflows}$	$Q_{recharge}$
20	180	2178.49	40.85
25	185	1767.36	51.82
30	190	1493.10	63.08
35	195	1297.05	74.65
40	200	1149.89	86.51
45	205	1035.32	98.68
50	210	943.57	111.14
55	215	868.43	123.91
60	220	805.74	136.98
65	225	752.62	150.34
70	230	707.04	164.01
75	235	667.49	177.98
80	240	632.83	192.25
85	245	602.20	206.82
90	250	574.94	221.69
95	255	550.52	236.86
100	260	528.50	252.33
105	265	508.55	268.10
110	270	490.38	284.17
115	275	473.76	300.54
120	280	458.51	317.21
125	285	444.45	334.18
130	290	431.46	351.45
135	295	419.40	369.03
140	300	408.19	386.90
145	305	397.73	405.07
150	310	387.95	423.55
155	315	378.79	442.32
160	320	370.18	461.40
165	325	362.08	480.77
170	330	354.45	500.45
175	335	347.23	520.42
180	340	340.41	540.70
185	345	333.94	561.28
190	350	327.80	582.15
195	355	321.97	603.33
200	360	316.41	624.81
205	365	311.12	646.59
210	370	306.07	668.66
215	375	301.25	691.04
220	380	296.64	713.72
225	385	292.22	736.70
230	390	287.99	759.98
235	395	283.93	783.56
240	400	280.03	807.44
245	405	276.29	831.62
250	410	272.68	856.11
255	415	269.21	880.89
260	420	265.87	905.97
265	425	262.65	931.35
270	430	259.55	957.04
275	435	256.55	983.02
280	440	253.65	1009.30
285	445	250.85	1035.89
290	450	248.13	1062.77
295	455	245.51	1089.96
300	460	242.97	1117.44
305	465	240.51	1145.23
310	470	238.12	1173.32
315	475	235.81	1201.70
320	480	233.56	1230.39
325	485	231.38	1259.38
330	490	229.26	1288.66
335	495	227.19	1318.25
340	500	225.19	1348.14



For the Existing Situation:

R_0 (from Quarry Centre)	303	m
R_0 (from Quarry Face)	143	m
$Q_{groundwater\ inflows}$	402	m^3/d
$Q_{groundwater\ inflows}$	4.7	l/s

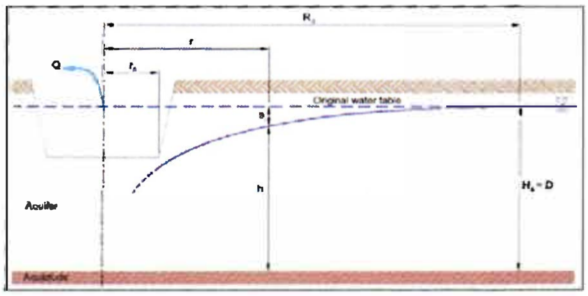
Radius of Influence and Groundwater Inflows

Iterative Method (Combined Thiem-Dupuit Equation & Rate-of-Recharge Method):

Bench at -34.5mOD:

1. Recharge Estimate:

			Notes:
Annual Rainfall (AR)	1,260	mm/yr	Annual mean at Markree Castle (Met Eireann)
Potential Evapotranspiration (PE)	509	mm/yr	Average of annual mean at Finner Camp and Knock Airport (Met Eireann)
Actual Evapotranspiration (AE)	484	mm/yr	Taken as 95% of PE
Effective Rainfall (ER)	776	mm/yr	AR - AE
Recharge Coefficient (rc)	90	%	Upper end estimate for thin moderately permeable overburden
Recharge (R)	698	mm/yr	ER x rc



2. Inputs:

			Notes:
k	0.108	m/d	Packer tests
H	41	m	Groundwater head above quarry floor outside zone of influence (annual average)
h_w	0	m	Groundwater head above quarry floor at quarry face
r_e	160	m	Equivalent Well radius, visual match on aerial photo for lower bench
R	0.0019123	m/d	Recharge per day (annual average)

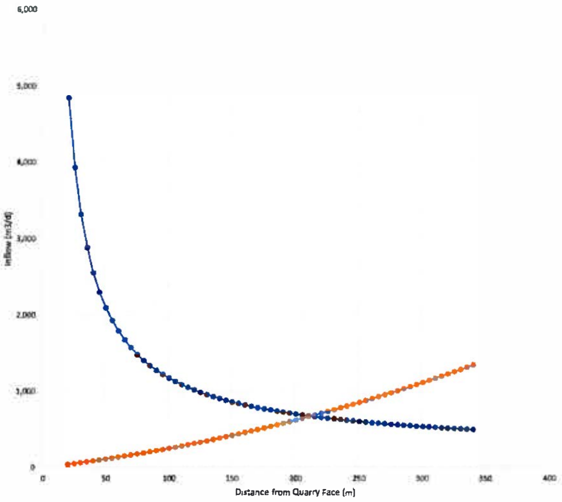
Thiem-Dupuit Equation:

$$Q = \frac{\pi k\left(H^2 - h_w^2\right)}{\ln\left[R_0/r_e\right]}$$

Assumptions:
- the aquifer is unconfined
- the aquifer has infinite areal extent
- the aquifer is homogeneous, and of uniform thickness
- there is only a small water table gradient
- groundwater flow is horizontal
- the pumping rate is constant
- the aquifer is fully penetrated
- the flow is in steady state
- the Dupuit assumptions are satisfied

3. Radius of Influence & Groundwater Inflows Estimate:

Distance from Quarry Face (m)	R_0 (m)	$Q_{groundwater\ inflows}$	$Q_{recharge}$
20	180	4842.38	40.85
25	185	3928.52	51.82
30	190	3318.88	63.08
35	195	2883.09	74.65
40	200	2555.98	86.51
45	205	2301.32	98.68
50	210	2097.39	111.14
55	215	1930.35	123.91
60	220	1791.00	136.98
65	225	1672.94	150.34
70	230	1571.62	164.01
75	235	1483.70	177.98
80	240	1406.66	192.25
85	245	1338.58	206.82
90	250	1277.99	221.69
95	255	1223.69	236.86
100	260	1174.75	252.33
105	265	1130.40	268.10
110	270	1090.02	284.17
115	275	1053.09	300.54
120	280	1019.18	317.21
125	285	987.93	334.18
130	290	959.04	351.45
135	295	932.25	369.03
140	300	907.32	386.90
145	305	884.07	405.07
150	310	862.34	423.55
155	315	841.97	442.32
160	320	822.84	461.40
165	325	804.84	480.77
170	330	787.86	500.45
175	335	771.83	520.42
180	340	756.66	540.70
185	345	742.28	561.28
190	350	728.64	582.15
195	355	715.67	603.33
200	360	703.33	624.81
205	365	691.56	646.59
210	370	680.34	668.66
215	375	669.62	691.04
220	380	659.37	713.72
225	385	649.55	736.70
230	390	640.14	759.98
235	395	631.12	783.56
240	400	622.46	807.44
245	405	614.13	831.62
250	410	606.12	856.11
255	415	598.41	880.89
260	420	590.99	905.97
265	425	583.83	931.35
270	430	576.92	957.04
275	435	570.25	983.02
280	440	563.81	1009.30
285	445	557.58	1035.89
290	450	551.56	1062.77
295	455	545.72	1089.96
300	460	540.08	1117.44
305	465	534.60	1145.23
310	470	529.30	1173.32
315	475	524.15	1201.70
320	480	519.15	1230.39
325	485	514.30	1259.38
330	490	509.59	1288.66
335	495	505.01	1318.25
340	500	500.56	1348.14



For Proposed Bench at -34.5mOD:

R_0 (from Quarry Centre)	371	m
R_0 (from Quarry Face)	211	m
$Q_{groundwater\ inflows}$	678	m^3/d
$Q_{groundwater\ inflows}$	7.8	l/s

Radius of Influence and Groundwater Inflows

Iterative Method (Combined Thiem-Dupuit Equation & Rate-of-Recharge Method):

Bench at -50mOD:

1. Recharge Estimate:

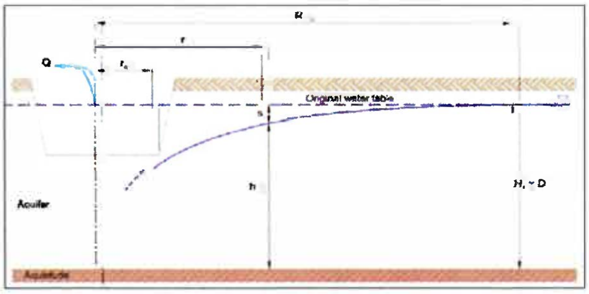
			Notes:
Annual Rainfall (AR)	1,260	mm/yr	Annual mean at Markree Castle (Met Eireann)
Potential Evapotranspiration (PE)	509	mm/yr	Average of annual mean at Finner Camp and Knock Airport (Met Eireann)
Actual Evapotranspiration (AE)	484	mm/yr	Takenas 95% of PE
Effective Rainfall (ER)	776	mm/yr	AR - AE
Recharge Coefficient (rc)	90	%	Upper end estimate for thin moderately permeableoverburden
Recharge (R)	698	mm/yr	ER x rc

2. Inputs:

			Notes:
k	0.108	m/d	Packertests
H	56.5	m	Groundwater head above quarry floor outside zone of influence (annual average)
h_w	0	m	Groundwater head above quarry floor at quarry face
r_e	160	m	Equivalent Well radius, visualmatchon aerial photo for lower bench
R	0.0019123	m/d	Rechargeper day (annual average)

3. Radius of Influence & Groundwater Inflows Estimate:

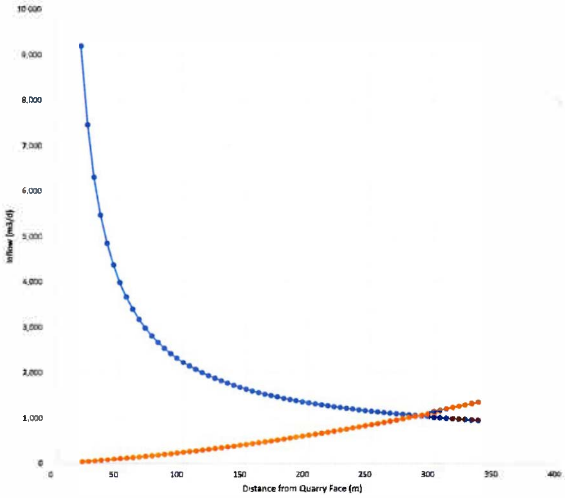
Distance from Quarry Face (m)	R_0 (m)	$Q_{groundwater\ inflows}$	$Q_{recharge}$
20	180	9195.76	40.85
25	185	7460.32	51.82
30	190	6302.61	63.08
35	195	5475.05	74.65
40	200	4853.85	86.51
45	205	4370.25	98.68
50	210	3982.97	111.14
55	215	3665.77	123.91
60	220	3401.14	136.98
65	225	3176.94	150.34
70	230	2984.54	164.01
75	235	2817.56	177.98
80	240	2671.27	192.25
85	245	2542.00	206.82
90	250	2426.92	221.69
95	255	2323.81	236.86
100	260	2230.87	252.33
105	265	2146.65	268.10
110	270	2069.96	284.17
115	275	1999.83	300.54
120	280	1935.44	317.21
125	285	1876.11	334.18
130	290	1821.24	351.45
135	295	1770.35	369.03
140	300	1723.02	386.90
145	305	1678.87	405.07
150	310	1637.60	423.55
155	315	1598.92	442.32
160	320	1562.59	461.40
165	325	1528.40	480.77
170	330	1496.17	500.45
175	335	1465.72	520.42
180	340	1436.91	540.70
185	345	1409.61	561.28
190	350	1383.70	582.15
195	355	1359.07	603.33
200	360	1335.63	624.81
205	365	1313.29	646.59
210	370	1291.98	668.66
215	375	1271.62	691.04
220	380	1252.15	713.72
225	385	1233.51	736.70
230	390	1215.64	759.98
235	395	1198.51	783.56
240	400	1182.05	807.44
245	405	1166.24	831.62
250	410	1151.04	856.11
255	415	1136.40	880.89
260	420	1122.29	905.97
265	425	1108.70	931.35
270	430	1095.58	957.04
275	435	1082.92	983.02
280	440	1070.68	1009.30
285	445	1058.86	1035.89
290	450	1047.42	1062.77
295	455	1036.34	1089.96
300	460	1025.62	1117.44
305	465	1015.22	1145.23
310	470	1005.15	1173.32
315	475	995.37	1201.70
320	480	985.88	1230.39
325	485	976.67	1259.38
330	490	967.72	1288.66
335	495	959.02	1318.25
340	500	950.56	1348.14



Thiem-Dupuit Equation:

$$Q = \frac{\pi k\left(H^2 - h_w^2\right)}{\ln\left[R_o / r_e\right]}$$

Assumptions:
- the aquifer is unconfined
- theaquifer has infinitearealextent
- the aquifer is homogeneous, and of uniform thickness
- there is only a small water table gradient
- groundwater flow is horizontal
- the pumping rate is constant
- the aquifer isfully penetrated
- the flow is insteady state
- the Dupuit assumptions are satisfied



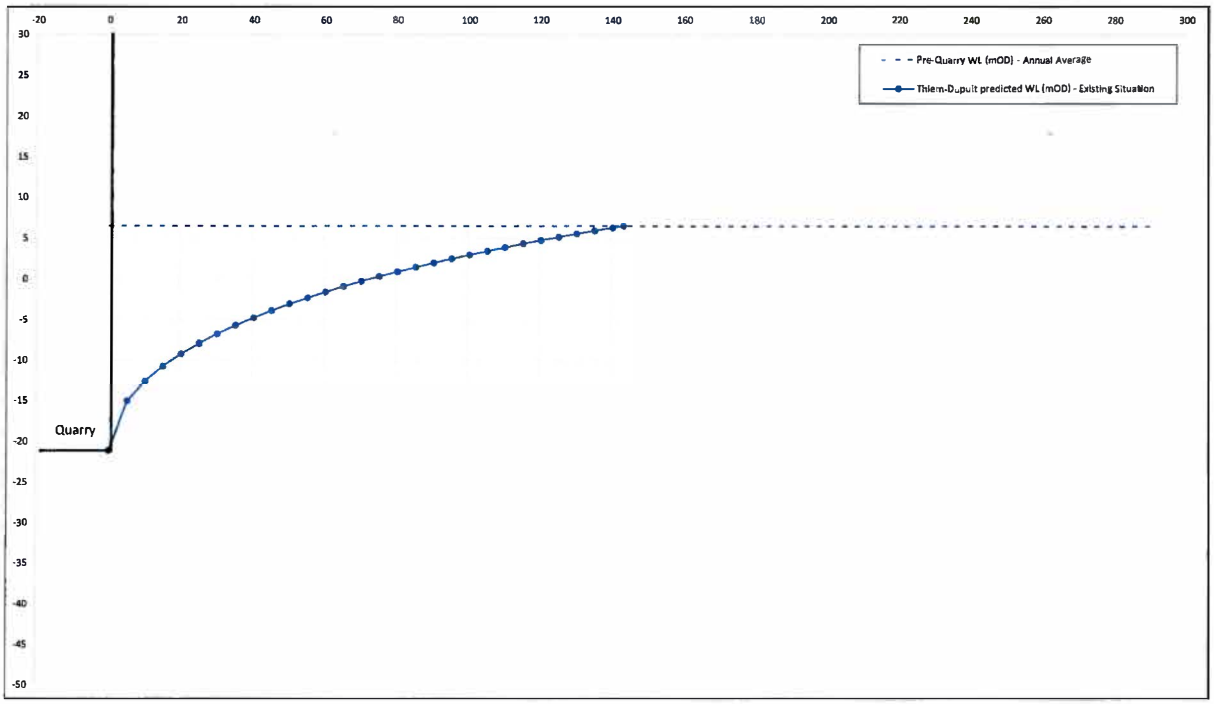
For Proposed Bench at -50mOD:

R_0 (from Quarry Centre)	446	m
R_0 (from Quarry Face)	286	m
$Q_{groundwater\ inflows}$	1057	m^3/d
$Q_{groundwater\ inflows}$	12.2	l/s

Drawdown Profile (Existing Situation)

Hydraulic Conductivity	K	0.108	m/d
Radius of Influence	R_0	303	m
Effective Radius of Quarry	r_e	160	m
Quarry Floor Level		-21	mOD
Aquifer Base		-21	mOD
Height of Water Table at Radius of Influence		6.5	mOD
Height of Water Table at Quarry Floor		-21	mOD
Head at boundary	H	27.5	m
Head at radius of interest	h_w	0	m
Drawdown at Quarry Face	s	27.5	m
Total flow into excavation	Q	401.826	m^3/d
	Q	4.7	l/s

R_0 (m)	Distance from Quarry Face (m)	Head (m)	Thiem-Dupuit predicted WL (mOD) - Existing Situation	Pre-Quarry WL (mOD) - Annual Average
160	0	0.00	-21.00	6.5
165	5	6.04	-14.96	6.5
170	10	8.47	-12.53	6.5
175	15	10.30	-10.70	6.5
180	20	11.81	-9.19	6.5
185	25	13.11	-7.89	6.5
190	30	14.27	-6.73	6.5
195	35	15.31	-5.69	6.5
200	40	16.26	-4.74	6.5
205	45	17.13	-3.87	6.5
210	50	17.95	-3.05	6.5
215	55	18.71	-2.29	6.5
220	60	19.42	-1.58	6.5
225	65	20.09	-0.91	6.5
230	70	20.73	-0.27	6.5
235	75	21.34	0.34	6.5
240	80	21.91	0.91	6.5
245	85	22.46	1.46	6.5
250	90	22.99	1.99	6.5
255	95	23.49	2.49	6.5
260	100	23.98	2.98	6.5
265	105	24.44	3.44	6.5
270	110	24.89	3.89	6.5
275	115	25.33	4.33	6.5
280	120	25.74	4.74	6.5
285	125	26.15	5.15	6.5
290	130	26.54	5.54	6.5
295	135	26.92	5.92	6.5
300	140	27.28	6.28	6.5
303	143	27.50	6.50	6.5
310	150			6.5
315	155			6.5
320	160			6.5
325	165			6.5
330	170			6.5
335	175			6.5
340	180			6.5
345	185			6.5
350	190			6.5
355	195			6.5
360	200			6.5
365	205			6.5
370	210			6.5
375	215			6.5
380	220			6.5
385	225			6.5
390	230			6.5
395	235			6.5
400	240			6.5
405	245			6.5
410	250			6.5
415	255			6.5
420	260			6.5
425	265			6.5
430	270			6.5
435	275			6.5
440	280			6.5
445	285			6.5
450	290			6.5



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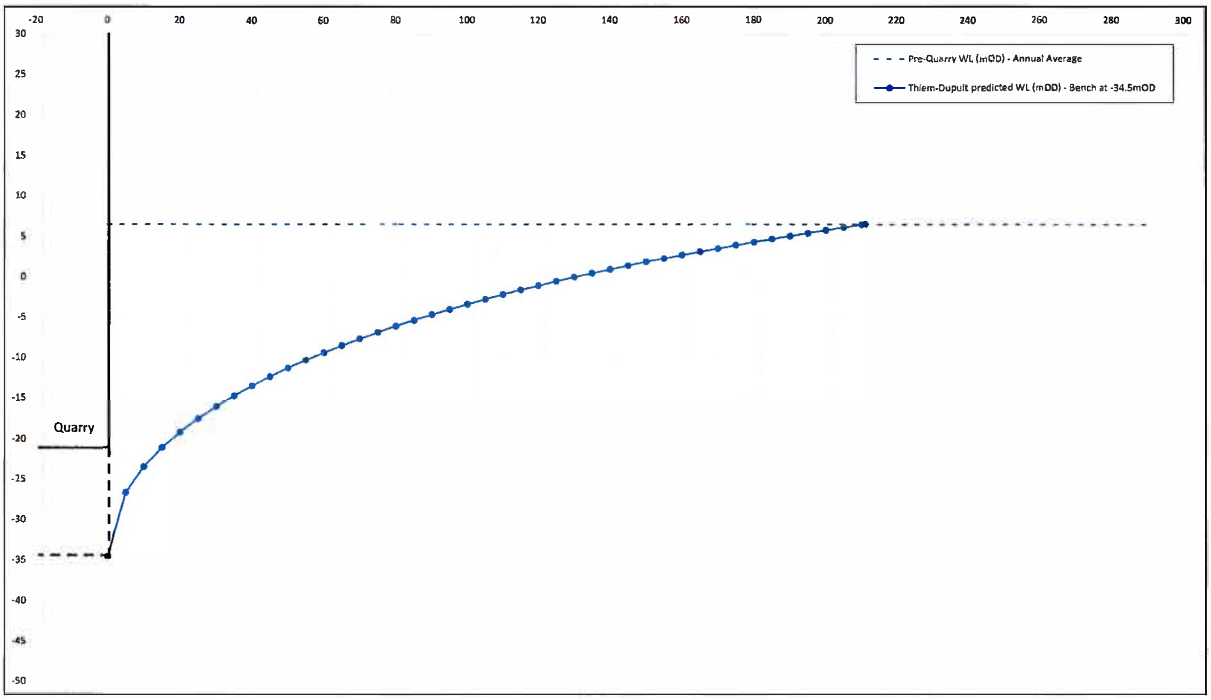
Drawdown Profile (Bench at -34.5mOD)

Hydraulic Conductivity	K	0.108	m/d
Radius of Influence	R_0	371	m
Effective Radius of Quarry	r_e	160	m
Quarry Floor Level		-34.5	mOD
Aquifer Base		-34.5	mOD
Height of Water Table at Radius of Influence		6.5	mOD
Height of Water Table at Quarry Floor		-34.5	mOD
Head at boundary	H	41	m
Head at radius of interest	h_w	0	m
Drawdown at Quarry Face	s	41	m
Total flow into excavation	Q	678.158	m^3/d
	Q	7.8	l/s

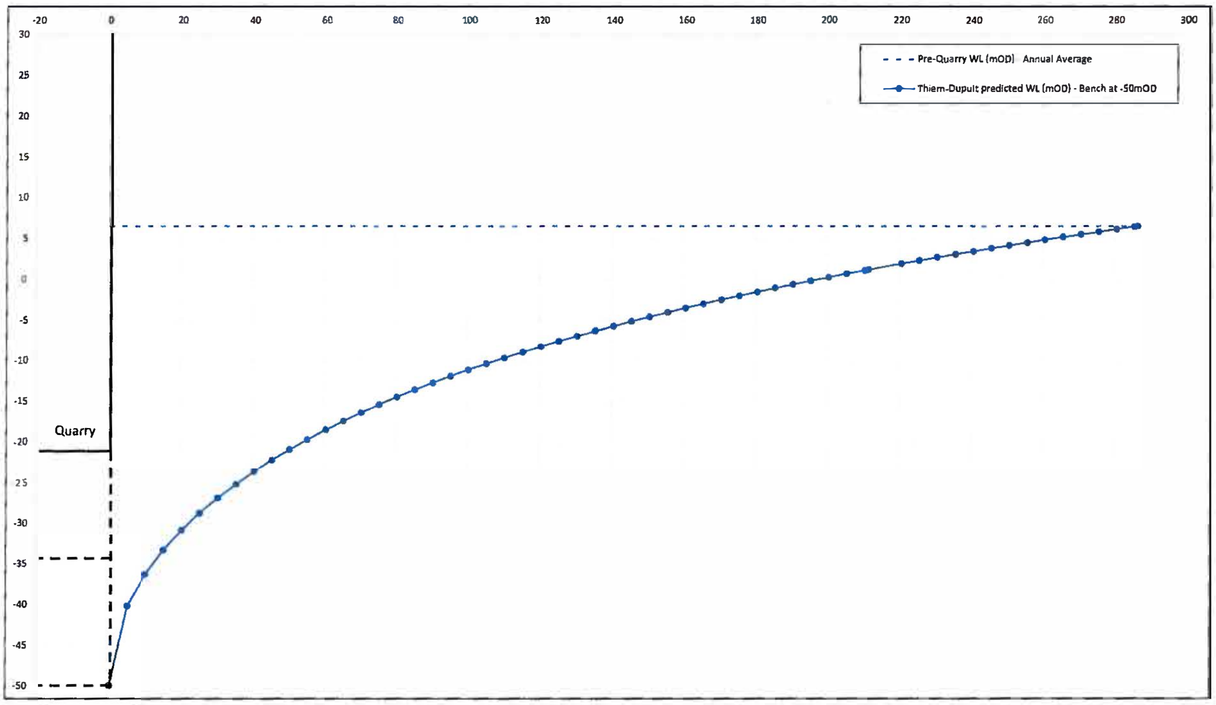
R_0 (m)	Distance from Quarry Face (m)	Head (m)	Thiem-Dupuit predicted WL (mOD) - Bench at -34.5mOD	Pre-Quarry WL (mOD) - Annual Average
160	0	0.00	-34.50	6.5
165	5	7.84	-26.66	6.5
170	10	11.01	-23.49	6.5
175	15	13.38	-21.12	6.5
180	20	15.34	-19.16	6.5
185	25	17.03	-17.47	6.5
190	30	18.53	-15.97	6.5
195	35	19.88	-14.62	6.5
200	40	21.12	-13.38	6.5
205	45	22.26	-12.24	6.5
210	50	23.31	-11.19	6.5
215	55	24.30	-10.20	6.5
220	60	25.23	-9.27	6.5
225	65	26.10	-8.40	6.5
230	70	26.93	-7.57	6.5
235	75	27.72	-6.78	6.5
240	80	28.47	-6.03	6.5
245	85	29.18	-5.32	6.5
250	90	29.87	-4.63	6.5
255	95	30.52	-3.98	6.5
260	100	31.15	-3.35	6.5
265	105	31.76	-2.74	6.5
270	110	32.34	-2.16	6.5
275	115	32.90	-1.60	6.5
280	120	33.44	-1.06	6.5
285	125	33.97	-0.53	6.5
290	130	34.48	-0.02	6.5
295	135	34.97	0.47	6.5
300	140	35.45	0.95	6.5
305	145	35.91	1.41	6.5
310	150	36.36	1.86	6.5
315	155	36.80	2.30	6.5
320	160	37.22	2.72	6.5
325	165	37.64	3.14	6.5
330	170	38.04	3.54	6.5
335	175	38.43	3.93	6.5
340	180	38.81	4.31	6.5
345	185	39.19	4.69	6.5
350	190	39.55	5.05	6.5
355	195	39.91	5.41	6.5
360	200	40.26	5.76	6.5
365	205	40.60	6.10	6.5
370	210	40.93	6.43	6.5
371	211	41.00	6.50	6.5
380	220			6.5
385	225			6.5
390	230			6.5
395	235			6.5
400	240			6.5
405	245			6.5
410	250			6.5
415	255			6.5
420	260			6.5
425	265			6.5
430	270			6.5
435	275			6.5
440	280			6.5
445	285			6.5
450	290			6.5



Drawdown Profile (Bench at -50mOD)

Hydraulic Conductivity	K	0.108	m/d
Radius of Influence	R_o	446	m
Effective Radius of Quarry	r_e	160	m
Quarry Floor Level		-50	mOD
Aquifer Base		-50	mOD
Height of Water Table at Radius of Influence		6.5	mOD
Height of Water Table at Quarry Floor		-50	mOD
Head at boundary	H	56.5	m
Head at radius of interest	h_w	0	m
Drawdown at Quarry Face	s	56.5	m
Total flow into excavation	Q	1056.538	m^3/d
	Q	12.2	l/s

R_o (m)	Distance from Quarry Face (m)	Head (m)	Thiem-Dupuit predicted WL (mOD) - Bench at -50mOD	Pre-Quarry WL (mOD) - Annual Average
160	0	0.00	-50.00	6.5
165	5	9.79	-40.21	6.5
170	10	13.74	-36.26	6.5
175	15	16.70	-33.30	6.5
180	20	19.15	-30.85	6.5
185	25	21.26	-28.74	6.5
190	30	23.13	-26.87	6.5
195	35	24.82	-25.18	6.5
200	40	26.36	-23.64	6.5
205	45	27.78	-22.22	6.5
210	50	29.10	-20.90	6.5
215	55	30.33	-19.67	6.5
220	60	31.49	-18.51	6.5
225	65	32.58	-17.42	6.5
230	70	33.62	-16.38	6.5
235	75	34.60	-15.40	6.5
240	80	35.53	-14.47	6.5
245	85	36.43	-13.57	6.5
250	90	37.28	-12.72	6.5
255	95	38.10	-11.90	6.5
260	100	38.88	-11.12	6.5
265	105	39.64	-10.36	6.5
270	110	40.37	-9.63	6.5
275	115	41.07	-8.93	6.5
280	120	41.74	-8.26	6.5
285	125	42.40	-7.60	6.5
290	130	43.03	-6.97	6.5
295	135	43.65	-6.35	6.5
300	140	44.24	-5.76	6.5
305	145	44.82	-5.18	6.5
310	150	45.38	-4.62	6.5
315	155	45.93	-4.07	6.5
320	160	46.46	-3.54	6.5
325	165	46.98	-3.02	6.5
330	170	47.48	-2.52	6.5
335	175	47.97	-2.03	6.5
340	180	48.45	-1.55	6.5
345	185	48.91	-1.09	6.5
350	190	49.37	-0.63	6.5
355	195	49.82	-0.18	6.5
360	200	50.25	0.25	6.5
365	205	50.68	0.68	6.5
370	210	51.09	1.09	6.5
371	211	51.18	1.18	6.5
380	220	51.90	1.90	6.5
385	225	52.29	2.29	6.5
390	230	52.67	2.67	6.5
395	235	53.05	3.05	6.5
400	240	53.42	3.42	6.5
405	245	53.78	3.78	6.5
410	250	54.13	4.13	6.5
415	255	54.48	4.48	6.5
420	260	54.82	4.82	6.5
425	265	55.15	5.15	6.5
430	270	55.48	5.48	6.5
435	275	55.81	5.81	6.5
440	280	56.13	6.13	6.5
445	285	56.44	6.44	6.5
446	286	56.50	6.50	6.5



APPENDIX 7-21 CHANNEL SURVEY PHOTOGRAPHS & STREAM CROSS-SECTIONAL PROFILES

Photograph 1: Upstream of Culvert 1 (looking upstream)

Photograph 2: Culvert 1 (upstream end)

Photograph 3: Culvert 1 (downstream end) – Note Starflow flowmeter installed

Photograph 4: Reach 1 (looking upstream) – Note two quarry discharge pipes, one discharging

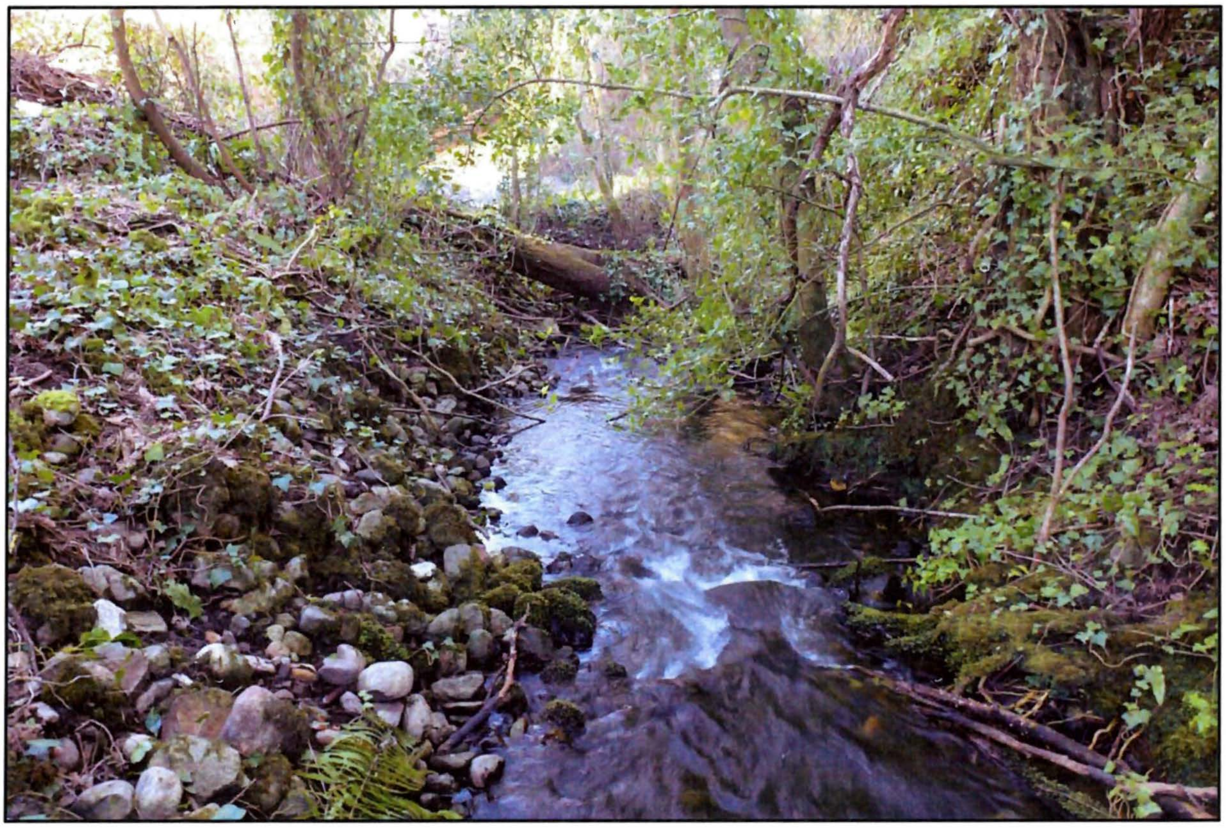
Photograph 5: Reach 1 (looking downstream)

Photograph 6: Reach 1 - Note overbank flow on west bank

Photograph 7: Reach 1 (looking downstream, approaching Culvert 2)

Photograph 8: Culvert 2 (upstream end)

Photograph 9: **Culvert 2 (downstream end)**



Photograph 10: **Reach 2 (looking downstream)**

Photograph 11: Culvert 3 (upstream end)

Photograph 12: Culvert 3 (downstream end)

Photograph 13: **Reach 3 (looking downstream) – Note concrete brick wall surrounding reach**

Photograph 14: **Culvert 4 (upstream end) – Note smaller pipe on left diverts water to private pumphouse**

Photograph 15: Culvert 4 (downstream end) – very overgrown on banks

Photograph 16: Reach 4 (looking downstream)

Photograph 17: Reach 4 (looking upstream from Culvert 5) – Note waterwheel in stream

Photograph 18: Reach 4 – Weir in stream next to waterwheel

Photograph 19: Reach 4 – Surface water drains on adjacent local road leading to stream

Photograph 20: Culvert 5 (upstream end) – Arched culvert under main public road R287

Photograph 21: Culvert 5 (downstream end)

Photograph 22: Reach 5 (looking downstream from bridge at Culvert 5)

Photograph 23: **Reach 5 (looking downstream from bridge at Byrne's residence)**

Photograph 24: **Reach 5 (looking downstream from bridge at Judge's residence)**

Photograph 25: Reach 5 (looking upstream at Culvert 6) – Note perforated concrete fence over stream

Photograph 26: Culvert 6 (upstream end)

Photograph 27: **Culvert 6 (downstream end)**

Photograph 28: **Reach 6 (looking downstream from bridge at Culvert 6)**

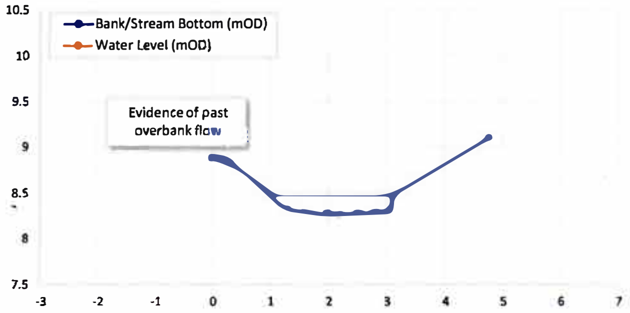
Photograph 29: **Culvert 7 (upstream end)**

Photograph 30: **Culvert 7 (downstream end)**

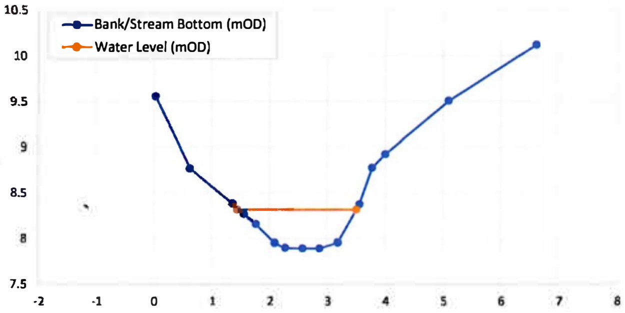
Photograph 31: **Reach 7 (looking downstream to Lough Gill)**

Stream Cross-Sectional Profiles

Section 1



Section 2



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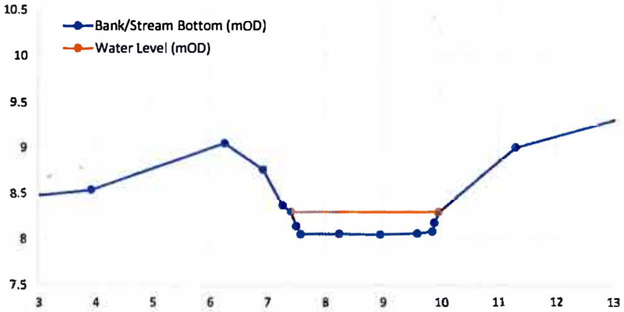

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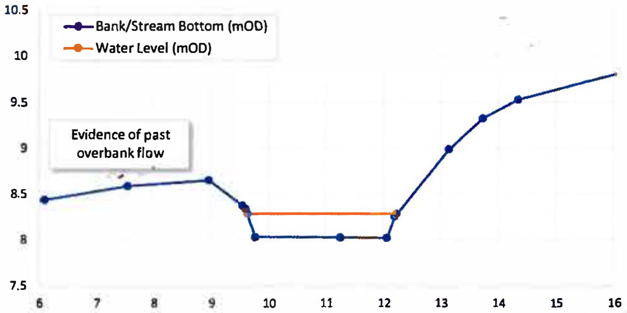

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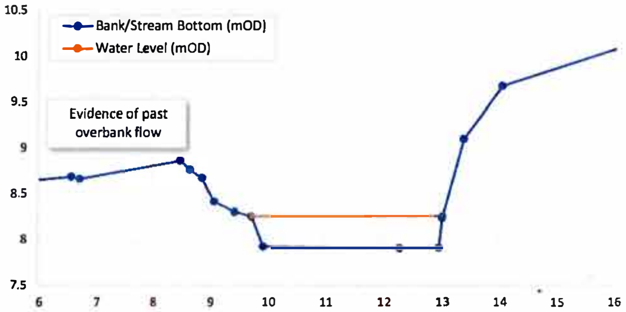

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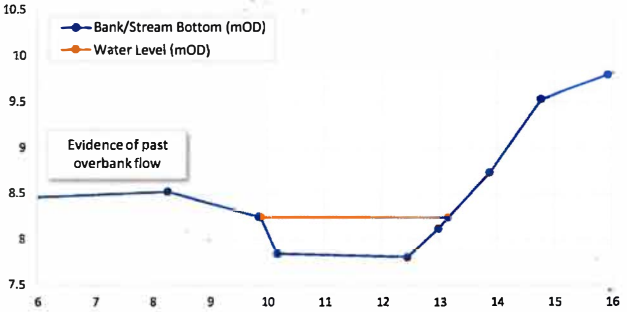

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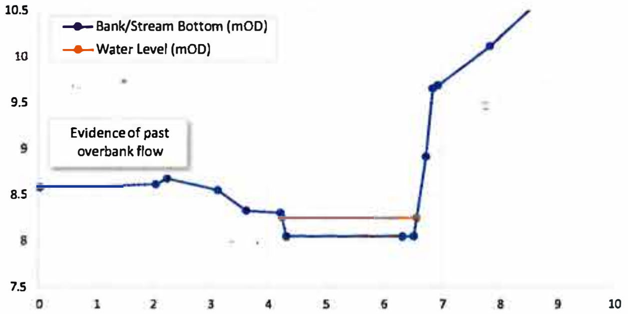

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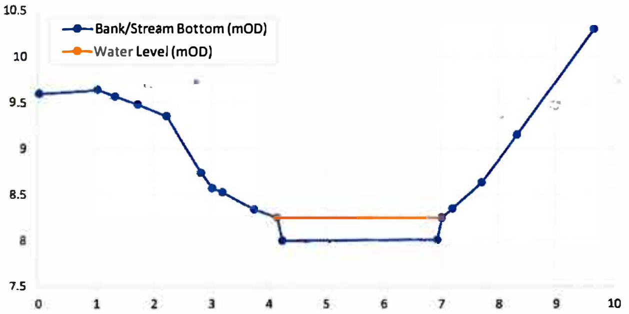

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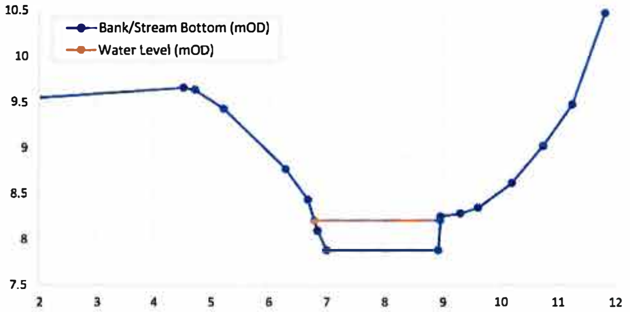

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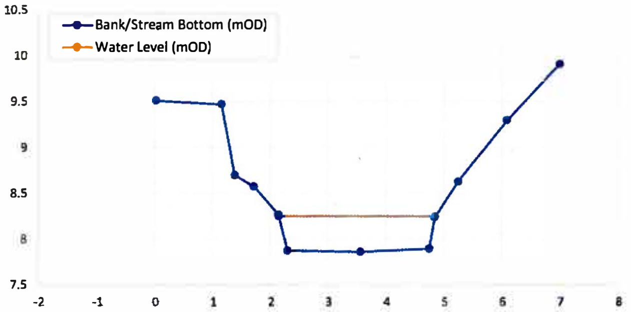
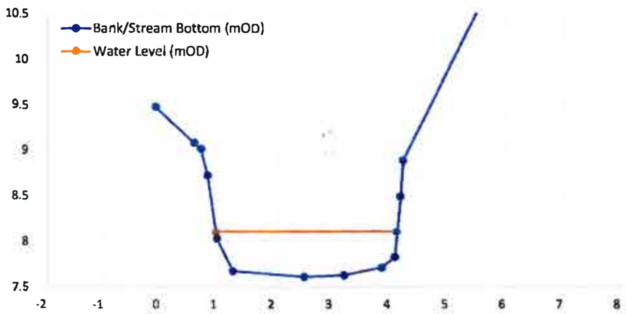


Stream Cross-Sectional Profiles

Section 11



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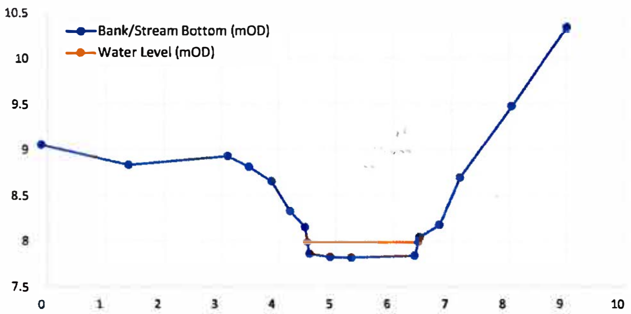

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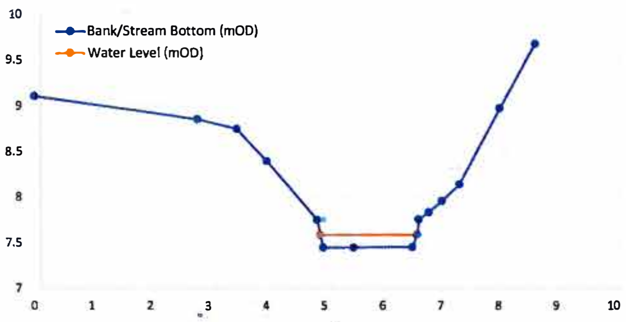

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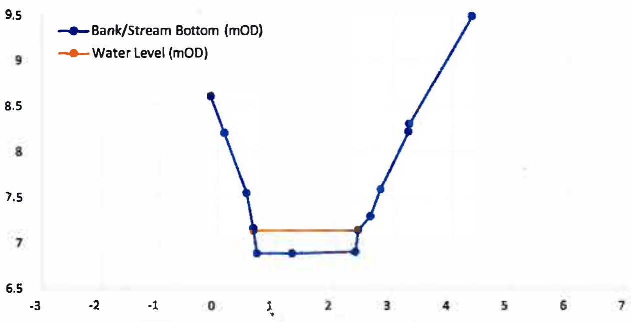

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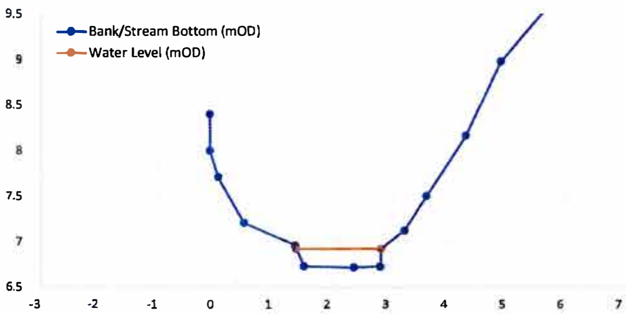

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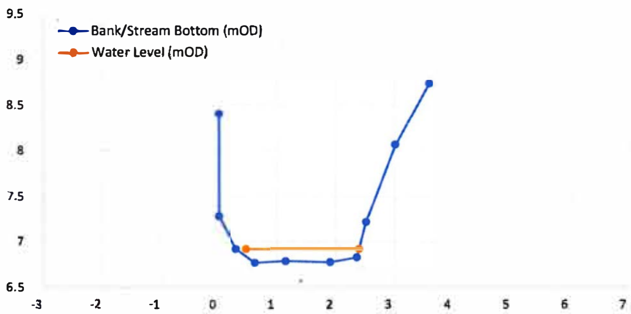

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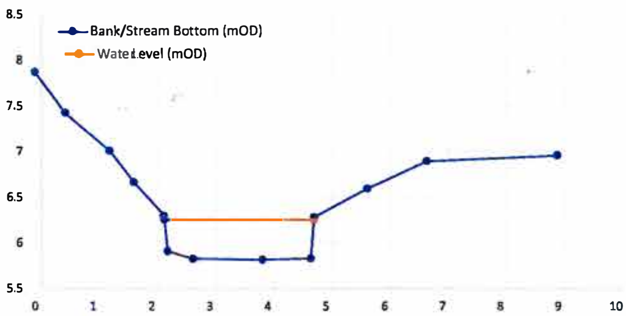

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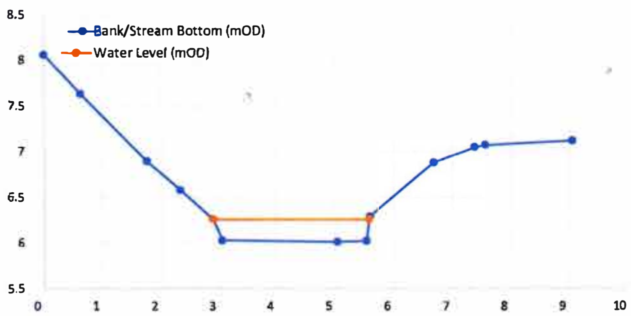

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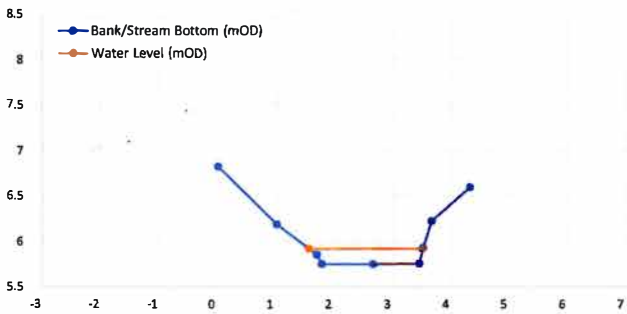

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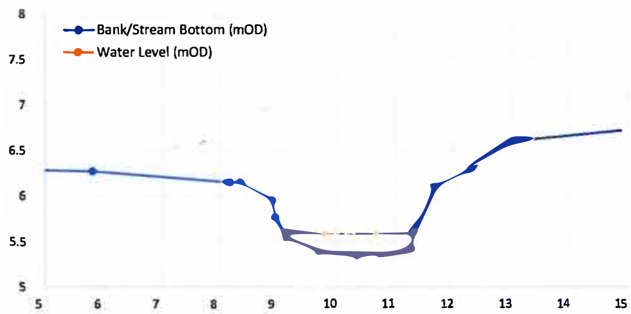
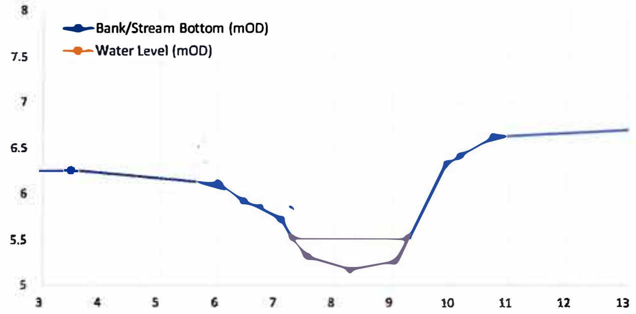


Stream Cross-Sectional Profiles

Section 21



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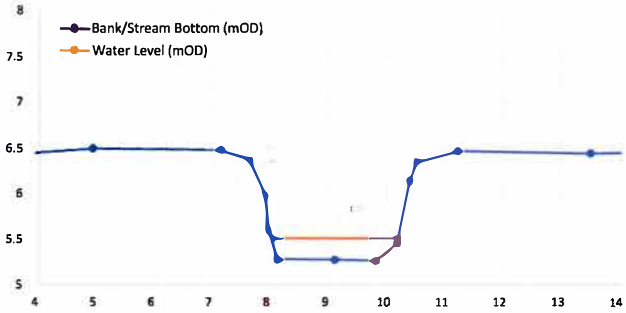

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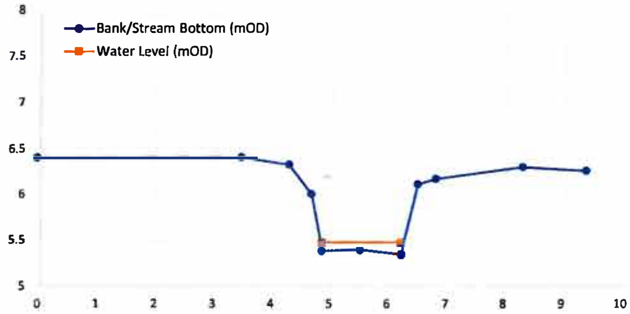

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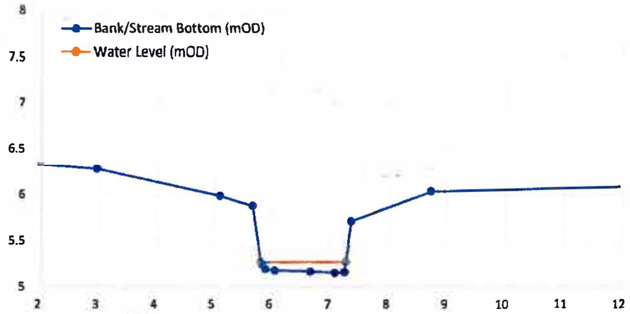

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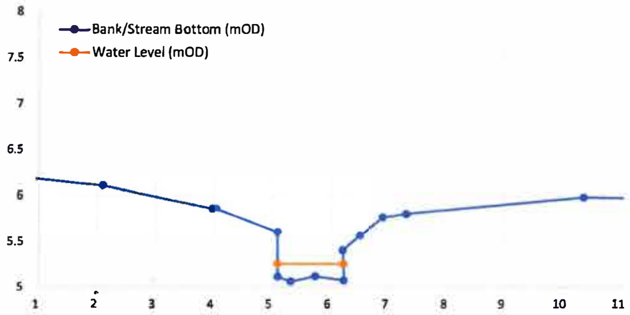

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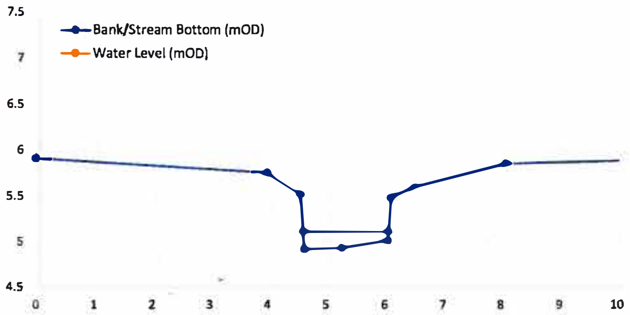

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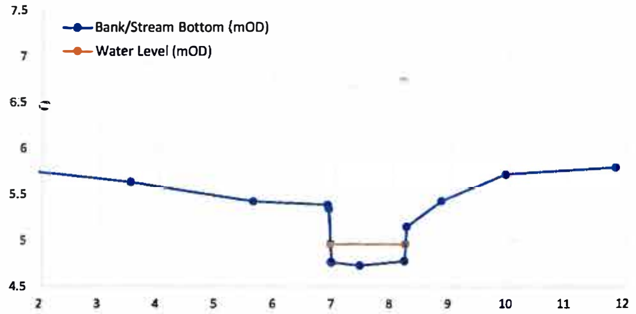

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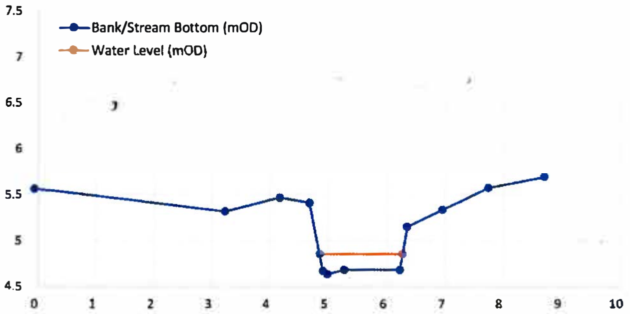

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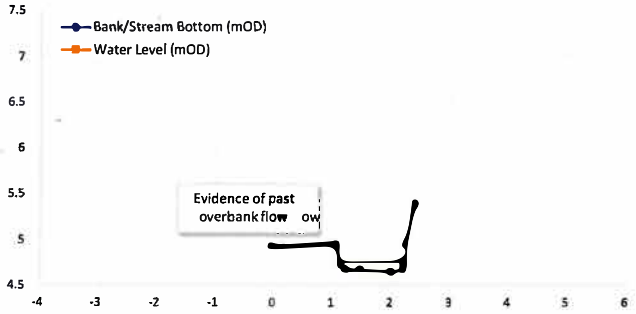

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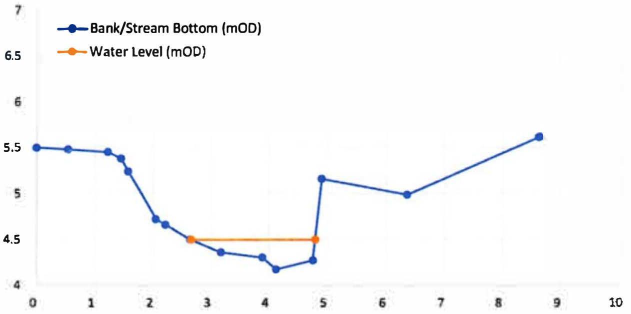
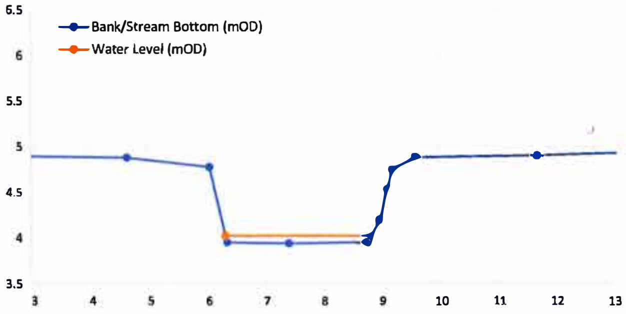


Stream Cross-Sectional Profiles

Section 31



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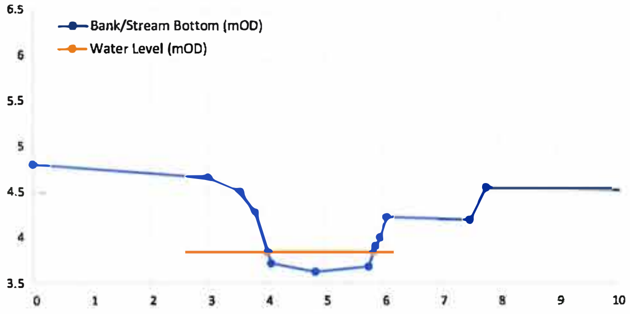

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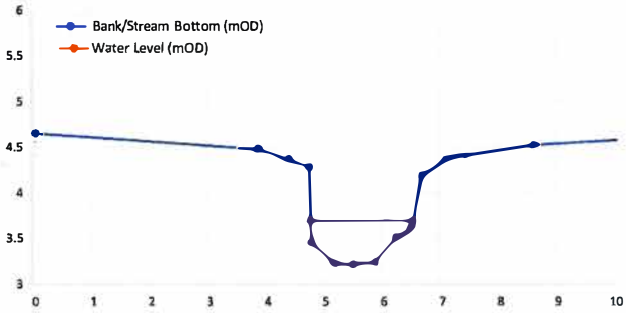

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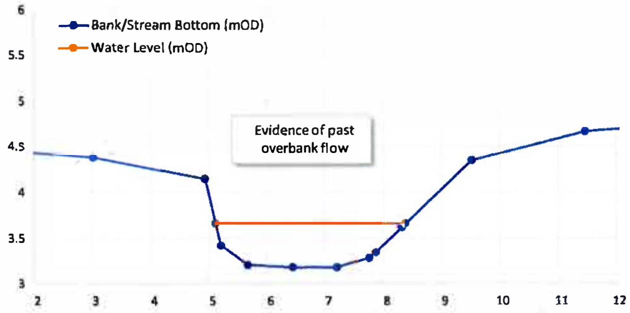

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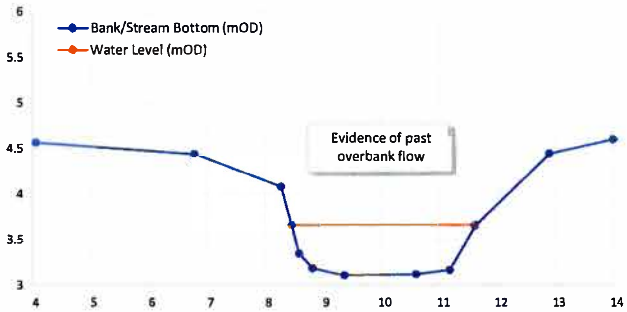

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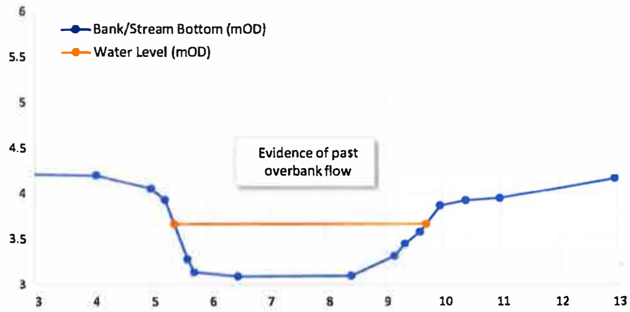

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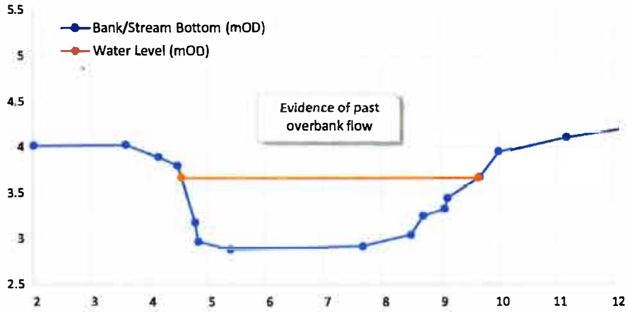

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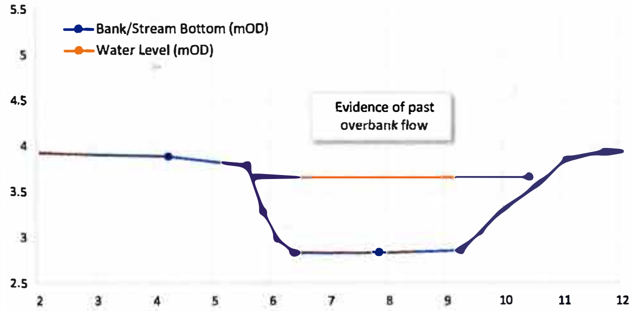

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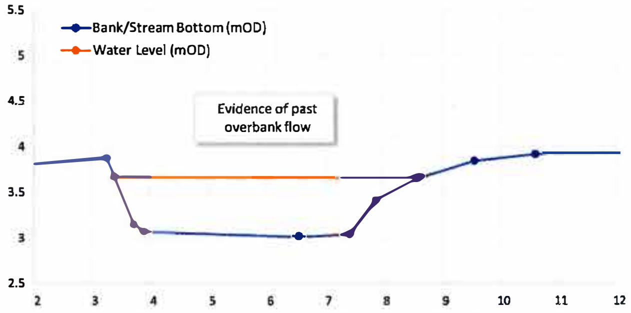
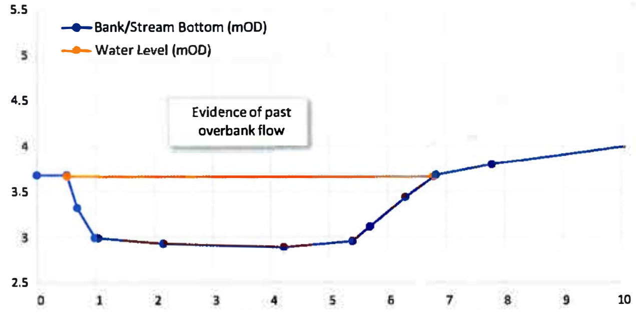
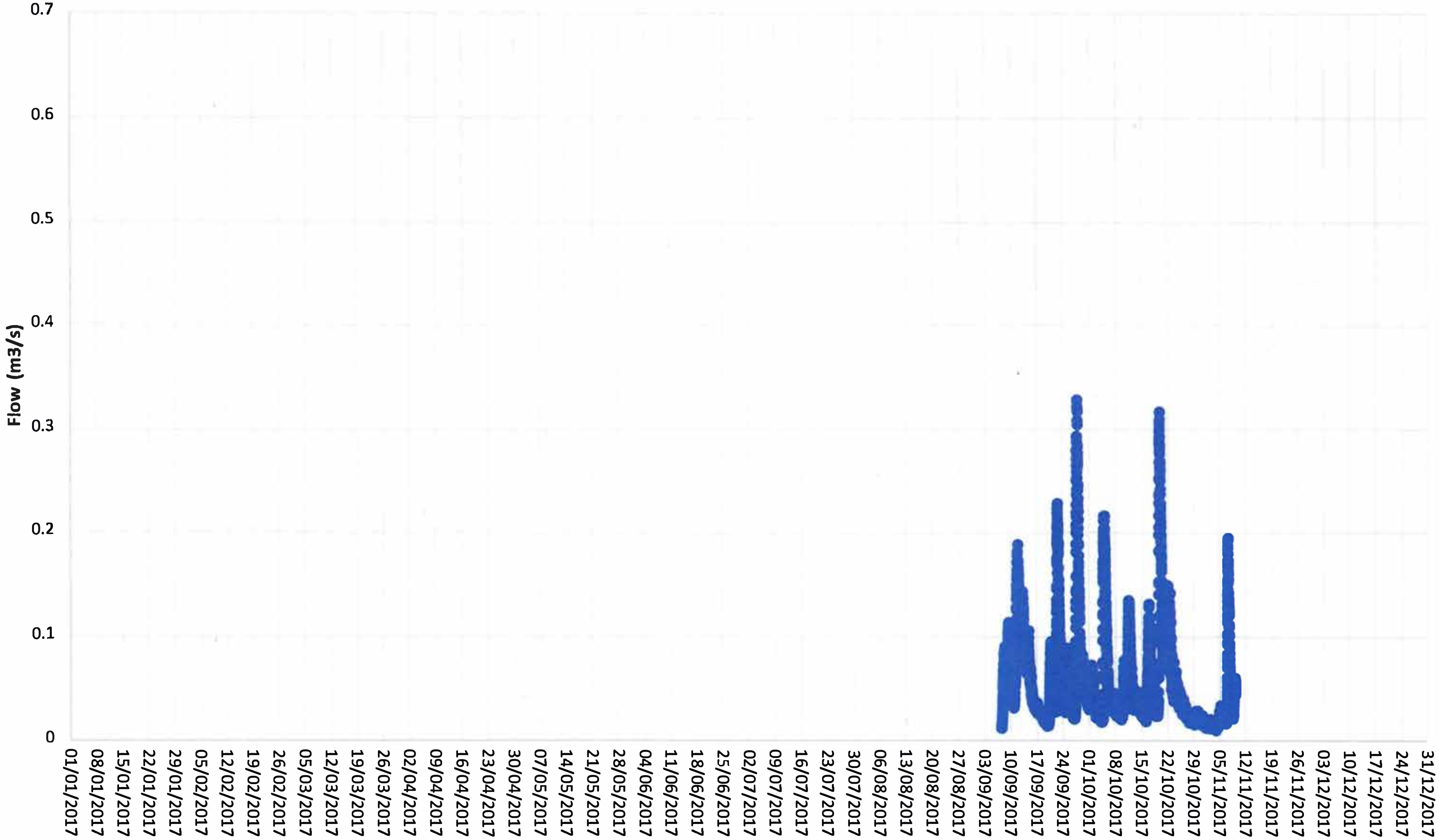


Section 40

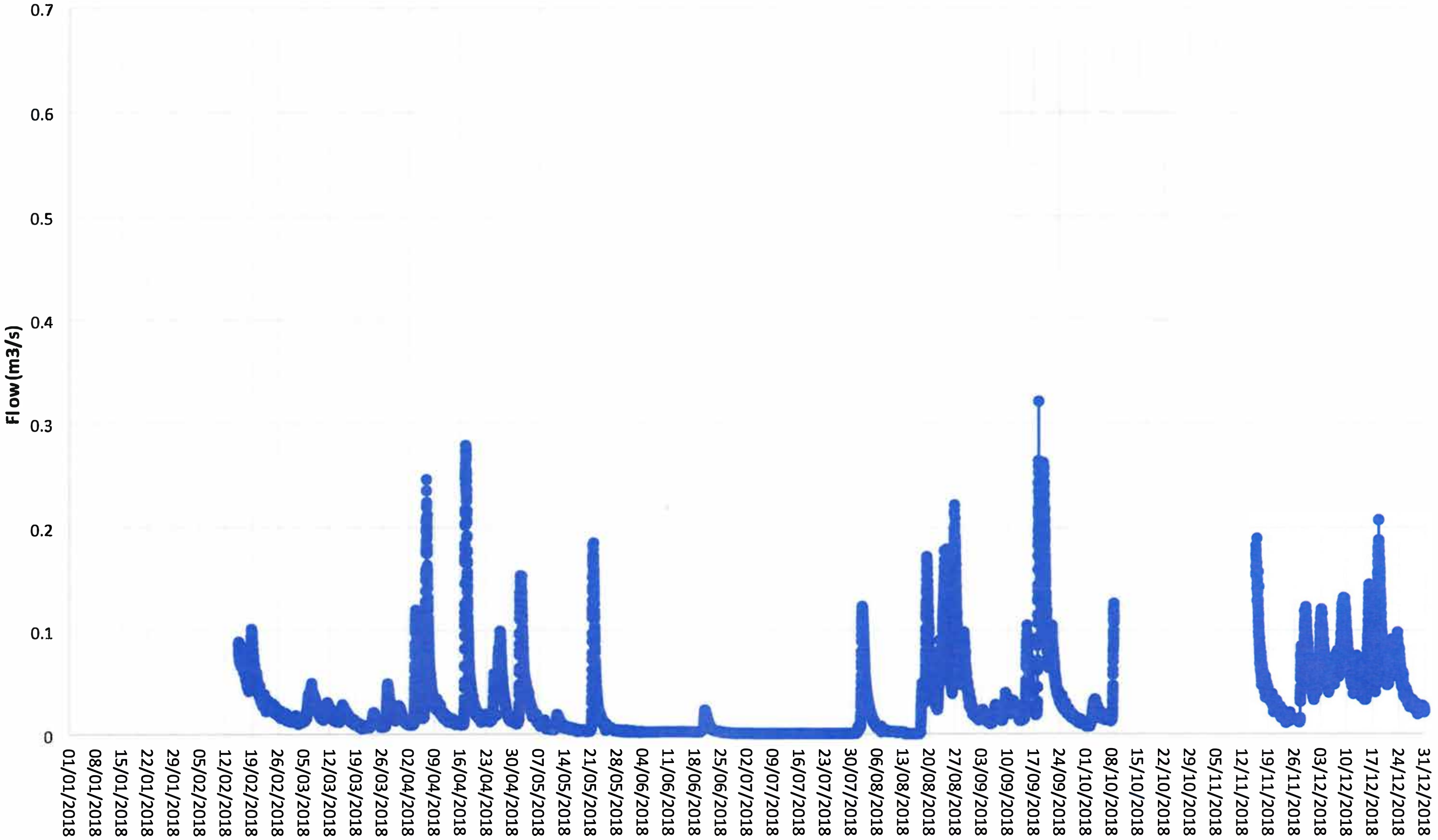


APPENDIX 7-22 HYDROGRAPHS & FLOW CALCULATIONS

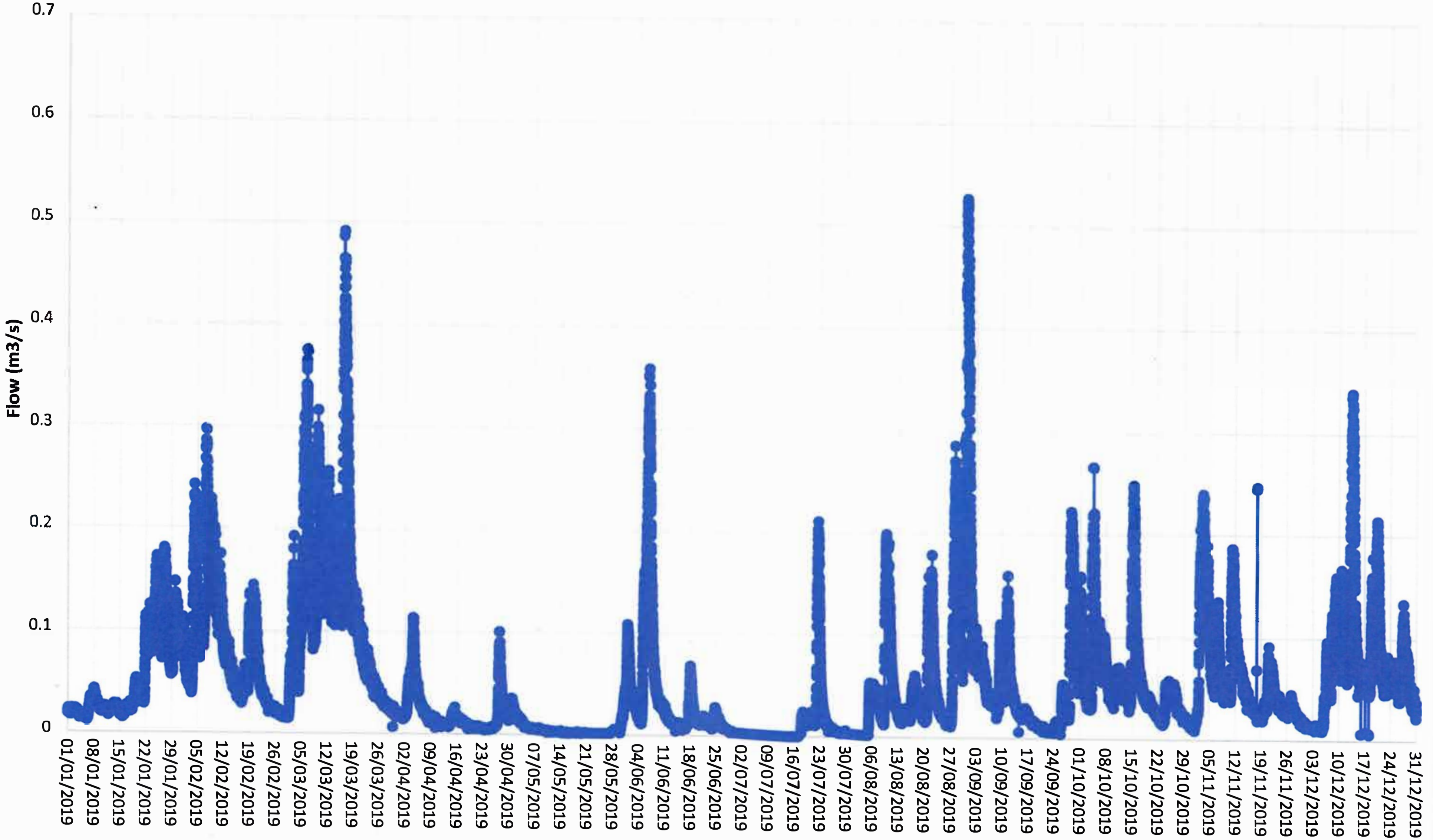
Flow Hydrograph, Aghamore Stream - Upstream of Discharge (2017)



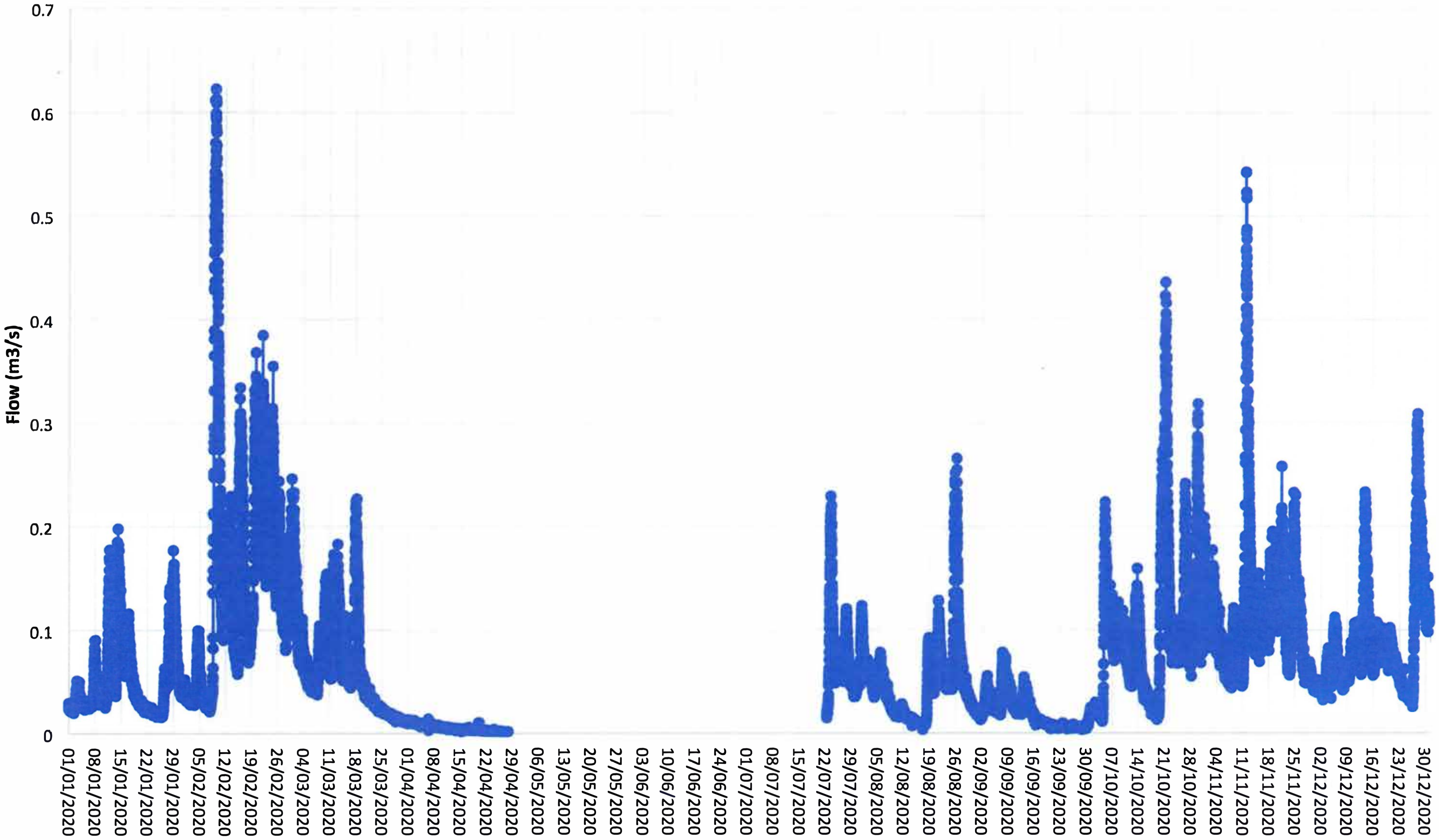
Flow Hydrograph, Aghamore Stream - Upstream of Discharge (2018)



Flow Hydrograph, Aghamore Stream - Upstream of Discharge (2019)



Flow Hydrograph, Aghamore Stream - Upstream of Discharge (2020)



Flow Duration Curve, Upstream of Discharge

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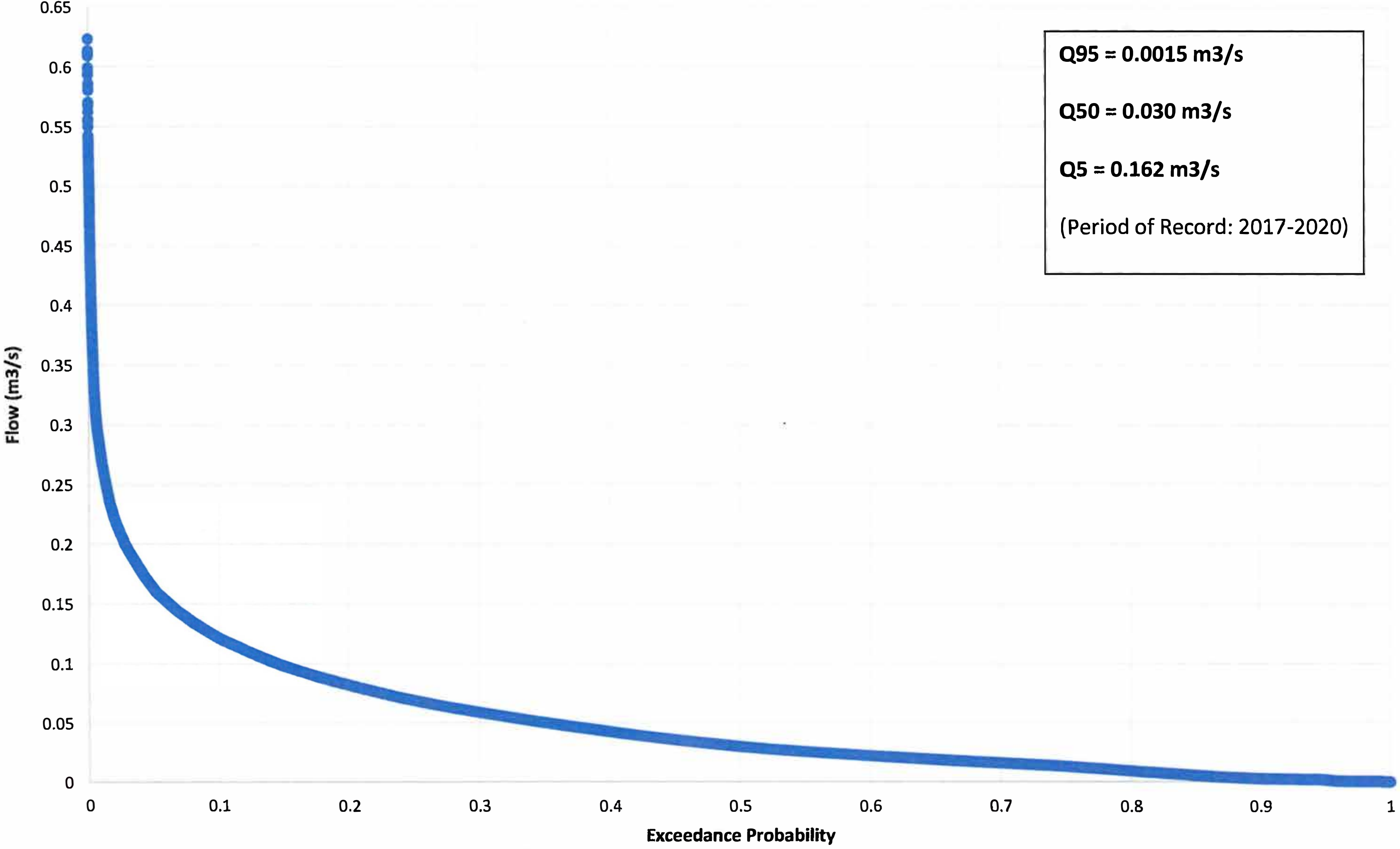

Q95 = 0.0015 m3/s

Q50 = 0.030 m3/s

Q5 = 0.162 m3/s

(Period of Record: 2017-2020)

Stream Cross-Section Calculations

	Reach No.	Channel Centre		Bank Full			S	n	Manning		Notes
		Easting (ITM)	Northing (ITM)	A (m^2)	WP (m)	R (m)			V (m/s)	Q_{max} (m^3/s)	
Section 1	-	570570.087	831874.943	1.545	4.498	0.343	0.00050	0.065	0.169	0.261	Field evidence of past overbank flow at this location
Section 2	1	570569.918	831892.256	5.044	6.447	0.782	0.00050	0.065	0.292	> 1.473	Section 2 located in small gorge, top of bank not surveyed
Section 3	1	570566.379	831915.101	3.378	5.821	0.580	0.00092	0.065	0.325	1.097	
Section 4	1	570564.762	831937.320	1.772	4.271	0.415	0.00092	0.065	0.260	0.460	Field evidence of past overbank flow at this location
Section 5	1	570563.232	831956.098	3.610	5.856	0.616	0.00008	0.065	0.097	0.348	Field evidence of past overbank flow at this location
Section 6	1	570562.130	831974.635	2.352	5.735	0.410	0.00008	0.065	0.074	0.173	Field evidence of past overbank flow at this location
Section 7	1	570564.670	831984.484	1.853	5.138	0.361	0.00008	0.065	0.068	0.125	Field evidence of past overbank flow at this location
Section 8	1	570569.095	832010.852	8.205	9.087	0.903	0.00008	0.065	0.124	1.021	
Section 9	1	570572.396	832018.913	7.285	8.313	0.876	0.00008	0.065	0.122	0.889	
Section 10	1	570576.044	832026.173	5.921	6.847	0.865	0.00008	0.065	0.121	0.716	
Section 11	2	570581.921	832048.599	6.265	7.035	0.891	0.00100	0.065	0.450	2.821	
Section 12	2	570595.658	832055.004	3.164	8.533	0.371	0.03210	0.070	1.321	4.180	
Section 13	2	570600.867	832062.909	5.806	9.469	0.613	0.03210	0.070	1.847	10.725	
Section 14	2	570609.168	832078.035	4.388	5.706	0.769	0.03210	0.070	2.148	9.427	
Section 15	3	570616.536	832090.897	5.453	6.301	0.865	0.00037	0.065	0.269	1.468	
Section 16	3	570616.125	832093.558	4.351	5.542	0.785	0.00037	0.065	0.252	1.098	
Section 17	4	570694.424	832181.212	3.941	8.786	0.449	0.01140	0.065	0.963	3.793	
Section 18	4	570700.250	832186.462	4.326	9.323	0.464	0.01140	0.065	0.985	4.259	
Section 19	4	570714.431	832202.855	2.394	5.137	0.466	0.01140	0.065	0.987	2.364	
Section 20	5	570739.284	832229.108	3.279	13.224	0.248	0.00189	0.065	0.264	0.866	
Section 21	5	570767.530	832244.169	2.835	7.040	0.403	0.00189	0.065	0.365	1.034	
Section 22	5	570779.033	832251.771	2.908	5.470	0.532	0.00189	0.065	0.439	1.277	
Section 23	5	570789.654	832259.343	1.722	5.141	0.335	0.01074	0.055	0.909	1.565	
Section 24	5	570798.425	832263.323	2.123	11.173	0.190	0.01074	0.055	0.623	1.322	
Section 25	5	570808.509	832268.818	1.944	9.184	0.212	0.01074	0.055	0.669	1.301	
Section 26	5	570822.717	832276.636	2.219	11.284	0.197	0.01074	0.055	0.637	1.414	
Section 27	5	570834.505	832283.738	3.231	12.907	0.250	0.01074	0.055	0.748	2.418	
Section 28	5	570841.960	832289.233	1.377	4.175	0.330	0.01074	0.055	0.899	1.239	
Section 29	5	570847.666	832293.155	0.319	1.602	0.199	0.01074	0.065	0.544	0.173	Field evidence of past overbank flow at this location
Section 30	6	570865.433	832303.567	4.534	9.433	0.481	0.01074	0.065	0.978	4.436	
Section 31	6	570881.121	832313.345	3.103	13.588	0.228	0.00684	0.065	0.475	1.475	
Section 32	6	570902.656	832325.211	2.408	5.672	0.425	0.00684	0.065	0.719	1.731	
Section 33	6	570922.170	832339.025	2.962	11.535	0.257	0.00684	0.065	0.514	1.523	
Section 34	7	570943.185	832345.099	5.747	11.513	0.499	0.00002	0.065	0.048	0.274	Field evidence of past overbank flow at this location
Section 35	7	570961.388	832353.255	5.765	10.648	0.541	0.00002	0.065	0.050	0.290	Field evidence of past overbank flow at this location
Section 36	7	570990.329	832373.123	6.215	14.544	0.427	0.00002	0.065	0.043	0.267	Field evidence of past overbank flow at this location
Section 37	7	571009.843	832375.621	5.771	11.880	0.486	0.00002	0.065	0.047	0.270	Field evidence of past overbank flow at this location
Section 38	7	571027.656	832383.554	5.252	13.279	0.396	0.00002	0.065	0.041	0.215	Field evidence of past overbank flow at this location
Section 39	7	571041.011	832387.681	3.821	7.180	0.532	0.00002	0.065	0.050	0.190	Field evidence of past overbank flow at this location
Section 40	7	571058.043	832390.662	3.920	6.787	0.578	0.00002	0.065	0.053	0.206	Field evidence of past overbank flow at this location

Notes:

A - Area

WP - Wetted Perimeter

R - Hydraulic Radius

S - Slope

n - Manning's roughness coefficient

V - Velocity

Q_{max} - Maximum flow rate

Manning Equation:

$$Q = VA = \left(\frac{1.00}{n}\right) AR^{\frac{2}{3}} \cdot \sqrt{S} \quad [SI]$$

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Culvert Calculations

	Description		Easting (ITM)	Northing (ITM)	IL (mOD)	WL (mOD)	A (m^2)	WP (m)	R (m)	S	n	V (m/s)	Q (m^3/s)	Q_{max} (m^3/s)	Notes
Culvert 1	Single concrete pipe, diameter 900mm	Upstream	570570.264	831874.957	8.333	8.470	0.636	2.827	0.225	0.00653	0.014	2.136	1.359	1.359	
		Downstream	570569.833	831892.249	8.220	8.316									
Culvert 2	Single concrete pipe, diameter 840mm upstream/1180mm downstream	Upstream	570578.629	832032.969	8.117	8.230	0.554	2.639	0.210	0.00917	0.014	2.416	1.339	1.339	Q_{max} restricted by smaller diameter upstream
		Downstream	570581.101	832044.712	*8.007*	8.120									
Culvert 3	Two concrete pipes, diameter 600mm	Upstream (L)	*570608.000*	*832076.000*	*6.833*	*7.071*	0.283	1.885	0.150	0.00950	0.014	1.967	0.557	1.113	
		Downstream (L)	*570615.000*	*832083.000*	*6.739*	*6.946*									
		Upstream (R)	*570608.000*	*832076.000*	*6.833*	*7.071*	0.283	1.885	0.150	0.00950	0.014	1.967	0.557		
		Downstream (R)	*570615.000*	*832083.000*	*6.739*	*6.946*									
Culvert 4	Two PVC/concrete pipes, diameter 450mm upstream (PVC)/600mm downstream (concrete)	Upstream (L)	570615.793	832093.607	6.805	6.920	0.159	1.414	0.112	0.00652	0.012	1.568	0.249	0.498	Q_{max} restricted by smaller diameter upstream
		Downstream (L)	570683.428	832172.200	6.129	6.416									
		Upstream (R)	570616.575	832093.490	6.783	6.920	0.159	1.414	0.112	0.00651	0.012	1.566	0.249		
		Downstream (R)	570683.943	832171.745	6.111	6.416									
Culvert 5	Arched culvert, height 766mm upstream, 1011mm downstream	Upstream	570722.439	832214.776	5.818	5.931	1.120	4.553	0.246	0.04696	0.030	2.836	3.176	3.176	Q_{max} restricted by smaller area upstream
		Downstream	570725.458	832217.564	5.625	5.732	1.564	5.050	0.310						
Culvert 6	Two concrete pipes, diameter 450mm upstream/600mm downstream	Upstream (L)	570847.521	832293.300	4.667	4.750	0.159	1.414	0.112	0.01071	0.014	1.722	0.274	0.509	Q_{max} restricted by smaller diameter upstream
		Downstream (L)	570865.375	832303.464	4.447	4.496									
		Upstream (R)	570847.895	832292.924	4.646	4.750	0.159	1.414	0.112	0.00788	0.014	1.477	0.235		
		Downstream (R)	570865.032	832302.853	4.490	4.496									
Culvert 7	Single concrete pipe, diameter 750mm	Upstream	570922.182	832339.001	3.268	3.691	0.442	2.356	0.188	*0.00378*	0.014	1.439	0.636	0.636	
		Downstream	*570925.938*	*832340.293*	*3.263*	*3.686*									

Notes:

IL - Invert Level
WL - Water Level (on date surveyed)
A - Area
WP - Wetted Perimeter
R - Hydraulic Radius
S - Slope
n - Manning's roughness coefficient
V - Velocity
Q - flow rate
Q_{max} - Maximum flow rate

Manning Equation:

$$Q = VA = \left(\frac{1.00}{n}\right) A R^{\frac{2}{3}} \sqrt{S} \qquad [\mathrm{SI}]$$

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Estimation of Peak Flow for Aghamore Stream at Culvert 1

1. Monitored Rainfall-Runoff Events

	Rainfall Event						Hydrograph						
No.	Start	Finish	Centre of Mass	Duration (hrs)	Total Rainfall (mm)	Mean Intensity (mm/hr)	Start RL	Peak Flow	Peak Flow (m^3/s)	T_p (hrs)	Lag (hrs)	1st IP	T_c (hrs)
1	27/09/2017 02:00	27/09/2017 16:00	27/09/2017 10:00	14	27.6	1.971	27/09/2017 09:00	27/09/2017 20:30	0.328	11.5	10.5	28/09/2017 18:15	26.25
2	04/10/2017 08:00	05/10/2017 00:00	04/10/2017 16:00	16	13.9	0.869	04/10/2017 15:00	05/10/2017 02:30	0.216	11.5	10.5	06/10/2017 06:15	30.25
3	05/04/2018 23:00	06/04/2018 17:00	06/04/2018 08:30	18	18.7	1.039	06/04/2018 03:45	06/04/2018 20:30	0.246	16.75	12	07/04/2018 19:00	26
4	16/04/2018 14:00	17/04/2018 04:00	16/04/2018 23:00	14	22.1	1.579	16/04/2018 20:00	17/04/2018 09:15	0.279	13.25	10.25	18/04/2018 08:15	28.25
5	01/05/2018 05:00	02/05/2018 03:00	01/05/2018 16:30	22	17.1	0.777	01/05/2018 14:00	02/05/2018 04:45	0.153	14.75	12.25	03/05/2018 03:30	24.5
6	20/05/2018 20:00	21/05/2018 12:00	21/05/2018 03:30	16	19.2	1.200	21/05/2018 02:30	21/05/2018 14:45	0.183	12.25	11.25	22/05/2018 12:00	24

Notes:

Start RL - Start of Rising Limb of Hydrograph

T_p - Time to Peak

1st IP - First inflection point on Receding Limb of Hydrograph

T_c - Time of Concentration

2. Estimation of Runoff Coefficient from Monitored Events

$Q_p = 0.278CiA$ Rational Method

Where:

Q_p	Peak flow (m^3/s)
C	Runoff Coefficient (-)
i	Mean intensity (mm/hr)
A	Catchment Area (km^2)

Rainfall Event	Q_p	i	A	C
1	0.328	1.971	2.722	0.220
2	0.216	0.869	2.722	0.329
3	0.246	1.039	2.722	0.313
4	0.279	1.579	2.722	0.234
5	0.153	0.777	2.722	0.260
6	0.183	1.200	2.722	0.202

3. Estimation of Peak Flow for Worst Case

No.	Duration (hrs)	Total Rainfall (mm)	ARF	Rainfall Frequency (AEP %)	Mean Intensity (mm/hr)
1	14	27.6	0.979	51.3	1.971
2	16	13.9	0.98	59.3	0.869
3	18	18.7	0.981	56.4	1.039
4	14	22.1	0.979	53.6	1.579
5	22	17.1	0.982	58	0.777
6	16	19.2	0.98	55.7	1.200
Worst Case	26.5	85.6	0.983	1	3.230

Notes:

ARF - Areal Reduction Factor

AEP - Annual Exceedance Probability

With lowest Runoff Coefficient:

C	0.202	-
i	3.230	mm/hr
A	2.722	km^2

Q_p	0.494	m^3/s

With highest Runoff Coefficient:

C	0.329	-
i	3.230	mm/hr
A	2.722	km^2

Q_p	0.804	m^3/s

Estimated Peak Flow (Q_p) ranges from 0.494 - 0.804 m^3/s

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APPENDIX 7-23 ASSIMILATIVE CAPACITY ANALYSIS

Assimilative Capacity Calculations for Discharge to Agham[illegible] Stream

1. Assimilative Capacity of Stream at Low Flow (General Case):

	Max. Permissible Conc. (mg/l)	Mean Background Conc. (mg/l)	95%ile Flow (m3/s)	Constant	Assimilative Capacity (kg/day)
Total Suspended Solids	25	5.01	0.002	86.4	3.454
Biological Oxygen Demand	2.6	1.36	0.002	86.4	0.214
Nitrate	50	2.98	0.002	86.4	8.125
Nitrite	0.015	0.01	0.002	86.4	0.001
Total Ammonia	0.14	0.034	0.002	86.4	0.018
Orthophosphate	0.075	0.019	0.002	86.4	0.010
Arsenic (Total)	10	0.57	0.002	86.4	1.630
Cadmium (Filtered)	0.9	0.25	0.002	86.4	0.112
Chromium (Total)	32	1	0.002	86.4	5.357
Copper (Total)	30	5.29	0.002	86.4	4.270
Lead (Filtered)	14	0.5	0.002	86.4	2.333
Mercury (Filtered)	0.07	0.005	0.002	86.4	0.011
Nickel (Filtered)	34	3.71	0.002	86.4	5.234
Selenium (Total)	10	0.4	0.002	86.4	1.659
Zinc (Total)	100	9	0.002	86.4	15.725

Note:

Assimilative Capacity = (Max Permissible Concentration - Concentration$_{Background}$) x Flow x 86.4

2. Concentrations Downstream of Discharge (General Case):

	Stream Flow (m3/day)	Mean Background Conc. (mg/l)	Max. Discharge Rate (m3/day)	Mean Discharge Conc. (mg/l)	Downstream Conc. (mg/l)	Max. Permissible Conc. (mg/l)
Total Suspended Solids	172.8	5.01	3500	1.5	1.665	25
Biological Oxygen Demand	172.8	1.36	3500	0.57	0.607	2.6
Nitrate	172.8	2.98	3500	4.06	4.009	50
Nitrite	172.8	0.01	3500	0.01	0.010	0.015
Total Ammonia	172.8	0.034	3500	0.014	0.015	0.14
Orthophosphate	172.8	0.019	3500	0.035	0.034	0.075
Arsenic (Total)	172.8	0.57	3500	0.66	0.656	10
Cadmium (Filtered)	172.8	0.25	3500	0.25	0.250	0.9
Chromium (Total)	172.8	1	3500	1	1.000	32
Copper (Total)	172.8	5.29	3500	4.5	4.537	30
Lead (Filtered)	172.8	0.5	3500	0.5	0.500	14
Mercury (Filtered)	172.8	0.005	3500	0.017	0.016	0.07
Nickel (Filtered)	172.8	3.71	3500	4.5	4.463	34
Selenium (Total)	172.8	0.4	3500	1.27	1.229	10
Zinc (Total)	172.8	9	3500	13.4	13.193	100

Note:

Downstream Concentration = [(Flow$_{Upstream}$ x Concentration$_{Upstream}$) + (Flow$_{Discharge}$ x Concentration$_{Discharge}$)] / (Flow$_{Upstream}$ + Flow$_{Discharge}$)

3. Assimilative Capacity Used (General Case):

	Max. Permissible Conc. (mg/l)	Mean Background Conc. (mg/l)	Downstream Conc. (mg/l)	Assimilative Capacity Used
Total Suspended Solids	25	5.01	1.665	-17%
Biological Oxygen Demand	2.6	1.36	0.607	-61%
Nitrate	50	2.98	4.009	2%
Nitrite	0.015	0.01	0.010	0%
Total Ammonia	0.14	0.034	0.015	-18%
Orthophosphate	0.075	0.019	0.034	27%
Arsenic (Total)	10	0.57	0.656	1%
Cadmium (Filtered)	0.9	0.25	0.250	0%
Chromium (Total)	32	1	1.000	0%
Copper (Total)	30	5.29	4.537	-3%
Lead (Filtered)	14	0.5	0.500	0%
Mercury (Filtered)	0.07	0.005	0.016	18%
Nickel (Filtered)	34	3.71	4.463	2%
Selenium (Total)	10	0.4	1.229	9%
Zinc (Total)	100	9	13.193	5%

Note:

% AC Used = [(Max Permissible Concentration - Concentration$_{Background}$) - (Max Permissible Concentration - Concentration$_{Downstream}$) / (Max Permissible Concentration - Concentration$_{Background}$)] x 100

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Background Concentrations (Upstream Samples)

	pH	Total Suspended Solids	BOD	Nitrate	Nitrite	Total Ammonia	Orthophosphate	Arsenic (Total)	Cadmium (Filtered)	Chromium (Total)	Copper (Total)	Lead (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Selenium (Total)	Zinc (Total)
Units	-	mg/l	mg/l O_2	mg/l NO_3	mg/l N	mg/l N	mg/l P	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
30/01/2018	7.72	< 3	1	4.76	0.006	0.03	< 0.02	< 1	< 0.5	< 2	10	< 1	< 0.01	< 3	< 0.8	< 18
27/02/2018	8.21	< 3	< 2	5.38	0.008	0.03	< 0.02	< 1	< 0.5	< 2	< 9	< 1	< 0.01	< 3	< 0.8	< 18
27/03/2018	7.32	3.1	4	3.69	0.004	0.03	< 0.02	< 2	< 0.5	< 2	< 9	< 1	< 0.01	17	< 0.8	< 18
23/04/2018	7.81	< 3	< 1	3	0.003	0.05	< 0.02	< 1	< 0.5	< 2	< 9	< 1	< 0.01	< 3	< 0.8	< 18
27/08/2018	7.24	< 3	2	1.1	0.008	0.06	< 0.02	< 1	< 0.5	< 2	< 9	< 1	< 0.01	< 3	< 0.8	< 18
06/11/2018	7.62	24.5	< 1	2.6	0.004	< 0.02	0.05	< 1	< 0.5	< 2	< 9	< 1	< 0.01	< 3	< 0.8	< 18
07/01/2019	7.31	< 3	< 1	< 0.7	< 0.08	0.03	< 0.02	< 1	< 0.5	< 2	< 9	< 1	< 0.01	< 3	< 0.8	< 18
28/03/2019	7.65						0.04									

Statistics:

pH	Total Suspended Solids	BOD	Nitrate	Nitrite	Total Ammonia	Orthophosphate	Arsenic (Total)	Cadmium (Filtered)	Chromium (Total)	Copper (Total)	Lead (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Selenium (Total)	Zinc (Total)
7.72	1.5	1	4.76	0.006	0.03	0.01	0.5	0.25	1	10	0.5	0.005	1.5	0.4	9
8.21	1.5	1	5.38	0.008	0.03	0.01	0.5	0.25	1	4.5	0.5	0.005	1.5	0.4	9
7.32	3.1	4	3.69	0.004	0.03	0.01	1	0.25	1	4.5	0.5	0.005	17	0.4	9
7.81	1.5	0.5	3	0.003	0.05	0.01	0.5	0.25	1	4.5	0.5	0.005	1.5	0.4	9
7.24	1.5	2	1.1	0.008	0.06	0.01	0.5	0.25	1	4.5	0.5	0.005	1.5	0.4	9
7.62	24.5	0.5	2.6	0.004	0.01	0.05	0.5	0.25	1	4.5	0.5	0.005	1.5	0.4	9
7.31	1.5	0.5	0.35	0.04	0.03	0.01	0.5	0.25	1	4.5	0.5	0.005	1.5	0.4	9
7.65						0.04									

Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
7.61	5.01	1.36	2.98	0.010	0.034	0.019	0.57	0.25	1	5.29	0.5	0.005	3.71	0.4	9

Note:

Where result is less than laboratory reporting limit, value of 50% of limit used

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Discharge Concentrations

	pH	Total Suspended Solids	BOD	Nitrate	Nitrite	Total Ammonia	Orthophosphate	Arsenic (Total)	Cadmium (Filtered)	Chromium (Total)	Copper (Total)	Lead (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Selenium (Total)	Zinc (Total)
Units	-	mg/l	mg/l O_2	mg/l NO_3	mg/l N	mg/l N	mg/l P	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
30/01/2018	7.96	< 3	< 1	6.53	0.007	< 0.02	< 0.02	< 1	< 0.5	< 2	< 9	< 1	0.015	5	1.45	< 18
27/02/2018	8.39	< 3	< 2	6.54	0.003	< 0.02	< 0.02	< 1	< 0.5	< 2	< 9	< 1	< 0.01	6	1.2	< 18
27/03/2018	8.18	< 3	< 1	7.05	0.003	< 0.02	< 0.02	< 1	< 0.5	< 2	< 9	< 1	< 0.01	6	1.21	< 18
23/04/2018	8.03	< 3	< 1	2.84	0.005	0.02	0.02	< 1	< 0.5	< 2	< 9	< 1	< 0.01	4	1.3	< 18
27/08/2018	8.65	< 3	< 1	1.87	0.006	0.03	< 0.02	1.6	< 0.5	< 2	< 9	< 1	< 0.01	5	1.26	< 18
06/11/2018	7.38	< 3	< 1	2.87	0.004	< 0.02	0.2	< 1	< 0.5	< 2	< 9	< 1	0.077	< 3	1.1	40
07/01/2019	8.51	< 3	< 1	0.7	< 0.08	< 0.02	< 0.02	< 1	< 0.5	< 2	< 9	< 1	< 0.01	4	1.37	< 18
28/03/2019	7.89						< 0.02									

Statistics:

pH	Total Suspended Solids	BOD	Nitrate	Nitrite	Total Ammonia	Orthophosphate	Arsenic (Total)	Cadmium (Filtered)	Chromium (Total)	Copper (Total)	Lead (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Selenium (Total)	Zinc (Total)
7.96	1.5	0.5	6.53	0.007	0.01	0.01	0.5	0.25	1	4.5	0.5	0.015	5	1.45	9
8.39	1.5	1	6.54	0.003	0.01	0.01	0.5	0.25	1	4.5	0.5	0.005	6	1.2	9
8.18	1.5	0.5	7.05	0.003	0.01	0.01	0.5	0.25	1	4.5	0.5	0.005	6	1.21	9
8.03	1.5	0.5	2.84	0.005	0.02	0.02	0.5	0.25	1	4.5	0.5	0.005	4	1.3	9
8.65	1.5	0.5	1.87	0.006	0.03	0.01	1.6	0.25	1	4.5	0.5	0.005	5	1.26	9
7.38	1.5	0.5	2.87	0.004	0.01	0.2	0.5	0.25	1	4.5	0.5	0.077	1.5	1.1	40
8.51	1.5	0.5	0.7	0.04	0.01	0.01	0.5	0.25	1	4.5	0.5	0.005	4	1.37	9
7.89						0.01									

Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
8.12	1.50	0.57	4.06	0.010	0.014	0.035	0.66	0.25	1	4.5	0.5	0.017	4.5	1.27	13.4

Note:
Where result is less than laboratory reporting limit, value of 50% of limit used

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APPENDIX 7-24 SITE CHARACTERISATION REPORT & WASTEWATER TREATMENT SYSTEM DESIGN SPECIFICATION

Trinity Green
Environmental Consultants

Clonfert
Maynooth
Co. Kildare
t: 01-6290616
m: 086-2434828
Vat No. 3251411B

Site Characterisation Report

By

Dr. Eugene Bolton

Applicant: Lagan Materials

Clonfert,
Maynooth
Co. Kildare
Email: info@trinitygreen.ie
Mobile 086-2434828

SITE CHARACTERISATION FORM

File Reference:

1.0 GENERAL DETAILS (From planning application)

Prefix. First Name: Lagan Materials Surname:

Address:

Site Location and Townland: Aughamore, Carraroe, Co. Sligo F91 RW83

Telephone No: Fax No:

E-Mail:

Maximum no. of Residents: No. of Double Bedrooms: No. of Single Bedrooms:

Proposed Water Supply: Mains ☐ Private Well/Borehole ☑ Group Well/Borehole ☐

2.0 GENERAL DETAILS (From planning application)

Soil Type, (Specify Type): Glaciofluvial Sands & Gravels

Aquifer Category: Regionally Important Rk Locally Important Poor

Vulnerability. Extreme ☐ High ☑ Moderate ☐ Low ☐ High to Low ☐ Unknown ☐

Bedrock Type: Dinantian Pure bedded Limestone

Name of Public/Group Scheme Water Supply within 1 km: None

Groundwater Protection Scheme (Y/N): Yes Source Protection Area: SI ☐ SO ☐

Groundwater Protection Response: $R2^1$

Presence of Significant Sites (Archaeological, Natural & Historical): Lough Gill about 1Km to northeast of site

Past experience in the area: Not in immediate area

Comments:

(Integrate the information above in order to comment on: the potential suitability of the site, potential targets at risk, and/or any potential site restrictions).

The groundwater is likely to be at high because of the High vulnerability.
There are 6 6workers on site - allow 40 litres /person and 25grams BOD There are up to 5 Lorry drivers calling - Allow 5 litres and 10 grams BOD This gives 265 litres or 2PE and 200 grams BOD or PE of 4

Note: Only information available at the desk study stage should be used in this section.

3.0 ON-SITE ASSESSMENT

3.1 Visual Assessment

Landscape Position: Undulating Landscape

Slope: Steep (>1:5) ☐ Shallow (1:5-1:20) ☐ Relatively Flat (<1:20) ☑

Surface Features within a minimum of 250m (Distance To Features Should Be Noted In Metres)

Houses: No houses within 250m of proposed location of percolation area

Existing Land Use: Existing Quarry

Vegetation Indicators: Nothing to indicate poor soakage

Groundwater Flow Direction: To Northwest

Ground Condition: Hard

Site Boundaries:	Hedge	Roads:	Road to west

Outcrops (Bedrock And/Or Subsoil): Limestone exposed in surrounding hills, Clayey gravel overburden in immediate area

Surface Water Ponding:	Small shallow area 200m south	Lakes:	Lough Gill 1Km Northeast
Beaches/Shellfish:	None	Areas/Wetlands:	None
Karst Features:	None	Watercourse/Stream*:	Stream along road to West 200m
Drainage Ditches*:	None	Springs / Wells*:	Well to Northeast in excess of 100m away

Comments:
(Integrate the information above in order to comment on: the potential suitability of the site, potential targets at risk, the suitability of the site to treat the wastewater and the location of the proposed system within the site).

Ground conditions are dry. Nothing to suggest poor soakage.

***Note and record** water level

3.2 Trial Hole (should be a minimum of 2.1m deep (3m for regionally important aquifers))

To avoid any accidental damage, a trial hole assessment or percolation tests should not be undertaken in areas, which are at or adjacent to significant sites (e.g. NHAs, SACs, SPAs, and/or Archaeological etc.), without prior advice from National Parks and Wildlife Service or the Heritage Service.

Depth of trial hole (m): 2.40

Depth from ground surface to bedrock (m) (if present):

Depth from ground surface to water table (m) (if present): 1.60

Depth of water ingress:

Rock type (if present): None Present

Date and time of excavation: 08/02/2021

Date and time of examination: 09/02/2021

	Depth of P/T Test*	Soil/Subsoil Texture & Classification**	Plasticity and dilatancy***	Soil Structure	Density/ Compactness	Colour****	Preferential flowpaths
0.1 m	P	Fill - 804	No trds or Ribs	structureless	Hard	brown	None
02 m	P						
0.3 m	P,						
0.4 m	P,	SAND	No trds or Ribs	Structureless	Firm to hard	Grey/Brown	
0.5 m	T1-3						
0.6 m	T1-3						
0.7 m	T1-3						
0.8 m	T1-3						
0.9 m							
1.0 m							
1 .1m							
1.2 m							
1.3 m							
1.4 m							
1.5 m							
1.6 m							
1.7 m							
1.8 m							
1.9 m							
2.0 m							
2.1 m							
2.2 m							
2.3 m							
2.4 m							
2.5 m		Base of trench					
2.6 m							
2.7 m							
2.8 m							
2.9 m							
3.0 m							

Evaluation:

The proposed location has a shallow cover of fill under which there is relatively compacted sand. level of compaction will reduce rate of soakage.
High watertable will mean a standard septic tank will not suffice.

Likely T value: 20.00

Note: *Depth of percolation test holes should be indicated on log above. (Enter P or T at depts as appropriate).
** See Append`x E for BS 5930 classification.
*** 3 samples to be tested for each horizon and results should be entered above for each horizon.
**** All signs of mottling should be recorded.

3.3(a) Percolation ("T") Test for Deep Subsoils and/or Water Table

Step 1: Test Hole Preparation

Percolation Test Hole	**1**	**2**	**3**
Depth from ground surface to top of hole (mm) (A)	600	600	600
Depth from ground surface to base of hole (mm) (B)	1,000	1,000	1,000
Depth of hole (mm) [B - A]	400	400	400
Dimensions of hole [length x breadth (mm)]	300 x 300	300 x 300	300 x 300

Step 2: Pre-Soaking Test Holes

Date and Time pre-soaking started	09/02/2021		09/02/2021		09/02/2021	

Each hole should be pre-soaked twice before the test is carried out. Each hole should be empty before refilling.

Step 3: Measuring T_{100}

Percolation Test Hole No.	**1**	**2**	**3**
Date of test	10/02/2021	10/02/2021	10/02/2021
Time filled to 400 mm	09:26	09:27	09:28
Time water level at 300 mm	10:01	09:57	10:11
Time to drop 100 mm (T_{100})	35.00	30.00	43.00
Average T_{100}			36.00

If T_{100} > 300 minutes then T-value >90 – site unsuitable for discharge to ground
If $T_{100} \leq$ 210 minutes then go to Step 4;
If T_{100} > 210 minutes then go to Step 5;

Step 4: Standard Method (where $T_{100} \leq 210$ minutes)

Percolation Test Hole	1			2			3		
Fill no.	Start Time (at 300 mm)	Finish Time (at 200 mm)	Δt (min)	Start Time (at 300 mm)	Finish Time (at 200 mm)	Δt (min)	Start Time (at 300 mm)	Finish Time (at 200 mm)	Δt (min)
1	10:01	10:44	43.00	09:57	10:35	38.00	10:11	11:02	51.00
2	10: 44	11:36	52.00	10:35	11:18	43.00	11:02	12:06	64.00
3	11:36	12:33	57.00	11:18	12:03	45.00	12:06	13:19	73.00
Average Δt Value			50.67			42.00			62.67
	Average Δt/4 = [Hole No.1]		12.67 (t_1)	Average Δt/4 = [Hole No.2]		10.50 (t_2)	Average Δt/4 = [Hole No.3]		15.67 (t_3)

Result of Test: T = 12.94 (min/25 mm)

Comments:

Soakage is acceptable

Step 5: Modified Method (where $T_{100} > 210$ minutes)

Percolation Test Hole No.	1				2				3			
Fall of water in hole (mm)	Time Factor $= T_f$	Time of fall (mins) $= T_m$	$K_{fs} = T_f / T_m$	T – Value $= 4.45 / K_{fs}$	Time Factor $= T_f$	Time of fall (mins) $= T_m$	$K_{fs} = T_f / T_m$	T – Value $= 4.45 / K_{fs}$	Time Factor $= T_f$	Time of fall (mins) $= T_m$	$K_{fs} = T_f / T_m$	T – Value $= 4.45 / K_{fs}$
300 - 250	8.1				8.1				8.1			
250 - 200	9.7				9.7				9.7			
200 - 150	11.9				11.9				11.9			
150 - 100	14.1				14.1				14.1			
Average T- Value	T- Value Hole 1= (t_1)			0.00	T- Value Hole 1= (t_2)			0.00	T- Value Hole 1= (t_3)			0.00

Result of Test. T = 0.00 (min/25 mm)

Comments:

3.3(b) Percolation ("P") Test for Shallow Soil / Subsoils and/or Water Table

Step 1: Test Hole Preparation

Percolation Test Hole	1	2	3
Depth from ground surface to top of hole (mm)	0	0	0
Depth from ground surface to base of hole (mm)	400	400.00	400
Depth of hole (mm)	400	400	400
Dimensions of hole [length x breadth (mm)]	300 x 300	300 x 300	300 x 300

Step 2: Pre-Soaking Test Holes

	1		2		3	
Date and Time pre-soaking started	09/02/2021		09/02/2021		09/02/2021	

Each hole should be pre-soaked twice before the test is carried out. Each hole should be empty before refilling.

Step 3: Measuring P_{100}

Percolation Test Hole No.	1	2	3
Date of test	10/02/2021	10/02/2021	10/02/2021
Time filled to 400 mm	09:34	09:35	09:36
Time water level at 300 mm	10:28	10:31	10:34
Time to drop 100 mm (P_{100})	54.00	56.00	58.00
Average P_{100}			56.00

If $P_{100} > 300$ minutes then T-value >90 – site unsuitable for discharge to ground
If $P_{100} \leq 210$ minutes then go to Step 4;
If $P_{100} > 210$ minutes then go to Step 5;

Step 4: Standard Method (where $P_{100} \leq 210$ minutes)

Percolation Test Hole	1			2			3		
Fill no.	Start Time (at 300 mm)	Finish Time (at 200 mm)	Δp (min)	Start Time (at 300 mm)	Finish Time (at 200 mm)	Δp (min)	Start Time (at 300 mm)	Finish Time (at 200 mm)	Δp (min)
1	10:28	11:37	69.00	10:31	11:32	61.00	10:34	11:43	69.00
2	11:37	12:49	72.00	11:32	12:41	69.00	11:43	12:58	75.00
3	12:49	14:07	78.00	12:41	13:57	76.00	12:58	14:22	84.00
Average Δp Value			73.00			68.67			76.00

	Average Δp/4 = [Hole No.1] 18.25 (p_1)	Average Δp/4 = [Hole No.2] 17.17 (p_2)	Average Δp/4 = [Hole No.3] 19.00 (p_3)

Result of Test. P = 18.14 (min/25 mm)

Comments:

Results are are within acceptable range

Step 5: Modified Method (where $P_{100} > 210$ minutes)

Percolation Test Hole No.	1				2				3			
Fall of water in hole (mm)	Time Factor = T_f	Time of fall (mins) = T_m	$K_{fs} = T_f / T_m$	P – Value = 4.45 / K_{fs}	Time Factor = T_f	Time of fall (mins) = T_m	$K_{fs} = T_f / T_m$	P – Value = 4.45 / K_{fs}	Time Factor = T_f	Time of fall (mins) = T_m	$K_{fs} = T_f / T_m$	P – Value = 4.45 / K_{fs}
300 - 250	8.1				8.1				8.1			
250 - 200	9.7				9.7				9.7			
200 - 150	11.9				11.9				11.9			
150 - 100	14.1				14.1				14.1			
Average P- Value	P- Value Hole 1= (p_1)			0.00	P- Value Hole 1= (p_2)			0.00	P- Value Hole 1= (p_3)			0.00

Result of Test: P = 0.00 (min/25 mm)

Comments:

4.0 CONCLUSION of SITE CHARACTERISATION

Integrate the information from the desk study and on-site assessment (i.e. visual assessment, trial hole and percolation tests) above and conclude the type of system(s) that is (are) appropriate. This information is also used to choose the optimum final disposal route of the treated wastewater.

Not Suitable for Development ☐

Suitable for [1]

1. Septic tank system (septic tank and percolation area): No

2. Secondary Treatment System

   a. septic tank and filter system constructed on-site and polishing filter; or: Yes

   b. packaged wastewater treatment system and polishing filter: Yes

Discharge Route

Discharge to Ground Water

5.0 RECOMMENDATION

Propose to install: Packaged wastewater treatment system and polishing filter

and discharge to: Ground Water

Trench Invert level (m):

Site Specific Conditions (e.g. special works, site improvement works testing etc.

It is recommended to install a Package aeration system and to polish the effluent through a soil polishing filter using a pressurised effluent distribution system. The watertable is iat 1.6m bgl. The base of the gravel infiltration layer should be about 400mm bgl. Soil is removed and the area leveled. A layer of 200mm washed gravel is placed on the surface of the prepared area. Distribution system (32mm diameter) is placed on this and covered with100mm gravel. This is covered with geotextile and finished with 200mm soil.
Effluent from the Treatment unit is pumped to the distribution pipework. With a vertical separation of 1.2m this si sufficient to meet requirements for an R2(1) response.

Size of Filter
3-people work on site full-time - Allow 40 litres of wastewater and 25g BOD Further 3 people temporary full time - allow 40 litres and 25 grams each
Up to 5 drivers - allow 5 litres and 10 grams per person
Total volume = (3 x 40) + (3 x 40) + (5 x 5) = 265 litres or a PE of 2
Organic loading = (3 x 25) + (3 x 25) + (5 x 10) = 200 grams of BOD or a PE of 4
The Treatment plant should be designed for at least 4 PE. The hydraulic load can be designed for a PE of 2 but a PE of 4 is used.
As the T-value is less than 20 filter can be loaded at 20 litres/m2. Taking the PE at 4 the equivelent hydraulic load is 600 litres requiring a filter of 30m2. The percolation area should be at least 4m from the road (internal) and 10 m from the office and 3m from all boundaries

[1] note: more than one option may be suitable for a site and this should be recorded

[2] A discharge of sewage effluent to "waters" (definition includes any or any part of any river, stream, lake, canal, reservoir, aquifer, pond, watercourse or other inland waters, whether natural or artificial) will require a licence under the Water Pollution Acts 1977-90. Refer to Section 2.6.2.

6.0 TREATMENT SYSTEM DETAILS

SYSTEM TYPE: Septic Tank System

Tank Capacity (m³)

Percolation Area		**Mounded Percolation Area**	
No. of Trenches		No. of Trenches	
Length of Trenches (m)		Length of Trenches (m)	
Invert Level (m)		Invert Level (m)	

SYSTEMTYPE: Secondary Treatment System

Filter Systems

Media Type	Area (m²)*	Depth of Filter	Invert Level
Sand/Soil			
Soil			
Constructed Wetland			
Other			

Package Treatment Systems

Type: Oakstown BAF

Capacity PE: 6.00

Sizing of Primary Compartment: 3.00 m³

SYSTEM TYPE Tertiary Treatment System

Polishing Filter: Surface Area (m²)* 30.00

or **Gravity Fed:**

No. of Trenches

Length of Trenches (m)

Invert Level (m)

Package Treatment System: Capacity (pe)

Constructed Wetland: Surface Area (m²)*

DISCHARGE ROUTE:

Groundwater ☑ Hydraulic Loading Rate * (l/m².d) 20.00

Surface Water ** ☐ Discharge Rate (m³/hr)

TREATMENT STANDARDS:

Treatment System Performance Standard (mg/l)	BOD	SS	NH_3	Total N	Total P
	20.00	30.00	20.00		

QUALITY ASSURANCE:

Installation & Commissioning

Installation supervised and Certified by qualified assessor or a suitably qualified person familiar with the EPA Code of Practice 2009.

On-going Maintenance

Annual maintenance contract - including desludging

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* Hydrolic loading rate is determined by the percolation rate of subsoil

** Water Pollution Act discharge licence required

7.0 SITE ASSESSOR DETAILS

Company: Trinity Green

Prefix: Dr. First Name: Eugene Surname: Bolton

Address: Clonfert, Maynooth, Co. Kildare

Qualifications/Experience: PhD Microbiology, Site Suitability Assessment Course (FETAC)

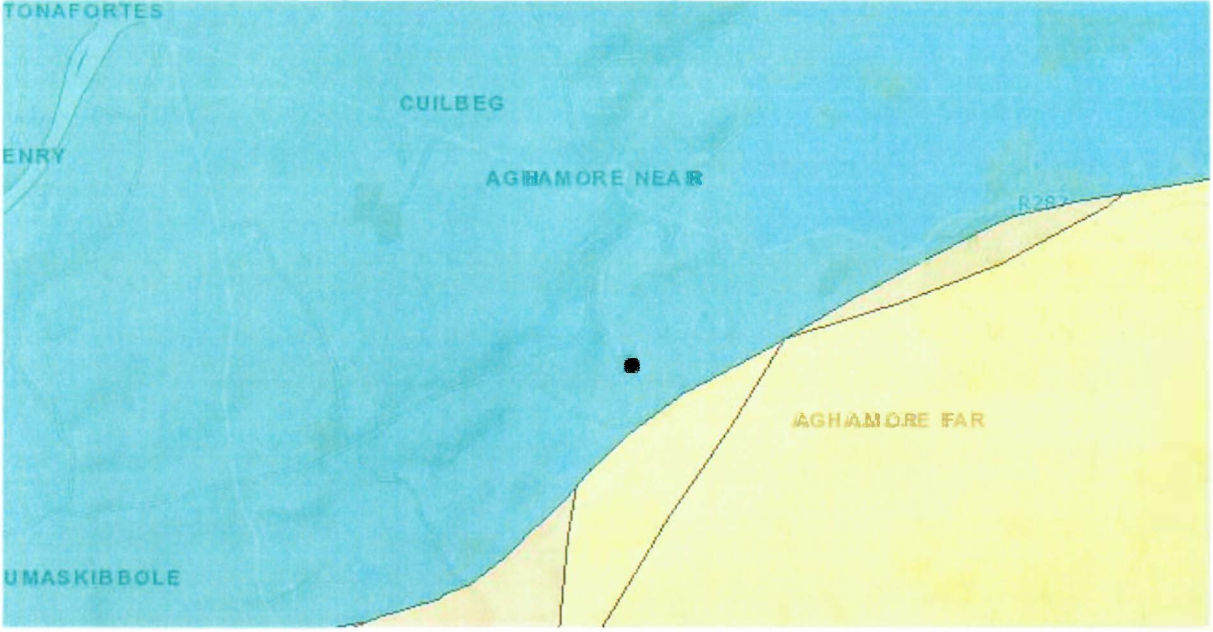
Date of Report: 15/02/2021

Phone: 086 2434828 Fax: e-mail info@trinitygreen.ie

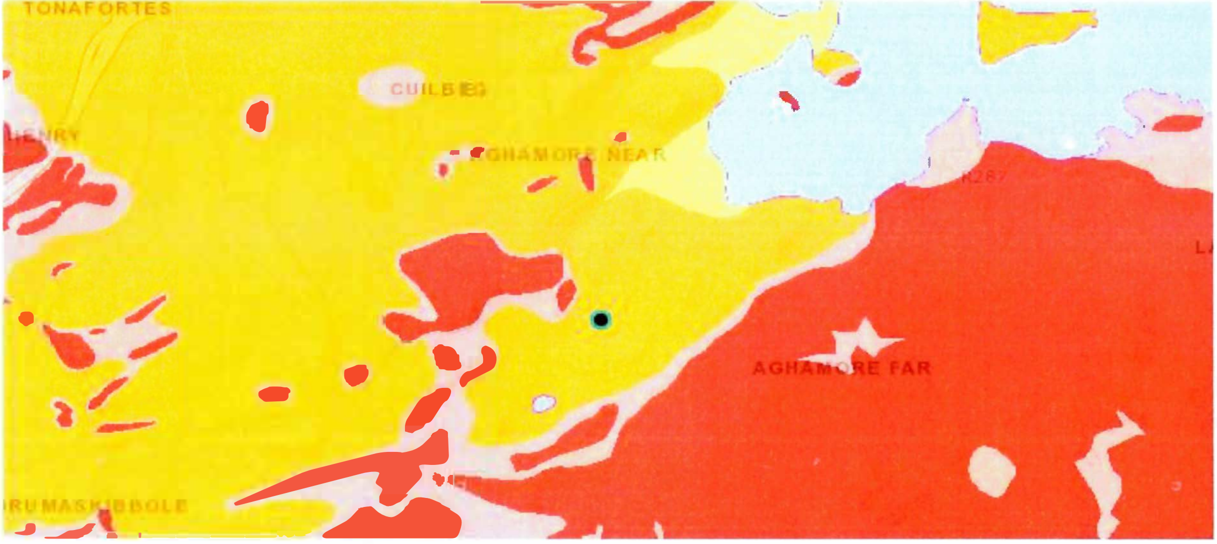
Indemnity Insurance Number: PSE0018 5337

Signature:

Maps – Aquifer, Vulnerability, Berdock



Aquifer is Rkc



Vulnerability is High

Bedrock is Dinantian Pure Bedded Limestones

Photos

Row 1 - P1, P2

Row 2 - P3, T1

Row 3 - T2, T3

Trial Pit

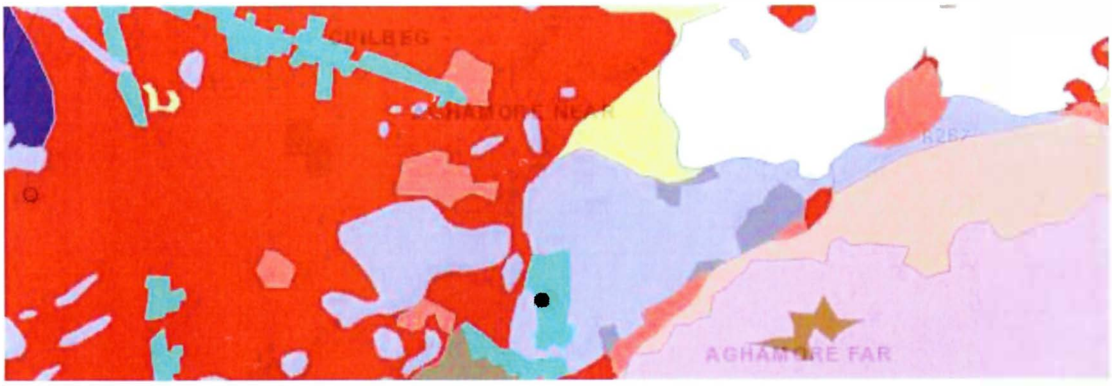

9/2/2021

Excavated Material


9/2/2021

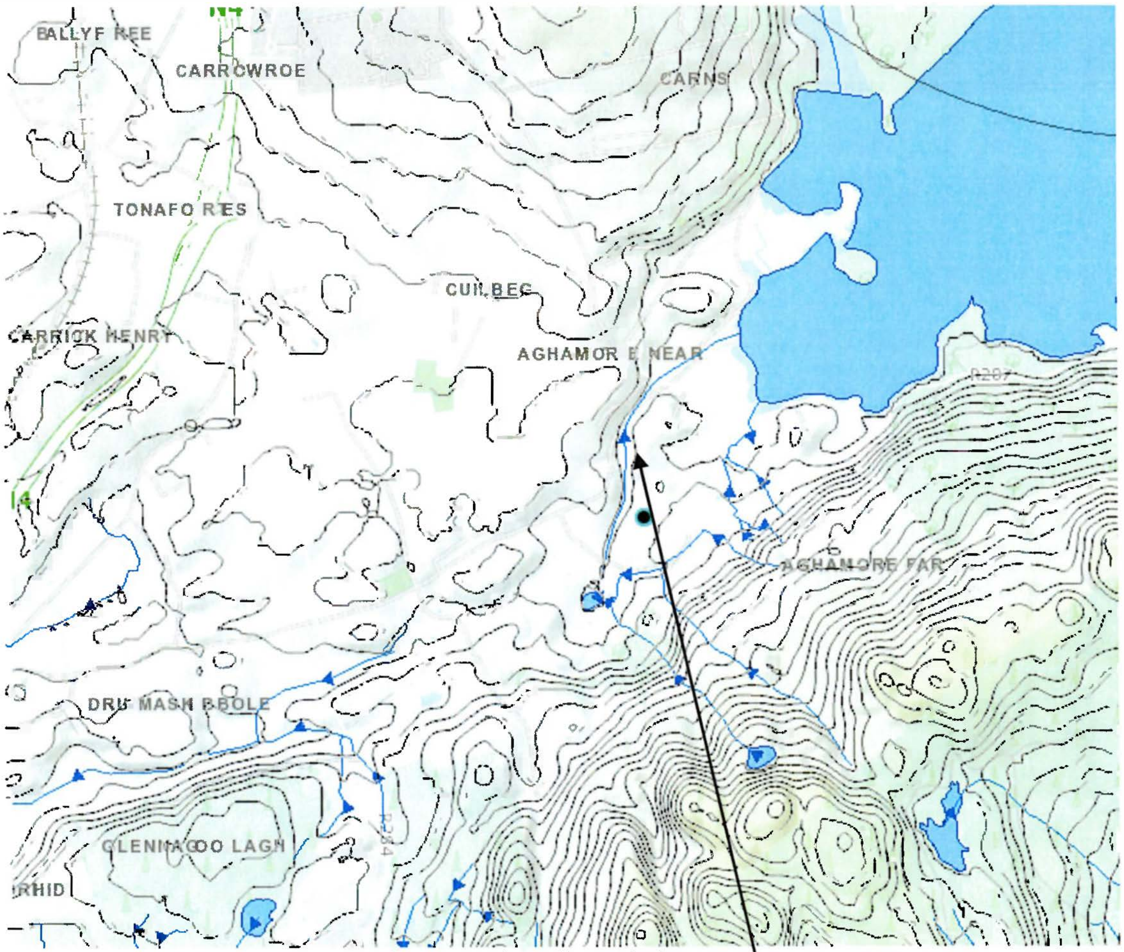
Site overview

Soil



Parent Material	GLs	IFS Soil Description	Derived from mainly calcareous parent materials
Parent Material Name	Glaciofluvial sands and gravels	County	SLIGO
Parent Material Description	Limestone sands and gravels (Carboniferous)	Category	Shallow well drained mineral (Mainly basic)
Soil Group	Rendzinas, Lithosols	Legend	BminSW - Shallow well drained mineral (Mainly basic)
IFS Soil Code	BminSW		

Site Location



Site - Location of Percolation area

Lagan Materials,
Aughamore,
Carraroe,
Co. Sligo

O'Reilly Oakstown Environmental

O'Reilly Oakstown Environmental

Oakstown, Trim
Co. Meath
Tel: 046 - 943 - 1389
Fax: 046 - 943 -7054

E: info@oreillyoakstown.com
W: www.oreillyoakstown.com
V.A.T Reg. No.: IE 6401624D
Company Reg. No.: 381624

Date: 16th February 2021

Applicant Name: Lagan Materials

Site Address: Aughamore, Carraroe, Co. Sligo

The following is the design specification for the Oakstown BAF 6 PE wastewater treatment system.

1. Waste Water Treatment System Design Details:

-Maximum Daily Design Loadings as per client & EPA- Commercial Loading Rates:

	Max No. of users	Flow Litres/day/person	Total Hydraulic Load	BOD5 (grams/day/person)	Total Organic Loading (grams/day)
Workers	6	40	240 litres	25	300
Drivers	5	5	25 litres	10	50
Total			**265 Litres**		**350grams**

- Oakstown BAF 6 PE Maximum Capacity Design Loadings.

Total Organic Loading	0.36kg BOD/day
Total Hydraulic loading	0.9m³ /day

- Typical treated effluent standard.

BOD	20mg/litre
TSS	30mg/litre

- Proposed system details ▶ Oakstown BAF 6P.E.

Volume of Total Plant	6.7m³
Volume of Primary Sedimentation Chambers	2.86m³
Volume of Secondary Aeration Chamber	1.2m³
Volume of Biomedia	0.8m³

O'REILLY
OAKSTOWN
ENVIRONMENTAL

2. Wastewater Treatment system description:

The Oakstown BAF 6 PE is designed to provide proven, cost effective primary and secondary wastewater treatment in robust steel reinforced concrete tanks.
The primary sedimentation chamber has a $2.2m^3$ capacity to allow anaerobic digestion to occur naturally while letting sludge settle on the tank floor.
Once primary treatment has taken place the effluent is further degraded in the aeration chamber where oxygen enriched wastewater provides ideal conditions for aerobic bacteria to thrive.
Before pumping to the main sewer the clear water is left to further settle in the clarifier chamber to eliminate any remaining settlable solids.

3. Guarantee and warrantees:

O'Reilly Oakstown provide a 12 month maintenance service contract on all systems from date of first occupation. We provide a 24 month warranty on all parts.

4. Percolation:

The percolation area designed must conform to the requirements of Chapter 10 or Table 8.1 of EPA Code of Practice 2009 Wastewater Treatment and Disposal System serving single houses.

The percolation area requirements are as follows:
Groundwater Protection Response: R2[1]
T-value: 12.14 as per Site Characterisation Form.
P-value: 18.14 as per Site Characterisation Form.
Depth from ground surface to water table: 1.6m BGL.
Depth from ground surface to bed rock: None Encountered BGL.
Depth from ground surface to mottling: None Encountered BGL.
Area of Soil Polishing filter: $30m^2$.
Soil Polishing Filter must be covered in 25-40mm drainage stone.
Soil Polishing Filter must be covered in geo-textile cover then in topsoil.
► See Site Characterisation report for percolation area details.

O'Reilly Oakstown Environmental

Oakstown, Trim
Co. Meath
Tel: 046 - 943 - 1389
Fax: 046 - 943 - 7054

E: info@oreillyoakstown.com
W. www.oreillyoakstown.com
V.A.T Reg. No.: IE 6401624D
Company Reg. No.: 381624

OAKSTOWN
BAF System

5. Client Responsibilities unless included in our quotation:

- Excavation and backfill.
- Connection to the main sewer as recommended by the site engineer.
- Provision of access for delivery by hi-ab truck to within 1 metre of the excavation.
- Provision of a power ducting from the tanks to the plant room.
- Mounting and connection of control panel to mains power in the plant room.

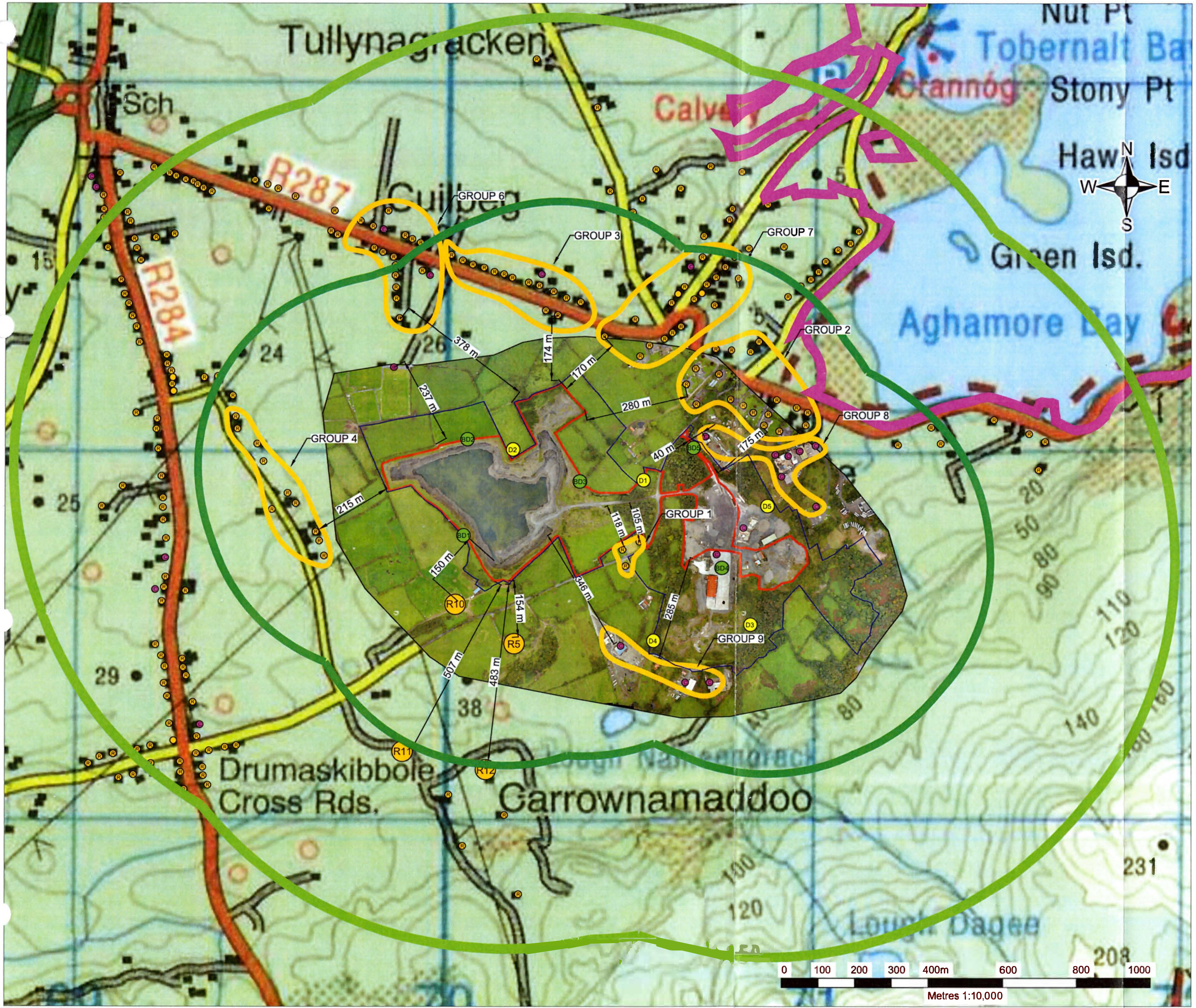
6. Operation and Maintenance:

The client is responsible for the operation and maintenance of the wastewater treatment system in accordance with the owner's manual supplied by O'Reilly Oakstown.

Please do not hesitate to contact us if there are any further queries.

Yours sincerely

Sarah O'Connor



NOTES

1. ORDNANCE SURVEY IRELAND LICENCE NO. CYAL50167032 (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND
2. AERIAL PHOTOGRAPHY CARRIED OUT BY SLR CONSULTING SEPTEMBER 2020

LEGEND

▬	APPLICATION AREA
Ⓡ	RESIDENCE
●	COMMERCIAL
▬	1 KM OFFSET
▬	500 M OFFSET
▬	GROUPS OF RECEPTORS
BD1	BASELINE DUST MONITORING LOCATION (SLR)
D1	BASELINE DUST MONITORING LOCATION (BHP)
▬	LOUGH GILL SAC

SLR

SLR CONSULTING IRELAND
7 DUNDRUM BUSINESS PARK
WINDY ARBOUR
DUBLIN 14
T: +353-1-2964667
F: +353-1-2964676
www.slrconsulting.com

LAGAN MATERIALS LTD.

LIMESTONE QUARRY AND AGGREGATE PROCESSING YARD
AGHAMORE NEAR, AGHAMORE FAR AND
CARROWNAMADDOO TOWNLANDS, CO. SLIGO

LOCAL RECEPTORS AND MONITORING LOCATIONS

FIGURE 8.1

Scale	Date
1:10,000 @ A3	MAY 2021

LAGAN
Part of the Breedon Group

9. Climate

CHAPTER 9

CLIMATE

CONTENTS

TABLES

APPENDICES

FIGURES

INTRODUCTION

Background

9.1 This chapter of the Environmental Impact Assessment Report (EIAR), prepared by SLR Consulting Ireland, provides supporting information to accompany a Planning Application to Sligo County Council by Lagan Materials Ltd. in respect of any potential climate related impacts from the site associated with the planning application area and the wider quarry development at Aghamore Near, Aghamore Far and Carrownamaddoo townlands, Co. Sligo.

9.2 The quarry operations comprise extraction of limestone using blasting techniques; processing (crushing and screening) of the fragmented rock to produce aggregates for road construction, site development works and in the production of asphalt materials.

9.3 Further information on the site infrastructure, operations, environmental management systems, and controls at the quarry site is provided in Chapter 2 of this EIAR.

9.4 Ancillary manufacturing facilities at the site, located adjacent to the processing area, include an asphalt plant.

Scope of Work

9.5 The following sections of this Chapter describe the potential climate change impacts associated with the proposed development. The following issues are addressed separately:

- climate change legislative framework/policy context;
- analysis of evolving environmental baseline trends;
- identifying climate change concerns in relation to proposed development;
- assessing effects (cumulative effects and uncertainty);
- identifying alternatives and mitigation measures;
- identifying monitoring and adaptive management.

Consultations / Consultees

9.6 A number of pre-planning consultation meetings have been held between officials of Sligo County Council and representatives of SLR Consulting Ireland and Lagan Materials Limited.

9.7 At the meetings, details of the proposed development were presented and issues likely to be of interest or concern were identified and discussed.

9.8 Following a review of published development plans and the site survey, it was considered that there was no requirement for any further formal consultations to be carried out in respect of climate for the purposes of this assessment.

Contributors / Author(s)

9.9 SLR Consulting Ireland undertook the impact assessment presented in this chapter on behalf of Lagan Materials Ltd. The lead consultant for the study was Aldona Binchy MSc. Eng PIEMA Environmental Engineering.

Limitations / Difficulties Encountered

9.10 There are currently no published guidelines and established methodology providing specifically for assessment of climate impacts from quarrying activities in Ireland. This Chapter of the EIAR has therefore been prepared on the basis of general cross-sectoral guidance.

ADDITIONAL INFORMATION

9.11 As outlined in Chapter 1, a planning application was submitted to Sligo County Council (Plan File Ref. No. 18/345 / ABP Ref. 305821-19) in August 2018 for similar development to that proposed as part of this application. In October 2019 Sligo County Council granted planning permission for the development (subject to 23 no. conditions). 2 no. third party appeals of the decision by Sligo County Council to grant permission for the proposed quarry development were made to An Bord Pleanala (ABP-305821-19). An Bord Pleanala refused permission for the proposed development on the 30th June 2020 for the 2 no. reasons – refer to Chapter 1 for further details.

9.12 In order to comprehensively address the reasons for refusal, and further comments contained within the An Bord Pleanala Inspectors Report a number of additional surveys / site investigations, field work and assessments have been carried out.

9.13 This Chapter 8 of the EIAR has been updated as follows:

- This assessment takes account of the revised planning application area and considers all activities associated with the revised application area, such as the recommencement of aggregate processing activities;
- The assessment takes account of cumulative impacts.

Legislative Framework/ Policy Context

Adaptation to Climate Change

9.14 The Irish National Policy Position on Climate Action and Low Carbon Development[1] establishes the fundamental national objective of achieving transition to a competitive, low carbon, climate-resilient and environmentally sustainable economy by 2050. It sets out the context for the objective; clarifies the level of greenhouse gas (GHG) mitigation ambition envisaged; and establishes the process to

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[1] https://www.dccae.gov.ie/en-ie/climate-action/publications/Pages/National-Policy-Position.aspx

pursue and achieve the overall objective. Specifically, the National Policy Position envisages that policy development will be guided by a long-term vision based on:

- an aggregate reduction in carbon dioxide (CO2) emissions of at least 80% (compared to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors;
- in parallel, an approach to carbon neutrality in the agriculture and land-use sector, including forestry, which does not compromise capacity for sustainable food production.

9.15 The evolution of climate policy in Ireland will be an iterative process based on the adoption by Government of a series of national plans over the period to 2050. Greenhouse gas mitigation and adaptation to the impacts of climate change are to be addressed in parallel national plans – respectively through National Mitigation Plans and National Climate Change Adaptation Frameworks. The plans will be continually updated, as well as being reviewed on a structured basis at appropriate intervals, and at a minimum, every five years. This will include early identification and ongoing updating of possible transition pathways to 2050 to inform sectoral strategic choices.

9.16 The Climate Action and Low Carbon Development Act 2015[2] was enacted in December 2015. The Act identified and provided for the development and submission to the Government of national mitigation and adaptation plans. It also established the institutional and governance framework within which these plans can be developed and implemented on a cyclical basis.

9.17 The Department of Communications, Climate Action & Environment (DCCAE) published a National Adaptation Framework (NAF) in January 2018[3]. The NAF sets out the national strategy to reduce the vulnerability of the country to the negative effects of climate change and to avail of positive impacts.

9.18 The NAF builds on the work already carried out under the National Climate Change Adaptation Network (NCCAF, 2012). Under the NAF a number of Government Departments will be required to prepare sectoral adaptation plans in relation to a priority area that they are responsible for. Local authorities are required to prepare local adaptation strategies. The NAF also aims to improve the enabling environment for adaptation through ongoing engagement with civil society, the private sector and the research community.

9.19 The production of aggregates was not specifically identified under the NAF to prepare sectoral adaptation plans in line with the requirements of the Climate Action and Low Carbon Development Act.

9.20 The Climate Action Plan 2019[4] sets out the Irish Government's plan to tackle climate breakdown and achieve net zero greenhouse gas emissions by 2050.

9.21 The Plan clearly identifies the nature and scale of the challenge. It outlines the current state of play across key sectors including Electricity, Transport, Built Environment, Industry and Agriculture and charts a course towards ambitious decarbonisation targets. Reflecting the central priority climate change will have in our political and administrative systems into the future, the Plan sets out governance arrangements including carbon-proofing our policies, establishment of carbon budgets, a strengthened Climate Change Advisory Council and greater accountability to the Oireachtas.

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[2] https://www.dccae.gov.ie/en-ie/climate-action/legislation/Pages/Climate-Action-and-Low-Carbon-Development-Act-2015.aspx

[3] https://www.dccae.gov.ie/en-ie/climate-action/topics/adapting-to-climate-change/national-adaptation-framework/Pages/default.aspx

[4] https://www.dccae.gov.ie/en-ie/climate-action/publications/Pages/Climate-Action-Plan.aspx

9.22 This Plan clearly recognises that Ireland must significantly step up its commitments to tackle climate disruption. The leadership role both the Government and public bodies can play in taking early action on climate is fundamental to achieving our decarbonisation goals.

Sectoral Adaptation Plans

9.23 Under the non-statutory 2012 Framework, four Government Departments prepared draft sectoral plans covering 5 sectors. These plans are:

- Sectoral Adaptation Plan for Flood Risk Management (OPW, 2015);
- Adaptation Planning - Developing Resilience to Climate Change in the Irish Agriculture and Forest Sector (DAFM, 2017);
- Adaptation Planning - Developing Resilience to Climate Change in the Irish Transport Sector (DTTAS, 2017);
- Adaptation Plan for the Electricity and Gas Networks Sector (DCCAE, 2017).

9.24 As mentioned previously a number of Government Departments are required develop statutory sectoral adaptation plans under NAF. These are to be prepared in accordance with a six-step adaptation planning process described in the Sectoral Planning Guidelines for Climate Change Adaptation[5]. The guidelines aim to ensure that a coherent and consistent approach to adaptation planning will be adopted by the key sectors in Ireland. The completed plans include actions that:

- Mainstream (integrate) adaptation into key sectoral plans and policies;
- Identify and understand the key vulnerabilities, risks, and opportunities facing their sectors. This should include major cross cutting risks;
- Ensure that plans related to emergencies assigned to a sectoral department as lead Government department under the Strategic Emergency Planning Guidelines are climate proofed;
- Identify and collect information on the costs and benefits of adaptation within their sectors;
- Build capacity within their sectors to cope with climate change;
- Identify and address key research gaps within their sectors;
- Improve co-ordination with the local government sector;
- Develop appropriate monitoring and verification systems within their sectors.

9.25 Sectoral Adaptation Plans have already been published for the following twelve sectors under 7 Government Departments[6]:

- Seafood - Department of Agriculture, Food and the Marine
- Agriculture - Department of Agriculture, Food and the Marine

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[5] https://www.dccae.gov.ie/documents/SPG%20Climate%20Change%20Adaptation.pdf

[6] https://www.dccae.gov.ie/en-ie/climate-action/topics/adapting-to-climate-change/national-adaptation-framework/sectoral-adaptation-planning/Pages/Sectoral.aspx

- Forestry - Department of Agriculture, Food and the Marine
- Biodiversity - Department of Culture, Heritage and the Gaeltacht
- Built and Archaeological Heritage - Department of Culture, Heritage and the Gaeltacht
- Transport infrastructure - Department of Transport, Tourism and Sport
- Electricity and Gas Networks - Department of Communications, Climate Action and Environment
- Communications networks - Department of Communications, Climate Action and Environment
- Flood Risk Management - Office of Public Works
- Water Quality - Department of Housing, Planning and Local Government
- Water Services Infrastructure - Department of Housing, Planning and Local Government
- Health - Department of Health.

Local Level Adaptation

9.26 The National Adaptation Framework (NAF) identifies the critical role to be played by local authorities in addressing climate change adaptation. This will effectively build on their existing expertise and experience as first responders in emergency planning scenarios. Under the NAF each local authority has developed their own adaptation strategies in line with guidelines developed for the sector.

9.27 The NAF explores how local authorities might adopt a joint or regional approach to adaptation planning. In January 2018 the Department of the Environment, Climate and Communications entered into a five-year financial commitment of €10m establishing four Climate Action Regional Offices (CAROs). Building on a business case prepared by the local government sector itself, this commitment recognises the significant obligation which has been placed on local government to develop and implement its own climate action measures, as well as the need to build capacity within the sector to engage effectively with climate change – both in terms of mitigation and adaptation.

9.28 The Climate Action Regional Offices are being operated by a lead local authority in the four different regions that have been grouped together based on a climate risk assessment with a focus on the predominant risk(s) in each geographical area. The establishment of these offices enables a more coordinated engagement across the whole of government and will help build on the experience and expertise which exists across the sector.

9.29 **Table 9-1** summarises the adaptation actions to climate change in Ireland.

Table 9-1
Summary of Adaptation to Climate Change Actions in Ireland[7]

Item	Status	Programs
National Climate Adaptation Strategy	Legislation enacted. Statutory Framework adopted	Climate Action and Low Carbon Development Act 2015 National Adaptation Framework
Action Plans	Sectoral Adaptation Plans published. Local authority plans published.	Local Authority Adaptation Strategy Development Guidelines (2018) Sectoral Planning Guidelines for Climate Change Adaptation (2018) Local Authority Adaptation Support Tool
Impacts, Vulnerability and Adaptation Assessments	National Vulnerability Assessment	2012 National Climate Change Vulnerability Scoping Study Climate Change Impacts on Biodiversity in Ireland (2013) Climate change Impacts on Phenology in Ireland(2013) COCOADAPT (2013) 2013 Hydro Detect Project Robust Adaptation to Climate Change in the Water Sector in Ireland (2013) Ensemble of Regional Climate Projections for Ireland(2015) Urb-ADAPT Sectoral Adaptation Plan for Flood Risk Management (OPW, 2015). Adaptation Planning - Developing Resilience to Climate Change in the Irish Agriculture and Forest Sector (DAFM, 2017) Adaptation Planning - Developing Resilience to Climate Change in the Irish Transport Sector (DTTAS, 2017). Adaptation Plan for the Electricity and Gas Networks Sector (DCCAE, 2017).
Research Programs	EPA Research Programme (Climate Pillar)	http://www.epa.ie
Climate services / Met Office	Established	http://www.met.ie
Web Portal	Established	http://www.climateireland.ie
Monitoring, Indicators, Methodologies	Established	Ensemble of regional climate model projections for Ireland (EPA 2015) http://www.climatecouncil.ie/
Training, Education	Ongoing / in development	http://www.climateireland.ie

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[7] http://climate-adapt.eea.europa.eu/countries-regions/countries/ireland

Green House Gas Emissions

9.30 Ireland is a party to both the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, which together provide an international legal framework for addressing climate change.

9.31 In December 2015, an ambitious new legally binding, global agreement on climate change was agreed in Paris. The Paris Agreement aims to restrict global temperature rise to well below 2°C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5°C. It aims to increase global ability to adapt to the adverse impacts of climate change and to foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten sustainable food production. It also seeks to achieve a balance between anthropogenic emissions by sources, and removals by sinks, of greenhouse gases in the second half of this century.

9.32 The first Irish National Mitigation Plan[8] represents an initial step to set us on a pathway to achieve the level of decarbonisation required. It is a whole-of-Government Plan, reflecting in particular the central roles of the key Ministers responsible for the sectors covered by the Plan – Electricity Generation, the Built Environment, Transport and Agriculture, as well as drawing on the perspectives and responsibilities of a range of other Government Departments.

9.33 The measures that will be implemented through the plan will lay foundations for transitioning Ireland to a low carbon, climate resilient and environmentally sustainable economy by 2050. To support this ongoing work, the Plan also includes over 100 individual actions for various Ministers and public bodies to take forward.

9.34 Emissions reduction measures and actions set out in this National Mitigation Plan are aligned with and build upon commitments made in the 2015 Energy White Paper. The Paper will be guided by the following strategic objectives:

- policy will contribute to reductions in Ireland's greenhouse gas emissions and enhancement of sinks in a manner that achieves the optimum benefits at least cost;
- a stable and predictable policy and regulatory framework will be underpinned by rigorous analysis and appraisal, supported by strong research and analytical capacity;
- the Government will pursue investment, innovation and enterprise opportunities towards building a competitive, low carbon, climate-resilient and environmentally sustainable economy; and
- the citizen and communities will be at the centre of the transition.

Paris Agreement

9.35 The Paris Agreement entered into force on the 4th November 2016[9].

9.36 The Paris Agreement aims to tackle 95% of global emissions through 188 Nationally Determined Contributions (NDCs) which will increase in ambition over time. Ireland's contribution to the Paris Agreement will be via the NDC tabled by the EU on behalf of its Member States. This is a binding target for an overall reduction of at least 40% in greenhouse gas emissions by 2030 (relative to 1990

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[8] https://www.dccae.gov.ie/en-ie/climate-action/topics/national-mitigation-plan/Pages/default.aspx

[9] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

levels). The target will be delivered by the EU by 2030 through reductions in the Emissions Trading Scheme (ETS) and non-ETS sectors of 43% and 30% respectively (relative to 2005).

Kyoto Protocol (2008 – 2012)

9.37 The EPA has overall responsibility for the national greenhouse gas inventory in Ireland's national system, which was established in 2007 under Article 5 of the Kyoto Protocol[10].

9.38 Ireland currently accounts for GHG emissions under the Kyoto Protocol. The Kyoto Protocol required Ireland to limit total national greenhouse gas emissions to 314.2 Mtonnes of CO_{2eq} over the five-year period 2008 – 2012 which is equivalent to 62.8 Mtonnes of CO_{2eq} per annum. The Kyoto Protocol limit is calculated as 13% above Ireland's 1990 baseline value which was established and fixed at 55.61 Mtonnes of CO_{2eq} following an in-depth review of Ireland's 2006 greenhouse gas inventory submission to the UNFCCC.[11]

EU 2020 Targets for non-ETS sector emissions[12]

9.39 Under the EU Commission's Climate and Energy Package, Ireland is required to deliver a 20% reduction in non-ETS greenhouse gas emissions by 2020 (relative to 2005 levels). In addition, Ireland also has binding annual emission limits for the period 2013-2020 to ensure a gradual move towards the 2020 target.

9.40 The non-ETS sectors cover those sectors that are outside the EU Emissions Trading Scheme and includes agriculture, transport, built environment (residential, commercial/institutional), waste and non-energy intensive industry. Member States are permitted to meet their annual targets through a number of mechanisms which include carry forward of a quantity of its annual emission allocation from the following year, use of transfers from other Member States and the limited use of international credits from project activities as long as certain criteria are met.

2015 Energy White Paper

9.41 The White Paper on Energy Policy, Ireland's Transition to a Low Carbon Energy Future 2015-2030[13], published in 2015, sets out a framework to guide energy policy in the period to 2030. The White Paper recognises that a radical transformation of our energy system is required to meet our national, EU and international climate objectives and sets a course for an energy sector where the State will provide the supports that enable consumers to become active energy citizens. It posits a policy approach where our energy system will change from one that is almost exclusively led by Government and utilities to one where individuals and communities are agents of change in the way Ireland generates, transmits, stores, conserves and uses energy. It sets out a vision, a framework and over 90 actions for Irish energy policy up to 2030 as we transition to a low carbon society and economy by 2050.

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[10] http://unfccc.int/kyoto_protocol/items/2830.php

[11] http://unfccc.int/files/national_reports/annex_i_natcom/submitted_natcom/application/pdf/nc6_br1_ire.pdf

[12] https://www.epa.ie/pubs/reports/air/airemissions/GHG_report2014.pdf

[13] https://www.dccae.gov.ie/en-ie/energy/publications/Pages/White-Paper-on-Energy-Policy.aspx

Catchment Flood Risk Assessment and Management (CFRAM) Programme[14]

9.42 The Catchment Flood Risk Assessment and Management (CFRAM) Programme (see www.cfram.ie) is the mechanism established to facilitate future adaptation to climate change. It provides for long-term flood risk management in Ireland and the embedment of flood risk assessment in the future development of capital projects. The future scenario flood maps produced under the CFRAM Programme facilitate this approach, inform other industrial sectors, and provide a valuable resource for local adaptation planning and sustainable land use management and planning.

EIA Directive 2014/52/EU

9.43 Directive 2014/52/EU[15] of the European parliament and of the Council of 16th April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment had to be transposed into national law by 16th May 2017, necessitating changes in laws, regulations, and administrative provisions across a number of legislative codes.

9.44 Key changes introduced in the 2014 Directive (in Annex IV - Information referred to in Article 5(1) – Information for the Environmental Impact Assessment Report) and the national transposing regulations (the European Union (Planning and Development)(Environmental Impact Assessment) Regulations, S.I. No. 296 of 2018) include a requirement for information on the impact of a project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change to be provided in the Environmental Impact Assessment Report.

Guidelines

Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (EC, 2013)[16]

9.45 EU Guidelines provide recommendations how to integrate climate change and biodiversity in Environmental Impact Assessment (EIA). The need for action on climate change and biodiversity loss is recognised across Europe and around the world. The guidelines contain explanation as to why climate change and biodiversity are so important in EIA, present the relevant EU-level policy background, provide advice on how to integrate climate change and biodiversity into selected stages of the EIA process. The annexes provide sources of further reading and links to other relevant information, data, and tools.

Assessing Greenhouse Gas Emissions and Evaluating their Significance (IEMA, 2017)[17]

9.46 IEMA Guidance provides information to assist practitioners with addressing greenhouse gas (GHG) emissions assessment and mitigation in statutory and non-statutory Environmental Impact Assessment (EIA). It complements IEMA's earlier guide on Climate Change Resilience and Adaptation and builds on the Climate Change Mitigation and EIA overarching principles. The requirement to consider this topic has resulted from the 2014 amendment to the EIA Directive.

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[14] https://www.cfram.ie/

[15] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0052

[16] http://ec.europa.eu/environment/eia/pdf/EIA%20Guidance.pdf

[17] https://www.iaia.org/pdf/wab/EIA%20Guide_GHG%20Assessment%20and%20Significance_IEMA_16May17.pdf

Climate Change and Major Projects (EC, 2016)[18]

9.47 This publication provides guidance for assessing vulnerability and risk from Climate Change for major projects funded by the European Regional Development Fund (ERDF) and the Cohesion Fund and listed in the concerned operational programmes.

Sectoral Planning Guidelines for Climate Change Adaptation[19]

9.48 The guidelines aim to ensure that a coherent and consistent approach to adaptation planning is adopted by the key sectors in Ireland. Sectors preparing sectoral adaptation plans under the NAF are required to prepare their plans in line with the process described in these guidelines while also being aware of the overall requirements regarding the development of sectoral adaptation plans.

Local Authority Adaptation Strategy Development Guidelines[20]

9.49 Guidance was produced to provide a consistent and coherent process for local authorities in helping them develop local adaptation strategies and contain information on the process of developing an adaptation strategy:

- provide background information on what adaptation entails and provides the rationale behind implementing a local scale adaptation strategy;
- outline the initial steps required in launching a strategy development process, describing key roles and who can fulfil them, and setting out important factors to consider in the early stages of strategy development;
- explains how to assess the role that weather extremes and periods of climate variability currently play within the local jurisdiction, and it describes why doing so is a fundamental element of working towards a more climate-resilient future;
- moves from the present to the identification of future climate risks, describing a staged risk assessment process and positioning the adaptation strategy within more detailed risk assessments undertaken during shorter term decision-making processes such as statutory plan-making;
- on the basis of the risk assessment process undertaken determination of adaptation goals and objectives and the types of adaptation actions that are available and outlines how each might be identified, assessed, prioritised and implemented is described;
- outlines the steps required to move from a phase of planning to one of implementation, and it explains the importance of monitoring and evaluation in ensuring that the strategy is achieving its anticipated adaptation objectives.

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[18] https://ec.europa.eu/clima/sites/clima/files/docs/major_projects_en.pdf

[19] https://www.dccae.gov.ie/documents/SPG%20Climate%20Change%20Adaptation.pdf

[20] https://www.dccae.gov.ie/documents/LA%20Adaptation%20Guidelines.pdf

RECEIVING ENVIRONMENT

Climate Environmental Baseline

Regional Context

9.50 Observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising sea level are unequivocal evidence of warming of the climate system globally. Global mean temperature has increased by 0.8°C compared with pre-industrial times for land and oceans, and by 1.0°C for land alone. Most of the observed increase in global average temperatures is very likely due to increases in anthropogenic greenhouse gas concentrations.

9.51 In future years, landmasses are expected to warm more than the oceans, and northern, middle and high latitudes. Despite possible reductions in average summer precipitation over much of Europe, precipitation amounts exceeding the 95th percentile are very likely in many areas; thus, episodes of severe flooding may become more frequent despite the general trend towards drier summer conditions. In an ensemble-based approach using outputs from 20 global climate models (GCMs), the Mediterranean, north-east and north-west Europe are identified as warming hot spots but with regional and seasonal variations in the pattern and amplitude of warming.

9.52 Regional climate models (RCMs) also project rising temperatures for Europe until the end of the 21st century, with an accelerated increase in the second half of the century. For precipitation, the larger-scale summer pattern shows a gradient from increases in Northern Scandinavia to decreases in the Mediterranean region. By contrast, increases in wintertime precipitation primarily north of 45°N are a consistent feature of RCM projections over Europe, with decreases over the Mediterranean. Overall, then, there are consistent projections of change for northern and north-west Europe, including Ireland.

9.53 Ireland has a typical maritime climate, with relatively mild and moist winters and cool, cloudy summers. The prevailing winds are south-westerly in direction. The climate is influenced by warm maritime air associated with the Gulf Stream which has the effect of moderating the climate, and results in high average annual humidity across the country. The area of least precipitation is along the eastern seaboard of the country, in the rain shadow of the Leinster uplands.

9.54 Mean seasonal temperature will change across Ireland. A number of studies have applied selected IPCC Special Reports on Emissions Scenarios (SRESs) to model climatic changes across Ireland at a regional scale. Despite the different methods and scenario combinations used, there is agreement in projected changes in temperature for Ireland. However, there are more disparities in the magnitude and sign for the precipitation changes projected for the island.

9.55 **Table 9-2** summarises climate impact projections for Ireland, estimates of projections confidence are derived from published projection data from the Local Authority Adaptation Strategy Development Guidelines.

Table 9-2

Climate Impacts Projections: 30-year overview[21]

Variable	Summary	Confidence	Projected changes
Sea Levels Rise	Strong increase	High	Projections of sea level rise to 2100 suggest a global increase in the range of 0.09-0.88m with a mean value of 0.48. For 2050, it is reasonable to assume a sea level rise in the region of 25 cm above present levels. It should be noted that due to an as yet limited understanding of some of the important effects that contribute to rates of increase, these estimates of sea level rise may prover optimistic , and estimates of up to 4-6 m have been projected by some models.
Storm surge	Strong increase	Medium	An increase in the numbers of intense cyclones and associated strong winds are expected over the north - east Atlantic. By the 2050s, storm surge heights in the range of 50-100cm are expected to increase in frequency for all coastal areas with exception of the southern coast.
Costal Erosion	Moderate increase	Low	Currently approximately 20% of Ireland's coastline is at risk of costal erosion, particularly areas of the south and east coast and also in isolated areas on the west coast. Rates of increase will be determined by local circumstances; however, it is expected that areas of the south-west are likely to experience the largest increase.
Cold Snaps/ Frost	Moderate decrease (winter/night)	High	By mid-century, minimum temperatures during winter are projected to increase by ~2^{0}C in the south-east and ~2.9^{0}C in the north. This change will results in fewer frost days and milder nigh-time temperatures.
Heatwaves	Strong increase (summer)	High	Seven significant heatwaves (defined as 5+ days@>25^{0}C) have been recorded in Ireland over the past 30 years, resulting in approximately 300 excess deaths. By mid-century, a projected increase in summer maximum daily temperature of approximately 2^{0}C will likely intensify heatwaves, with maximum temperatures increasing and heatwave duration lengthening.
Dry Spells	Strong increase (summer)	Medium	There have been seven periods of insignificant rainfall in Ireland in the past 40 years. Of these, the events of 1976 and 1995 were the most severe, averaging 52 and 40 days in duration respectively across Irish rainfall stations. An approximate 20% decrease in summer precipitation receipts in many areas is strongly indicated under a high emissions scenario. This decrease is likely to results in progressively longer periods without significant rainfall, posing potentially severe challenges to water sensitive sectors and regions.
Extreme Rainfall	Strong increase (winter)	Low	Heavy precipitation days (in which more than 20mm of rainfalls) are likely to increase in frequency in winter. By the 2050s an increase in the number of heavy precipitation days of around 20% above the level of 1981-2000 is projected under both low- medium and high emissions scenarios. This may have serious consequences for flood risk in sensitive catchments.
Flooding	Moderate increase (winter)	Low	An Irish Reference Network of hydrometric stations has been established to assess signals of climate charge in Irish hydrology. This network has detected an increasing trend in high river flows since 2000. Projections of future flows are beset by uncertainty at the catchment scale, but a broad signal of wetter winters and drier summers is evident across a number of independent studies.

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[21] Local Authority Adaptation Strategy Development Guideline, EPA 2016: http://www.epa.ie/pubs/reports/research/climate/EPA_Research_Report164.pdf

Variable	Summary	Confidence	Projected changes
Wind Speed	Minor increase (winter)	Medium	Observed wind speed over Ireland has not changed significantly in recent times, but it is anticipated that the distribution of wind will alter slightly in future, with winters marginally winder and summers marginally less so. Though the average wind speed is anticipated to change in only a minor way over the coming decades, the frequency of extreme windstorms is expected to increase due to alternations in the origin and track of tropical cyclones.

Local Context

9.56 The closest weather station to the application site and are considered representative of conditions experienced at the application site is Mullingar Meteorological Station, which is located approximately 100km to the south-east of the application site.

9.57 The moderating influence of the Atlantic Ocean is felt throughout Ireland. The annual mean temperature for different areas in Ireland varies between mountainous regions, lowlands and the coast. Mean daily maximum temperatures are typically between 7.4 to 19.2°C and mean daily minimum temperatures are typically between 1.5 to 11.1°C for the general Mullingar area (refer to **Table 9-3**)

Table 9-3

Average Temperatures Mullingar 1979-2008

TEMPERATURE (DEGREES CELSIUS)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Mean Daily Max	7.4	7.9	9.8	12.1	14.9	17.3	19.2	18.9	16.7	13.2	9.9	7.9	12.9
Mean Daily Min	1.5	1.5	2.8	4.1	6.3	9.2	11.1	10.8	8.9	6.2	3.5	2.2	5.7
Mean Temp.	4.5	4.7	6.3	8.1	10.6	13.2	15.2	14.8	12.8	9.7	6.7	5.0	9.3

9.58 The east of Ireland, which is sheltered from Atlantic frontal systems, is sunnier than the west. The sunniest months are May and June. The mean daily duration recording of sunshine for the area around Mullingar is 3.6 hours. December is the dullest month, with 1.6 hours of mean daily duration. May is the sunniest month, with 5.8 hours of mean daily duration, explained largely by its long days and finer weather.

9.59 Results from the synoptic meteorological station at Mullingar, located approx. 35km north-east of the application site over the period 1990-2010, indicate that the main wind direction is from a west and south-westerly direction, with winds between 200° and 280°. The lowest frequency is for winds blowing from the north and northeast direction.

9.60 A windrose for the wind data recorded at Mullingar station is presented in **Figure 9-1**.

9.61 During the period 1970-2008, the mean monthly total for the year rate of precipitation was 941.3 mm/ year at Mullingar station, with winter months receiving the heaviest amounts. The average rainfall data indicates that the greatest daily total (58.2mm) falls in the month of August (refer to **Table 9-4**).

Table 9-4

Average Precipitation Mullingar (mm) 1979-2008

RAINFALL (MM)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Mean Monthly Total	91.7	72.0	78.3	62.1	68.7	70.5	61.8	80.8	73.8	102.1	82.4	97.1	941.3
Greatest Daily Total	30.3	24.7	29.5	27.6	26.1	52.9	26.6	58.2	42.1	48.8	43.7	38.8	58.2

IMPACT ASSESSMENT

Methodology

9.62 In Ireland some sectors have independently begun the process of identifying key vulnerabilities for their activities. The report by the Irish Academy of Engineering, Ireland at Risk Critical Infrastructure – Adaptation for Climate Change (The Irish Academy of Engineering, 2009) and the report by the Heritage Council and Fáilte Ireland (the National Tourism Development Authority), Climate Change, Heritage and Tourism, Implications for Ireland's Coast and Inland Waterways (ed. Kelly and Stack, 2009) are examples of initiatives of this kind.

9.63 Other research work on adaptation in specific sectors has been carried out or commissioned by other Government Departments/bodies such as the OPW, CoFoRD (programme of competitive forest research for development research programme, etc. (e.g. CLIMADAPT).

9.64 A National Climate Change Vulnerability Scoping Study (Sweeney and Coll, 2012) was undertaken to identify first generation vulnerabilities for Ireland based on a sensitivity analysis across key sectors. The analysis identified a clustering of impacts and their importance in relation to an assessment of likely resilience by sector. The assessment methodology used was an impacts-first, science-first classical approach. The priority sectors identified are biodiversity and fisheries; water resources and the built coastal environment; forestry and agriculture.

9.65 As each sector develops its sectoral adaptation plan (under the Climate Action and Low Carbon Development Act 2015), detailed vulnerability and risk analysis will be required. Some preliminary work has been undertaken on costing the impacts of climate change in Ireland. This is now being supported by more detailed analysis of the current and future costs of flood risk management.

9.66 The implementation of adaptation is being supported by the development of a suite of guidelines, tools and approaches. These include the Local Authority Adaptation Strategy Development Guideline; and the Irish climate information platform “Climate Ireland”, which includes data, information, tools and approaches for local level adaptation decision making. Work is ongoing to develop sectoral decision-making tools and supports.

9.67 The EPA is currently funding a research project called Urb-Adapt which aims to identify the impact of climate change on Dublin city and surrounding towns within the greater Dublin region. The project aims to identify possible risks to the population living in that area and future risks posed to it by the changing climate.

9.68 There are no specific tools developed for assessing climate change for extraction industry. The Climate Change and Major Project guideline on how to make vulnerable investments resilient to climate change provides methodology for undertaking a vulnerability and risk assessment.

9.69 Climate change adaptation and mitigation shall be integrated in the preparation and approval of proposed development. Adaptation seeks to ensure adequate resilience of proposed development to the adverse impacts of climate change based on Vulnerability. Mitigation seeks to reduce the emissions greenhouse.

Development Vulnerability

9.70 The vulnerability of a system (e.g. development) is defined as: "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and 31 extremes. Vulnerability is a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity" (IPCC, 2007).

9.71 Sensitivity in the context of vulnerability assessment is defined as: "the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g. a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g. damages caused by an increase in the frequency of coastal flooding due to sea level rise) (IPCC, 2007).

9.72 Adaptive capacity in the context of vulnerability assessment is defined as: "the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences." (IPCC, 2007).

9.73 The timescale for the project vulnerability assessment shall correspond to the lifespan of the development. During the lifespan, there could be significant changes in frequency and intensity of weather events due to climate change, which should be taken into account. A detailed methodology for the development vulnerability assessment is provided in **Appendix 9- A**.

Greenhouse Gases Emissions

9.74 All projects have the potential to emit greenhouse gas (GHG) emissions to atmosphere during the construction, operational and decommissioning phase of the development. Direct GHG emissions may be caused by operational activities, and project decommissioning. Indirect GHG emissions may be due to increased demand for energy and indirect GHG activities. Indirect GHG activities are linked to the implementation of the proposed project and may include transport, office space heating of buildings or loss of habitats that provide carbon sequestration, (e.g. through land-use change).

9.75 The significance of project's GHG emissions should be based on its net impact, which may be positive or negative. Where GHG emissions cannot be avoided, the significance of a project's emissions shall be reduced by mitigation or project design. Where GHG emissions remain significant but cannot be reduced further approaches to compensate project emissions should be considered.

9.76 Currently in Ireland, there is no set methodology to evaluate significance criteria or a defined threshold for GHG emissions for mineral extraction industry. Due to the inconsistences between the different methods and their assumptions for assessment, there is no single agreed method by which to assess a project carbon budget. The method of assessment varies according to the type and scale of the development.

9.77 Due to a lack of guidelines and an established methodology, the assessment of significance of the GHG emissions is based on whether the development's GHG emissions cumulatively represent a considerable contribution to the global atmosphere and whether the development as continued or extended will replace existing development that would have a higher GHG profile.

9.78 Where the GHG emissions cannot be avoided, the mitigation should aim to reduce the development emissions at all stages.

Assessment

Development Vulnerability

9.79 The aim of the vulnerability assessment is to identify the relevant climate hazards for the project at the foreseen location. Detailed development vulnerability assessment for the proposed development is presented in **Appendix 9-B.**

9.80 Based on the development vulnerability assessment, measures to improve the resilience of the project to extreme rainfall, flood, flash flood, storms, and winds are required.

Greenhouse Gas Emissions

9.81 For the purpose of this assessment, GHG emissions have been calculated for the proposed development based on the potential cumulative annual energy usage for future years.

9.82 The proposed development provides for extraction in line with previously permitted levels, i.e. up to 300,000 tonnes of rock per year. However, it is expected that extraction rates will vary from 150,000 to 300,000 tonnes per annum, depending on market demand. The quarry will use the existing established access and traffic routes.

9.83 Ancillary manufacturing facilities at the site, located adjacent to the processing area, include an asphalt plant.

9.84 Based on a 50-week year, 5.5 days per week, and 24 tonne loads, the above operations will, on a cumulative basis, result in an average of maximum of 164 daily HGV return trips (82 HGVs inward and 82 HGVs outward). It has been assumed that the average distance travelled for one movement will be 50km.

9.85 It is estimated that ca. 3,000l/week of diesel will be consumed to power the generator on site.

9.86 Total cumulative annual GHG emissions for the proposed development are presented in **Table 9-5.**

Table 9-5
GHG Emissions Calculations

Type	Value	Distance Travelled(km)	Conversion factor	Calculated	Total annual CO_2e kg
Traffic (movements)	21450	50	0.71266	1528.6557	-
Energy (Diesel)	144,000l		2.60016	390024	-
TOTAL					391552.6557

9.87 Based on the calculated total of 391552.6557 CO_{2e} kg and a comparison to Ireland's 2018 emissions value of 60.51 MTonnes of CO_{2e}, it is assessed that proposed operations would represent a maximum of just 0. 000647 % of Ireland's annual CO_{2e} emissions for the duration.

9.88 Based on the scale and extent of proposed activities, GHG emissions are assessed as not making a significant contribution to the global atmosphere.

MITIGATION

9.89 Mitigation is designed to increase the resilience of the development, or wider environmental receptors, to climate change and focuses on increasing capacity to absorb climate related shocks.

Project Adaptation against Expected Climate Change Effects

9.90 In the context of climate change, measures to increase the adaptive capacity of the proposed development and disaster risk reduction strategies can be developed with a view to reducing vulnerability and increasing the resilience of the planned development. Significant incidents related to the climate change that affect operation of the proposed development should be recorded for future analysis.

9.91 Based on a development vulnerability assessment (refer to **Appendix 9-B**), measures to improve the resilience of the project to extreme rainfall, flash flood, storms, and winds are required. **Table 9-6** details specific mitigation measures for the proposed development relating to climate change adaptation.

Table 9-6
Mitigation Measures Related to Climate Change Adaptation

Main Concerns Related to:	Proposed Alternatives or Mitigation Measures
Extreme Rainfall, Flood, Flash Flood	Consider design that allows for rising water levels and ground water levels.
	Design adequate project's drainage.
Storms and Winds	Ensure the project design that can withstand increases high winds and storms
	Ensure the choice of equipment working at the project is weather efficient.

Risk Reduction Mechanism	Secure insurance for damage of assets / incidences.

Proposed Reduction of GHG Emissions

9.92 Lagan Materials Ltd shall adopt GHG monitoring programme at the proposed development. Based on the GHG monitoring results Lagan Ltd shall establish short, medium, and long-term objectives and targets for GHG reduction programme and energy management plan.

9.93 **Table 9-7** details specific mitigation measures for the Aghamore Quarry related to GHG reduction programme.

Table 9-7

Mitigation Measures Related to GHG Reduction Programme

Main Concerns Related to:	Proposed Alternatives or Mitigation Measures
Increased demand for energy	Consider using renewable energy sources/ suppliers. Use low carbon construction materials.
Direct GHG emissions	Use energy efficient machine ry/ en ergy
GHG emissions related to transport	Unnecessary equipment/ transport journeys should be avoided by management of transport and travel demands. Equipment should not be left idling.

MONITORING

Project Adaptation against Expected Climate Change Effects

9.94 A framework and set of indicators shall be developed to assess project preparedness for adaptation against climate change. Provision shall be made for a periodic review of plans and the allocation of reporting responsibilities for a regime to measure and evaluate progress on adaptation. This process shall include updates from implementation the adaptation plans on regular basis. Enhancement and monitoring related to projects' predicted impacts with climate change should be set out in an Environmental Management Plan.

GHG Emissions

9.95 Monitor report and review GHG reduction progress.

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10. Noise & Vibration

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CHAPTER 10

NOISE AND VIBRATION

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INTRODUCTION

Background

10.1 This chapter of the Environmental Impact Assessment Report (EIAR), prepared by SLR Consulting Ireland, provides supporting information to accompany a Planning Application to Sligo County Council by Lagan Materials Ltd. It assesses the levels of noise and vibration at the site associated with the planning application area and the wider quarry development at Aghamore Near, Aghamore Far and Carrownamaddoo townlands, Co. Sligo.

10.2 The quarry operations comprise extraction of limestone using blasting techniques; processing (crushing and screening) of the fragmented rock to produce aggregates for road construction, site development works and in the production of asphalt materials.

10.3 Further information on the site infrastructure, operations, environmental management systems, and controls at the established quarry site is provided in the Chapter 2 of this EIAR.

10.4 The proposed development provides for extraction in line with previously permitted levels, i.e. up to 300,000 tonnes of rock per year. However, it is expected that extraction rates will vary from 150,000 to 300,000 tonnes per annum, depending on market demand. The quarry will use the existing established access and traffic routes.

10.5 Ancillary manufacturing facilities at the site, located adjacent to the processing area, include an asphalt plant.

10.6 Based on a 50-week year, 5.5 days per week, cumulative operations at the site will result in an average of maximum of 164 daily HGV return trips (82 HGVs inward and 82 HGVs outward) generated by the proposed development and the existing asphalt plant.

10.7 The noise impact assessment presented herein describes and assesses the existing noise baseline characteristics of the local area. The anticipated effects of the proposed development are then applied to these baseline conditions and the resulting noise impacts assessed. Mitigation measures are identified where necessary to eliminate or minimise adverse impacts, insofar as practical.

10.8 An operational vibration assessment has been undertaken; vibration assessment is based on existing vibration monitoring at the quarry.

10.9 In order to assist the understanding of acoustic terminology and the relative change in noise, a glossary of terms and phrases, which specifically relate to this chapter, is provided in Appendix 10-A.

Scope of Work

10.10 The following sections of this EIAR Chapter describe the potential noise impacts associated with the proposed development, and in order to assess the cumulative impact the existing asphalt plant has been included in the assessment. The following issues are addressed separately:

- methodology used to assess potential impacts from activities at properties (dwellings and farms) and sensitive ecological receptors;
- baseline conditions pertaining to existing background and ambient noise levels around the project site;
- existing vibration levels;

- noise and vibrations impact evaluation criteria;
- prediction of the noise and vibrations levels and identification of potential impacts;
- assessment of severity of impacts, with reference to the evaluation criteria;
- description of mitigation measures that will be incorporated into the design and operation of the scheme to eliminate or minimise the potential for noise and vibrations impact;
- a summary of any residual impacts; and
- monitoring proposals.

Consultations / Consultees

10.11 A number of pre-planning consultation meetings have been held between officials of Sligo County Council and representatives of SLR Consulting Ireland and Lagan Materials Limited.

10.12 At the meetings, details of the proposed development were presented and issues likely to be of interest or concern were identified and discussed.

10.13 Following a review of published development plans and the site survey, it was considered that there was no requirement for any further formal consultations to be carried out in respect of noise and vibrations for the purposes of this assessment.

Contributors / Author(s)

10.14 SLR Consulting Ireland undertook the impact assessment presented in this chapter on behalf of Lagan Ltd. The lead consultant for the study was Aldona Binchy MSc. Eng PIEMA Environmental Engineering.

Limitations / Difficulties Encountered

10.15 This assessment is compiled on the basis of published guidance documents, and site-specific field surveys. No difficulties were encountered in compiling the required information.

ADDITIONAL INFORMATION

10.16 As outlined in Chapter 1, a planning application was submitted to Sligo County Council (Plan File Ref. No. 18/345 / ABP Ref. 305821-19) in August 2018 for similar development to that proposed as part of this application. In October 2019 Sligo County Council granted planning permission for the development (subject to 23 no. conditions). 2 no. third party appeals of the decision by Sligo County Council to grant permission for the proposed quarry development were made to An Bord Pleanala (ABP-305821-19). An Bord Pleanala refused permission for the proposed development on the 30th June 2020 for the 2 no. reasons – refer to Chapter 1 for further details.

10.17 In order to comprehensively address the reasons for refusal, and further comments contained within the An Bord Pleanala Inspectors Report a number of additional surveys / site investigations, field work and assessments have been carried out.

10.18 This Chapter 10 of the EIAR has been updated as follows:

- Additional baseline noise monitoring has been undertaken at the application site;

- This assessment takes account of the revised planning application area and considers all activities associated with the revised application area, such as the recommencement of aggregate processing activities;
- The locations of local receptors have been updated to take account of any new sensitive receptors in the vicinity of the application site since the last application;
- The assessment takes account of cumulative impacts associated with the existing asphalt plant on-site.

REGULATORY BACKGROUND

Noise

10.19 The following sections describe the main legislative policy requirements in respect of noise associated with the proposed development.

10.20 Currently, there is no national or regional legislation which specifically addresses noise and vibrations for the mineral extraction and production of aggregates. However, there are a number of guidance documents that are relevant in the context of noise and vibrations action planning.

Planning Policy and Development Control

National Spatial Strategy (NSS) / National Planning Framework – Project Ireland 2040

10.21 The National Spatial Strategy (NSS) 2002-2020 (published in November 2002) was a 20-year coherent national planning framework for Ireland. It aimed to achieve a better balance of social, economic, and physical development across Ireland, supported by more effective and integrated planning. The strategy emphasised continued strong growth in the Greater Dublin Area (GDA), but with significant improvement in other regions to achieve more balanced regional development. The NSS provided the policy framework for all regional and local plans.

10.22 The National Planning Framework 2040 (published in February 2018) is a national planning framework for Ireland. The framework provides the policies for all regional and local plans. In the framework, the extractive industries are recognised as important for the supply of aggregates and construction materials to variety of sectors. It emphases that the planning process will play a key role in realising the potential of the extractive industries and protecting reserves of aggregates and minerals. Aggregates and minerals will continue to be enabled where this is compatible with protection of the environments.

10.23 The Project Ireland 2040 National Planning Framework does make reference to noise in general terms under section 9.4 *Creating a Clean Environment for a Healthy Society* in acknowledging that noise is unwanted sound but is an inevitable consequence of everyday life and it becomes a problem when it occurs in the incorrect place or at the incorrect time or on a frequent or recurring basis. The National Planning Framework aims to support the following measures:

- ***Noise Management and Action Planning***

  Measures to avoid, mitigate, and minimise or promote the pro-active management of noise, where it is likely to have significant adverse impacts on health and quality of life, through strategic noise mapping, noise action plans and suitable planning conditions.

- ***Noise, Amenity and Privacy***

  This includes but is not limited to, good acoustic design in new developments, in particular residential development, through a variety of measures such as setbacks and separation between noise sources and receptors, good acoustic design of buildings, building orientation, layout, building materials and noise barriers and buffer zones between various uses and thoroughfares.

- ***Quiet Areas***

  The further enjoyment of natural resources, such as our green spaces and sea frontage, through the preservation of low sound levels or a reduction in undesirably high sound levels, is particularly important for providing respite from high levels of urban noise. As part of noise action plans, an extra value placed on these areas, in terms of environmental quality and the consequential positive impact on quality of life and health, due to low sound levels and the absence of noise, can assist in achieving this.

10.24 National Planning Framework Objective 65 on noise states:

"Promote the pro-active management of noise where it is likely to have significant adverse impacts on health and quality of life and support the aims of the Environmental Noise Regulations through national planning guidance and Noise Action Plans."

10.25 There are no specific policies relating to air emissions in the National Planning Framework for extractive industry or related production activities.

10.26 There are no specific policies in relation to noise emissions in NPF for construction aggregates. The general objective is to facilitate the development while at the same time protect the environment.

Local Planning Policy - Sligo County Development Plan 2017-2023

10.27 Sligo County Development Plan 2017-2023 P-NC-1 states that;

"When assessing proposals for activities that are likely to generate significant levels of noise, seek to protect the amenity of dwellings, community facilities and other noise-sensitive developments by ensuring that all new (and where possible existing) developments incorporate appropriate measures to minimise noise nuisance."

Guidelines

British Standard 5228: 2009+A1:2014

10.28 British Standard 5228-1:2009+A:2014 Noise and vibration control on construction and open sites, Part 1: Noise (BS5228) sets out a methodology for predicting noise levels arising from a wide variety of construction and related activities. It can be used to predict noise levels arising from the operations of proposed minerals extraction sites. BS5228 also sets out tables of sound power levels generated by a wide variety of mobile equipment.

10.29 Noise levels generated by site operations and experienced at local receptors will depend upon a number of variables, the most significant of which are:

- the amount of noise generated by plant and equipment being used at the development site, generally expressed as a sound power level;
- the periods of operation of the plant at the development site, known as the "on-time";

- the distance between the noise source and the receptor, known as the “stand-off”;
- the attenuation due to ground absorption or barrier screening effects; and
- any reflections of noise due to the presence of hard vertical faces (ie. walls).

Guidelines for Noise Impact Assessment (IEMA)

10.30 The Guidelines for Noise Impact Assessment produced by the Institute of Environmental Management and Assessment (IEMA) are generally recognised as established good practice standards for scope, content, and methodology of noise impact assessment.

10.31 These guidelines address the key principles of noise impact assessment and are applicable to all development proposals where noise effects are likely to occur. These guidelines state that for any assessment, the noise level threshold and significance should be determined by the assessor, based upon the specific evidence and likely subjective response to noise. An example impact scale offered by the IEMA guidelines is shown in Table 10-1.

Table 10 - 1

Example Impact Scale from the Change in Sound Levels (IEMA)

Long-term Impact Classification	**Short-term Impact Classification**	**Sound Level Change** dB L_{pAeqT} (+ive or -ive) T = either 16hr day or 8hr night
Negligible	Negligible	≥ 0 dB and < 1 dB
	Minor	≥ 1 dB and < 3 dB
Minor	Moderate	≥ 3.0 dB and < 5 dB
Moderate	Major	≥ 5.0 dB and < 10 dB
Major		≥ 10.0

10.32 The criteria above reflect the key benchmarks that relate to human perception of sound. A change of 3dB is generally considered to be the smallest change in environmental noise that is perceptible to the human ear under most normal conditions. A 10dB change in noise represents a doubling or halving of the noise level. The difference between the minimum perceptible change and the doubling or halving of the noise level is split to provide greater definition to the assessment of changes in noise level.

10.33 To determine the overall noise impact, the magnitude and sensitivity Noise Effects Descriptors are presented in Table 10-2.

Table 10 - 2

Noise Effects Descriptors (IEMA)

Very Substantial	Greater than 10 dB L_{Aeq} change in sound level perceived at a highly sensitive noise receptor
Substantial	Greater than 5 dB L_{Aeq} change in sound level at a noise-sensitive receptor, or a 5 to 9.9 dB L_{Aeq} change in sound level at a highly sensitive noise receptor
Moderate	A 3 to 4.9 dB L_{Aeq} change in a sound level at a sensitive or highly sensitive noise receptor, or a greater than 5 dB L_{Aeq} change in sound level at a receptor of some sensitivity

Slight	A 3 to 4.9 dB L_{Aeq} change in a sound level at a receptor of some sensitivity
None / Not Significant	Less than 2.9 dB L_{Aeq} change in sound level and/or all receptors of negligible sensitivity to noise or marginal to the zone of the influence of the proposed development

10.34 As recognised in the IEMA guidance, there are however many factors which affect people's perception and their responses to noise. Guidance on assessment of the magnitude of noise impact and the significance of the effects are presented in Table 10-3.

Table 10 - 3

Relationship between Noise Impact, Effect and Significance (IEMA)

Magnitude (Nature Of Impact)		**Description Of Effect** (On A Specific Sensitive Receptor)	**Significance**
Substantial	Beneficial	Receptor Perception = Marked Change Causes a material change in behaviour and/ or attitude, e.g. individuals begin to engage in activities previously avoided due to preceding environmental noise conditions. Quality of life enhanced due to change in character of the area.	More Likely to be Significant (Greater justification needed- based on impact magnitude and receptor sensitivities- to justify a non-significant effect) ↕ (Greater justification needed- based on impact magnitude and receptor sensitivities- to justify a significant effect) Less Likely to be Significant
Moderate		Receptor Perception = Noticeable Improvement Improved noise climate resulting in small change in behaviour and/or attitude, e.g. turning down volume of television; speaking more quietly; opening windows. Affects the character of the area such that there is a perceived change in the quality of life.	
Slight		Receptor Perception = Just Noticeable Improvement Noise impact can be heard, but does not result in any change in behaviour or attitude. Can slightly affect character of the area but not such that there is a perceived change in quality of life.	
Negligible		N/A = no discernible effect on receptor	Not Significant
Slight	Adverse	Receptor Perception = Non-intrusive Noise impact can be heard, but does not cause change in behaviour or attitude, e.g. turning up volume of television, speaking more loudly; closing windows. Can slightly affect the character of the area but not such that there is a perceived change in the quality of life.	Less Likely to be Significant Greater justification needed- based on impact magnitude and receptor sensitivities- to justify a significant effect) ↕ Greater justification needed- based on impact magnitude and receptor sensitivities- to justify a non-significant effect) More Likely to be Significant
Moderate		Receptor Perception = Intrusive Noise impact can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; closing windows. Potential for non-awaking sleep disturbance. Affects the character of area such that there is a perceived change in the quality of life.	
Substantial		Receptor perception = Disruptive Causes material change in behaviour and /or attitude, e.g. avoiding certain activities during periods of intrusion. Potential for sleep disturbance resulting in getting to sleep, premature awakening, and difficulty in getting back to sleep. Quality of life diminished due to change in character of area.	
Severe		Receptor Perception = Physically Harmful Significant Changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or psychological effects, e.g. regular sleep deprivation / awakening ; loss of appetite, significant , medically definable harm, e.g. auditory and non-auditory.	Significant

Design Manual for Roads and Bridges

10.35 The Design Manual for Roads and Bridges (DMRB) considers the following criterion to determine 'affected roads' which have the potential to impact at surrounding receptors:

- road alignment will change by 5m or more;

- daily traffic flows will change by 1,000 Annual Average Daily Traffic (AADT) or more;
- Heavy Duty Vehicle (HDV) flows will change by 200 AADT or more;
- daily average speed will change by 10km/hour or more; or
- peak hour speed will change by 20km/hour or more.

AQTAG09 - Guidance on Effects of Industrial Noise on Wildlife

10.36 AQTAG09 (Air Quality Technical Advisory Group 09) guidance provides guidance to assist planning and/or licensing officials handling pollution prevention and control applications for industrial installations on relevant noise emissions and relates these to the requirements of the Habitats Regulations.

10.37 The Habitats Directive (92/43/EEC) specifies that, where specific noise from industry, measured at the habitat / nest site is below the levels in Table 10-4, it is considered unlikely that it will have an adverse impact on designated species. Where noise levels are exceeded further, assessment that is more detailed will be required.

Table 10 - 4

Specific Noise Levels at Habitat / Nest Site

Parameter	Noise Level, DB
$L_{Amax,F}$	80
$L_{Aeq,1hr}$	55

Noise and Human Health

10.38 Environmental noise exposure response relationships and thresholds for health endpoints for industry are not available at European or Irish level in legislation or guidelines.

10.39 The proposed quarry operations noise would differ significantly from what is considered "environmental noise" in the WHO guidelines and quarry operations noise would not be considered to be continuous long-term exposure as most of the proposed operations are intermittent and daytime only.

WHO Environmental Noise Guidelines

10.40 World Health Organisation (WHO) Europe have produced the WHO Environmental Noise Guidelines 2018 for the European Region as a regional update to the WHO Community Noise Guidelines. The Guidelines include a review of evidence on the health effects of environmental noise to incorporate significant research carried out in recent years. The guidelines provide recommendation for protecting human health from exposure to environmental noise from various sources. The guidelines assess several environmental noise sources such as aircraft, rail, road, wind turbines and leisure noise.

10.41 The 2002 EU Directive introduced annual average indicators of noise exposure (Lden and Lnight) as long-term exposure indicators, which differ from those used in the earlier WHO Guidelines for Community Noise (1999).

Vibrations

10.42 Currently, there is no regional or local legislation relating to the extraction of rock and vibrations. There are a number of guidance documents that are relevant in the context of vibration action planning and these are outlined below.

Quarries and Ancillary Activities

10.43 EPA Guidance on Quarries and Ancillary Activities suggest limit values for groundborne vibrations and air overpressure:

Groundborne vibration

Peak particle velocity = 12 mm per second, measured in any of the three mutually orthogonal directions at the receiving location (for vibration with a frequency of less than 40 hertz).

Air overpressure

125 dB (Linear maximum peak value), with a 95 % confidence limit. Any blasting will be restricted to normal hours (e.g. 11:00 -17:00 hrs Monday to Friday). Advance notification of blasting will be provided to nearby residents within 600m through use of written notes, signage at site entrance, telephone, or warning sirens or a combination of these methods.

10.44 The DoEHLG (2004) Guidelines for Planning Authorities (Quarries and Ancillary Activities: Guidelines for Planning Authorities, DoEHLG 2004) suggest similar limit values.

British Standard 6472:2008

10.45 British Standard 6472:2008 Guide to Evaluation of Human Exposure to Vibration in Buildings gives guidance on human exposure to blasting induced vibration in buildings. It is applicable to blasting associated with rock extraction.

10.46 BS6472 gives details of the maximum satisfactory magnitudes of vibration for residential properties which is shown in Table 10-5. This table relates to the magnitude of vibration below which the probability of adverse comment is low.

Table 10 - 5

Maximum Satisfactory Magnitudes of Vibration with Respect to Human Response for Up to Three Blasting Events per Day

Place	Time	Satisfactory magnitude (peak particle velocity, mm/sec)
Residential	Day (08.00 – 18.00 M to F) (08.00 – 13.00 Sat)	6.0 to 10.0
	Night	2.0
	Other Times	4.5
Offices	Any Time	14.0
Workshops	Any Time	14.0

British Standard 7385-2:1990

10.47 British Standard 7385-2:1990 Evaluation and Measurement for Vibration in Buildings – Part 2: Guide to Damage Levels from Groundborne Vibration gives guidance on vibration limits to prevent building damage. It is applicable to blasting associated with rock extraction.

10.48 The damage threshold criteria provided in BS7385 are based on systematic studies using a carefully controlled vibration source in the vicinity of buildings. Vibration limits for transient vibrations (such as those associated with blasting operations) above which cosmetic damage could occur are provided in Table 10-6 below.

Table 10 - 6
Transient Vibration Guide Values for Cosmetic Damage

Type of Building	PPV (mm/Sec) 4 To 15 Hz	PPV (mm/Sec) 15 Hz And Above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/sec	50 mm/sec
Unreinforced or light framed structures Residential or light commercial buildings.	15 mm/sec at 4Hz increasing to 20 mm/sec at 15 Hz	20 mm/sec at 15Hz increasing to 50 mm/sec at 40 Hz and above.

10.49 The definition of "cosmetic damage" is the formation of hairline cracks or the growth of existing cracks in plaster, dry wall surfaces, or mortar joints. BS7385-2 notes that the probability of damage tends towards zero at 12.5mm/sec peak component particle velocity.

RECEIVING ENVIRONMENT

Study Area

10.50 The application site is located in the townlands of Aghamore Near, Aghamore Far and Carrownamaddoo, County Sligo approximately 3.5km south of Sligo and 1.5km east of the N4 Road.

10.51 The application area forms the existing quarry area, along with the associated processing area located on the eastern site of the local road that bisects the application site. Material extracted from the quarry area will be processed within the quarry void using mobile processing plant and transported to the processing area for further processing using mobile plant and stockpiling, pending transport off-site.

10.52 The quarry area is surrounded by agricultural lands. The application site is not subject to any statutory or non-statutory nature conservation designations. Dwellings in the vicinity of application site are generally located along the local road network, both as isolated farmhouse structures or in small clusters. The nearest dwellings to the landholding site boundary are identified on Figure 10-1.

Baseline Study Methodology

Noise

10.53 Environmental noise surveys were carried out to capture typical background noise levels at the noise-sensitive receptors closest to the application site. The methodology of the surveys and the results are set out below. The weather conditions during the survey periods were acceptable for noise monitoring, being generally dry with little or no wind. The baseline noise surveys were carried out by SLR.

10.54 The baseline noise measurements were taken using a Type 1 sound level meter (Larson Davis 831 SLM). The sound level meter was calibrated before the measurements, and its calibration checked after by the operator. No calibration drifts were found to have occurred during surveys. All noise equipment had been calibrated to a traceable standard by UKAS (United Kingdom Accreditation Service) accredited laboratories within 12 months preceding the surveys.

10.55 At the measurement positions, the following noise level indices were recorded:

- LAeq,T is the A-weighted equivalent continuous noise level over the measurement period, and effectively represents an "average" value.
- LA90,T is the A-weighted noise level exceeded for 90% of the measurement period. This parameter is often used to describe the background noise.
- LA10,T is the A-weighted noise level exceeded for 10% of the measurement period. This parameter is often used to describe traffic noise.

10.56 Environmental baseline noise surveys were undertaken by SLR staff at the nearest noise sensitive receptors to the application site on 26th February 2018, 26th August 2020 and 29th September 2020. The weather conditions were favourable, with no winds (<5m/s). Noise measurements were undertaken over four, non-consecutive, 15-minute periods and over 1 hr periods during the daytime (07:00 to 19:00). The monitoring periods chosen are considered to give representative daytime noise levels at each noise sensitive location.

10.57 During the surveys, the sound level meter was located in free-field conditions (i.e. at least 3.5m from the nearest vertical reflecting surface, with the microphone approximately 1.5m above ground level).

10.58 All noise levels are recorded in 'A-weighted' decibels, dB(A). A-weighting is the process by which noise levels are corrected to account for the non-linear frequency response of the human ear. All noise levels are quoted in dB(A) relative to a sound pressure of 20 Pa.

Vibrations

10.59 At the quarry vibration monitoring was previously carried out at each blasting event.

10.60 During each blasting event at the quarry both Ground Vibration and Air Blast (Air Overpressure) were monitored at a minimum at one sensitive location (i.e. the location nearest to the blast).

Sources of Information

10.61 Baseline information was gathered through a combination of desk-based study, site visit, and technical assessments consistent with current standard methodologies and published best practice guidelines, in order to provide relevant data to allow an assessment of likely significant effects of the proposed development on sensitive receptors within the zone of influence.

Field Survey / Monitoring

Noise

10.62 The noise monitoring locations used for the purposes of the baseline noise survey, shown in Figure 10-1, comprise the following:

BN1	at residences closest to the south eastern boundary;
BN2	at the residences closest to north eastern boundary;

- BN3 at the residences closest to northern boundary;
- BN4 at the residences closest to western boundary;
- BN5 at the residences closest to south western boundary;
- BN6 at the residences to north east of the processing yard.

10.63 Noise monitoring results for the baseline survey on are provided in Table 10-8; logarithmic average LAeq values are provided in Table 10-9.

10.64 The following observations are made in respect of the baseline noise monitoring undertaken around the application site:

- Measured baseline noise levels at monitoring point BN1 were mainly dominated by road traffic noise on the adjoining local road, sheep noises when traffic abated;
- Measured baseline noise levels at BN2 were mainly dominated by road traffic noise on the adjoining local road, traffic on the R287 and vans pulling in and out of an ESB office;
- Measured baseline noise levels at BN3 were mainly dominated by heavy road traffic noise along the R287;
- Measured baseline noise levels at BN4 were mainly dominated by road traffic noise along the R284, dogs barking at residence and children playing;
- Measured baseline noise levels at monitoring point BN5 were mainly dominated by road traffic noise on the adjoining local road.
- Measured baseline noise levels at monitoring point BN6 were mainly dominated by road traffic noise on the adjoining local road.

Table 10 - 7
Summary of Measured Noise Levels, Free Field dB

Date	Location	$L_{Aeq,T}$(dB)	$L_{A10,T}$(dB)	$L_{A90,T}$(dB)
26/02/2018	BN1	49	42	31
26/02/2018	BN1	56	49	32
26/02/2018	BN1	51	44	30
26/02/2018	BN1	54	45	29
26/02/2018	BN2	56	51	40
26/02/2018	BN2	56	48	39
26/02/2018	BN2	53	47	38
26/02/2018	BN2	54	45	37
26/02/2018	BN3	73	75	42
26/02/2018	BN3	70	70	40
26/02/2018	BN3	74	76	43
26/02/2018	BN3	74	77	44
26/02/2018	BN4	48	45	37
26/02/2018	BN4	49	44	36
26/02/2018	BN4	42	44	35
26/02/2018	BN4	57	51	33
26/02/2018	BN5	59	49	37

Date	Location	$L_{Aeq,T}$(dB)	$L_{A10,T}$(dB)	$L_{A90,T}$(dB)
26/02/2018	BN5	58	50	37
26/02/2018	BN5	63	57	33
26/02/2018	BN5	63	51	27
26/08/2020	BN1	54	45	35
29/09/2020	BN2	59	54	38
26/08/2020	BN3	69	69	43
29/09/2020	BN4	49	49	41
26/08/2020	BN5	59	57	33
29/09/2020	BN6	64	61	35

Table 10 - 8

Summary of Measured Noise Levels, Free Field dB (Average Values)

Location	Receptors effected	Period	$L_{AeqAVGE}$
BN1	R Group 1, R Group 9	Daytime	53
BN2	R Group 2, R Group 7	Daytime	56
BN3	R Group 3, R Group 6	Daytime	72
BN4	R Group 4	Daytime	51
BN5	R5, R10, R11, R12	Daytime	60
BN6	R Group 8	Daytime	64

10.65 Table 10-8 provides detail of the closest receptors affected by the noise emissions from the activities around at the application site in relation to the noise monitoring locations.

Vibrations

10.66 Historical blasting operations at the Aghamore Quarry have been monitored at neighbouring residences.

10.67 Blast monitoring results for Aghamore Quarry are provided in Table 10-9.

Table 10 - 9

Blast Monitoring Results

Date	Location	PPV (mm/sec)	Air Overpressure (dBL)
15/03/2010	Rooney	0.9	119
15/03/2010	Moran	1.9	-
28/04/2010	Rooney	0.6	123
28/04/2010	Moran	1.6	112
17/05/2010	Rooney	0.51	121
17/05/2010	Scanlons	<0.5	<125
08/06/2010	Rooney	2.4	112
08/06/2010	Hughes	0.3	114
08/06/2010	Moran	1	114
06/08/2010	Kelly	1.08	112
06/08/2010	Rooney	1.4	115
08/09/2010	House at Crossroads	2.15	107
08/09/2010	Mullanes	1.5	109
08/09/2010	Rooney	1.5	119
13/10/2010	Rooney	1.46	118

Date	Location	PPV (mm/sec)	Air Overpressure (dBL)
24/11/2010	Rooney	3.7	115
24/11/2010	Moran	0.6	121
23/01/2012	Location 1	4.57	124
23/01/2012	Location 2	<0.5	<125
15/06/2012	Location 1	4.7	125
15/06/2012	Location 2	5.5	108
06/07/2012	Location 1	2.7	122
06/07/2012	Location 2	1.4	116
13/08/2012	Location 1	2.3	114
13/08/2012	Location 2	0.5	101
31/08/2012	Location 1	0.7	109
31/08/2012	Location 2	5.72	125.8
26/10/2012	Location 1	1.2	122
26/10/2012	Location 2	1.5	111
29/01/2013	Location 1	<0.5	<125
27/02/2013	Location 1	4.3	111
27/02/2013	Location 2	1.3	114
14/03/2013	Location 1	1.8	118
14/03/2013	Location 2	1.3	117
24/04/2013	Location 1	3.4	112
24/04/2013	Location 2	3.8	106
02/10/2013	Location 1	5.3	118
02/10/2013	Location 2	1.7	111
14/01/2014	Location 1	7.3	123
14/01/2014	Location 2	3.2	118
10/03/2014	Location 1	2.9	114.4
10/03/2014	Location 2	6.3	116.7

10.68 All the levels recorded are within the threshold limits.

Sensitive Receptors

Human

10.69 Sensitive locations are those where people may be exposed to noise from the existing or planned activities. The closest receptors to the application site have been identified (refer to Figure 10-1). This is a cautious approach, as noise generating activities are located at greater distances within the site. The relevant receptors are listed in Table 10-10 and their locations are shown in Figure 10-1.

10.70 There are 12 sensitive receptors identified within the 500 m study area of the application site. A summary of the closest sensitive receptors in each direction surrounding the planning application area and their respective proximity to the nearest noise generating activity within the site is presented in Table 10-10 below.

Table 10 - 10
Noise Sensitive Receptors within 500m

Receptor Reference	Receptor	Sensitivity	Distance (m) / Direction from quarry activities	Distance (m) / Direction from yard activities
R Grou p1	Residential	Medium	10 5(SE)	17 0(SW)
RGrou p2	Residential	Medium	28 0(NE)	18 0(NE)
R Group 3	Residential	Medium	174(N)	650(NW)
R Grou p4	Residential	Medium	215(W)	1000(W)
R5	Residential	Medium	15 4(S)	60 0(SW)
R Grou p6	Residential	Medium	37 8(NW)	1010 (NW)
R Group 7	Residential	Medium	170(NE)	450(N)
R Grou p8	Residential/ Farm	Medium	177(E)	190(N)
R Grou p9	Residential	Medium	34 6(SE)	2 85(S)
R10	Residential	Medium	404 (SW)	7 60(SW)
R11	Residential	Medium	507 (S)	1000(SW)
R12	Residential	Medium	483(S)	1000(SW)

Ecological

10.71 The application site is not subject to any statutory nature conservation designation. Ecological receptors of concern are those areas designated under EU Habitats Directive (92/43/EEC).

10.72 Based on the nature, size and scale of the planned operations, it is considered that the maximum distance for which the project should be evaluated in terms of Natura 2000 sites is up to a maximum radius of 2km from the application site, unless, there are any potential source-pathway-receptor links between it and any Natura 2000 site(s) beyond this distance.

10.73 There is one Natura 2000 site within a 2km radius of the project site at Aghamore, this site is listed in Table 10-11.

Table 10 - 11
Natura 2000 Site within a 2km of the Proposed Project Site

Natura 2000 site	Site code	Location at closest point to project site (m)
Lough Gill SAC	001976	365

10.74 At a distance of 365m, Lough Gill SAC lies within the potential zone of influence of the proposed development. They have therefore deemed as relevant and have been screened-in as part of this assessment.

IMPACT ASSESSMENT

Noise

10.75 To determine the noise impact at the site, SLR Consulting Ireland carried out a noise prediction assessment, whereby the levels of noise were calculated at the nearest noise sensitive receptors (residences) shown on Figure 10-1. The operational LAr, 1hr noise predictions at each receptor location are based on the prediction noise assessment methodology used was based on BS5228:

Part 1 (2009) + A1:2014 "Code of Practice for Noise and Vibration Control on Construction and Open Sites''.

10.76 For the purposes of this impact assessment, no reduction has been adopted for noise screening around the application site for the soil stripping berms construction and pit restoration.

10.77 A reduction of -15dB(A) has been adopted for full noise screening by constructed perimeter berms around the application site. In all likelihood, the actual reduction will be greater and further noise attenuation will be provided by the high quarry pit faces and proposed vegetation planting.

10.78 On the basis of EPA (2006) Guidance on Quarries and Ancillary Activities and DoEHLG (2004) Guidelines for Planning Authorities noise limit, applied to the nearest noise-sensitive receptors, an absolute limit of 55dB LAeq,1hr during the daytime (07:00 to 18:00 hours) have been adopted for the normal daytime operations. The limit of 70dB LAeq, 1hr for periods of up to eight weeks in any working year at the noise-sensitive receptors have been adopted for the temporary site set up activities of temporary works with long term environmental benefits.

10.79 For the purposes of this assessment, it is assumed that all of the noise sources are active for 100% of the time, at the distances stated during the working hours of the development and the attenuation distance to the selected receptors is calculated from the operational plant area. In addition, in order to assess the cumulative impact from the development the existing asphalt plant has been taken into account in the assessment.

10.80 On this basis, it is considered that the noise impact assessment presented herein is conservative and represents a worst-case scenario. Detailed noise assessment calculations are provided in Appendix 10-B.

10.81 The noise sources listed in Table 10-12 have been considered in the noise assessment for the proposed operations:

Table 10 - 12

Noise Sources

Plant	Octave Band Sound Pressure Levels @ 10m, Hz								LAeq@10m
	63	125	250	500	1k	2k	4k	8k	
Excavator	82	82	71	73	69	67	66	58	76
Crusher	91	91	88	87	85	83	78	68	90
HGV	77	77	76	72	71	69	64	54	76
Drill Rig	79	75	73	74	77	77	75	70	83
Asphalt Plant	79	75	73	74	77	77	75	70	83

10.82 The plant and equipment used at the quarry will not generate impulsive or tonal noise; no penalty was added to the predicted operational $L_{Ar,\ 1hr}$ noise level for presence of tonal or impulsive elements or prediction of resultant noise level at each receptor.

Impact Assessment

10.83 The noise prediction / assessment was undertaken to calculate the level of noise arising from the site activity at the nearest sensitive receptors shown on Figure 10-1. Detailed noise assessment calculations are provided in Appendix 10-B.

10.84 Within the planning application boundary, an area of 10.9 hectares has been used for the extraction of limestone and therefore has been completely stripped of overburden and topsoil material.

10.85 No further stripping of topsoil or overburden materials will be carried out within the application area.

10.86 The application area forms the existing quarry area, along with the associated processing area located on the eastern site of the local road that bisects the application site. Material extracted from the quarry area will be processed within the quarry void using mobile processing plant and transported to the processing area for further processing using mobile plant and stockpiling, pending transport off-site.

Stone Extraction, Processing & Ancillary Manufacturing Activities

10.87 The following noise sources have been considered in the noise assessment for the facility operations:

- Excavator;
- Crusher;
- HGV;
- Drilling Rig;
- Asphalt Plant.

10.88 For the purposes of the noise assessment, it is assumed that all the equipment will be used continuously on-site at all time during working hours.

10.89 It is considered that the noise assessment presented herein is very conservative and represents a worst-case scenario.

10.90 A noise prediction assessment was undertaken to calculate the level of noise arising from the proposed activities at the nearest sensitive receptors, shown on Figure 10-1. Detailed noise assessment calculations are provided in Appendix 10-B.

10.91 The operational LAr, 1hr noise prediction for each receptor location is presented in Table 10-14 below. The table also shows the comparison between the predicted operational LAr, 1hr noise level and the noise limit at each receptor during each time-period.

Table 10 - 13
Operational Noise Levels

Activity	Receptors	Period	Noise Limit $L_{Aeq, 1hr}$ dB(A)	Operational $L_{Aeq, 1hr}$ dB(A)*	Difference
Stone Extraction and Processing Activities, including ancillary asphalt plant	R Group 1	Daytime	55.0	54	-1
	R Group 2	Daytime	55.0	52	-3
	R Group 3	Daytime	55.0	54	-1
	R Group 4	Daytime	55.0	52	-3
	R5	Daytime	55.0	55	0
	R Group 6	Daytime	55.0	48	-7
	R Group 7	Daytime	55.0	55	0
	R Group 8	Daytime	55.0	55	0
	R Group 9	Daytime	55.0	50	-5
	R10	Daytime	55.0	47	-8
	R11	Daytime	55.0	45	-10
	R12	Daytime	55.0	46	-9

*Operational Noise Level = Predicted Noise Level without a 5 dB penalty

10.92 It can be seen from the above figures that the daytime noise criterion limits arising specifically from site operations at the sensitive receptors are comfortably met at all noise sensitive locations during site operations.

10.93 To identify the potential impact of continuous (full-time) site activities, activity at the proposed development, predicted specific LAeq, 1hr dB(A) noise levels have been logarithmically added to existing ambient noise levels. The cumulative levels have been compared to the existing ambient noise levels at each of the noise sensitive locations for each time-period. The cumulative assessment is shown in Table 10-15 below.

Table 10 - 14

Cumulative Operational Noise Levels

S L

Activity	Receptors	Period	Existing Baseline $L_{Aeq,T}$ dB(A)	Operational $L_{Ar,\ 1hr}$ dB(A)*	Cumulative $L_{Aeq,\ T}$ dB(A)*	Difference		
Stone Extraction and Processing Activities, including ancillary asphalt plant	R Group 1	Daytime	53	54	57	+4	Moderate	Minor
	R Group 2	Daytime	56	52	57	+1	Minor	Negligible
	R Group 3	Daytime	72	54	72	0	Negligible	Negligible
	R Group 4	Daytime	51.0	52	55	+4	Moderate	Minor
	R5	Daytime	60.0	55	61	+1	Minor	Negligible
	R Group 6	Daytime	72.0	48	72	0	Negligible	Negligible
	R Group 7	Daytime	56.0	55	58	+2	Minor	Negligible
	R Group 8	Daytime	60	55	61	+1	Minor	Negligible
	R Group 9	Daytime	53.0	50	55	+2	Minor	Negligible
	R10	Daytime	60.0	47	60	0	Negligible	Negligible
	R11	Daytime	60.0	45	60	0	Negligible	Negligible
	R12	Daytime	60.0	46	60	0	Negligible	Negligible

10.94 With reference to the Guidelines for Noise Impact Assessment produced by the Institute of Environmental Management and Assessment (IEMA), the cumulative long term noise impact from the proposed development are assessed to be MINOR at Group 1 receptors and Group 4 receptors; at all other receptors is determined to be NEGLIGIBLE. Short term impact are assessed to be MODERATE at Group 1 and Group 4, MINOR at Group 2, R5, Group 7, Group 8, Group 9, at all other receptors is determined to be NEGLIGIBLE.

10.95 In view of the above findings, it is considered that mitigation measures to reduce the noise impacts of plant associated with the planned development are necessary.

Ecological Receptors

10.96 Ecological receptors of concern are those areas designated under EU Habitats Directive (92/43/EEC).

10.97 The application site is not subject to any statutory nature conservation designation, the nearest protected site is located 365m from the application area.

10.98 Based on the nature, size and scale of the planned development / intensification, it is considered that the maximum distance for which the project should be evaluated in terms of Natura 2000 sites is up to a maximum radius of 2km from the application site unless there are any potential source-pathway-receptor links between the facility at Aghamore and any Natura 2000 site(s) beyond this distance.

10.99 At a distance greater than 2km, and in the absence of any potential source-pathway-receptor link, it is considered that no Natura 2000 sites would be affected by any direct loss of habitat or impacted upon by the effects of noise.

10.100 The operational $L_{Ar,\ 1hr}$ noise prediction for ecological receptor location is presented in Table 10-16 below. Table 10-16 also shows the comparison between the predicted operational $L_{Ar,\ 1hr}$ noise level and the prescribed noise limit for protection of wildlife.

Table 10 - 15

Operational Noise Levels at Ecological Receptors at Aghamore

Receptors	Period	Noise limit $L_{AEQ,\ 1HR}$ DB(A)	Operational* $L_{AEQ,\ 1HR}$ DB(A)	Difference
Lough Gill SAC 001976	Daytime	55.0	48	-7

*Operational Noise Level = Predicted Noise Level without the 5 dB penalty

10.101 As can be seen from the above figures the noise criterion limits for protection of wildlife arising specifically from proposed activity and the existing asphalt manufacturing plant at Aghamore are comfortably met at all nearby ecological noise sensitive locations.

Traffic

10.102 The criterion for assessment of "affected roads" contained within the latest DMRB guidance focuses on roads with relatively high changes in flows or high proportion of HDV / HGV traffic. Affected roads are defined as those that meet any of the following criteria:

- road alignment will change by 5m or more; or
- daily traffic flows will change by 1,000 Annual Average Daily Traffic (AADT) movements or more; or
- HDV / HGV flows will change by 200 AADT or more; or
- daily average speed will change by 10 km/hr or more; or
- peak hour speed will change by 20km/hr or more.

10.103 Based on a 50-week year, 5.5 days per week, all above operations will result in an average of maximum of 164 daily HGV return trips (82 HGVs inward and 82 HGVs outward) generated by the proposed development and existing asphalt plant.

10.104 The HDV / HGV flows, including the cumulative levels from the ancillary asphalt plant, will be below the assessment criteria.

Vibrations

10.105 Stone extraction at Aghamore Quarry will be carried out by blasting.

10.106 Drilling of holes for blasting will involve the use of a mobile rig to drill holes through the upper rock surface parallel to the active face. The duration of drilling prior to each blast will vary with the number and depth of charge holes required. Drilling of holes will be carried out during permitted operational hours.

10.107 The closest vibrations sensitive receptors (within 500m) to the blasting activities within the application area are detailed in Table 10-17. Vibration attenuation increases with distance; thus, vibration impacts at any receptors located further away from the site boundary would be lesser.

Table 10 - 16

Vibration Sensitive Receptors

Receptor Reference	Receptor
R Group 1	Residential
R Group 2	Residential
R Group 3	Residential
R Group 4	Residential
R5	Residential
R Group 6	Residential
R Group 7	Residential
R Group 8	Residential/ Farm
R Group 9	Residential
R10	Residential
R11	Residential
R12	Residential

10.108 The number of blasts carried out at the quarry depends on the amount of rock that needs to be cleared out. The duration of a blast in terms of noise is of short duration, similar to a clap of thunder.

10.109 Blasting-induced vibration is of short duration and transient in nature. A typical blast consists of a number of drilled holes into which are placed explosive charges. The charged holes are detonated individually by use of detonators each with different delays.

Residences

10.110 The main reason for complaints from blast-induced vibration is usually attributed to the fear of damage and/or nuisance rather than actual damage or nuisance itself. The human body is very sensitive to vibration; this can result in concerns being raised at vibration levels well below the threshold of cosmetic damage to buildings or the levels stated in the existing planning conditions.

10.111 In general terms a person will become aware of blast-induced vibration at levels of around 0.3 mm/second peak particle velocity (ppv). However, people are very poor at determining relative magnitudes of vibration, for example, the difference between 4.0 mm/sec ppv and 6.0 mm/sec ppv is unlikely to be distinguishable by an individual person. Even though vibration levels between 0.6 mm/sec ppv and 50.0 mm/sec ppv are routinely experienced in everyday life within a property and are considered wholly safe, when similar levels are experienced through blasting operations, it is not unusual for such a level to give rise to subjective concern.

10.112 Table 10-18 gives examples of vibration levels routinely generated in a property.

Table 10 - 17
Vibration Levels Generated by Everyday Activities

Activity	Vibration Level (Peak Particle Velocity, mm/sec)
Walking, measured on a wooden floor	1.0 to 2.5
Door slam, measured on a wooden floor	2.0 to 5.0
Door slam, measured over the doorway	12.0 to 35.0
Foot stamps, measured on a wooden floor	5.0 to 50.0

10.113 With regard to physical damage to properties, extensive research has been carried out around the world, the most prominent being undertaken by the United States Bureau of Mines (USBM). Damage to a structure could occur if the dynamic stresses induced in a structure exceed the allowable design stress for the specific building material. Classifications of building damage range from very fine plaster cracking up to major cracking of structural elements.

10.114 When defining damage to buildings, the following classification is used:

- Cosmetic – the formation of hairline cracks or the growth of existing cracks in plaster, dry wall surfaces, or mortar joints.
- Minor – the formation of large cracks or loosening or falling of plaster on dry wall surfaces, or cracks through bricks/concrete blocks.
- Major or Structural – damage to structural elements of the building

10.115 Studies by USBM concluded that vibration levels in excess of 50 mm/sec ppv are required to cause structural damage. The onset of cosmetic damage can be associated with lower levels. Vibration levels between 19 mm/sec ppv and 50 mm/sec ppv are generally considered safe. It should be noted that these limits are for the worst-case structure conditions and that they are independent of the number of blasting events and their durations.

10.116 British Standard 7385-2:1990 Evaluation and Measurement for Vibration in Buildings – Part 2: Guide to Damage Levels from Groundborne Vibration gives guidance on vibration limits to prevent building damage. It is applicable to blasting associated with mineral extraction.

10.117 The damage threshold criteria provided in BS7385 are based on systematic studies using carefully controlled vibration sources in the vicinity of buildings. Vibration limits for transient vibrations (such as those associated with blasting operations) above which cosmetic damage could occur are provided in Table 10-7. BS7385-2 notes that the probability of damage tends towards zero at 12.5 mm/sec peak component particle velocity.

10.118 Historical blast monitoring results at Aghamore Quarry confirm that the blasting operations at the quarry have complied with the DoEHLG (2004) and EPA (2006) recommended threshold limit values for groundborne vibration (12 mm/sec peak particle velocity) and air overpressure (125 dBL Linear max peak with a 95% confidence limit).

10.119 The comprehensive environmental monitoring programme implemented at the quarry confirms that the quarry has operated within the recommended blasting emission limit values set out in the best practice guidelines for the sector.

10.120 Based on the above, it is concluded that blasting operations within the planning application area at Aghamore Quarry will not have a significant impact on any sensitive receptors.

Ecological Receptors

10.121 The impact from blasting activities for ecological receptors would consist of disturbance (including noise, vibration, and visual disturbance).

10.122 Increases in human disturbance including noise and visual disturbance from human activity can have a range of impacts depending upon the sensitivity of the ecological receptor, the nature, and duration of the disturbance and its timing.

10.123 The response of individual species to increased levels of human disturbance will depend upon a number of factors including the sensitivity, reproductive status, previous exposure to human disturbance, behaviour during the event, species tolerance to disturbance, location in relation to the source, availability of alternative nearby habitat, and environmental factors (i.e. topography, vegetation and atmospheric conditions which can influence noise levels).

10.124 The level of disturbance will also be dependent upon the existing ambient noise levels and maximum noise levels.

10.125 Any blasting operations at the quarry extension will be carried out in accordance with emission limit values recommend by the EPA and DoEHLG of 12mm/second (peak particle velocity) and for air overpressure of 125dB with a 95% confidence limit with any ground vibration limited in its extent around the quarry site.

10.126 At a distance of 365m at its closest point, the Lough Gill SAC is considered to be of sufficient distance from the Aghamore Quarry that no changes in baseline disturbance levels are predicted from an extension of quarrying operations within the defined boundaries of this SAC where there would be any effects on any of the Annex II qualifying species.

10.127 No likely exposure to hazard and no effects predicted on any qualifying Annex II species, or on the integrity of the Lough Gill SAC.

Cumulative Impacts

10.128 Cumulative noise impacts arising from the application site have been assessed, the cumulative assessment was based on measured noise levels of current activities on site and off site in the quarry area. Local existing and planned developments were reviewed as part of this assessment

10.129 This noise impact assessment shows that the long-term cumulative noise impact from the proposed operations at local receptors is determined to be MINOR to NEGLIGIBLE.

10.130 Noise levels arising from proposed activities will not have the potential to increase the existing ambient noise levels in the vicinity of the proposed development of the quarry and aggregate processing yard at Aghamore.

10.131 A search of the myplan.ie and An Bord Pleanála online planning portal searches was carried out to determine if there were any other planned developments in the vicinity (c. 1km radius) of the application site that have recently been granted permission or are currently under consideration and which have the potential to have a significant adverse cumulative impacts on the local environment.

10.132 There is existing soil facility to the south west of the application area.

10.133 Soil facility traffic will use the same road as the quarry's main traffic route, the relatively small activity associated with the soil facility is not expected to have any likely significant adverse impact on traffic volumes on the local road network.

10.134 It is considered in light of the available assessments that the proposed development will not have any significant adverse cumulative effect on noise and vibrations

10.135 Noise levels arising from proposed activities will not have the potential to increase the existing ambient noise levels in the vicinity of Aghamore Quarry.

'Do-nothing Scenario'

10.136 At present, the noise environment within the study area is dominated by road traffic noise emanating from the local roads, natural sounds such as farmyard animals or barking dogs are also audible.

10.137 Over time, it is anticipated that the volume of road traffic in general, will increase as economic activity increases and that this in turn is likely to lead to an increase in ambient and background noise levels.

Interaction with Other Impacts

10.138 The potential impact of noise generated by the proposed development on sensitive receptors including sensitive ecological receptors and people living in the area has been assessed in this chapter of the EIAR. The impact of the proposed development activity on these receptors is further considered in Chapter 4 'Population and Human Health' and Chapter 5 'Biodiversity'.

MITIGATION MEASURES

Noise

10.139 Where necessary, the three established strategies for impact mitigation are avoidance, reduction and remedy. Where it is not possible or practical to mitigate all impacts, then the residual impacts must be clearly described in accordance with the system for impact description set out in the EPA Guidelines. The adoption of Best Practicable Means is generally considered to be the most effective means of controlling noise emissions.

10.140 Notwithstanding the findings of the impact assessment presented above, which determined that the proposed activities at Aghamore Quarry will have negligible noise impact, and in line with practice, the following best practice measures will be implemented wherever practicable at the proposed site to minimise the potential noise impact of on-site activities:

Screening:-

- screening berms will be erected to act as acoustic barriers adjacent to the closest residences along the eastern boundary;
- existing perimeter hedge planting will be retained;
- berms will be inspected on a regular basis and maintained as necessary.

Plant:-

- all mobile plant used at the development will have noise emission levels that comply with the limiting levels defined in EC Directive 86/662/EEC and any subsequent amendments;
- all plant items will be properly and regularly maintained and operated according to the manufacturers' recommendations, in such a manner as to avoid causing excessive noise (i.e. all

moving parts are kept well lubricated, all cutting edges are kept sharpened, the integrity of silencers and acoustic hoods are maintained);

- all plant will be fitted with effective exhaust silencers which are maintained in good working order to meet manufacturers' noise rating levels. Any defective silencers will be replaced immediately.

Traffic:-

- any deliveries will be programmed to arrive during daytime hours only;
- care will be taken when unloading vehicles to reduce or minimise potential disturbance to local residents;
- access / internal haul roads will be kept clean and maintained in a good state of repair, i.e. any potholes are filled, and large bumps removed, to avoid unwanted rattle and "body-slap" from heavy goods vehicles;
- vehicles waiting within the pit will be prohibited from leaving their engines running and there should be no unnecessary revving of engines.

10.141 Experience from other sites has shown that by implementing these measures, typical noise levels from construction works can bring about a reduction of 5dB(A) or more in ambient noise levels.

Vibrations

10.142 Historical blast monitoring results indicate that the air overpressure levels and the groundborne vibration levels (i.e. Peak Particle Velocity) complied with the DoEHLG (2004) / EPA (2006) limit values.

10.143 The blast design and blasting methodology for the site operations carried out within the planning application area have been and will be optimised to ensure that the levels have been and are within these recommended limits.

10.144 The following measures shall be implemented at the planning application area to minimise disturbances due to any future blasting operations. These mitigation measures are in accordance with the 'best practice / mitigation' measures described in Section 3.2 of the DoEHLG (2004) guidelines:

- Blasting will be carried out between the hours of 09:00 hrs to 18:00 hrs from Monday to Friday (except in emergencies or for health and safety reasons beyond the control of the operator).
- Blasting shall not be carried out on Saturdays, Sundays or public holidays;
- Notification of each blast shall be given in writing 48 hours in advance of each blast to all residences within 500m radius of the quarry;
- Blast notifications shall be provided by pre and post siren warnings;
- All blasting operations shall be carried out by a certified 'shotfirer' in accordance with the relevant health and safety regulations;
- The optimum blast ratio shall be maintained, and the maximum instantaneous charge shall be optimised.
- The blast design and blasting methodology uses the monitoring results to optimise and ensure consistent blast designs.

10.145 Efficient blasts use as much of the explosive energy as possible for rock fragmentation, and by implication ground vibration and air overpressure is inefficient use of this energy. Therefore, optimisation of the blast design is economically beneficial to the company (through improved rock fragmentation), and also minimises the potential environmental impacts.

10.146 To avoid any risk of damage to properties in the vicinity of the site, the groundborne vibration levels from blasting shall not exceed a peak particle velocity of 12 mm/sec. To minimise impact on local residences Blasting Protocol shall be implemented for the site. The Blasting Protocol shall include 'best practice / mitigation' measures described in Section 3.2 of the DoEHLG (2004) guidelines and Health & Safety guidelines.

RESIDUAL IMPACT ASSESSMENT

Noise

10.147 The worst-case scenario noise assessment has shown that in accordance with the scale in the Guidelines for Noise Impact Assessment produced by the Institute of Environmental Management and Assessment (IEMA) the cumulative noise impact from plant associated with the development at all receptors is NEGLIGIBLE.

10.148 Table 10-19 summarise the impacts, mitigation measures and residual impact for operational plant noise at each of the noise sensitive receptor considered.

Table 10 - 18

Operational Noise Summary Table

Receptors	Increase in operational noise $I_{aeq,\,1hr}$ db(a)	Impact without mitigation measures		Mitigation	Reduction in noise from mitigation $I_{aeq,\,1hr}$ db(a)	Increase in operational noise $I_{aeq,\,1hr}$db(a)	Residual Short-term impact	Residual Long-term impact
		Short Term	Long Term					
R Group 1	+4	Moderate	Minor	Required	-5	0	Negligible	Negligible
R Group 2	+1	Minor	Negligible	Short term Required	-5	0	Negligible	Negligible
R Group 3	0	Negligible	Negligible	Not Required	-5	0	Negligible	Negligible
R Group 4	+4	Moderate	Minor	Required	-5	0	Negligible	Negligible
R5	+1	Minor	Negligible	Short term Required	-5	0	Negligible	Negligible
R Group 6	0	Negligible	Negligible	Not Required	-5	0	Negligible	Negligible
R Group 7	+2	Minor	Negligible	Short term Required	-5	0	Negligible	Negligible
R Group 8	+1	Minor	Negligible	Short term Required	-5	0	Negligible	Negligible
R Group 9	+2	Minor	Negligible	Short term Required	-5	0	Negligible	Negligible
R10	0	Negligible	Negligible	Not Required	-5	0	Negligible	Negligible
R11	0	Negligible	Negligible	Not Required	-5	0	Negligible	Negligible
R12	0	Negligible	Negligible	Not Required	-5	0	Negligible	Negligible

10.149 Based on the historical blasting results, it is concluded that blasting operations carried out within the application area will not have residual impact on any sensitive receptors.

MONITORING

10.150 Noise monitoring shall be undertaken around the application site. Noise monitoring locations shall be reviewed and revised where and as/when necessary. The results of the noise monitoring shall be submitted to the Sligo County Council on a regular basis for review and record purposes.

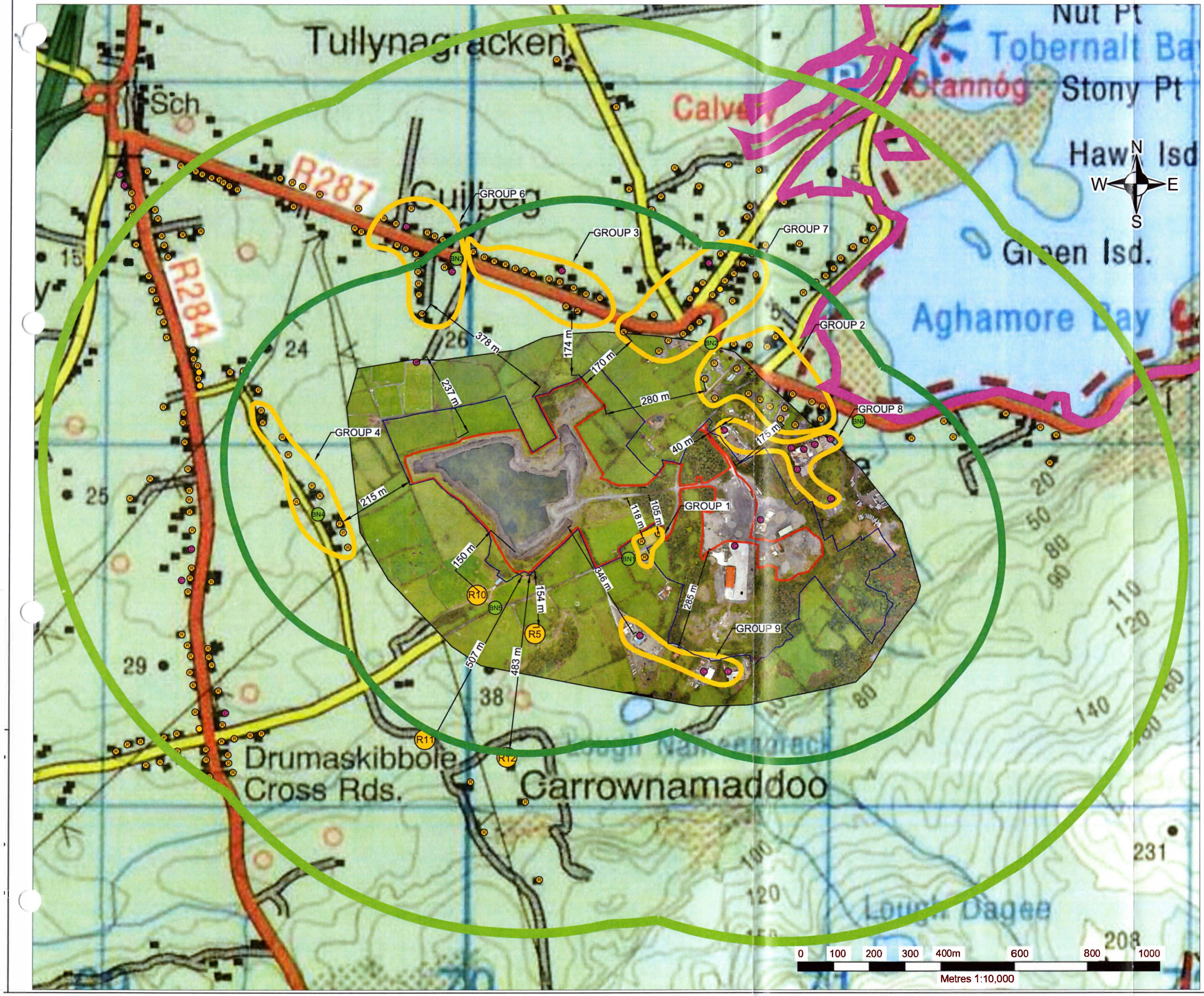
10.151 All blasts carried out at the quarry at Aghamore shall be monitored to ensure compliance with planning conditions.

10.152 The blast monitoring results shall be submitted on a regular basis to Sligo County Council for record purposes.

FIGURES

Figure 10-1

Receptors and Noise Monitoring Locations



NOTES

1. ORDNANCE SURVEY IRELAND LICENCE NO. CYAL50167032 (C) ORDNANCE SURVEY IRELAND / GOVERNMENT OF IRELAND
2. AERIAL PHOTOGRAPHY CARRIED OUT BY SLR CONSULTING SEPTEMBER 2020

LEGEND

▬	APPLICATION AREA
Ⓡ	RESIDENCE
●	COMMERCIAL
▬	1 KM OFFSET
▬	500 M OFFSET
▬	GROUPS OF RECEPTORS
BN1	BASELINE NOISE MONITORING LOCATION (SLR)
▬	LOUGH GILL SAC

SLR
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LOCAL RECEPTORS AND MONITORING LOCATIONS

FIGURE 10.1

Scale 1:10,000 @ A3
Date MAY 2021

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11. Material Assets

CHAPTER 11

MATERIAL ASSETS

CONTENTS

INTRODUCTION

Background

11.1 This chapter of the Environmental Impact Assessment Report (EIAR) relates to the potential effects of the recommencement / deepening of the existing quarry and recommencement of aggregate processing activities at Aghamore Near, Aghamore Far and Carrownamaddoo townlands in Co. Sligo on material assets.

11.2 The proposed development provides for:

- Recommencement of quarry operations within the previously permitted quarry extraction area (c. 10.9ha);
- Deepening of the previously permitted quarry area by 2 no. extractive benches from c. -21m OD to -50m OD;
- Recommencement of aggregate processing (crushing and screening) within the existing processing area, located to the east of the local road that bisects the site;
- The provision of a settlement lagoon (c. 2,830m2);
- The provision of 2 no. wheelwashes;
- The provision of a double stacked portacabin office;
- The provision of a wastewater treatment system;
- Additional stockproof / trespass proof boundary fencing;
- All within an application area of c. 22.5 Ha.

11.3 For further detail of the proposed development and the application site context, refer to chapter 2 of this EIAR.

Scope of Work

11.4 According to the EPA (EPA (2003) Advice Notes on Current Practice,

> *"Resources that are valued and that are intrinsic to specific places are called 'material assets'. They may be of either human or natural origin and the value may arise for either economic or cultural reasons".*

11.5 Under Schedule 6 of the Planning and Development Regulations (2001) as amended, material assets also refers to architectural and archaeological heritage and cultural heritage.

11.6 The EPA guidelines in relation to the preparation of EIAR[1] note the following in respect of material assets:

> *"Material assets can now be taken to mean built services and infrastructure. Traffic is included because in effect traffic consumes roads infrastructure."*

11.7 The specific headings in the guidelines in relation to material assets refer to built services, roads and traffic and waste management.

11.8 Chapter 14 of this EIAR addresses roads & traffic and Chapter 12 addresses architectural heritage, archaeological heritage and cultural heritage separately to this chapter.

11.9 This material assets impact assessment comprises the consideration of existing resources pertinent to the proposed development and the application area that are not addressed elsewhere in this EIAR and the likely development impacts on those resources. On this basis, this section addresses built services and waste management. Built services are understood to refer to electricity, telecommunications, gas, water supply infrastructure and sewerage.

Consultations / Consultees

11.10 A number of pre-planning consultation meetings have been held between officials of Sligo County Council and representatives of SLR Consulting Ireland and Lagan Materials Limited.

11.11 At the meetings, details of the proposed development were presented and issues likely to be of interest or concern were identified and discussed.

11.12 Following a review of published development plans and the site survey, it was considered that there was no requirement for any further formal consultations to be carried out in respect of material assets for the purposes of this assessment.

Contributors / Author(s)

11.13 This section of the EIAR was prepared by Peter Kinghan, who is a Technical Director with SLR Consulting Ireland. Peter is a Chartered Mineral Surveyor and has previously worked on numerous extractive industry planning applications and EIAR.

Limitations / Difficulties Encountered

11.14 No limitation or difficulties were encountered in the preparation of this chapter of the EIAR.

ADDITIONAL INFORMATION

2.1 As outlined in Chapter 1, a planning application was submitted to Sligo County Council (Plan File Ref. No. 18/345 / ABP Ref. 305821-19) in August 2018 for similar development to that proposed as part of this application. In October 2019 Sligo County Council granted planning permission for the development (subject to 23 no. conditions). 2 no. third party appeals of the decision by Sligo County

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[1] Environmental Protection Agency (2017). *Guidelines on the Information to be contained in Environmental Impact Assessment Reports.*

Council to grant permission for the proposed quarry development were made to An Bord Pleanala (ABP-305821-19). An Bord Pleanala refused permission for the proposed development on the 30th June 2020 for the 2 no. reasons – refer to Chapter 1 for further details.

2.2 In order to comprehensively address the reasons for refusal, and further comments contained within the An Bord Pleanala Inspectors Report a number of additional surveys / site investigations, field work and assessments have been carried out.

2.3 This Chapter 11 of the EIAR has been updated as follows:

- Site Context and Sensitive Reseptors have been updated to account for the changes to the application area;
- This assessment takes account of the revised planning application area and considers all activities associated with the revised application area, such as the recommencement of aggregate processing activities;
- The assessment takes account of cumulative impacts associated with the existing asphalt plant on-site;
- Updated planning searches have been undertaken in respect of lands in the vicninty of the application site.

REGULATORY BACKGROUND

Guidelines

11.15 This chapter of the EIAR has been prepared on the basis of the draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports by the EPA (2017).

Technical Standards

11.16 There are no technical standards relevant to this section of the EIAR.

RECEIVING ENVIRONMENT

Study Area

11.17 The study area relates to the vicinity of the application site and to those dwellings and buildings on the roads surrounding the application site.

Baseline Study Methodology

11.18 The baseline study comprises a desk-top review of online and published resources, information provided by the applicant and information contained in the other sections of this EIAR. Ordnance Survey maps and aerial photography were also examined.

Sources of Information

11.19 Baseline information was obtained from the following sources:

- Myplan.ie (http://myplan.ie/index.html);
- Historic Environment Viewer (http://webgis.archaeology.ie/historicenvironment/);
- Sligo County Development Plan 2017;
- The environmental topic chapters of this EIAR;
- OS Maps;
- aerial photographs;
- Openstreetmap.org.

Site Context

11.20 The application site is located south of Sligo town, off the R287 regional road in the town lands of Aghamore Near, Aghamore Far and Carrownamaddoo. Although there is a dispersed pattern of housing development in the vicinity, there is no distinctive village or settlement in the immediate vicinity: refer to EIAR Chapter 4 Population and Human Health.

11.21 The quarry area on the western side of the local road that bisects the application site is bounded on all sides by agricultural land and there are a number of dwellings located along the roads in the vicinity. The processing area located on the eastern side of the road is bounded by agricultural lands to the east, and industrial land uses to the north and south. There is a sports ground located to the northwest of the application area. The site is accessed from a local road (L3603). Lough Gill is located c. 365m north-east of the application site.

11.22 Existing facilities at the site include the weighbridge & weighbridge office and a garage / workshop. These facilities are located within the processing area on the eastern part of the application site. There is an existing asphalt plant located to adjacent to the aggregate processing area.

Built Services

11.23 Electrical power is currently provided to the application site via mains supply. Electricity will provide the principal source of energy for office lighting and heating.

11.24 Site based staff at the application site are contactable by mobile phone, landline and email and broadband connections to the site office are provided via a mobile network.

11.25 It is proposed to install a new wastewater treatment system that will service toilets from the proposed double stacked portacabin office – refer to Site Characterisation report submitted with the Planning Application documentation, and Figure 2.1 showing the proposed location. Details of the proposed system (Oakstown BAF 6 PE wastewater treatment system) are provided with the Site Characterisation report.

11.26 A supply well in the processing area will be used for water supply (see **Figure 7-1**); water from the well will be used for wheelwashes, dust suppression and non-potable use in the office canteen and toilets.

11.27 Potable water will be provided to the site via a water cooler dispenser system.

Waste Management

General Waste Management

11.28 Lagan Materials Ltd., as a member of the Irish Concrete Federation commits themselves to the principles of the Federations Environmental Code. The code states:-

> *"ICF members will minimise production of waste and where appropriate consider its beneficial use including recycling. They will deal with all waste in accordance with the relevant legislation and other controls in place, including using waste contractors with valid Waste Collection Permits"*

11.29 Potential waste produced and the measures used to control it are described as follows:-

- Scrap metal – these materials are chiefly produced from the maintenance of the possessing plants and can cause a nuisance if allowed to build up in an uncontrolled manner. A designated scrap metal area will be demarcated on site and the build-up of scrap is controlled by the regular removal by licensed scrap metal dealers.

- Used Oil and Oil Filters – any waste oil/oil filters that may arise from servicing of fixed or mobile plant will be removed from the site by a licensed waste contractor.

- Used Batteries – similarly all used batteries will be removed from site for collection and recycling by a licensed waste contractor in accordance with the Waste Management Regulations.

- Domestic Style Waste (Canteen Waste) – domestic waste generated at the offices and employee's facility will be collected by a licensed waste collection contractor.

Extractive Waste Management

11.30 Almost all products and by-products arising from the aggregate processing have commercial value. Any waste materials from the site are stored, collected, recycled and/or disposed of in accordance with any requirements of Sligo County Council.

11.31 Topsoil and overburden stored within the application site is not considered waste; such materials are an essential component of the restoration programme. These materials are required for the reshaping and landscaping of the worked out area to make it more suitable for after-use.

Sensitive Receptors

11.32 The application site is located is a rural area, but the nearby roads and in particular the roads to the north-east and north-west display a pattern of ribbon development. There is a more dispersed pattern of residential development along the local road to the south of the site north. There are a number of industrial and commercial developments to the south-east of the site associated with the manufacturing area of the site and the nearby business park.

11.33 The closest residential dwelling to the development area is located approx. 105 metres to the south of the access road of the quarry area. There are no residences within 150 metres of the quarry void.

11.34 There are no schools, churches or shops in the vicinity. The St John's Football Club is located to the north-west of the application site.

11.35 Figure 4.1 identifies residential properties, community facilities and commercial operations within the locality and shows 500m and 1km bands from the application boundary.

IMPACT ASSESSMENT

Evaluation Methodology

11.36 The evaluation of effects on built services and waste comprises a qualitative assessment based on the quantitative and qualitative analysis of potential effects on the environment undertaken in other sections of this EIAR. The assessment also takes into account a review of relevant literature and professional judgement in relation to impacts on built services and waste.

Built Services

Operational Stage Impacts

11.37 The operational phase of the development would comprise the extraction of aggregate from the extraction area and the recommencement of processing within the quarry and the processing area located on the eastern portion of the site. It also includes the restoration of the site.

11.38 No significant effects are anticipated in relation to built assets or waste management.

Post-Operational Stage Impacts

11.39 During the post operational period, all works on the site would have ceased and the site would have been restored. Any activity on the site would be limited to post-restoration uses and any aftercare required for a limited period following restoration.

11.40 No significant effects are anticipated in relation to built assets or waste management.

Waste

Construction and Operational Stage Impacts

11.41 During the operational stage, aggregate will be extracted from the quarry and will be processed within the quarry void using mobile plant before being transported to the eastern side of the road for further processing using mobile plant. Following the cessation of extraction operations, the relevant areas will be restored.

11.42 As outlined above, there are existing waste management arrangements in place in relation to general waste, ancillary operational waste and extractive waste. These arrangements will remain in place for the duration of the construction stage. The waste produced by the operational stage will be limited to the domestic style waste generated by the employees operating the facility and any ancillary generation of operational waste (e.g. batteries, tyres, waste oil).

11.43 It is considered, therefore, that the generation of waste will be medium term, temporary and slight in its effects.

Post-Operational Stage Impacts

11.44 During the post-operational stage, extraction and restoration operations will have ceased and activities will be limited to intermittent aftercare for a limited period. Any waste generated on the site will be limited to general waste produced by any employees that are engaged in aftercare on an intermittent basis and any ancillary operational waste related to aftercare. Any such waste will be handled in accordance with the established practices on site and will be removed by a licenced contractor.

11.45 It is considered, therefore, that the generation of waste during this period will be short-term, temporary and slight in its effects.

Unplanned Events

11.46 According to the EPA guidelines, unplanned events, such as accidents, can include *"spill from traffic accidents, floods or land-slides affecting the site, fire, collapse or equipment failure on the site"*. The 2014 EIA directive refers to *"major accidents, and/or natural disasters (such as flooding, sea level rise, or earthquakes)"*.

11.47 In this instance, the vulnerability of the proposed development to accidents, unplanned events or natural disasters is relatively limited owing to the relatively simple nature of the development works, the established nature of the techniques, regulations and procedures to be followed, the material to be handled on site and the relatively rural location of the proposed works.

11.48 Unplanned events in relation to the proposed development could potentially relate to:

- instability following the extraction of rock;
- spill from traffic accidents;
- flooding.

11.49 Adhering to the HSA Safe Quarry Guidelines to the Safety Health and Welfare at Work (Quarries) Regulations 2008 should limit the potential for unplanned events in the form of instability in the quarry faces. In any event, instability following the extraction of rock would be unlikely to have any significant impacts on employment, human health or amenity, particularly beyond the site. On completion of quarrying activities the application area will be left for natural recolonisation by locally occurring grass and shrub/scrub species and the quarry void will fill with water., all existing boundary fences and hedgerows will be retained to ensure that the site is secure and all plant and machinery will be removed from the quarry void.

11.50 Chapter 7 (water) notes that spillages of fuels or chemicals during site activities could happen without proper control and supervision. Discharged water off-site could potentially breach water quality limits without monitoring. Pump failure in the quarry could result in the quarry floor flooding leading to the potential for groundwater pollution by plant and equipment; uncontrolled discharge of water to the Aghamore Stream could potentially lead to localised flooding off-site in the worst case. Appropriate mitigation measures and monitoring have been proposed to ensure that there are no potential impacts on the water environment as a result of unplanned events at the site.

11.51 The traffic and transport assessment, carried out as part of the EIAR (Chapter 14), indicates that existing road network can accommodate the proposed development. Chapter 14 also recommends the erection of warning signage and the improvement of sightlines at the entrance to the application area. It is considered that the risk of an accident resulting in a spillage would be no greater in relation to this development than it is for any other form of development that relies on the transportation of goods and materials by HGVs.

11.52 It is considered that the material assets as outlined in this section are not particularly vulnerable to such unplanned events and unplanned events would be unlikely to cause significant, sudden environmental effects in respect of built services or waste.

Cumulative / Synergistic Impacts

11.53 A search of the Sligo County Council online planning search facility indicates that there are no other planned developments in the vicinity of the application site and in the adjoining townlands of Carrownamaddoo, Cuilbeg, Aghamore Near, Tullynagracken South, Drumaskibbole, Ballydawley, Castledargan, which were granted planning permission in the last five years[2] and have the potential to have any significant adverse cumulative impacts on the local environment. It is noted that planning permission has recently been granted for development consisting of the filling of lands with construction and demolition waste in Carrownamaddoo townland c. 450 metres from the application area (Plan File Ref. No. 18/49) subject to 7 no. conditions. This proposed development is considered small scale, short term in duration (5 years) and is located sufficient distance from the application area and therefore no cumulative impacts are considered.

11.54 The potential for cumulative impacts from the existing asphalt plant located within the landholding has been assessed in the relevant chapters of the EIAR.

11.55 It is considered that the only impact that has the potential for significant cumulative impact on material assets is traffic. The traffic impact of the proposed development and the existing asphalt plant is assessed and discussed in chapter 14 of this EIAR. The assessment concludes that the relevant junctions and links will have sufficient capacity for the traffic generated by the quarry development and the existing asphalt plant.

Transboundary Impacts (If any)

11.56 It is not anticipated that the impacts of the proposed development would have any significant transboundary effects on material assets.

Interaction with Other Impacts (if any)

11.57 It is not anticipated that the effects of the proposed development on material assets would interact significantly with other impacts.

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[2] Planning search conducted on 21st April 2021 on Sligo County Council website.

‘Do-nothing Scenario’

11.58 In a ‘do-nothing scenario’, operations at the quarry would not recommence.

11.59 A ‘do-nothing scenario’ would not result in any significant adverse impact in relation to built services and on-site waste generation and the effect of a ‘do-nothing scenario’ would be neutral in relation to these factors.

11.60 However, in the medium term an alternative source of aggregates would need to be found.

MITIGATION MEASURES

Construction and Operational Stage

11.61 As no significant effects are anticipated in relation to built assets or waste management during the construction and operational stage, no specific mitigation measures are proposed.

11.62 Waste generated at the site will continue to be appropriately stored and removed by licenced contractors.

Post – Operational Stage

11.63 As no significant effects are anticipated in relation to built assets or waste management during the post-operational stage, no specific mitigation measures are proposed.

11.64 Waste generated at the site will continue to be appropriately stored and removed by licenced contractors.

RESIDUAL IMPACT ASSESSMENT

Construction Stage

11.65 As no significant effects are anticipated in relation to built assets or waste management and no mitigation measures are required during the construction stage, no residual impact is anticipated.

Operational Stage

11.66 As no significant effects are anticipated in relation to built assets or waste management and no mitigation measures are required during the operational stage, no residual impact is anticipated.

Post – Operational Stage

11.67 As no significant effects are anticipated in relation to built assets or waste management and no mitigation measures are required during the post-operational stage, no residual impact is anticipated.

MONITORING

11.68 Monitoring is not proposed in relation to material assets.

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12. Cultural Heritage

12. Cultural Heritage

CHAPTER 12

CULTURAL HERITAGE

CONTENTS

PLATES

INTRODUCTION

Background

12.1 This Chapter of the Environmental Impact Assessment Report (EIAR), commissioned by SLR Consulting Ireland on behalf of Lagan Materials Ltd., addresses the impacts on the archaeological, architectural and cultural heritage of the application site and the surrounding area of a proposal for the recommencement / deepening of the existing quarry and recommencement of aggregate processing activities at Aghamore Near, Aghamore Far and Carrownamaddoo townlands, County Sligo. The site location and study area are indicated in **Figure 12-1**.

Scope of Work / Methodology

12.2 This study, which complies with the requirements of Directive EIA 2014/52/EU, is an assessment of the known or potential cultural heritage resource within a specified area and includes the information that may reasonably be required for reaching a reasoned conclusion on the significant effects of the project on the environment, taking into account current knowledge and methods of assessment. It consists of a collation of existing written and graphic information in order to identify the likely context, character, significance and sensitivity of the known or potential cultural heritage, archaeological and structural resource using an appropriate methodology (EPA 2002 and 2003).

12.3 The study involved detailed investigation of the archaeological and historical background of the development site, the landholding and the surrounding area extending from the development boundary (**Fig. 12-1**). This area was examined using information from the Record of Monuments and Places of County Sligo, the Sligo County Development Plan, lists of previous excavations and cartographic and documentary sources. Field inspections were carried out on the 1st of May 2018 and the 25th of November 2020 in an attempt to identify and assess any known archaeological sites and previously unrecorded features and portable finds within the area of landholding.

12.4 An impact assessment and mitigation strategy have been prepared. An impact assessment is undertaken to outline potential adverse impacts that the proposed development may have on the cultural resource, while a mitigation strategy is designed to avoid, reduce or offset such adverse impacts.

12.5 The application site is located in the Townlands of Carrownamaddoo, Aaghamore Near and Aghamore Far, Co. Sligo, on OS Six Inch sheet No. 20, 1.3km to the west of the N4 Dublin to Sligo road, and directly to the east and west of the L3603. The proposed development involves the recommencement of the existing operational and processing area and deepening of the existing quarry area within an application area of c. 22.5 Ha.

12.6 Extracts from the Record of Monuments and Places for County Sligo are presented on a map of the local area around the site in Figure 12-1. RMP sites included on the Records of Monuments and Places statutory mapping are identified by black circles. The application area is indicated by the red line.

Contributors / Author(s)

12.7 The assessment was prepared by Dr. Charles Mount who is a member of the Institute of Archaeologists of Ireland and a member of the Discovery Programme and has more than thirty years of cultural heritage assessment experience. He holds M.A. and Ph.D. degrees in archaeology as well as a professional diploma in EIA and SEA Management.

Limitations / Difficulties Encountered

12.8 No difficulties were encountered during the desktop study, field survey or in the preparation of this report.

REGULATORY BACKGROUND

12.9 The following paragraphs set out the regulatory background with regard to cultural impact assessments in Ireland in general and the site-specific planning background relevant to this cultural impact assessment, in particular.

Legislation

12.10 No specific Irish legislation exists governing cultural heritage assessments.

Planning Policy and Development Control

12.11 The Sligo County Development Plan 2017-2023 (CDP) is the statutory plan detailing the development objectives/policies of the local authority. The plan includes objectives and policies, relevant to this assessment, i.e. with regard to cultural heritage.

Cultural Heritage

12.12 Chapter 7 of the County Development Plan sets out the policies on cultural heritage within the county. The Council recognises the importance of identifying, valuing and safeguarding the archaeological and architectural heritage of Sligo.

12.13 The Council's aim is to: protect and enhance archaeological sites, monuments, their setting, appreciation and amenity within the Plan area, including those that are listed in the Record of Monuments and Places (RMP) or newly discovered archaeological sites and/or sub-surface archaeological remains. The Plan contains a number of policies aimed at the protection of archaeological heritage in the county.

P-AH-1 Protect and enhance archaeological sites, monuments, their setting, appreciation and amenity within the Plan area, including those that are listed in the Record of Monuments and Places (RMP) or newly discovered archaeological sites and/or sub-surface archaeological remains.

P-AH-2 Require archaeological impact assessment, surveys, test excavation and/or monitoring for planning applications in areas of archaeological importance, if a development proposal is likely to impact upon in-situ archaeological monuments, their setting and archaeological deposits.

P-AH-3 Require the preservation of the context, amenity, visual integrity and connection of archaeological monuments to their setting. Views to and from archaeological monuments shall not be obscured by inappropriate development. Where appropriate, archaeological visual impact assessments will be required to demonstrate the continued preservation of an archaeological monument's siting and context.

P-AH-4 Secure the preservation *in-situ* or by record of:

- the archaeological monuments included in the Record of Monuments and Places as established under section 12 of the National Monuments (Amendment) Act, 1994;
- any sites and features of historical and archaeological interest;
- any subsurface archaeological features that may be discovered during the course of infrastructural/development works in the operational area of the Plan. Preservation relates to archaeological sites or objects and their settings. Preservation in-situ is most effectively achieved by the refurbishment of existing buildings, in situations where it is possible to retain the greater part of existing structures without the need for new foundations.

P-AH-5 Protect historic burial grounds that are recorded monuments and encourage their maintenance in accordance with best conservation principles. Development may be restricted or conditions requiring substantial excavation may be imposed in and adjacent to former burial grounds.

P-AH-6 Where possible, facilitate and enhance public access to and understanding of the archaeological heritage and disseminate archaeological information and advice to prospective developers and the general public.

P-AH-7 Require that all development proposals for industrial buildings and sites of industrial archaeological importance be accompanied by an industrial archaeology assessment of the surrounding environment. New development should be designed in sympathy with existing features and structures. Protect and preserve the archaeological value of underwater archaeological sites and associated features. In assessing proposals for development, the Council will take account of the potential underwater archaeology of rivers, lakes, intertidal and subtidal environments.

Cuil Irra Peninsula – Carrowmore, Knocknarea and Carns Hill
P-AH-9 Refer to the National Monuments Section, DAHG all development proposals within the archaeological and historic landscape of the Cuil Irra Peninsula (which includes the core areas of Knocknarea, Carrowmore and Carns Hill) as identified in Fig. 7.A (see Co. Development Plan).

P-AH-10 Ensure that Archaeological Impact Assessments are requested at pre-planning and planning application stage for all development proposals within the archaeological and historic landscape of the Cuil Irra Peninsula (which includes the core areas of Knocknarea, Carrowmore and Carns Hill).

Protected Structures

12.14 The Council's aim is to: Preserve, protect and enhance the architectural heritage of County Sligo for future generations. The area's architectural heritage is of national and regional importance and is central to Sligo's ability to promote itself as a centre for cultural tourism. The Plan contains a number of policies aimed at the protection of architectural heritage in the county.

P-ARH-1 Preserve, protect and enhance the architectural heritage of County Sligo for future generations. The area's architectural heritage is of national and regional importance and is central to Sligo's ability to promote itself as a centre for cultural tourism.

P-ARH-2 Ensure that any development, modifications, alterations, or extensions affecting a protected structure, an adjoining structure or a structure within an ACA is sited and designed appropriately and is not detrimental to the character of the structure, to its setting or the general character of the ACA.

P-ARH-3 Exempt a development proposal from the normal requirement for the payment of a development contribution if the proposal involves restoration/refurbishment of a protected structure to a high architectural standard.

P-ARH-4 Facilitate enabling development to be carried out in conjunction with works to protected structures where consistent with the parameters outlined in subsection 7.3.5 Enabling Development.

P-ARH-5 Protect important non-habitable structures such as historic bridges, harbours, railways or non-structural elements such as roadside features (e.g. historic milestones, cast-iron pumps and post-boxes), street furniture, historic gardens, stone walls, landscapes, demesnes and curtilage features, in cases where these are not already included in the Record of Protected Structures.

P-ARH-6 Promote the retention and re-use of the vernacular built heritage through increasing public awareness of its potential for re-use and its adaptability to change.

P-ARH-7 When considering proposals to adapt vernacular buildings to meet contemporary living standards and needs, require applicants to apply the conservation principles and guidelines set out in the ICOMOS Charter on the Built Vernacular Heritage (Mexico 1999) – refer to Appendix H of this Plan.

Architectural Conservation Areas (ACA)

12.15 An Architectural Conservation Area (ACA) is a place, area, group of structures or townscape that is of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest or value, or contributes to the appreciation of Protected Structures.

12.16 There are a number of policy objectives outlined in Section 12.4.3 of the SDP in respect of architectural conservation which state:

P-ACA-1 Conserve and enhance the special character of the Architectural Conservation Areas in this plan. The special character of an area includes its traditional building stock and material finishes, spaces, streetscapes, shop fronts, landscape and setting.

P-ACA-2 Protect all buildings, structures, groups of structures, sites, landscapes and all features considered to be intrinsic elements to the special character of the ACA from demolition and non sympathetic alterations.

P-ACA-3 Promote appropriate and sensitive reuse and rehabilitation of buildings and sites within ACAs.

P-ACA-4 Require the retention of original windows, doors, renders, roof coverings, chimneys, rainwater goods and other significant features of structures of architectural heritage merit, whether protected or not.

P-ACA-5 Seek the repair and reuse of traditional shopfronts and where appropriate, encourage new shopfronts of a high quality architectural design.

P-ACA-6 Ensure that new development within or adjacent to an ACA respects the established character of the area and contributes positively in terms of design, scale, setting and material finishes to the ACA.

P-ACA-7 Promote high quality architectural design within ACAs, including redevelopment in the traditional or historicist manner, where appropriate.

P-ACA-8 Ensure that all new signage, lighting, advertising and utilities on buildings within an ACA are designed, constructed, and located in such a manner that they do not detract from the character of the ACA.

P-ACA-9 Protect and enhance the quality of open spaces within ACAs and ensure the protection and where necessary reuse of street furniture and use of appropriate materials during the course of public infrastructure schemes within ACAs.

Guidelines

12.17 The report format and some of the descriptions of effects are based on the **Guidelines on the Information to be contained in Environmental Impact Assessment Reports** (Draft), published by the Environmental Protection Agency (EPA) in May 2017.

Significant Risks

12.18 There are no known significant risks to human health or environmental effects, which may occur in relation to this cultural heritage assessment.

RECEIVING ENVIRONMENT

Study Area

12.19 The overall study area extends 1km from the application area in all directions and is shown in **Figure 12-1**.

Baseline Study Methodology

12.20 Research has been undertaken in two phases. The first phase comprised a paper survey of all available archaeological, historical and cartographic sources. The second phase involved a field inspection and archaeological assessment of the proposed development area.

Paper Study

12.21 This involves a search of relevant documents. The following sources were examined and a list of sites and areas of archaeological potential compiled:

- Record of Monuments and Places County Sligo
- The Sites and Monuments Record
- Available aerial photography
- Cartographic and written sources relating to the study area
- Sligo County Development Plan 2017-2023
- The National Inventory of Architectural Heritage

The Record of Monuments and Places

12.22 This was established under section 12 (1) of the 1994 National Monuments (Amendment) Act and provides that the Minister shall establish and maintain a record of monuments and places where the Minister believes there are monuments, such record to be comprised of a list of monuments and relevant places and a map or maps showing each monument and relevant place in respect of each county in the State. The associated files contain information of documentary sources and field inspections where these have taken place. All available information on these sites is provided in Appendix 12.1.

Cartographic Sources

12.23 This included seventeenth century mapping as well the 1st and 2nd editions of the Ordnance Survey six-inch maps and Documentary sources provide more general historical and archaeological background.

The County Development Plan

12.24 This notes structures listed for preservation.

Field Inspection

12.25 Field inspections were carried out to determine the location, extent and ascertain the significance of any archaeological sites and to identify any previously unrecorded or suspected sites and potable finds.

RECEIVING ENVIRONMENT, HISTORICAL AND ARCHAEOLOGICAL LANDSCAPE

The Landscape

12.26 The application site is located in the Townlands of Aghamore Near, Aghamore Far and Carrownamaddoo, Co. Sligo, on OS Six Inch sheet No. 20, 1.3km to the west of the N4 Dublin to

Sligo directly to the east and west of the L3603. The application site is situated in undulating countryside.

Historical and Archaeological Background

12.27 The following is a brief summation of the main types of sites and monuments that are known from the county along with the historical development of the study area. It is intended as a guide to the types of sites and monuments that might be encountered in the study area.

12.28 The site is situated in the townlands of Aghamore Near, Aghamore Far and Carrownamaddoo, in the barony of Carbury, and the civil parish of St. John's.

The Prehistoric Period

12.29 To date no prehistoric settlements or artefacts dated to the prehistoric period have been identified from the study area.

The Early Medieval Period

12.30 In the Early Medieval period (500 AD-1170 AD) the study area formed part of the Kingdom of Cenel Cairpre which was ruled by the Cairpre Mor and the Cairpre Gabra kings. By the twelfth century the Sligo part of Cenel Cairpre was known as Carbridrumclif (MacCotter 2008, 132-3).

12.31 Classically settlement at this period is indicated by the presence of enclosed farmsteads known as ringforts, when enclosed with earthen banks, and cashels when enclosed by stone walls. There are 10 ringforts and cashels known in the study area in Drumaskibbole, Tullynagracken, Carrownamaddoo and Aghamore Near townlands indicating substantial settlement in the study area during the early medieval period.

The Later Medieval Period

12.32 In 1235 Richard de Burgo, who had been granted Connacht by King Henry III, carried out the conquest of Connacht and the study area. The Manor of Sligo, containing the study area, was granted to Hugh de Lacy who granted it to Maurice Fitz Gerald (Orpen 1911-20, Vol 2, 193-7). In the fourteenth century the study area came to William de Burgo, Earl of Ulster, but after his death in 1333 control of Leyny was assumed by local lords. Later medieval Anglo-Norman settlement is often indicated by the presence of earth and timber Motte and Bailey castle and Moated sites that were constructed for defence. However, there are no examples of either site type in the study area.

The Post-Medieval Period

12.33 In the Down Survey of 1655-6 Aghamore Near was held by the Scottish Nobleman Sir Frederick Hamilton and he retained it in 1670 and Carrownamaddoo was held by Captain John Parker and he retained it in 1670 (http://downsurvey.tcd.ie). The Hamilton Estate held Aghamore into the eighteenth century which were leased to Sir ralph Gore in 1754. In 1765 Aghamore came into the hands of John Cooper (NLI Killadoon Papers MSS 36,010-36,070, 5, 25).

BUILDINGS

Protected Structures

12.34 The Sligo County Development Plan 2017-2023 and the Record of Protected Structures was examined as part of the baseline study for this chapter of the EIAR. The review established that there are no Protected Structures situated within the application area. There are no Protected structures listed within the study area.

Non-designated Structures

12.35 The National Inventory of Architectural Heritage (NIAH) which is maintained by the Dept. of Culture, Heritage and the Gaeltacht was examined as part of the baseline study for this chapter of the EIAR on the 22nd of September 2020. The review established that there are no additional structures included in the NIAH situated within the application area or the study area.

ARCHAEOLOGY

Archaeological Assessment

Recorded Monuments

12.36 Examination of the Record of Monuments and Places (RMP) for Co. Sligo indicated that the site of one Recorded Monument that has been removed, SL020-094--- Aghamore Near Enclosure, is located within the application area (see Fig. 12-1 and Appendix 12.1). This is included in the RMP as:

SL020-094--- Aghamore Near Enclosure
Shown as a hachured enclosure on the 1st edition OS 6-inch map with a road running N-S through it. A NE section of hachured enclosure is shown on the current OS 6-inch map. The site has since been removed by quarrying.

The location of this monument has been quarried down into geological strata completely removing it (see Plate 12-1). An OSI orthophoto taken in 1995 shows that the extraction had already taken place and the monument removed by that date (see Plate 12-2).

12.37 The area of notification of one Recorded Monument is slightly within the application area SL020-093--- Ringfort – cashel in Aghamore Near townland. It is described in the RMP as:

> Comprises a circular area (int. diam. 20m) enclosed by a bank (Wth 3.50m, H 0.15m) and wide external ditch (Wth 6m). There is no indication of an entrance. The site is heavily overgrown.

This monument is situated c.30m north-east of the application area and will not be directly impacted (see Plate 12-3). The setting of the monument is impacted by the existing extraction. It has an unscreened view of the existing quarry to the west (see Plate 12-4). To the north-west the view of the extraction is screened by the rising ground and existing field bank and hedgerow (see Plate 12-5).

12.38 The next closest RMP site SL020-086---- a ringfort in Carrownamaddoo townland is situated c.95m to the north-west of the application area. This and the remaining Recorded Monuments in the study area are considered too far distant to be directly or indirectly impacted by the current proposal.

Undesignated Monuments

12.39 Examination of the Sites and Monuments Record (SMR) which is maintained by the Dept. of Culture, Heritage and the Gaeltacht on 22 September 2020 indicated that there are no undesignated monument included within the application area or the study area.

Cartographic Sources

12.40 The Ordnance Survey 1st and 3rd edition six-inch maps and the first edition 25-inch maps of the area were examined. The analysis did not indicate any previously unrecorded archaeological sites in the application area or vicinity.

Place Name Evidence

12.41 The place names were extracted from the cartography in order to facilitate the search for structures and monuments and small finds, to help identify any unrecorded monuments or structures, to search for any published papers and documents related to the study area and to assist in the study of the historical development of the area. The English translations of the townland names of the study presented above below are based on Logainm.ie. The placenames mainly refer to natural and topographic features. Carns refers to a group of monuments outside the study area on Carns Hill (RMP SL014-231 – 231004)

12.42 Aghamore Near and Far: great big field
Carns: pile of rocks
Carrickhenry henry's rock
Carrownamaddoo: quarter of the dogs
Cuilbeg: small wood
Drumaskibbole: ridge of the barn
Tonafortes arable field
Tullynagracken South: hill of the skins

Previous archaeological investigations in the study area

12.43 The existing quarry development was the subject of an EIS carried out in 1996 by Frank L Benson & Partners (Reg No. 96172) that included an archaeological and cultural heritage assessment.

12.44 The existing quarry was the subject of licensed monitoring carried out by Mary Henry Archaeological Services in 2000 and 2002 the reports from Excavation.ie are presented below.

> Aghamore Near No archaeological significance 00E0757
> Monitoring was undertaken of ground disturbance at Aghamore Near, Co. Sligo. The owners of the site had obtained planning permission to extend an existing quarry into a greenfield area. One of the conditions of planning required that all groundworks be monitored. A number of archaeological sites, as recorded in the RMP for County Sligo, are close to the site of the development. However, there was no recorded monument within the confines of the part of the site being extended in late 2000.

Aghamore Near No archaeological significance 00E0757 extension
Monitoring of topsoil-stripping on a greenfield site was carried out as part of an extension to a quarry site. No archaeological remains were uncovered during the monitoring.

12.45 There has been one licensed monitoring project carried out within the study area that uncovered no archaeological material (see below).

Aghamore Near and Carns No archaeological significance 11E0084
Monitoring of the groundworks at Aghamore Near took place in May 2011. The works involved the replacement of existing pipes in the vicinity of sites SL020-093, 094 095 and SL10-238, classified as a ringfort, two enclosures and a ritual site (holy well) respectively. The trench was excavated using a JCB JC1320 machine with a 12in. toothed bucket. The excavated trench measured 0.4m (approx.) in width and was 0.8m in depth. The stratigraphy encountered during the excavation of the trench was generally uniform. A (0.1m) layer of humus was underpinned by a (0.5m) layer of gravel and deposited fill associated with the laying of the original pipe. A (0.2m) layer of natural grey clay was visible under this material. Nothing of archaeological significance was encountered during the groundworks.

12.46 There has been one geophysical survey carried out within the study area carried out by Target Archaeological geophysics (see below).

Aghamore Near, Co. Sligo 06R0161
Geophysical survey was undertaken over approximately 0.4ha of a single pasture field located in Aghamore Near townland, Co. Sligo. The survey was carried out for Readymix Plc. & The Irish Concrete Federation and has been requested as part of an Environmental Impact Assessment for a proposed quarry extension. The survey was undertaken in the location of ringfort site SL020:093. The aim of the geophysical survey was to gain detailed locational information on the nature form and extent of buried archaeological features within and at the perimeter of RMP SL020:093. No definitive archaeological type responses were identified from survey. It is expected that where buried archaeological remains are present within the investigation area they are likely to remain beyond detection due to the levels of natural variation recorded.

County Development Plan

12.47 No sites of archaeological importance, National Monuments, or protected structures listed in the Sligo Development Plan 2017-23 are located within the proposed development area.

Aerial Photographs

12.48 Examination of the Ordnance Survey 1995, 2000 and 2005 imagery as well as Google earth imagery from 2006, 2009, 2014, 2018, 2019 and 2020 and Bing imagery from 2016 did not indicate any additional cultural heritage sites in the application area.

Field Assessment

12.49 Field inspections were carried out on the 1st of May 2018 and the 25th of November 2020 in an attempt to identify any previously unknown archaeological or cultural heritage sites.

12.50 Area 1

This is the existing area of extraction with an entrance road from the L3603. that has already been assessed under Planning Application Reg. No. 02/271 (see Plate 12-6 and 12-7 and Fig. 12-1). There is no indication of any cultural heritage material.

Area 2

This is a quadrilateral-shaped area in the northern part of the application area. The entire area has been stripped of topsoil and subsoil down to the bedrock and the soil is stored in the northern part of the area (See Plate 12-8). There is no indication of any cultural heritage material.

Area 3

This is a hexagonal-shaped area of south-sloping pasture, enclosed by hedgerow, in the south-east part of the application area (See Plate 12-9). There is no indication of any cultural heritage material.

Area 4

This is a triangular-shaped overgrown area north of the entrance road (See Plate 12-10). There is no indication of any cultural heritage material.

Area 5

This is a polygonal-shaped north-sloping overgrown area south of the entrance road (See Plate 12-11). There is no indication of any cultural heritage material.

Area 6

This is the existing quarry processing area with access roads that is situated east of the extraction area and east of the L3603 (See Plate 12-12). There is no indication of any cultural heritage material.

ASSESSMENT OF POTENTIAL IMPACTS

Direct Impacts

12.51 There will be no direct impacts on any known items of archaeology, cultural heritage or buildings of heritage interest in the application area.

12.52 The existing extraction has some impact on the setting of RMP SL020-093--- Ringfort – cashel.

Indirect Impacts

12.53 There will be no indirect impacts on any known items of archaeology, cultural heritage or buildings of heritage interest in the application area or the vicinity.

Interactions with Other Impacts

12.54 No interaction with other impacts has been identified.

Do Nothing Impacts

12.55 If the proposed development were not to proceed there would be no negative impact on the cultural heritage.

Worst Case Impact

12.56 In the worst case scenario, the development might disturb previously unknown deposits or artefacts without preservation by record taking place in the unextracted green field area 3.

RECOMMENDATIONS / PROPOSED MITIGATION MEASURES

Direct Impacts

12.57 Due to the possibility of the survival of previously unknown subsurface archaeological deposits or finds within the unstripped part of the green field area 3 topsoil-stripping in this area should be archaeologically monitored.

12.58 The impact on the setting of RMP SL020-093--- Ringfort – cashel should be mitigated by the construction of a landscaped screening berm on the east side of the quarry where it faces the monument, and the retention of the field bank and hedgerow to the north.

Indirect Impacts

12.59 No indirect impacts warranting specific mitigation were identified during the course of the cultural heritage assessment.

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PLATES

Plate 12-1

View of the location of RMP SL020-094--- Aghamore Near Enclosure and the existing application site access road. The area has been extracted down to geological levels completely removing the monument.

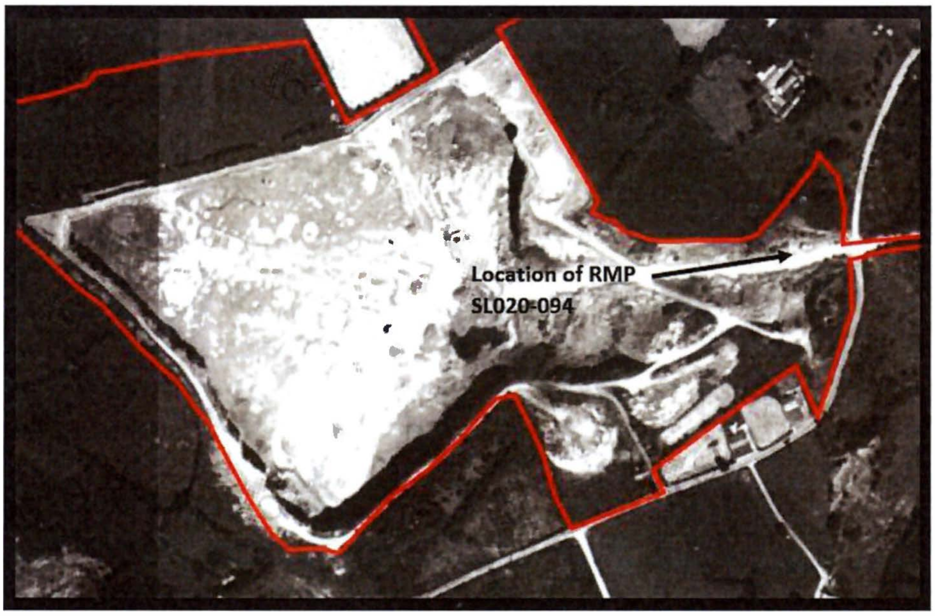

Plate 12-2

OSI 1995 Air Photo that indicates that the location of RMP SL020-094--- Aghamore Near Enclosure had already been extracted by 1995

Plate 12-3
View of RMP SL020-093--- Ringfort – cashel looking north-east.

Plate 12-4
View from RMP SL020-093--- Ringfort – cashel looking south-west to the quarry.

Plate 12-5
View from RMP SL020-093--- Ringfort – cashel looking north-west.

Plate 12-6
2020 Google earth Aerial image showing the application area (red line) with the fieldwork areas numbered.

Plate 12-7
Area 1 Panoramic view of the existing extraction area looking west.

Plate 12-8
Panoramic view of area 2 looking north-west.

Plate 12-9
View of area 3 looking south-west.

Plate 12-10
View of area 4 looking south-west.

Plate 12-11
View of area 5 looking east.

Plate 12-12
Panoramic view of area 6 looking south.

FIGURES

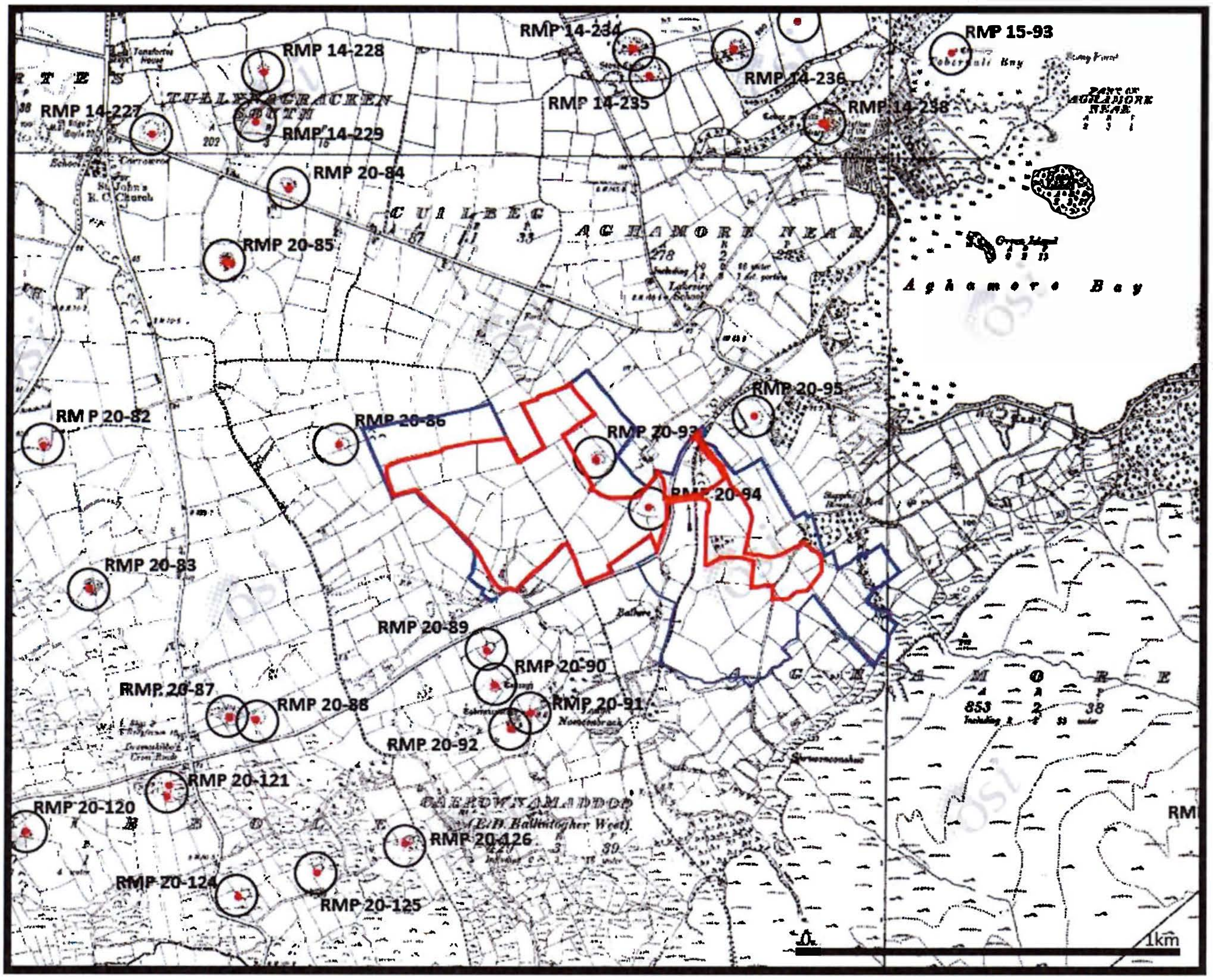

Figure 12-1

The study area. RMP sites are indicated with black circles. The application area is indicated with a red line and the landholding with a blue line.

APPENDICES

Appendix 12-1
Sites in the Record of Monuments and Places

SL014-227--- Tullynagracken South Ringfort – rath
In undulating pasture to the SE of the Sligo-Dublin road. An oval area (25m N-S; 32m E-W) is enclosed to the N and NE by an earth and stone bank (int. H 0.2m; ext. H 0.94m; Wth 1.6m) and from NE to SW by a scarp (H 1.27m). There is no fosse. The entrance (Wth 3.6m) is located to the N.

SL014-227--- Tullynagracken South Enclosure
No information in file.

SL014-229--- Tullynagracken South Earthwork
No information in file.

SL014-234001- Carns Ringfort - cashel
In undulating pasture on high ground, with rising ground to N. The cashel and possible souterrain are mentioned by Wood-Martin and Milligan, but the extant remains are poorly preserved. An oval area (21m NE-SW) is enclosed by a bank (int. H 0.25m; ext. H 0.38m; Wth 1.6m) from NW to SE and by a scarp (H 0.88m) elsewhere. There is no fosse. There is a possible entrance (Wth 1.6m) in the SE.

SL014-234002- Carns Souterrain
A possible souterrain is located to the E of Carns cashel (SL014-234001-), in an area of heavy undergrowth. The site consists of a rectangular cut in bedrock (L 4.1m; Wth 1.43m; D 1.1m), orientated E-W. The cut is three sided (N, E and S) and its possible terminus to the W could not be examined because of dense vegetation. There is no trace of cap stones and the site has been recently used to burn refuse.

SL014-235001- Carns Souterrain
A souterrain recorded within a cashel (SL014-225001-) by Wood-Martin and Milligan was no longer recognisable in 1994 (SMR (1989) file). The cashel has become very overgrown with scrub in the intervening period and no traces of this potential monument was identified.

SL014-235002- Carns South Ringfort - cashel
On S slope in a field in pasture. A field report dating to 1994 recorded 'an oval raised area (int. dims. 30m N-S; 40m E-W), which has been nearly reduced to surrounding ground level in places. No indication of a wall, but large stones have been incorporated into nearby field walls.' (SMR (1989) file). However the site has become very overgrown in the intervening period and there are no remains now visible at ground level.

SL014-236--- Carns South Ringfort - cashel
In dense hazel scrub, on S downslope at edge of a field of pasture. A cashel is mentioned by Wood-Martin and Milligan but because of the dense overgrowth it did not prove possible to locate it precisely.

SL014-237--- Carns South Enclosure
On a S-facing slope in undulating pasture. An enclosure was identified on an aerial photograph (GSI G 32-3, Roll 169, Print 20). It is not marked on any edition of the OS 6-inch map and there are no remains visible remains at ground level.

SL014-238---- Aghamore near Ritual site - holy well
In a wooded area, beside a N-S flowing stream, on the S side of a steep wooded hill. This holy well is called 'Tobernalt'. It is enclosed within a circular setting (diam. 2.15) defined by a stone wall (H 2.27m; wall T 0.5m),

which has an entrance to the SE (Wth 0.63m). The surrounding area has been landscaped. There is what is known locally as a 'Mass Rock' or altar (SL014-238002-) 5.5m to the SE of the well. Among plaques of modern date, affixed to the internal walls of the holy well, is a sandstone cross (H 0.43m; W 0.19m; T 0.06m), with a circular head. The site also contains statues and stations of the cross of modern date. A holly tree hung with votive offerings and rags stands on high ground to the NW of the holy well. Locally it is said that the mass rock was used to say mass in penal times and there has been a revival in recent years, with an annual mass being said by the Bishop of Elphin at 6am on Garland Sunday (last Sunday in July). Though no cures were recorded, it is locally believed that the waters of the stream cure blindness. The holy well is very well attended at all times.

SL014-238001- Aghamore near Cross
This sandstone ringed cross is set in the wall above the holy well named 'Toberan Aillt' on the OS 6-inch map together with plaques of modern date. It measures 0.43m h, 0.19m W and is 0.06m T. with a circular head. The cross is probably not older than the 20th century in date.

SL014-238002- Aghamore near Mass-rock
In a wooded area c.5.5m SE of 'Tobernalt' holy well. Almost square, flat-topped structure (dims. 1.3m N-S; 1.16m E-W; H 0.95m) constructed of unworked stones of various sizes. Concrete has been applied to the sides and top in relatively modern times. This is known locally as a Mass Rock or Penal Altar.

SL015-093---- Lough Gill Crannog
No information in file.

SL020-082---- Carrickhenry Enclosure
Located in undulating pasture planted with trees. Comprises an oval raised area (int. diams. 16m by 16.50m, H 2.50m) conical in section and enclosed by a low and broad bank (Wth 2m, H 2m) with an entrance gap (Wth 4m) but no indication of a ditch.

SL020-083--- Drumaskibbole Ringfort – rath
Located on a rise in undulating ground in pasture. Comprises an oval raised area (int. diam. 33m E-W by 20m N-S) enclosed by a low and broad bank of earth and stone (Wth 2m, H 0.50m). The entrance is on the W (Wth 2m) where a stretch of bank sweeps down off the site onto the level of the field. No indication of a ditch.

SL020-084001- Tullynagracken South Ringfort – rath
Located on a gentle S facing slope in flat to undulating ground in rough pasture. It overlooks the Ox Mountains and Knocknarea. Comprises a roughly circular raised area (int. diam. 22m). This is enclosed by a stone wall with an entrance on the S defined by a pair of upright stones. There is a hut in the interior (SL020-084002-OPW file).

SL020-084002- Tullynagracken Hut site
Located on a gentle S-facing slope in flat to undulating ground in rough pasture. Comprises a rectangular hut (int. dims. 5m by 4m) defined by a wall footing of upright stones with an entrance on the E situated within a cashel (SL020-084001-).

SL020-085001- Tullynagracken South Ringfort – rath
Located just off the summit of a ridge in undulating pasture with views onto the Ox Mountains and Knocknarea. Comprises a circular raised area (int. diam. 21m) enclosed by a bank (Wth 2.70m, H 0.60m) which has been removed in the N. There is an annex (int. diam. 7m) on the E enclosed by a badly preserved stone wall. No indication of a ditch or entrance.

SL020-085002- Tullynagracken South Enclosure

Located just off the summit of a ridge in undulating pasture with views onto the Ox Mountains and Knocknarea. There is an annex (int. diam. 7m) on the E of a cashel (SL020-085001-) which is enclosed by a badly preserved stone wall. No indication of a ditch or entrance.

SL020-086--- Carrownamaddoo Ringfort – rath
In pasture, on gently elevated ground, in undulating terrain. Raised, roughly circular area (26m E–W; 23.5m N–S) defined by a scarp (ext. H 1.2m at W; ext. H 1.6m at E). At SE–SW the scarp is incorporated into a field fence/property boundary which respects the curve of the rath. At W the scarp is topped with a low stony rim (Wth 1m), possibly wall footings. Elsewhere along the top of the scarp, a few stones are visible, barely protruding above the sod. Stones also protrude randomly in parts on the external slope of the scarp. The SW quadrant of the interior is slightly raised above the rest of the interior. In the E half of the interior, there is a slight slope down to E mirroring the contours of the low rise on which the rath is sited. There is a low stony rise (max. dim. c. 1.3m) slightly NE of centre in the interior.

SL020-087--- Drumaskibbole Ringfort – rath
Roughly circular area (int. diam. 24m) enclosed by a broad bank, external ditch and outer bank. There is an entrance in the SE part of the inner bank with a corresponding causeway through the ditch.

SL020-088--- Drumaskibbole Ringfort – rath
Circular raised area (int. diam. 26m) enclosed by a low, broad bank and an external ditch. On the E side the site has been partly embanked. There is an entrance gap in the SE.

SL020-089--- Carrownamaddoo Ringfort – rath
Oval raised area, heavily overgrown, and enclosed by a bank and external ditch. There is an entrance gap in the NE.

SL020-090--- Carrownamaddoo Children's burial ground
Identified as 'Caltragh' on the Current OS 6-inch map. Comprises a rectangular platform (int. dims. 25m by 25m, H 2.35-3m) composed of earth and stone and internally sloping. This is defined by a rectangular stone and earth field boundary at ground level.

SL020-091--- Carrownamaddoo Ritual site - holy well
Identified as 'Tobernacaltragh' on the 1st edition OS 6-inch map. Located along the course of a stream bed. There are no visible surface remains.

SL020-092--- Carrownamaddoo Ringfort – rath
Indicated as a roughly circular hachured area on the current OS 6-inch map. Comprises a circular, heavily overgrown area, enclosed by a bank. There are no indications of a ditch.

SL020-093--- Aghamore Near Ringfort – rath
Comprises a circular area (int. diam. 20m) enclosed by a bank (Wth 3.50m, H 0.15m) and wide external ditch (Wth 6m). There is no indication of an entrance. The site is heavily overgrown.

SL020-094--- Aghamore Near Enclosure
Shown as a hachured enclosure on the 1st edition OS 6-inch map with a road running N-S through it. A NE section of hachured enclosure is shown on the current OS 6-inch map. The site has since been removed by a quarrying.

SL020-095--- Aghamore Far Enclosure
The monument is not represented on the OS 6-inch 1st edition (1837). It is depicted on the OS 25-inch plan (1909) as a raised (potentially circular) area represented on the east by an arc of hachures; this appears to

indicate a possible enclosure. Houses have been built on the site which predate 1995 as they are shown on the OSI photo for that year.

SL020-120--- Drumaskibbole Enclosure
Located on a rise overlooking a stream in undulating pasture. Comprises a rectangular area (int. diam 20m) enclosed by a low wall of boulders. There is an entrance gap in the N. No indication of a ditch. Probably an animal pen.

SL020-121001- Drumaskibbole Enclosure
Situated on a S-facing slope in pasture. Identified on an aerial photograph (ACP V 203/111 -2; Roll 177, pr. 19) as an irregularly shaped enclosure with associated field system (SL020-121002-). There are no surface remains.

SL020-121002- Drumaskibbole Field boundary
A field system of small irregular-shaped fields extending to N and NE of a possible enclosure (SL020-121001-) was identified on an aerial photograph (ACP V203/111-2). There are no visible surface remains.

SL020-124--- Drumaskibbole Ringfort – rath
Located at the end of a ridge in undulating pasture with views onto Ballysadare Bay and Knocknarea. Comprises an oval raised area (int. diam. 24.60m E-W, 18.30m N-S.). It is enclosed by a mostly degraded bank (Wth 2.20m, H 0.20m). The entrance may be located in the SE. No indication of a ditch.

SL020-125--- Drumaskibbole Ringfort – cashel
Located on the top of an elongated steep-sided ridge in pasture. Comprises a circular area (int. diam. 20m) enclosed by a wall which survives as a foundation coarse of large boulders (Wth 2.80m, H 0.40m) with a more modern field wall built along it. The entrance is in the SW. Field boundaries run off the site on the N and SE.

SL020-126--- Drumaskibbole Ringfort – cashel
Located on an E-W running ridge with steep sides in pasture. Comprises an oval raised area (int. diam 19.50m) enclosed by a mostly ruined stone wall of which the inner and outer facing of the foundation course survives (Wth 2m, H 0.65m). The entrance is in the NE (Wth 2.60m) and a section of field wall is attached to the cashel wall on the N.

LAGAN

Part of the Breedon Group

13. Landscape

CHAPTER 13

LANDSCAPE

CONTENTS

TABLES

FIGURES

INTRODUCTION

Background

13.1 This chapter if the EIAR assesses the landscape and visual impacts arising from the proposed development at Aghamore Near, Aghamore Far and Carrownamaddoo townlands, Co. Sligo.

13.2 Aghamore Quarry is located along the local road south west of the settlement of Aghamore, 200m south of the R287 – Regional Road and approximately 4km south of the centre of Sligo town. The existing quarry development consists of a large extraction area located on the western side of this local road, together with an associated processing area, located on the eastern side of the road. This planning application concerns the recommencement of the existing quarry development, and the deepening of the existing extraction area to a depth of -50m OD, the construction of a settlement lagoon, as well as the recommencement of processing activities within the processing area to the east of the local road, within an overall application area of c. 22.5 hectares. Further details on the proposed development are contained in chapter 2 of this EIAR.

Scope of Work / EIA Scoping

13.3 The draft EPA guidelines in relation to the preparation of an EIAR[1] suggest the following typical headings that may be included in respect of the prescribed environmental factor 'The Landscape':

- Landscape Appearance and Character;
- Landscape Context;
- Views & Prospects; and
- Historical Landscapes.

13.4 These headings are incorporated in the below assessment, as appropriate. However, in the absence of more detailed Irish guidance, the overall scope of work of this 'Landscape' chapter is based on the information contained in the third edition of the *Guidelines for Landscape and Visual Impact Assessment* issued by the Landscape Institute and Institute of Environmental Management & Assessment[2] (hereafter referred to as GLVIA3).

13.5 GLVIA3 emphasises that landscape and visual effects are related but independent issues; landscape effects are changes in the landscape, its character and quality, while visual effects relate to the appearance of these changes and the resulting effect on visual amenity. The scope of work covered by this assessment can be summarised as follows:

- a description of the planning context relevant to this Landscape and Visual Impact Assessment (LVIA) (i.e. the Regulatory Background);

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[1] Environmental Protection Agency (2017). Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. Draft dated August 2017. Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford

[2] Landscape Institute and Institute of Environmental Management & Assessment (2013) *Guidelines for Landscape and Visual Impact Assessment*. Third Edition, Routledge.

- a description of the landscape and the visual baseline, including the identification of relevant landscape and visual receptors (i.e. the Receiving Environment);
- a description of the aspects of the development which are likely to cause landscape and those likely to cause visual effects, an assessment of landscape and visual receptor sensitivity and the magnitude of the landscape and visual effects, as well as their combined level of significance (i.e. the Impact Assessment);
- a description of additional measures required to reduce/avoid any significant landscape and visual effects identified (i.e. the Mitigation Measures); and
- a summary of the degree of the landscape and visual effects, following the implementation of the mitigation measures (i.e. the Residual Impact Assessment).

13.6 Wherever possible, identified effects are quantified, however the nature of landscape and visual impact assessment requires interpretation by professional judgement. Please refer to **Appendix 13-A** at the end of this chapter, for the detailed methodology used in this assessment, which is illustrated by the following Figures:

- **Figure 13-1**: Landscape Baseline and Viewpoint Locations;
- **Figure 13-2**: Zone of Theoretical Visibility (ZTV) Map;
- **Figure 13-3**: Viewpoints A & B;
- **Figure 13-4**: Viewpoints C & D; and
- **Figure 13-5**: Viewpoints E & F.

Consultations / Consultees

13.7 A number of pre-planning consultation meetings have been held between officials of Sligo County Council and representatives of SLR Consulting Ireland and Lagan Materials Limited.

13.8 At the meetings, details of the proposed development were presented and issues likely to be of interest or concern were identified and discussed.

13.9 Following a review of published development plans and the site survey, it was considered that there was no requirement for a separate formal consultation to be carried out regarding the potential landscape and visual effects of the proposed development.

Contributors / Author(s)

13.10 The assessment including site work and completion of figures was carried out by Anne Merkle, an Associate Landscape Architect with SLR Consulting Ireland. Anne graduated from the University of Applied Sciences in Nürtingen (Germany) in Landscape Architecture (Dipl.-Ing. (FH)), in 2002. She has since gained 18 years' experience working for landscape consultancies in Ireland, specialising in Landscape and Visual Impact Assessments for a wide range of projects, including quarries, waste recovery facilities, wind farms, powerlines and mixed developments. In 2017, Anne completed an

MSc in Biodiversity and Land Use Planning (at NUIG). She is a full member of the Irish Landscape Institute (MILI) since 2005.

Limitations / Difficulties Encountered

13.11 No difficulties were encountered during the desktop study, field survey or in the preparation of this report.

ADDITIONAL INFORMATION

13.12 As outlined in Chapter 1, a planning application was submitted to Sligo County Council (Plan File Ref. No. 18/345 / ABP Ref. 305821-19) in August 2018 for similar development to that proposed as part of this application. In October 2019 Sligo County Council granted planning permission for the development (subject to 23 no. conditions). 2 no. third party appeals of the decision by Sligo County Council to grant permission for the proposed quarry development were made to An Bord Pleanala (ABP-305821-19). An Bord Pleanala refused permission for the proposed development on the 30th June 2020 for the 2 no. reasons – refer to Chapter 1 for further details.

13.13 In order to comprehensively address the reasons for refusal, and further comments contained within the An Bord Pleanala Inspectors Report a number of additional surveys / site investigations, field work and assessments have been carried out.

13.14 This Chapter 13 of the EIAR has been updated as follows:

- Additional field surveys have been undertaken.
- The landscape and visual impact assessment has been updated to take account of the revised planning application area to include the aggregate processing area that lies to the east of the local road and bisects the application site. For example, the zone of theoretical visibility has been updated for the revised application area.

REGULATORY BACKGROUND

13.15 The following paragraphs set out the regulatory background with regard to LVIA in Ireland in general and the site-specific planning background relevant to the proposed development, in particular.

Legislation

13.16 There is no specific legislation relevant to this section of the EIAR. However, the information provided within this chapter is informed by the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018[3].

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[3] European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018: http://www.irishstatutebook.ie/eli/2018/si/296/made/en/pdf

13.17 Also, Ireland ratified the European Landscape Convention[4], which promotes the protection, management and planning of landscapes. The National Landscape Strategy for Ireland 2015-2025[5] was published "to ensure compliance with the European Landscape Convention and establish principles for protecting and enhancing the landscape while positively managing its change".

13.18 Article 1a of the European Landscape Convention defines landscape as *"an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors"*. This definition has been included in the Planning and Development (Amendment) Act 2010, along with the requirement that objectives relating to landscape shall be included in development plans.

Planning Policy and Development Control

13.19 The Sligo County Development Plan 2017-2023 (SCDP)[6] is the statutory plan detailing the development objectives/policies of the authority. Those policies/designations, with relevance to this assessment, are listed below. Refer to **Figure 13-1** – Landscape Baseline and Viewpoint Locations for the location and extent of the relevant designations.

13.20 In addition, the National Parks and Wildlife Service (NPWS) website[7] was reviewed for protected nature conservation sites in proximity to the application area.

Landscape

13.21 Chapter 7 of the SCDP contains policies and objectives in relation to landscape. Section 7.4.3 of the Sligo CDP 2017-2023 refers to the Landscape Characterisation Map which formed part of previous County Development Plans including the CDP 2011-2017. This categorises the County's landscapes according to the following:

13.22 Normal Rural Landscapes: *"areas with natural features (e.g. topography, vegetation) which generally have the capacity to absorb a wide range of new development forms – these are largely farming areas and cover most of the County. At the same time, certain areas located within normal rural landscapes may have superior visual qualities, due to their specific topography, vegetation pattern, the presence of traditional farming or residential structures. These areas may have limited capacity for development or may be able to absorb new development only if it is designed to integrate seamlessly with the existing environment."*

13.23 Sensitive Rural Landscapes: *"areas that tend to be open in character, highly visible, with intrinsic scenic qualities and a low capacity to absorb new development – e.g. Knocknarea, the Dartry Mountains, the Ox Mountains, Aughris Head, Mullaghmore Head etc."*

13.24 Visually Vulnerable Areas: *"distinctive and conspicuous natural features of significant beauty or interest, which have extremely low capacity to absorb new development - examples are the Ben Bulben plateau, mountain and hill ridges, the areas adjoining Sligo's coastline, most lakeshores etc."*

13.25 Policies of relevance to this assessment contained in the Sligo CDP 2017-2023 are outlined below.

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[4] European Landscape Convention: https://www.coe.int/en/web/conventions/full-list/-/conventions/rms/0900001680080621

[5] National Landscape Strategy for Ireland 2015-2025: https://www.chg.gov.ie/app/uploads/2015/07/N-Landscape-Strategy-english-Web.pdf

[6] Sligo County Development Plan 2017-2023: https://www.sligococo.ie/cdp/

[7] National Parks and Wildlife Service: https://www.npws.ie/

13.26 **Policy P-LCAP-1:** *"Protect the physical landscape, visual and scenic character of County Sligo and seek to preserve the County's landscape character.*

Planning applications that have the potential to impact significantly and adversely upon landscape character, especially in Sensitive Rural Landscapes, Visually Vulnerable Areas and along Scenic routes, may be required to be accompanied by a visual impact assessment using agreed and appropriate viewing points and methods of assessment."

13.27 **Policy P-LCAP-2**: *"Discourage any development that would be detrimental to the unique visual character of designated Visually Vulnerable Areas."*

13.28 **Policy P-LCAP-4**: *"Strictly control new development in designated Sensitive Rural Landscapes while considering exceptions that can demonstrate a clear need to locate in the area concerned. Ensure that any new development in designated Sensitive Rural Landscapes:*

- *does not impinge in any significant way on the character, integrity and distinctiveness of the area;*
- *does not detract from the scenic value of the area;*
- *meets high standards of siting and design; and*
- *satisfies all other criteria with regard to, inter alia, servicing, public safety and prevention of pollution."*

Scenic Routes and Protected Views

13.29 The CDP refers to Scenic Routes as *"public roads passing through or close to Sensitive Rural Landscapes, or in the vicinity of Visually Vulnerable Areas, and affording unique scenic views of distinctive natural features or vast open landscapes. In addition to remote views, scenic routes have often a distinctive visual character conferred by old road boundaries, such as stone walls, established hedgerows, lines of mature trees, adjoining cottages or farmyards together with their traditional, planted enclosures etc., all of which warrant protection."*

13.30 The Policy in regard to Scenic Routes is set out in **Policy P-LCAP-3** which states *"Preserve the scenic views listed in Appendix F and the distinctive visual character of designated Scenic Routes by controlling development along such Routes and other roads, whilst facilitating developments that may be tied to a specific location or to the demonstrated needs of applicants to reside in a particular area. ..."*

13.31 The Scenic Routes with Scenic views to be preserved as documented in the SCDP under Policy P-LCAP-3 that occur within the study area are tabulated below and illustrated in **Figure 13-1 – Landscape Baseline and Viewpoint Locations**.

Table 13-1
Scenic Routes

ID	Name	View Details
4	N4 Collooney By-Pass from northern roundabout at Collooney to Carrowroe.	Views of Ballysadare Bay, Knocknarea, Union Wood, Slieve Daeane, Slieve Dargan.

ID	Name	View Details
12	R284 from Carrowroe to junction with road L-3605 north of Ballygawley.	Views of Ballygawley Lough, Slieve Dargan and Slieve Daeane.
14	R287 from Carrowroe to junction with road L-3605 at Correagh.	Views of Lough Gill, Slish Wood, Slieve Dargan, Slieve Daeane and Killery Mountain.
36	L3602 along Garvoge River and Lough Gill from Sligo to junction with R287	Views of Garvoge River and Lough Gill.

Extractive Industry Policy

13.32 Section 4 of the CDP contains a number of relevant policies with regard to the extractive industry as follows.

13.33 **Policy P-MEQ-2** *"Ensure that extraction and associated processes are carried out in a sustainable manner, which minimises the impact on residential amenities, natural environment and water quality, and do not impinge on existing rights-of-way or walking routes."*

13.34 **Policy P-MEQ-3** *"Seek the reuse of worked out quarries for recreational, industrial, ecological and other uses, following appropriate restoration."*

Protected Structures

13.35 Chapter 12 of this EIAR documents the assessment of effects on protected structures within the study area.

Protected Nature Conservation Sites

13.36 A number of protected sites are located within the study area. The closest of these is the Lough Gill Special Area of Conservation (SAC) and proposed Natural Heritage Area (pNHA), which is located approximately 365m northeast of the application area. The Ballygawley Lough pNHA is located approximately 2.5km south west of the site. Further detail on these sites is provided in EIAR Chapter 4 – Biodiversity.

Guidelines

13.37 This landscape and visual impact assessment was undertaken based on the Landscape Institute and Institute of Environmental Management & Assessment **Guidelines for Landscape and Visual Impact Assessment (Third Edition**, 2013, published by Routledge; hereafter referred to as GLVIA3).

13.38 The report format and some of the descriptions of effects are based on the **Guidelines on the Information to be contained in Environmental Impact Assessment Reports** (Draft), published by the Environmental Protection Agency (EPA) in August 2017.

Technical Standards

13.39 Photography and visual representations are based on the Landscape Institute – Technical Guidance Note 06/19 – 'Visual Representation of Development Proposals'. However, since there is no Irish standard/guidance and in our experience a less stringent approach to visual representations is acceptable in Ireland, it is considered sufficient to provide annotated viewpoint photography only (i.e. Type 1 in said guidance), despite this LVIA forming part of an EIAR. It is further considered sufficient to illustrate two viewpoints on one A3 sized sheet.

13.40 No other specific technical standards were referred to as part of this landscape and visual impact assessment.

Significant Risks

13.41 There are no known significant risks to human health or environmental effects, which may occur in relation to this landscape and visual impact assessment.

RECEIVING ENVIRONMENT

Study Area

13.42 A study area of approximately 3km surrounding the application area was identified following the desk top study and the preparation of the zone of theoretical visibility (ZTV) mapping (refer to **Figure 13-2**). It should be noted that the visual envelope, i.e. the area from where the application site is visible, was found to be smaller than the 3km radius study area, due largely to the visual screening afforded by existing topography and vegetation.

Baseline Study Methodology

13.43 Refer to **Appendix 13-A** at the end of this chapter for information on the selection of landscape and visual receptors.

Viewpoints

13.44 Refer to **Figures 13-3**, **13-4 & 13-5** for the six selected representative and illustrative viewpoints (VP A-F). All photographs were taken in November 2020, using a Nikon D610 digital SLR camera, with a fixed 50mm lens. The nature of some of the views was of relatively wide panoramas and it was, therefore, considered beneficial to present the photographs in this way. The panoramic views consist of two to four photographic frames merged together using *Adobe Photoshop* software. It should be noted that photography is a tool to assist in the visualisation process and cannot be expected to replicate the actual view that would be attained on the ground.

Sources of Information

13.45 The desktop study and field work were supported by, *inter alia*:

- Sligo County Development Plan 2017-2023;
- digital as well as paper (Ordnance Survey Ireland) mapping at different scales; and
- information available on the internet (such as information on recreational facilities and nature conservation sites).

Field Survey

13.46 A detailed site survey was carried out on 26th November 2020 in partially cloudy, but bright conditions. Visibility was good. The assessment concentrated on the publicly accessible areas such as the road and public footpath networks, residential and outdoor recreational areas.

Landscape Baseline

Landscape Character of the Application Site and its surroundings

13.47 The application area is located south west of the small settlement of Aghamore, west of Aghamore Bay on the westernmost edge of Lough Gill. It comprises an existing quarry void and processing area, set within farmland at elevations ranging from 15m AOD withing the processing area, up to 34m AOD along the western boundary of the quarry. The site, together with much of the farmed landscape of the Study Area is categorised as a Normal Rural Landscape according to the Landscape Characterisation Map in the SCDP. A number of overhead powerlines cross the farmland close to the western site boundary. Two regional and several local roads featuring individual and clusters of dwellings surround the site. The regional road are the R287 located approximately 190m to the north east of the site and the R284 540m to west.

Landscape Character of the study area

13.48 The landscape immediately surrounding the site and in the much of the northern and western part of the study area comprises undulating farmland with a variable field pattern which is well defined by hedgerows with individual mature trees. Approximately 1.5km to the north, the suburban edge of the town of Sligo, featuring residential areas and some larger scale buildings associated with industrial or commercial uses are present. Elevation in the farmed landscape within the study area varies between approximately 30m in the vicinity of the application area to just over 100m AOD, 1.5km to the north. A number of overhead powerlines extend south and south west across the landscape from an existing substation on the R287 regional Road. The farmland and suburban areas are categorised as a Normal Rural Landscape.

13.49 The eastern part of the study area features the Lakeland landscape associated with Lough Gill which is fringed with mature wooded vegetation. Much of the shoreline is categorised as a sensitive rural landscape, with some sections also classed as Visually Vulnerable.

13.50 The southern part of the study area features an upland landscape associated with Slieve Dargan and Slieve Daeane and associated summits which collectively form a ridgeline with a south west to north east orientation. This mountain ridgeline overlooks Lough Gill, specifically Aghamore Bay and also the application site from the south and comprises rough terrain with rock outcrops and scant woody vegetation reaching maximum elevations of 263 and 275m AOD at Slieve Dargan and Slieve Daeane respectively. The whole mountain range is categorised as a Sensitive Rural Landscape, while the ridgelines are categorised as Visually Vulnerable. This area presents a dominating, distinctive skyline backdrop to the farmland to the north and Lough Gill.

Outdoor Recreational Facilities within the Study Area

13.51 The North West Trail Cycle Route (http://www.cycleni.com/102/north-west-trail/) passes the application area within 240m to the east, as it follows the roads along the shores of Lough Gill.

13.52 The Sligo Way long distance walking route passes the application area approximately 1.5km to the south east. It should however be noted that this walk is entirely located to the south east of the ridgeline formed by Slieve Dargan, Slieve Daeane and other highpoints, i.e. the side facing away from the application area.

13.53 A number of other local signposted walking routes are located within the 3km study area, along the shores of Lough Gill.

Visual Baseline

General Visibility

13.54 The visibility of the application area was initially assessed by a desktop study of OSI Discovery Maps (1:50,000) and available aerial photography. This was followed by 3D computer modelling and calculation of the zone of theoretical visibility (ZTV), using LSS (McCarthy Taylor) software, in accordance with the methodology provided in **Appendix 13-B** at the end of this section.

13.55 The ZTV was calculated for both the proposed deepened extraction area, as well as the section of the processing area included within the application area. It should be noted that the ZTV mapping is based on a bare terrain; that is, the computer model does not include built structures or vegetation, with the exception of the vegetation immediately surrounding the site, which was included on this occasion. Therefore, while the ZTV illustrates the screening provided by the site boundary vegetation, the extent of visibility which is illustrated would be further reduced if buildings and vegetation in the wider area were included in the model.

13.56 In SLR's experience, views from within areas with a visibility of a subtended vertical angle of up to 0.4 degrees tend to be screened by hedgerows and other vegetation (if present) and/or built structures in an urban environment. These areas are, therefore, coloured in shades of grey on the ZTV mapping, in order to differentiate them from the other areas of more probable visibility, which are marked in shades of yellow, orange and red.

13.57 The resulting ZTV is depicted on **Figure 13-2** and indicates that the application area is potentially most visible from the mountain landscape associated with Slieve Dargan and Slieve Daeane, up to 2km to the south and east of the site and from the elevated areas at the southern edge of Sligo Town, in the vicinity of Tullynagracken and Carns, within 2km to the north of the site. It should be noted that large parts of these aeras of visibility cover inaccessible steep mountain slopes and not publicly accessible farmland.

13.58 The ZTV further indicates potential visibility of the application area, albeit to a lesser extent, from locations within 2km to the north west and south west, as well as up to 5km to the north east on Lough Gill (i.e. areas in shades of grey). During the site survey it was confirmed that due to dense hedgerows within the farmland areas to the north west and south west and due to abundant woodland vegetation on the south western shores of Lough Gill, there is no inter-visibility between the application area and these areas shaded in grey. This is illustrated by **Viewpoint F** on **Figure 13-5.**

13.59 The site survey further revealed that roadside/intervening vegetation restricts views of the application area in many of the areas shaded in yellow, orange and red on the ZTV mapping. A small section of the application area, however neither the existing quarry, nor the processing area, is visible from a short section of the local road to the south west of the site entrance (refer to **Viewpoint A** on **Figure 13-3**).

13.60 The upper sections of the existing quarry void are visible from a number of locations along and in the vicinity of the local road heading in a north western direction towards Sligo town from the settlement of Aghamore (i.e. the L3602). In these views the existing processing area is screened by intervening vegetation (refer to **Viewpoints B, C & D** on **Figures 13-3 & 13-4**).

13.61 In a number of views along the local road to the south of the highpoint in the townland of Carns, approximately 1.3km north of the application area, the upper sections of the existing quarry void, as well as parts of the processing area are visible (refer to **Viewpoint E** on **Figure 13-5**).

13.62 Due to the bare rocky terrain on the northern slopes of Slieve Dargan and Slieve Daeane, the existing quarry void and processing area are expected to be openly visible, as indicated by the ZTV mapping (refer to **Figure 13-2**). However, due to the inaccessibility of this area, this could not be confirmed. At the same time, this inaccessibility ensures that there are no visual receptors affected in this area.

Sensitive Receptors

Landscape Receptors

13.63 The components of the landscape that are likely to be affected by the proposed development, i.e. the landscape receptors, are the:

- **undulating farmland landscape** of the site and to its north and west (i.e. the 'Normal Rural Landscapes');
- **lake lands landscape** of Lough Gill (including areas of 'Sensitive Rural Landscapes' and 'Visually Vulnerable Areas'); and the
- **mountainous landscape** surrounding Slieve Dargan and Slieve Daeane (i.e. a 'Sensitive Rural Landscape' with a skyline that is a 'Visually Vulneralbe Area'); and

13.64 It should be noted that since the proposed works will take place within the existing established quarry and processing area, no characteristic individual landscape elements, such as hedgerows, will be affected. A small area of emerging scrub will be removed to facilitate the proposed settlement lagoon; however, this area does not contribute to the overall landscape character and is therefore not considered further.

Visual Receptors

13.65 The receptors with views of the application area consist of road users and local residents. Those experiencing similar views of the application area are placed into Visual Receptor Groups (VRGs). The location and extent of each of the VRGs is indicated on **Figure 13-2** and described in **Table 13-2** below. The table further lists the types of receptors present in each VRG, describes the nature of views/visual amenity within the areas and lists the representative viewpoints provided (refer to **Figures 13-3, 13-4 & 13-5**).

Table 13-2
Visual Receptor Groups (VRG)

VRG	Location / Extent	Types of Receptors	Nature of Views / Visual Amenity
1	Approximately 250m long stretch along local road to the south west of the entrance to the application area.	Approx. 3 residential properties and road users within the area.	Close distance (0-50m) view north towards sloping agricultural land, some of which forms part of the application area. The quarry boundary post & wire fence is visible along the skyline, the quarry void is however screened by topography. Medium visual amenity, due short distance of views of undulating rural agricultural land and and presence of manmade features (e.g. road, properties, telegraph/electricity poles, walls). **Viewpoint A** represents a typical view.
2	Intermittently along an approximately 1,400m long stretch of the local road at Tullynagracken and adjoining properties/minor roads.	Approx. 15-20 residential properties and road users within the area.	Long distance panoramic views over undulating farmland, towards the mountain range associated with Slieve Dargan and Slieve Daeane. The upper sections of the existing quarry void are visible as a narrow band in the middle ground of all views, embedded into the farmland and partially screened by intervening vegetation. The processing area forming part of the application area is fully screened by vegetation. Medium/high visual amenity, due to the scenic panoramic views dominated by the mountain range, reduced somewhat by the presence of many residential/farm properties and electricity poles at the lower elevations in the foreground. **Viewpoints B, C & D** represent typical views.
3	Approximately 450m long stretch along local road at Carns and a number properties along a minor road to the south.	Approx. 7 residential properties and road users, including recreational visitors within the area.	Long distance panoramic views over undulating farmland, towards the mountain range associated with Slieve Dargan and Slieve Daeane (note: scenic views towards Lough Gill are available from the same location, in a south eastern direction). The upper sections of the existing quarry void are visible as a narrow band in the middle ground of all views, embedded into the farmland and partially screened by intervening vegetation. The processing area forming part of the application area is partially visible, amongst dense vegetation. Medium/high visual amenity, due to the scenic panoramic views dominated by the mountain range, reduced somewhat by the presence of residential/farm properties and electricity poles at the lower elevations in the foreground. **Viewpoint E** represents a typical view.

IMPACT ASSESSMENT

Evaluation Methodology

13.66 Refer to **Appendix 13-A** at the end of this chapter for information on the assessment of landscape and visual sensitivity, the assessment of the magnitude of change in the landscape and on views, as well as the assessment of landscape and visual effects and their significance.

Operational Stage Landscape Effects

13.67 The operational stage of the proposed development, for the purpose of this assessment, is considered to include the extraction and restoration period, i.e. the 12 years proposed life of the development.

13.68 Works resulting in potential landscape effects will include:

- rock extraction within the existing quarry void, resulting in deepening of the void;
- the construction of a settlement lagoon to the east of the quarry void; and
- the final restoration of the quarry void and processing area to a natural habitat, including flooded quarry void, woodland and hedgerow planting.

Landscape Sensitivity

13.69 **Table 13-3** below describes the value attached to each of the identified landscape receptors, as well as their susceptibility to the changes caused by the proposed development

Table 13-3
Sensitivity of Landscape Receptor

Landscape Receptor	Value	Susceptibility	Overall Sensitivity
Undulating Farmland Landscape	No specific 'landscape' designation. Presence of a number of scenic routes, views from which are however focused on the mountainous area to the south and Lough Gill to the east. The undulating farmland does not have a striking landform and is not rare in the local area. No natural conservation areas are present and the landscape is influenced by man-made elements. The value level of this landscape is therefore assessed as **COMMUNITY**	Designated as 'Normal Rural Landscape' in the SCDP which is defines as an area *"with natural features (e.g. topography, vegetation) which generally have the capacity to absorb a wide range of new development forms"*. Considering the presence of abundant hedgerow and woodland vegetation in the local area, as well as the proposed development being confined within the existing quarry development, which is a long-established element in the local landscape, the susceptibility of the farmland landsacape is assessed as **LOW**	**LOW**
Lake lands landscape	Presence of local authority designated 'Sensitive Rural Landscapes' and 'Visually Vulnerable Areas', some scenic routes and nature conservation sites. The value level of this landscape is therefore assessed as **LOCAL AUTHORITY**	'Sensitive Rural Landscape' defined in SCDP as an area with *"a low capacity to absorb new development"*. 'Visually Vulnerable Area' defined in SCDP as an area with *"an extremely low capacity to absorb new development"*. However, considering the physical separation from the proposed development, the abundant screening vegetation, as well as the proposed development being confined within the existing quarry development, which is a long-established element in the local landscape, the susceptibility of the lake lands landscape is assessed as **LOW**	**LOW**
Mountainous landscape	Presence of local authority designated 'Sensitive Rural Landscapes' and 'Visually Vulnerable Areas' and some scenic routes. The value level of this landscape is therefore assessed as **LOCAL AUTHORITY**	'Sensitive Rural Landscape' defined in SCDP as an area with *"a low capacity to absorb new development"*. 'Visually Vulnerable Area' defined in SCDP as an area with *"an extremely low capacity to absorb new development"*. However, considering the physical separation from the proposed development, the dominance of the mountainous range over the adjoining farmland, as well as the proposed development being confined within the existing quarry development, which is a long-established element in the local landscape, the susceptibility of the mountainous landscape is assessed as **LOW**	**LOW**

Magnitude of Landscape Change

13.70 **Table 13-4** below describes the size and scale, geographical extent and duration/reversibility of the landscape change, all of which contribute to the assessment of the magnitude of this change.

Table 13-4
Factors of Magnitude of Landscape Change

Factor	Description	Level of effect
Size & Scale	All of the proposed works will be contained within the existing long-established quarry and processing areas. Except for a small area of scrub, no vegetation removal will be required and there will be an imperceptible change to the landform, due to the lowering of the quarry floor and the construction of the settlement lagoon. Overall, there will be a negligible change in landscape character, as the key characteristics will not be affected.	**NEGLIGIBLE**
Geographical Extent	The changes will influence the landscape at the site level only.	**NEGLIGIBLE**
Duration/ Reversibility	The operational stage (rock extraction + final restoration) will last for a total of 12 years and is theoretically reversible. While the changes to the landform will remain, the site will be restored to a natural habitat, including additional hedgerow and woodland planting, which will contribute to the local landscape characteristics.	**MEDIUM-TERM REVERSIBLE**

13.71 The magnitude of landscape change, due to the proposed development, is judged to be **NEGLIGIBLE**, as the negligible scale and negligible geographical extent are deemed to offset the medium-term duration of the effect.

Assessment of Landscape Effects and Significance

13.72 The sensitivity of all landscape receptors (i.e. Undulating Farmland Landscape, Lake Lands Landscape & Mountainous Landscape) was assessed as LOW. The magnitude of landscape change was assessed as NEGLIGIBLE. In combination the landscape effect is judged to be **NEGLIGIBLE**, i.e. not a significant landscape effect.

Post – Operational Stage Landscape Effects

13.73 The post-operational stage of the proposed development, for the purpose of this assessment, is considered to be the period following the cessation of the extraction activities and the completion of the restoration works. The landform within the rock quarry will remain permanently changed. However, the restoration to a natural habitat of the overall site, will ensure that the landscape effects will remain **NEGLIGIBLE** at the post-operational stage.

Operational Stage Visual Effects

13.74 For the duration of the operational stage, i.e. the extraction and restoration stage, the proposed development will be screened in views from the vast majority of locations within the study area, including all locations beyond the site boundary to the west, north west, south west and north east.

Visual effects will be experienced only in views from the three VRGs identified earlier in this section (refer to **Table 13-2 and Figure 13-2**).

13.75 **VRG 1:** In views from a short section of the local road to the south west of the site entrance, as well as associated residential properties, some of the proposed woodland/hedgerow planting along the southern and western boundary of the quarry area will be visible. This planting will have a beneficial effect, as it will strengthen the existing hedgerow/woodland landscape elements. Neither the proposed extraction works, nor any activities within the processing yard area will be visible by this VRG. Refer to **Viewpoint A**, on **Figure 13-3.**

13.76 **VRG 2:** In intermittent views from the local road to the north west of Aghamore, as well as associated minor roads and residential properties, some of the proposed woodland/hedgerow planting along the boundaries of the quarry area will be visible in the middle ground of views. This planting will have a beneficial effect, as it will strengthen the existing hedgerow/woodland landscape elements. Neither the proposed extraction works, nor any activities within the processing yard area will be visible by this VRG. Refer to **Viewpoint B, C & D**, on **Figures 13-3 & 13-4.**

13.77 **VRG 3:** In views from a short section of the local road to the south of the highpoint at Carns, as well as associated residential properties, some of the proposed woodland/hedgerow planting along the boundaries of the quarry area will be visible in the middle ground of views. This planting will have a beneficial effect, as it will strengthen the existing hedgerow/woodland landscape elements. Also, some of the activities within the processing yard area will be distantly visible, while the proposed extraction works will be fully screened by topography. Refer to **Viewpoint E**, on **Figure 13-5.**

13.78 It should be noted that no static lighting will be installed within the quarry void. Any mobile lighting on the machinery used within the quarry is unlikely to become visible, due to the low elevation of the works in the quarry void. Existing static light sources within the processing yard area will be retained and will be used for a short durations in the winter time, when works take place during hours of darkness, within the permitted working hours. These lights will be visible amongst other lights illuminating the roads, properties and other commercial premises in the local area. Considering the presence of other light sources and the short duration those within the application area will be used, it is not considered that significant additional night-time light pollution will be produced due to the proposed development.

Visual Receptor Sensitivity

13.79 **Table 13-5** below describes the value placed on views from within each of the VRGs identified earlier (refer to **Table 13-2** above). It further describes the susceptibility of each of the identified Visual Receptor Groups (VRGs) to change. The table further describes the value placed on views from within each of the VRGs and makes a judgement of the overall sensitivity of each VRG.

Table 13-5
Sensitivity of Visual Receptors

VRG	Value	Susceptibility	Sensitivity
1	No protected or locally promoted views towards the application area. **LOW**	Residents: **HIGH** Road users, where views are incidental to the journey: **LOW**	**MEDIUM** **LOW**
2	No protected or locally promoted views towards the application area. **LOW**	Residents: **HIGH** Road users, where views are incidental to the journey: **LOW**	**MEDIUM** **LOW**
3	The OSI Discovery Series Mapping promotes a scenic view along this road (note: the focus of this view is Lough Gill and the mountain range associated with Slieve Dargan and Slieve Daeane). **HIGH**	Residents/Recreational Visitors: **HIGH** Road users, where views are incidental to the journey: **LOW**	**HIGH** **MEDIUM**

Magnitude of Visual Change

13.80 **Table 13-6** below describes the magnitude of change to views from each of the VRGs, in terms of the size and scale, geographical extent and duration/reversibility.

Table 13-6
Factors of Magnitude of Visual Change

VRG	Description of Factors of Visual Change	Level of Effect	Magnitude
1	**Size & Scale:** The visual changes in views from this VRG (i.e. hedgerow/woodland planting) will take place at a **close distance, in the neighbouring field, along the existing field boundaries**. As the proposed planting will be an enhancement of the existing vegetation and will be of similar type, there will be **no new elements** added to the views. The **view composition will be slightly altered**, as more of the neighbouring field will be screen, however the **visual amenity of existing views will not change**.	**SMALL**	**SLIGHT** (**beneficial**, due to the enhancement of existing landscape elements)
	Geographical Extent: The views are available from a **very short linear route**, i.e. 250m along the local road to the south west of the site entrance, as indicated on **Figure 13-2.** There will be a **small number of viewers** as this road is only infrequently. Three properties are located within this VRG.	**NEGLIGIBLE**	
	Duration/Reversibility: The changes within the application area will be visible **for the duration of the operational stage, i.e. a 12 years period**.	**MEDIUM-TERM REVERSIBLE**	

VRG	Description of Factors of Visual Change	Level of Effect	Magnitude
2	**Size & Scale:** The visual changes in views from this VRG (i.e. hedgerow/woodland planting) will take place at distances between **0.3-1.5km within a narrow band in the middle ground of the available views**. As the proposed planting will be an enhancement of the existing vegetation and will be of similar type, there will be **no new elements** added to the views and the **composition and visual amenity of existing views will not be altered.**	**NEGLIGIBLE**	**NEGLIGIBLE** (as the negligible size/scale is considered the overriding factor; **beneficial,** due to the enhancement of existing landscape elements)
	Geographical Extent: The views are available **intermittently from a 1,400m long linear route,** along the local road to the north west of Aghamore, as indicated on **Figure 13-2.** There will be a **small number of viewers** as views from the road are glimpsed only, and views from the 15-20 associated properties area partially restricted by intervening vegetation.	**SMALL**	
	Duration/Reversibility: The changes within the application area will be visible **for the duration of the operational stage, i.e. a 12 years period**.	**MEDIUM-TERM REVERSIBLE**	
3	**Size & Scale:** The visual changes in views from this VRG (i.e. hedgerow/woodland planting & activities within the processing yard area) will take place at distances between **1.1-1.5km within a narrow band in the middle ground of the available views.** The proposed planting will be an enhancement of the existing vegetation and will be of similar type. The activities within the processing yard area will be barely noticeable at this distance and will be similar to other commercial/activities in the vicinity of the application area and what previously took place within the site. Therefore, **no new elements** will be added to the views and the **composition and visual amenity of existing views will not be altered.**	**NEGLIGIBLE**	**NEGLIGIBLE** (as the negligible size/scale is considered the overriding factor; **neutral**, as vegetation enhancement and visibility of processing activities are deemed to offset each other)
	Geographical Extent: The views are available from a **short linear route**, i.e. 450m along the local road to the south of the highpoint at Carns, as indicated on **Figure 13-2.** There will be a **small number of viewers** as this road is mostly used by local residents (note: the scenic viewpoint, while marked on OSI mapping, does not appear to be frequently visited; also, it is not locally signposted and no official parking facilities are provided). Seven properties are located within this VRG.	**NEGLIGIBLE**	
	Duration/Reversibility: The changes within the application area will be visible **for the duration of the operational stage, i.e. a 12 years period**.	**MEDIUM-TERM REVERSIBLE**	

Significance of Visual Impact

13.81 The sensitivity of the residents within **VRG 1** was assessed as MEDIUM and that of the road users as LOW. The magnitude of visual change on views for VRG 1 was assessed as SLIGHT. In combination the visual effect on residents is judged to be **MINOR** and that on road users as **MINOR-NEGLIGIBLE.** Both are considered beneficial and not significant visual effects.

13.82 The sensitivity of the residents within **VRG 2** was assessed as MEDIUM and that of the road users as LOW. The magnitude of visual change on views for VRG 2 was assessed as NEGLIGIBLE. In combination the visual effect on residents is judged to be **MINOR-NEGLIGIBLE** and that on road users as **NEGLIGIBLE.** Both are considered beneficial and not significant visual effects.

13.83 The sensitivity of the residents and recreational uses within **VRG 3** was assessed as HIGH and that of the road users as MEDIUM. The magnitude of visual change on views for VRG 3 was assessed as NEGLIGIBLE. In combination the visual effect on residents/cyclists is judged to be **MINOR** and that on road users as **MINOR-NEGLIGIBLE.** Both are considered neutral and not significant visual effects.

Post – Operational Stage Visual Effects

13.84 On completion of all extraction and restoration works (i.e. the operational stage), the visibility of the application area will return to its current state, with some enhanced vegetation surrounding the site. The existing upper quarry face will continue to be visible but will also continue to weather and crevices will be colonised by locally occurring grass and scrub species. In time the appearance of the rock face will be softened and more and more integrate into the surrounding farmland landscape.

13.85 As a result, the visual effects will in time reduce to **NEGLIGIBLE** for all visual receptors during the post-operational stage.

Direct/Indirect Effects

13.86 All landscape and visual effects described above are direct effects. The proposed development is not considered to have indirect effects in landscape and visual terms, i.e. the proposed development is unlikely to cause consequential changes to the surrounding landscape character areas or to existing views of the landscape surrounding the application area.

Compliance with Planning Policies/Impact on Landscape Designations

Landscape

13.87 This landscape and visual impact assessment concluded that the effects on landscape character will be negligible and that the visual effects, due to the proposed development will be minor or less than minor for all visual receptors. Further to that, Visually Vulnerable Areas and Sensitive Rural Landscapes will not be affected. It is therefore considered that the proposed development is in compliance with the SCDP Landscape **Policies P-LCAP-1, P-LCAP-2 & P-LCAP-4.**

Scenic Routes

13.88 **Figure 13-2**, the ZTV mapping, indicates that there is very limited likelihood of visibility of the proposed development from any of the designated scenic routes within the study area (i.e. Scenic

Routes 4, 12, 14 & 36, refer to Figure 13-1 for their location). The site survey confirmed that roadside and intervening vegetation screens views towards the application area from these routes, in addition to topography. Therefore, the distinctive visual character of these scenic routes will not be affected by the proposed development, which is considered to be in compliance with SCDP Landscape **Policy P-LCAP-3.**

Extractive Industry Policy

13.89 Due to the location within an existing quarry development and associated screening provided by topography, as well as screening from boundary vegetation, the proposed development will not have impact on residential amenity. Further to that, there will be no visibility from any designated walking routes. The restoration of the quarry development will be to a natural habitat, which is a beneficial ecological after use. It is therefore considered that the proposed development is in compliance with the SCDP Extractive Industry **Policies Policy P-MEQ-2 & Policy P-MEQ-3.**

Outdoor Recreational Facilities

13.90 The proposed development will be neither visible from the North West Trail Cycle Route, nor from the Sligo Way or any other locally signposted walking routes. It will therefore not have any impact on outdoor recreational facilities within the study area.

Unplanned Events (i.e. Accidents)

13.91 It is highly unlikely that any unplanned events within the application area would result in noticeable landscape or visual impact.

Cumulative / Synergistic Impacts

13.92 There are no known existing developments or developments currently in the planning process that would result in cumulative landscape or visual impacts in combination with the proposed continuation of use of the existing quarry and processing area, as well as the proposed deepening of the quarry void.

Transboundary Impacts

13.93 The proposed development is not located in the vicinity of a national boundary. Therefore, transboundary landscape or visual impacts will not arise.

Interaction with Other Impacts

13.94 There are no known interactions with other impacts.

'Do-nothing Scenario'

13.95 If no further works within the planning application area were carried out, the existing quarry, would be restored in line with the current restoration plan (Planning Reference No. 02/271), which would lead to a similar result to what is proposed, as part of the restoration of this development.

MITIGATION MEASURES

Operational Stage

13.96 The undulating topography of the application site and surrounding land, as well as the abundant hedgerows and woodland vegetation along the site boundaries and in the wider landscape are naturally mitigating factors, significantly reducing potential landscape and visual impacts.

13.97 A landscape and restoration plan forms part of this EIAR. The plan the restoration of the site to a natural habitat, on completion of all extraction works. The landscape/restoration proposals will consist of the following (refer to section 2 of the EIAR):

- Hedgerow and woodland planting, using native species, in advance of operations along the boundaries of the quarry area which, along with vegetation to be retained would further mitigate landscape and visual effects;
- on completion of all extraction works: removal of all plant, buildings and stockpiles from the site;
- breaking up and re-grading of the processing area and area to be left for natural recolonisation;
- installation of fencing surrounding the quarry void for security reasons;
- natural flooding of the quarry void and subsequent creation of a wetland habitat; and
- leaving the remainder of the application area to natural recolonisation, thereby instigating a diversity of habitats.

13.98 No additional mitigation measures are considered necessary during the operational stage of the proposed development.

Post – Operational Stage

13.99 All restoration works will be completed during the operational stage of the development. It is anticipated that the site will substantially integrate with the surrounding landscape at the post-operational stage of the development and no further mitigation measures are therefore considered necessary at this stage.

RESIDUAL IMPACT ASSESSMENT

Operational Stage

13.100 As no additional mitigation measures are proposed during the operational stage, the residual levels of landscape and visual effects will be as per the assessment above. In summary, the assessment has found that the proposed development will have negligible landscape effects during the operational stage (i.e. levels of impact not considered to be significant).

13.101 The visual impact on views ranges from none for the majority of locations within the study area to minor or less than minor (i.e. impacts not regarded as significant) for a limited number of viewpoints immediately south and within 1.5km to the north of the application area.

Post – Operational Stage

13.102 As no additional mitigation measures are proposed during the post-operational stage, the residual landscape and visual effects will be as per the assessment above. In summary, on completion of all extraction and restoration works the predicted landscape and visual impacts will reduce to / remain at negligible.

MONITORING

13.103 There are no monitoring requirements, arising from this landscape and visual assessment.

REFERENCES

Environmental Protection Agency (August 2017) Guidelines on the Information to be contained in Environmental Impact Assessment Reports - Draft, EPA Ireland

The Landscape Institute with the Institute of Environmental Management and Assessment (2013) Guidelines for Landscape and Visual Impact Assessment, Third Edition, Routledge

The Landscape Institute (2019) Technical Guidance Note 06/19: Visual Representation of Development Proposals, Landscape Institute

FIGURES

Figure 13-1
Landscape Baseline and Viewpoint Locations

Figure 13-2
Zone of Theoretical Visibility (ZTV) Map

Figure 13-3
Viewpoints A & B

Figure 13-4
Viewpoints C & D

Figure 13-5
Viewpoints E & F

NOTES

1. EXTRACT FROM 1:50,000 O.S DISCOVERY MAP NO. 25
2. ORDNANCE SURVEY IRELAND LICENCE NO. **CYAL50167032** (c) ORDNANCE SURVEY & GOVERNMENT OF IRELAND.

LEGEND

LAND INTEREST BOUNDARY

PLANNING APPLICATION AREA

APPROXIMATE DISTANCE FROM CENTRE OF APPLICATION AREA

VIEWPOINT LOCATIONS

LANDSCAPE CHARACTERISATION MAP - SLIGO COUNTY DEVELOPMENT PLAN

NORMAL RURAL LANDSCAPES

SENSITIVE RURAL LANDSCAPES

VISUALLY VULNERABLE AREAS

SCENIC ROUTES

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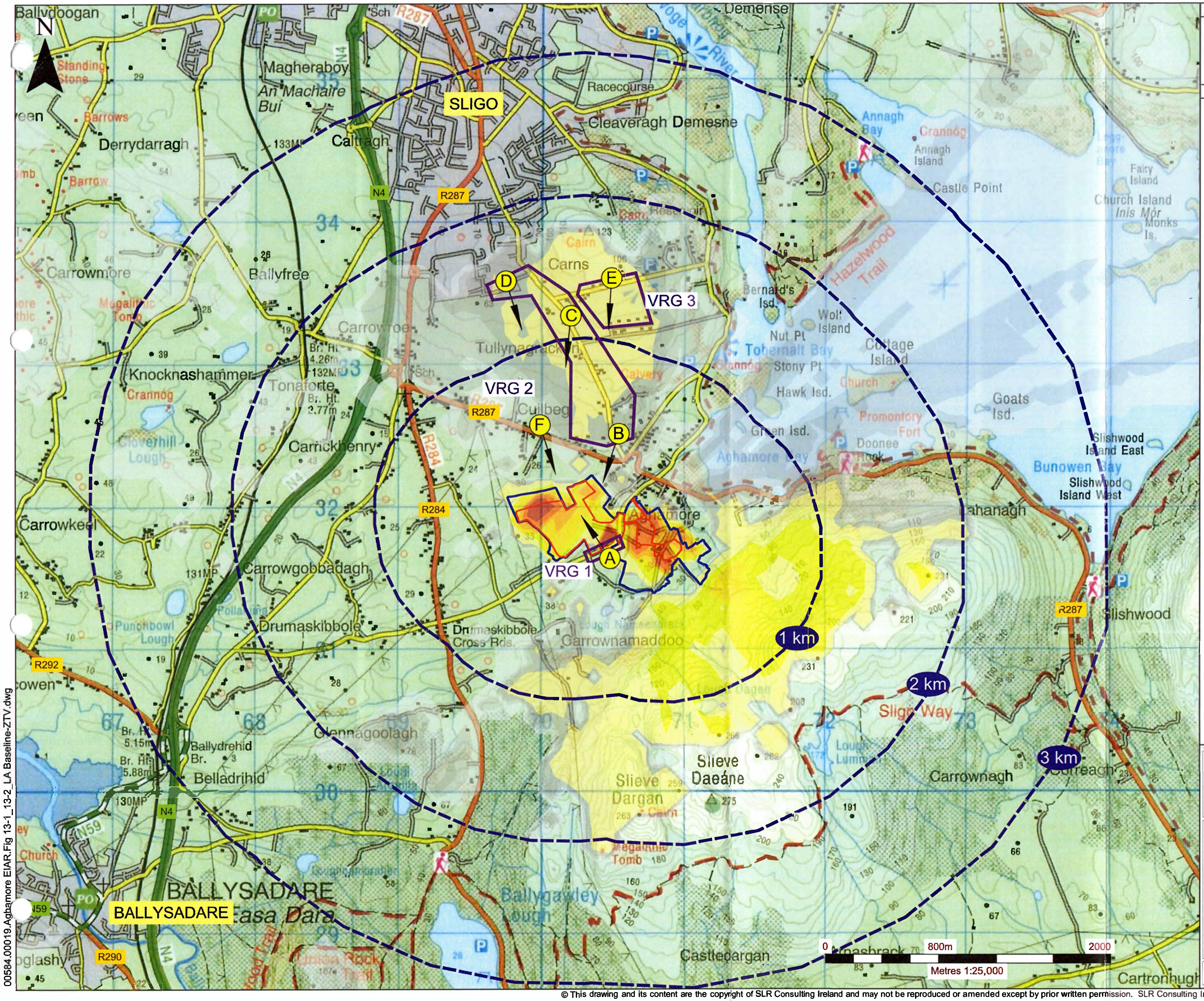
LANDSCAPE BASELINE AND VIEWPOINT LOCATIONS

FIGURE 13-1

Scale	Date
1:25,000 @ A3	MAY 2021

00584.00019.Aghamore EIAR.Fig 13-1_2_3_4_5_VLIA.dwg



NOTES

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LEGEND

- LAND INTEREST BOUNDARY
- PLANNING APPLICATION AREA
- DISTANCE FROM THE APPLICATION AREA BOUNDARY
- VIEWPOINT LOCATIONS
- VISUAL RECEPTOR GROUPS (VRG) (I.E. RECEPTORS WITH SIMILAR VIEWS OF THE APPLICATION AREA)

VERTICAL SUBTENDED ANGLES VISIBLE:

- SUBTENDED VERTICAL ANGLE GREATER THAN 25.6 DEGREES
- SUBTENDED VERTICAL ANGLE 12.8 TO 25.6 DEGREES
- SUBTENDED VERTICAL ANGLE 6.4 TO 12.8 DEGREES
- SUBTENDED VERTICAL ANGLE 3.2 TO 6.4 DEGREES
- SUBTENDED VERTICAL ANGLE 1.6 TO 3.2 DEGREES
- SUBTENDED VERTICAL ANGLE 0.8 TO 1.6 DEGREES
- SUBTENDED VERTICAL ANGLE 0.4 TO 0.8 DEGREES
- SUBTENDED VERTICAL ANGLE 0.2 TO 0.4 DEGREES
- SUBTENDED VERTICAL ANGLE 0.1 TO 0.2 DEGREES
- SUBTENDED VERTICAL ANGLE LESS THAN 0.1 DEGREES (= NO THEORETICAL VISIBILITY)

NOTE: Vegetation cover and built structures are not taken into account as part of the ZTV calculation process.
Areas in grey (i.e. less than 0.4 degrees) tend to be screened by hedgerows and vegetation, if present. Please refer to Appendix 13-B of the EIAR for the ZTV methodology.

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ZONE OF THEORETICAL VISIBILITY (ZTV) MAP

FIGURE 13-2

Scale
1:25,000 @ A3

Date
APRIL 2021

00584.00019.Aghamore EIAR.Fig 13-1_13-2_LA Baseline-ZTV.dwg

NOTES

1. EXTRACT FROM 1:50,000 O.S DISCOVERY MAP NO. 25
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LEGEND

▬	LAND INTEREST BOUNDARY
▬	PLANNING APPLICATION AREA
2 km	DISTANCE FROM THE APPLICATION AREA BOUNDARY
A	VIEWPOINT LOCATIONS
VRG 1	VISUAL RECEPTOR GROUPS (VRG) (I.E. RECEPTORS WITH SIMILAR VIEWS OF THE APPLICATION AREA)

VERTICAL SUBTENDED ANGLES VISIBLE:

🟥	SUBTENDED VERTICAL ANGLE GREATER THAN 25.6 DEGREES
🟧	SUBTENDED VERTICAL ANGLE 12.8 TO 25.6 DEGREES
🟧	SUBTENDED VERTICAL ANGLE 6.4 TO 12.8 DEGREES
🟨	SUBTENDED VERTICAL ANGLE 3.2 TO 6.4 DEGREES
🟨	SUBTENDED VERTICAL ANGLE 1.6 TO 3.2 DEGREES
🟨	SUBTENDED VERTICAL ANGLE 0.8 TO 1.6 DEGREES
🟨	SUBTENDED VERTICAL ANGLE 0.4 TO 0.8 DEGREES
⬜	SUBTENDED VERTICAL ANGLE 0.2 TO 0.4 DEGREES
⬜	SUBTENDED VERTICAL ANGLE 0.1 TO 0.2 DEGREES
⬜	SUBTENDED VERTICAL ANGLE LESS THAN 0.1 DEGREES (= NO THEORETICAL VISIBILITY)

NOTE: Vegetation cover and built structures are not taken into account as part of the ZTV calculation process. Areas in grey (i.e. less than 0.4 degrees) tend to be screened by hedgerows and vegetation, if present. Please refer to Appendix 13-B of the EIAR for the ZTV methodology.

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ZONE OF THEORETICAL VISIBILITY (ZTV) MAP

FIGURE 13-2

Scale	Date
1:25,000 @ A3	APRIL 2021

00584.00019.Aghamore EIAR.Fig 13-1_13-2_LA Baseline-ZTV.dwg

VIEWPOINT A: Local Road south west of the settlement of Aghamore.

Grid Reference (ITM): **570419:831704** Approximate Elevation: **19m AOD** Distance from application area: **20m** Direction of View: **North west**

Description: Views into the neighbouring undulating pasture fields are available from a number of locations along this road, where the roadside hedgerow is kept low. Manmade elements, such as the road, walls, buildings & electricity lines are common in these views. The fence along the northern boundary of the existing quarry development is visible along the skyline. However, the quarry void/faces are fully screened by existing topography in all locations along this road. This will not change, due to the proposed deepening of the quarry. Some additional hedgerow/woodland planting is proposed to be carried out in the field visible in the above view. The processing area, which forms part of the application area, is also fully screened in views from this road, due to topography and dense vegetation.

VIEWPOINT B: Local road north west of the settlement of Aghamore.

Grid Reference (ITM): **570460:832500** Approximate Elevation: **34m AOD** Distance from application area: **330m** Direction of View: **South west**

Description: Views from this section of the road are generally restricted by roadside vegetation. This view is taken over field gate, looking over rolling farmland with mature hedgerow vegetation and mature trees against the backdrop of the mountain skyline associated with Slieve Dargan and Slieve Daeane. Part of the application area, featuring the existing quarry, is visible in the middle ground of the view, specifically the upper portion of the south western quarry face. The proposed works associated with the lowering of the quarry void will not be visible in this view. The processing area, which forms part of the application area, is screened by intervening vegetation and topography in views from this area.

NOTES

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3. PHOTOS TAKEN 26TH NOVEMBER 2020.

LEGEND

▭	LAND INTEREST BOUNDARY
▭	PLANNING APPLICATION AREA
2 km	APPROXIMATE DISTANCE FROM APPLICATION AREA BOUNDARY
Ⓐ ↗	VIEWPOINT LOCATIONS

VIEWPOINT LOCATION MAP (1:50,000 @ A3)

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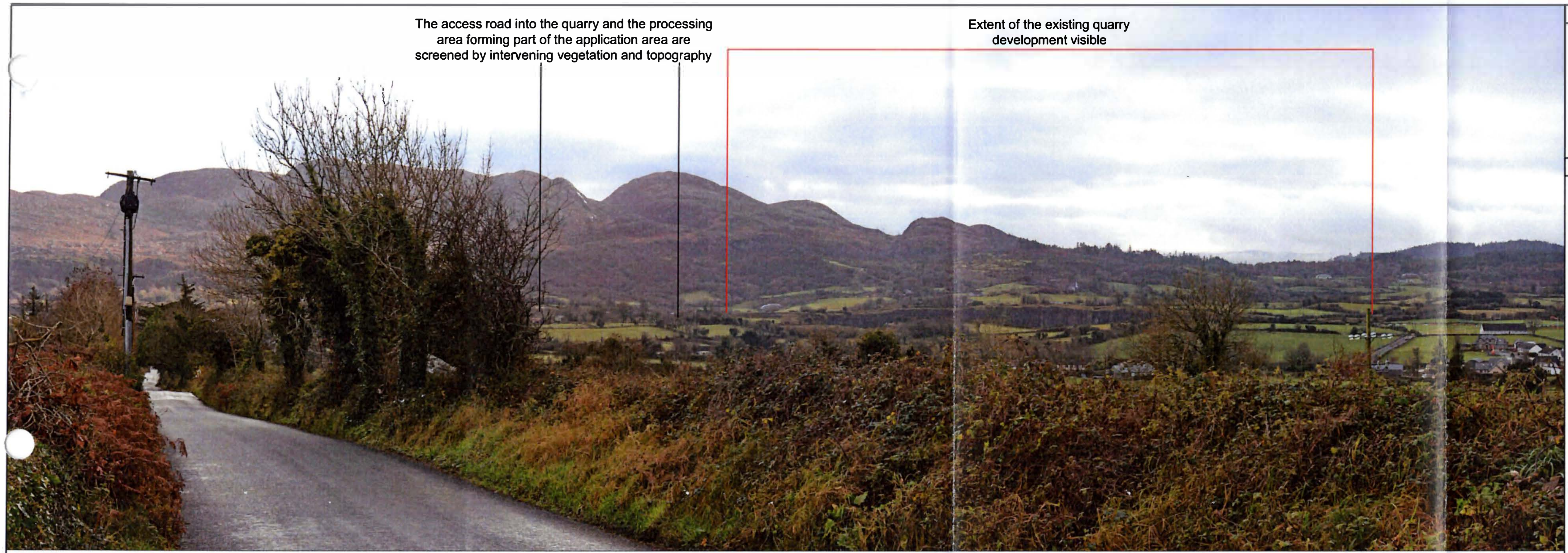
VIEWPOINTS A & B

FIGURE 13-3

Scale	Date
N/A	APRIL 2021

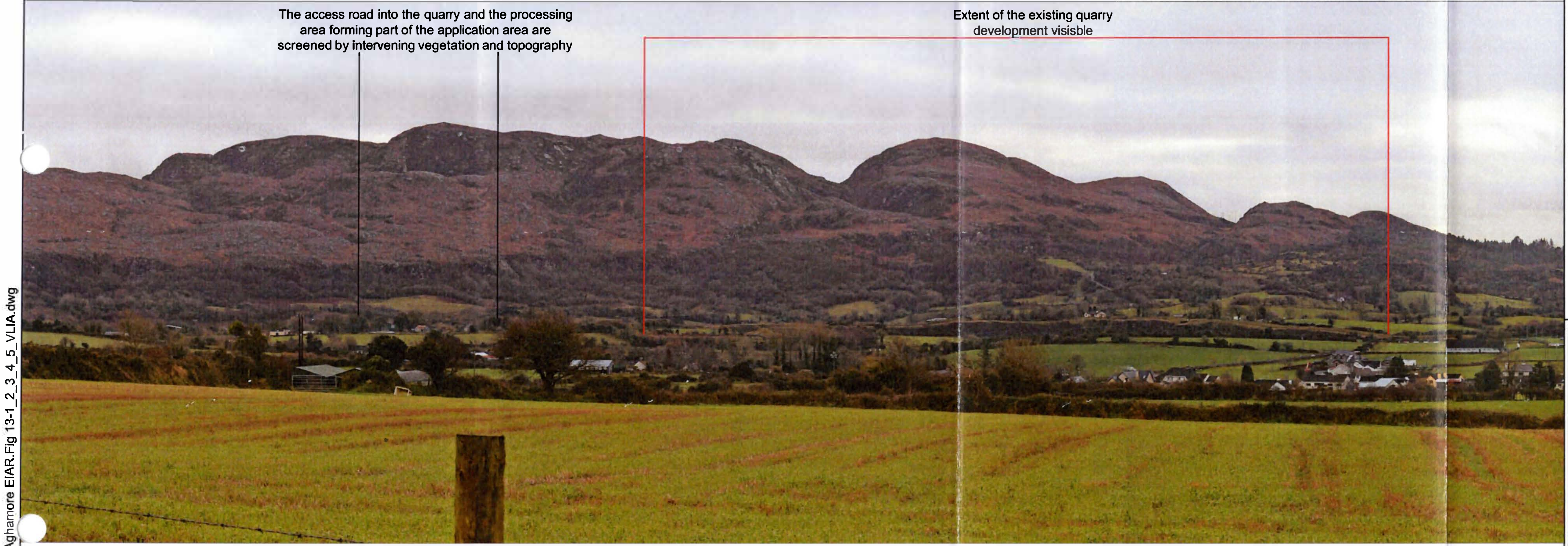
00584.00019.Aghamore EIAR.Fig 13-1_2_3_4_5_VLIA.dwg



VIEWPOINT C: Local Road in the townland of Tullynagracken.

Grid Reference (ITM): **570171:833269** Approximate Elevation: **76m AOD** Distance from application area: **1,090m** Direction of View: **South**

Description: Views from this section of the road are generally restricted by roadside vegetation, as can be seen in the above view. Where the roadside vegetation is low, panoramic views open up, looking over a wide expanse of rolling farmland, scattered with dwellings and with mature hedgerow vegetation and mature trees against the backdrop of the mountain skyline associated with Slieve Dargan and Slieve Daeane. Part of the application area, featuring the existing quarry, is visible in the middle ground of these views, specifically the upper portion of the south western quarry face. The proposed works associated with the lowering of the quarry void will not be visible in this view. The processing area, which forms part of the application area, is screened by intervening vegetation and topography in views from this area.



VIEWPOINT D: Southern Edge of residential area of Sligo Town.

Grid Reference (ITM): **569733:833548** Approximate Elevation: **72m AOD** Distance from application area: **1,420m** Direction of View: **South east**

Description: There are a number of similar panoramic views available from the southern edge of the residential area of Sligo Town. The views are of a wide expanse of rolling farmland, scattered with dwellings and with mature hedgerow vegetation and mature trees against the backdrop of the mountain skyline associated with Slieve Dargan and Slieve Daeane. Part of the application area, featuring the existing quarry, is visible in the middle ground of these views, specifically the upper portion of the south western quarry face. The proposed works associated with the lowering of the quarry void will not be visible in this view. The processing area, which forms part of the application area, is screened by intervening vegetation and topography in views from this area.

NOTES

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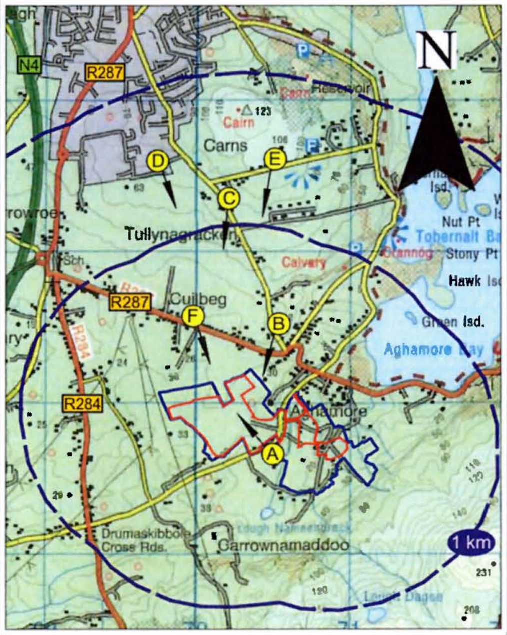
LEGEND

▭	LAND INTEREST BOUNDARY
▭	PLANNING APPLICATION AREA
2 km	APPROXIMATE DISTANCE FROM APPLICATION AREA BOUNDARY
A	VIEWPOINT LOCATIONS

VIEWPOINT LOCATION MAP (1:50,000 @ A3)



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VIEWPOINTS C & D

FIGURE 13-4

Scale	Date
N/A	APRIL 2021

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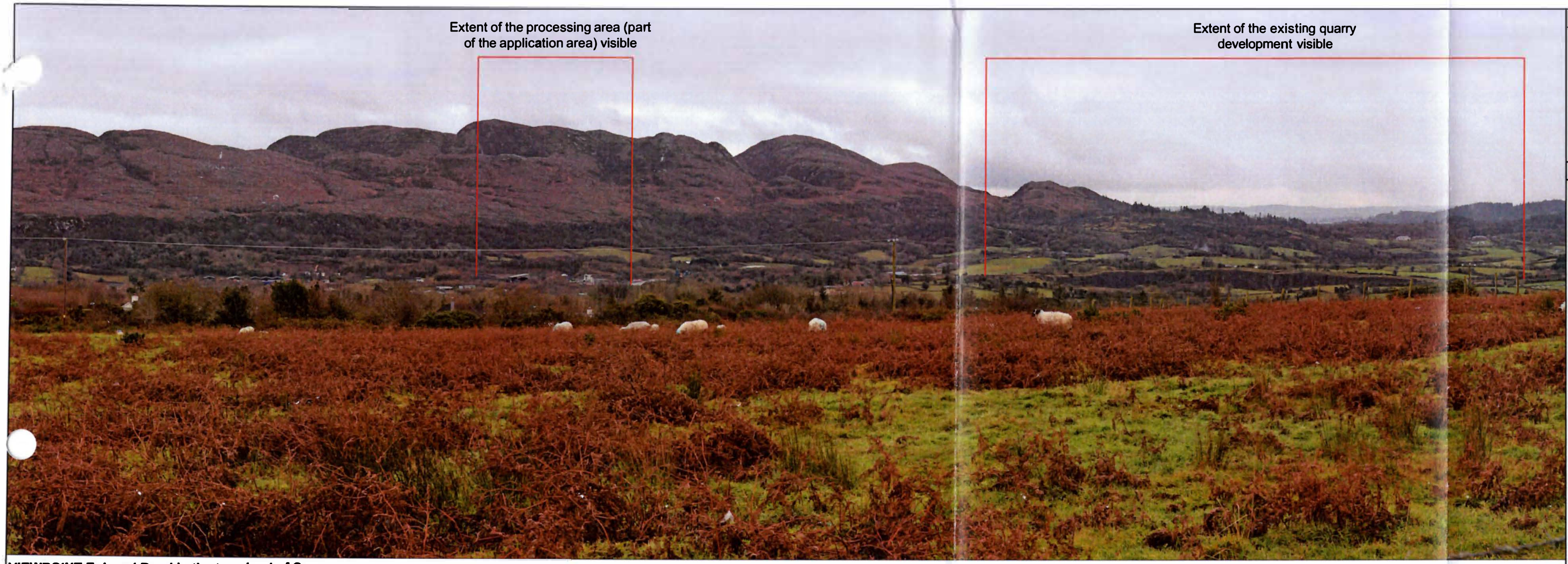
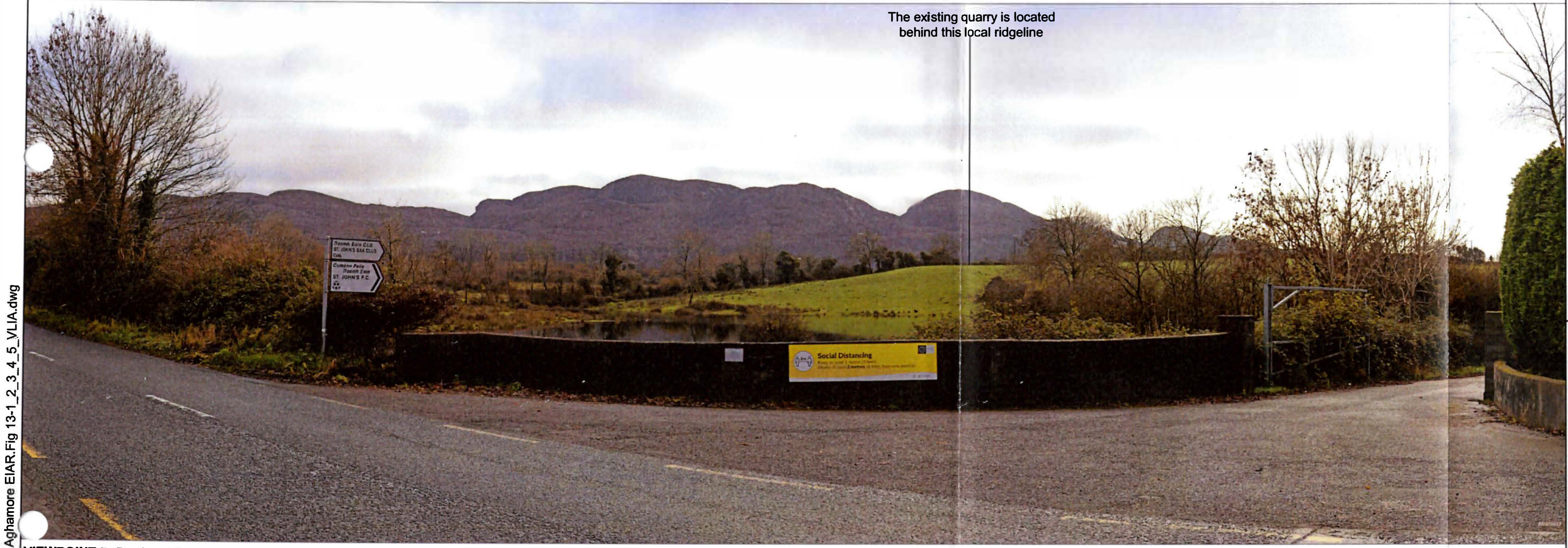


VIEWPOINT E: Local Road in the townland of Carns.

Grid Reference (ITM): **570413:833579** Approximate Elevation: **99m AOD** Distance from application area: **1,360m** Direction of View: **South**

Description: There are open panoramic views from an approximately 400m long section of this road, the main focus being Lough Gill further to the east (to the left of what is shown in the above view). Views in a more southern/western direction look over a wide expanse of rolling farmland, scattered with dwellings and with mature hedgerow vegetation and mature trees against the backdrop of the mountain skyline associated with Slieve Dargan and Slieve Daeane. Two sections of the application area, featuring the existing quarry and part of the processing area, are visible in the middle ground of these views, specifically the upper portion of the south western quarry face. The proposed works associated with the lowering of the quarry void will not be visible in this view. Some of the activities within the processing area will be distantly and therefore barely visible.



VIEWPOINT F: Regional Road at the entrance to St. John's GAA Club.

Grid Reference (ITM): **569956:832524** Approximate Elevation: **23m AOD** Distance from application area: **410m** Direction of View: **South east**

Description: The existing application area, as well as the proposed works are/will be fully screened in all views from the R287 - Regional road, due to intervening topography and vegetation, as is illustrated by the above representative view.

NOTES

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LEGEND

▬	LAND INTEREST BOUNDARY
▬	PLANNING APPLICATION AREA
2 km	APPROXIMATE DISTANCE FROM APPLICATION AREA BOUNDARY
Ⓐ	VIEWPOINT LOCATIONS

VIEWPOINT LOCATION MAP (1:50,000 @ A3)

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LAGAN MATERIALS LTD.
ENVIRONMENTAL IMPACT ASSESSMENT REPORT

LIMESTONE QUARRY AT
AGHAMORE AND
CARROWNAMADDOO, CO. SLIGO

VIEWPOINTS E & F

FIGURE 13-5

Scale	Date
N/A	APRIL 2021

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14. Traffic

CHAPTER 14

TRAFFIC

Lagan Materials Ltd.
Aghamore Near, Aghamore Far and Carrownamaddoo townlands, County Sligo
EIAR – Recommencement and Deepening of Existing Quarry and Associated Processing Area
May 2021

CONTENTS

TABLES

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Glossary of Terms

Road Network:	The existing and proposed public and private roads within the study area.
Traffic Growth:	The normal expected growth in traffic over time.
Trip:	One movement, in or out of the study area by foot, cycle or vehicle.
Thresholds:	Minimum intervention levels at which Transport and Traffic Assessments are to be conducted.
Generated Trips:	Additional trips made as a result of the presence of a development.
Peak Time:	Time of day at which the transport demands from a development are greatest.
Capacity Calculations:	Standardised methods of estimating traffic capacity on links and at junctions.
Trip Distribution:	The estimated directional distribution of the estimated traffic at each junction in the study area.

Trip Assignment:	The final estimated flows of traffic for each direction of travel at each junction and along each link within the study area.
TRICS:	A database containing empirically obtained trip generation data for a wide range of different types of developments.
AADT:	Annual Average Daily Traffic – The mean daily traffic volume over the course of a year on a particular route.
Level of Service:	Level of Service (LOS) is a measure of the capacity of a road related to the average vehicular speed and level of congestion on the road. It is ranges from LOS A to LOS F, with A representing free flow and F representing stop/start traffic. LOS C represents stable flow conditions

Introduction

General

14.1 PMCE Ltd. were commissioned by Lagan Materials Ltd. to undertake an assessment of the traffic impacts associated with the recommencement / deepening of the existing quarry and the recommencement of aggregate processing activities at Aghamore Near, Aghamore Far and Carrownamaddoo townlands, Co. Sligo, within an overall application area of c. 22.5ha.

14.2 A Traffic and Transport Assessment has been prepared in support of this Environmental Impact Assessment Report for the proposed development.

Information Reviewed

14.3 In preparing this assessment, reference has been made to the following documents: -

- "Traffic and Transport Assessment Guidelines" (September 2014) published by Transport Infrastructure Ireland (TII);
- Unit 5.3 (Travel Demand Projections) of the "Project Appraisal Guidelines" (2019) published by Transport Infrastructure Ireland);
- Traffic Count Survey Data, collected by NDC (Nationwide Data Collection); andTII Publications document DN-GEO-03031, "Rural Road Link Design" (June 2017) published by Transport Infrastructure Ireland (TII);TII Publications document DN-GEO-03060, "Geometric Design of Junctions (priority junctions, direct accesses, roundabouts, grade-separated and compact grade-separated junctions)" (June 2017) published by Transport Infrastructure Ireland (TII); andUnit 16.1 (Expansion Factors for Short Period Traffic Counts) of the "Project Appraisal Guidelines" (2016) published by Transport Infrastructure Ireland.

Scope

14.4 The objective of this assessment is to examine the traffic implications associated with the proposed development in terms of its integration with existing traffic in the area. The report determines and quantifies the extent of additional trips generated by the proposed development, and the impact on operational performance of such trips on the local road network.

14.5 In addition, an assessment has been undertaken of the cumulative traffic impacts arising from the proposed development in combination with the existing asphalt plant at the site.

Methodology

14.6 The methodology adopted for this appraisal involved, in brief: -

- A site visit, conducted on the 19th November 2020, during which the weather was dry, and the ground surface was dry.
- Classified traffic turning counts undertaken on the 21st February 2018 at two locations: the R287/L3603/L36025 and the R284/L3603 junctions. This traffic count data was projected using TII Growth Factors to determine the background traffic data for the year 2020. The Growth Factors used are conservative and are considered to adequately reflect typical traffic volumes, which are currently lower than usual due to the Covid-19 pandemic. Obtaining current traffic count data was considered, but deemed unsuitable, as it may not adequately reflect the likely post-pandemic traffic volumes.
- Existing Traffic Assessment – The traffic count data was used to develop 'Junctions 9' models for the quarry access, the quarry/processing plant crossroads junction, the R287/ L3603/L36025 and the R284/L3603 junctions.
- Trip Generation and Trip Assignment – Development traffic volumes were derived and the likely distribution on the adjacent road network determined based on the predicted routes vehicles will travel to/from the quarry.
- Future Year Assessments – The estimated future year volumes on the study area network, as a result of the increase in background traffic and any development related traffic, was used to assess the future operational performance of the junctions and surrounding road network for 2022 (assumed year of opening) and at two future assessment years, the opening year +5 (2027) and the opening year +15 (2037).

ADDITIONAL INFORMATION

14.7 As outlined in Chapter 1, a planning application was submitted to Sligo County Council (Plan File Ref. No. 18/345 / ABP Ref. 305821-19) in August 2018 for similar development to that proposed as part of this application. In October 2019 Sligo County Council granted planning permission for the development (subject to 23 no. conditions). 2 no. third party appeals of the decision by Sligo County Council to grant permission for the proposed quarry development were made to An Bord Pleanala (ABP-305821-19). An Bord Pleanala refused permission for the proposed development on the 30th June 2020 for the 2 no. reasons – refer to Chapter 1 for further details.

14.8 In order to comprehensively address the reasons for refusal, and further comments contained within the An Bord Pleanala Inspectors Report a number of additional surveys / site investigations, field work and assessments have been carried out. This Chapter 14 of the EIAR has been updated as follows: This assessment takes account of the revised planning application area and considers all activities associated with the revised application area, such as the recommencement of aggregate processing activities; The assessment takes account of cumulative impacts associated with the existing asphalt plant on-site. This assessment takes account of the response to further information made to Sligo County Council in respect of the traffic aspects of the previous planning application (planning ref. 18/345).

14.9 A further site visit was carried out on 19th November 2020.

Location Plan

14.10 Figure 14.1 shows the existing quarry / processing area and surrounding area.

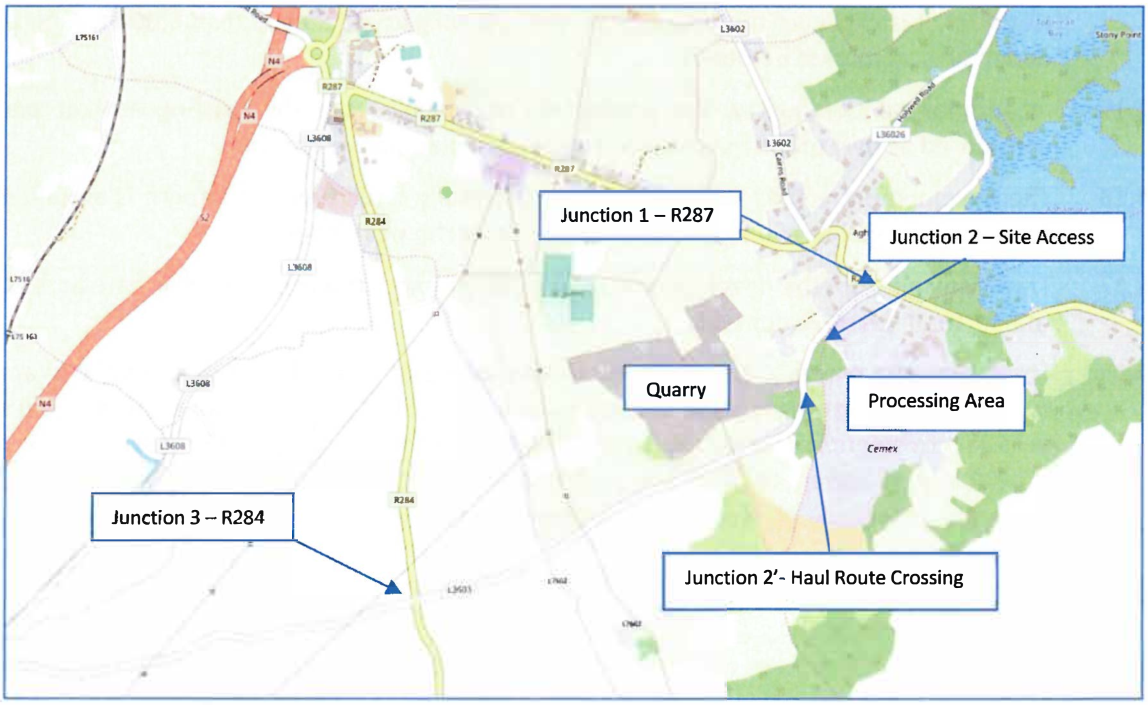


Figure 14.1: LOCATION PLAN (Source OpenStreetMap)

Existing Conditions

The Site

14.11 The lands which are the subject of this application comprise c. 22.5 hectares and are located in the townlands of Aghamore Near, Aghamore Far and Carrownamaddoo, Co. Sligo (refer to Figure 14.1). The proposed development is located wholly within the existing quarry and associated processing area (located on the eastern side of the local road that bisects the application site) and no lateral extension of the development is proposed.

14.12 The application site is located near two regional roads, the R287 to the South and the R284 to the East. The site occupies ground with elevations ranging between -21m OD (Quarry Floor) and 34m

OD. The lower quarry floor is currently at -21 m OD, with the previous planning permission (Plan File Ref. No 02/271) authorising extraction to -34.5m OD. The application area forms the existing quarry area, along with the associated processing area located on the eastern site of the local road that bisects the application site. The processing area occupies ground with elevations at c. 15 mOD.

14.13 The existing quarry has historically been used for the extraction of limestone and the applicant intends to recommence limestone extraction from the existing quarry area in addition to the recommencement of aggregate processing activities within the existing aggregate processing area on-site.

14.14 It is proposed to maintain extraction rates in line with previously permitted levels, i.e. up to 300,000 tonnes of rock per year, resulting in a maximum of 50 loads per day from the development. However, it is expected that extraction rates will vary from 150,000 to 300,000 tonnes per annum, depending on market demand.

14.15 In addition to the quarry, the production of asphalt from the existing asphalt plant will be considered as part of the estimation of projected cumulative impacts.

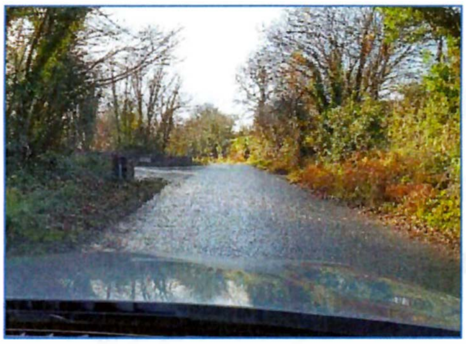
14.16 The development will directly employ approximately 6 full time staff and it is assumed that staff arrivals and departures will primarily occur during the peak hours.

14.17 Traffic to and from the development shall be accommodated using the main site access located to the north of the development.

14.18 The quarry and processing area are located on opposite sides of the L3603. Traffic to and from the quarry/processing area will use an existing haul route crossing located south of the main site access. Vehicle movements between the quarry and the processing area would primarily be associated with the haulage of aggregates from the quarry to the processing area for further processing (crushing / screening / stockpiling), resulting in a maximum of 31 loads per day.

Existing Road Network

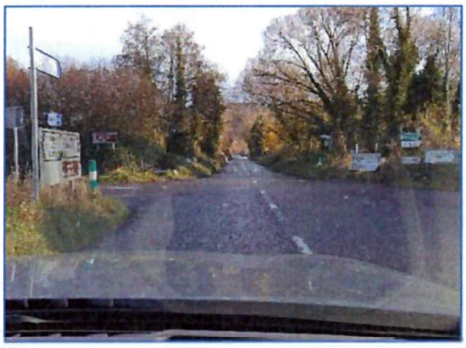
L3603 Local Road



14.19 In the vicinity of the development site the L3603 Local Road extends in a predominantly northeast to southwest direction between its junctions with the R287 Regional Road to the northeast, and the R287 Regional Road to the southwest. It has an approximate carriageway width ranging between 4.8m and 6.0m with no hard shoulder or pedestrian facilities.

14.20 The L3603 has a posted speed limit of 80kph which reduces to 60kph on the approach to its junctions with the R284 and R287.

R287 Regional Road



14.21 In the vicinity of the development site, the R287 Regional Road extends south-eastwards, from its junction with the N4 National Road, through Aghamore to its junction with the R280.

14.22 The R287 meets the L3603 at a crossroad junction formed by the L36025 to the east, the L3603 to the west and the R287 to the north & south of the junction. This junction is to the south of Aghamore on the R287, and approximately 250m east of the quarry access on the L3603.

14.23 The R287 has a posted speed limit of 60kph at the junction and a paved width between 5.3m and 5.7m.

14.24 There are no hard shoulders or pedestrian facilities along the R287 in the vicinity of its junction with the L3603.

R284 Regional Road

14.25 The R284 Regional Road extends in a north to south direction from its junction with the R287 to the north, to its junction with the R280 in Leitrim village to the south.

14.26 The R284 meets the L3603 at a crossroad junction approximately 1.2km west of the quarry access along the L3603. The R284 has a posted speed limit of 60kph in the vicinity of the junction and a paved width of approximately 6.0m.

14.27 The R287 has hard shoulders on both sides in the vicinity of its junction with the L3603, with flexible bollards located in the hard shoulder on the northern arm of the junction.

Study Area

14.28 The study area for this assessment is shown on Figure 1 1, and includes: -

- Junction 1 – the R287/L3603/L36025 Junction;
- Junction 2 – the Quarry Access;
- Junction 2A - Haul Route crossing of L3603, which caters for the transport of quarry materials to the processing area;
- Junction 3 – the R284/L3603 Junction; and
- The L3603.

Traffic Volumes

14.29 Classified traffic turning counts were carried out on Wednesday 21st February 2018 at the R287/L3603/L36025 junction and at the R284/L3603 junction. The counts were carried out between 7:00am and 7:00pm, this time period encompassing the proposed main operating hours of the quarry and also the peak hours on the adjacent road network. This traffic count data was projected using TII Growth Factors to determine the background traffic data for the year 2020. The Growth Factors used are conservative and are considered to adequately reflect typical traffic volumes, which are currently lower than usual due to the Covid-19 pandemic. Obtaining current traffic count data was considered, but deemed unsuitable, as it may not adequately reflect the likely post-pandemic volumes.

Surveyed vehicles were split into two categories, LV (Light Vehicles) & HV (Heavy Vehicles).

14.30 The traffic count data has been converted to Annual Average Daily Traffic (AADT) values using the methods described in "Expansion Factors for Short Period Traffic Counts" (Unit 16.1 "Project Appraisal Guidelines" 2016). Annexes A to C of this document were used in the expansion of traffic counts to AADT.

14.31 A combined factor of 0.802 was arrived at by combining the individual hourly factors for the count duration. This factor was then used to determine the 24-hour traffic flow, which was then converted to a Weekly Average Daily Traffic (WADT) using a factor of 0.98 for a Wednesday traffic count. Finally, the WADT was converted to AADT using a factor of 1.08 for the month of February. These factors were used to calculate the AADT on the roads at each of the junctions.

14.32 The results of the traffic survey at the R287/L3603/L36025 junction are summarised in Table 14.1 . From the survey data the peak hours at this junction have been established as: -

- 07:45hrs to 08:45hrs – Weekday AM Peak Hour; and
- 17:00hrs to 18:00hrs – Weekday PM Peak Hour.

Table 14.1 JUNCTION 1 (R287/L3603/L36025 CROSSROADS)

Hour Ending	R287 (SE)	L3603	R287 (NW)	L36025
08:00	103	14	95	4
09:00	206	31	189	40
10:00	182	24	161	33
11:00	128	20	119	27
12:00	113	22	107	22
13:00	138	18	115	25
14:00	138	25	133	38
15:00	128	21	128	27
16:00	17 1	22	153	32
17:00	185	23	155	37
18:00	223	23	191	55
19:00	178	12	155	41

Period Total	**1893**	**255**	**1701**	**381**
Period Total HGVs	***45***	***31***	***60***	***2***
% HGVs	***2%***	***12%***	***4%***	***1%***
AADT	**2498**	**337**	**2245**	**503**

14.33 The results of the traffic survey at the R284/L3603 junction are summarised in Table 14.2 . From the survey data, the peak hours at the junction have been established as: -

- 08:15hrs to 09:15hrs – Weekday AM Peak Hour; and
- 17:00hrs to 18:00hrs – Weekday PM Peak Hour.

Table 14.2 JUNCTION 3 (R284/L3603 CROSSROADS)

Hour Ending	R284	L3603 (E)	R284 (S)	L3603 (W)
08:00	128	17	122	21
09:00	273	37	31 1	71
10:00	194	35	191	42
11:00	161	26	155	28
12:00	175	26	174	33
13:00	155	33	145	31
1400	160	27	158	43
15 :00	181	31	169	37
16:00	202	36	201	31
17:00	251	42	242	55
18:00	298	48	295	55
19:00	224	22	217	37
Period Total	2402	380	2380	484
Period Total HGVs	*83*	*32*	*88*	*35*
% HGVs	*3%*	*8%*	*4%*	*7%*
AADT	3170	501	3141	639

Proposed Development

General - Quarry

14.34 The proposed development consists of the recommencement / deepening of the existing quarry and recommencement of aggregate processing activities in the existing processing area, within an overall application area of c. 22.5ha.

14.35 It is proposed to maintain extraction rates in line with previously permitted levels, i.e. up to 300,000 tonnes of rock per year, resulting in a maximum of 50 loads per day from the development. However, it is expected that extraction rates will vary from 150,000 to 300,000 tonnes per annum, depending on market demand.

Trip Generation and Assignment

Aggregate extraction and export

14.36 A maximum of 300,000 tonnes shall be extracted per annum, which equates to approximately 50 loads per day (see Table 14.3 *E*) based upon the following assumptions: -

- The facility will operate for 50 weeks per year.
- Material will be transported from the site in 20 tonne and 28 tonne loads (24 tonnes average assumed).
- The facility will operate 5.5 days per week (Monday to Saturday) inclusive.
- The facility opening times will be 07:00 to 18:00 Monday to Friday and 08:00 to 14:00 on Saturday.

Table 14.3 *E*XPORTED LIMESTONE

Exported Quantities of Material	
Quantity per annum	300,000
Quantity per week (50 operational weeks / year)	6,000
Loads per week (24 tonnes / load)	250
Loads per Hour (61 working hours / week)	5 (4.09)
Loads per Day (11 working hours / weekday)	50 (45.0)

14.37 It is anticipated that the development will employ approximately 6 full time staff. Staff movements will generate 12 peak hour trips, 6 trips inbound during the morning peak hour and 6 trips outbound during the evening peak hour

14.38 10 trips have been assumed to occur daily to cater for possible miscellaneous trips associated with the site. These miscellaneous trips allow for operations meetings, site inspections, maintenance operations for plant and machinery, etc. It is not considered that these trips would coincide with the peak hours, however, for a robust traffic assessment they have been included in the development's peak hour traffic.

Derived Trip Rate (Limestone extraction and export)

14.39 Table 14.4Table 14.9: contains a summary of trips associated with the proposed development. The figure of 50 loads per day was used to calculate the total predicted daily trips for exported material. Using these figures (with staff and miscellaneous trips), the total number of trips is expected to be 132, based on the figures outlined in Table 14.4: .

Table 14.4: SUMMARY OF PREDICTED DAILY TRIPS

	Predicted Daily Trips		
	Arrivals	**Departures**	**Total**
Exported Limestone	50	50	**100**
Staff	6	6	**12**
Miscellaneous	10	10	**20**
Total	**66**	**66**	**132**

Cumulative Impacts

14.40 An assessment has been undertaken of the cumulative traffic impacts arising from the proposed development in combination with the existing asphalt plant at the site.

14.41 Production rates of 60,000 tonnes of asphalt per annum have been adopted for the purposes of this cumulative assessment. The limestone required for this production would be sourced on-site, while the remaining materials required for production would be imported (e.g. Sand, High PSV stone and Bitumen).

14.42 Table 14.5 to Table 14.8 detail the required quantities of materials for the production of asphalt.

Table 14.5: EXPORTED ASPHALT

Exported Quantities of Asphalt	
Quantity per annum	14.43 60,000
Quantity per week (50 operational weeks / year)	14.44 1,200
Quantity per Day (weekday) (5 working Day / load)	14.45 240
Loads per Day (24 tonnes / weekday)	14.46 10

Table 14.6: IMPORTED PSV STONE (ASPHALT PRODUCTION)

Imported Quantities of PSV Stone	
Quantity per day	14.47 76
Loads per Day (24 tonnes /Day)	14.48 4 (3.16)

Table 14.7: IMPORTED BITUMEN (ASPHALT PRODUCTION)

Imported Quantities of Bitumen	
Quantity per day	14.49 11
Loads per Day (30 tonnes Day)	14.50 1 (0.36)

Table 14.8: IMPORTED SAND (ASPHALT PRODUCTION)

Imported Quantities of Sand	
Quantity per day	14.51 4
Loads per Day (24 tonnes/Day)	14.52 1 (0.16)

Derived Trip Rate (Cumulative Impacts)

14.53 Table 14.9: contains a summary of trips associated with the cumulative impacts of the proposed development. The figure of 64 loads per day was used to calculate the total predicted daily trips for exported and imported material. Using these figures (with staff and miscellaneous trips), the total number of trips is expected to be 164, based on the figures outlined in Table 14.9: .

Table 14.9: SUMMARY OF PREDICTED DAILY TRIPS (CUMULATIVE ASSESSMENT)

	Predicted Daily Trips		
	Arrivals	**Departures**	**Total**
Exported Limestone	50	50	**100**
Exported Asphalt	10	10	**20**
Imported PSV Stone (Asphalt Production)	4	4	**8**
Imported Bitumen (Asphalt Production	1	1	**2**
Imported Sand (Asphalt Production)	1	1	**2**
Staff	6	6	**12**
Miscellaneous	10	10	**20**
Total	**82**	**82**	**164**

Trip Distribution and Assignment

Trip Distribution

14.54 Appendix 14.A contains extracts from the TRICS database giving the forecast arrivals/departures distribution for quarry sites. Movements to and from quarries tend to have a short turnaround within the sites, e.g. that vehicles generally arrive and depart within a short time period, likely to be less than an hour.

14.55 These trips have been distributed throughout the day according to trip rates derived from the Trip Rate Information Computer System (TRICS) database which is based on surveyed traffic for similar types of developments in similar locations.

Trip Assignment

14.56 The assignment of the development traffic on the adjacent road network is based on an assessment of the existing traffic flows at nearby junctions derived from the traffic count data. Traffic assignment at the Site access junction is based on the historical traffic distribution pattern, as advised by the applicant, with most traffic departing to, and arriving from, the direction of the R287 (Aghamore).

14.57 Figure 14-2 and Figure 14-3 illustrate the trip assignment that has been applied to the development traffic as part of the junction capacity analysis. The trip distribution has been examined for: -

- Cars and Light Goods Vehicles (Figure 14.2); and
- Heavy Goods Vehicles (Figure 14.3).

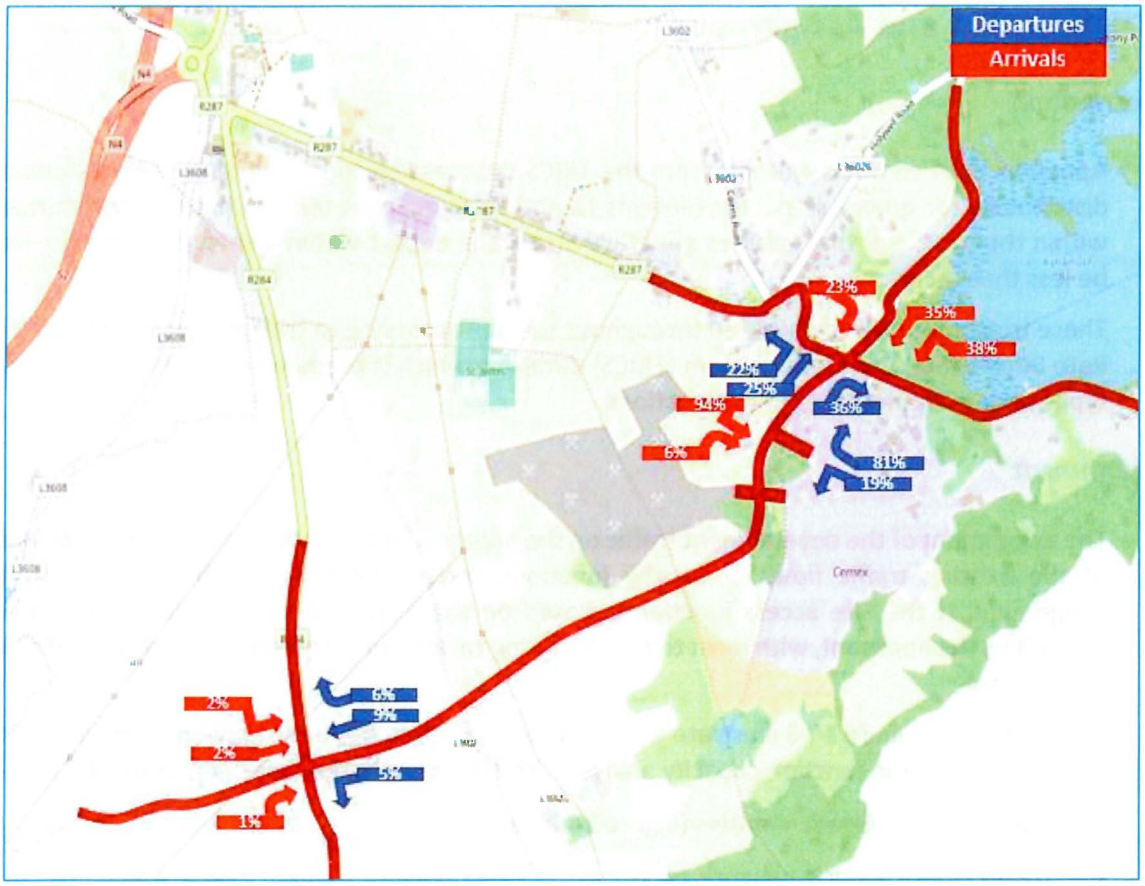


Figure 14.2: Assignment of Quarry Traffic onto the Road Network (LVs)

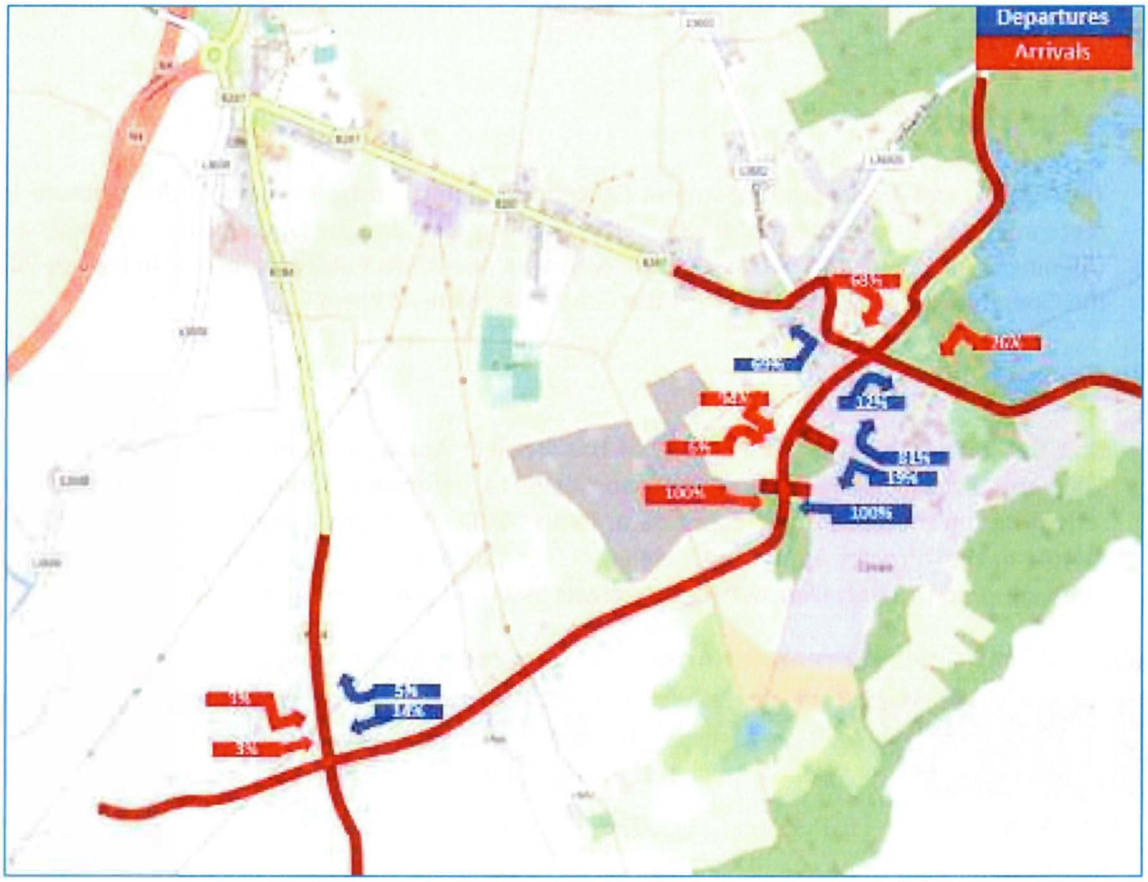


Figure 14.3: Assignment of Quarry Traffic onto the Road Network (HGVs)

Road Impacts

Assessment Years

14.58 The “Traffic and Transport Assessment Guidelines” published by Transport Infrastructure Ireland recommend the assessment of traffic in the Opening Year, for the Opening Year +5 years and the Opening Year +15 years. The assessment years for the impact assessment are therefore 2022 for the Opening Year, 2027 and 2037 for the Future Assessment Years.

Traffic Growth

14.59 Unit 5.3 (Travel Demand Projections) of the “Project Appraisal Guidelines” (2016) published by Transport Infrastructure Ireland has been used to determine future year traffic flows on the network from the 2018 traffic count data. Table 14.10: contains a summary of the traffic growth factors in the "Project Appraisal Guidelines". For this assessment, a central growth scenario has been adopted (a ‘central’ growth scenario was assumed given the site location and scale).

Table 14.10: FUTURE YEAR TRAFFIC GROWTH FIGURES (BORDER)

Year	Low Growth		Central Growth		High Growth	
	LV	HV	LV	HV	LV	HV
2016-2030	1.0133	1.0307	**1.0147**	**1.0323**	1.0178	1.0357
2030-2040	1.0028	1.0118	**1.0045**	**1.0136**	1.0082	1.0173

Link Capacity Assessment

General

14.60 Table 6.1 of the TII Publications document DN-GEO-03031 provides guidance on the capacity, for a Level of Service D (LOS D), of different road types by cross-section. It advises that the capacity of a Type 3 Single Carriageway road with 6.0m cross-section is 5,000 AADT for a Level of Service D. The following are the approximate carriageway widths of the roads which are part of this study:

- L3603 - Average cross-section width of between 4.8 to 6.0m with no hard shoulders present.
- R287 - Average cross-section width between 5.3 and 5.7m with no hard shoulders present.
- R284 - Average cross-section width of between 6.0m and 6.2m with no hard shoulders present.

14.61 It is considered that the roads which are part of this study are most similar to the Type 3 Single Carriageway cross-section in this document with a capacity of 5,000 AADT for Level of Service D.

14.62 The link roads were assessed reflecting two scenarios, as follows:

- Scenario 1: assessment of the traffic related impacts associated with the recommencement and deepening of the existing quarry with extraction rates of limestone in line with the previously permitted output of 300,000 tonnes per annum; and
- Scenario 2: assessment of the traffic related impacts associated with the cumulative impacts of future quarry operations in combination with the existing asphalt plant.

L3603 Local Road

14.63 The combined background and Site Traffic volumes on the L3603, outlined in Table 14.11: , and Table 14.12: for each of the assessment years, is less than the LOS D capacity of 5,000 AADT for a Type 3 Single Carriageway. It is considered that the L3603 will operate within capacity for each of the assessment years. The traffic associated with the proposed development represents between 22.08% and 25.05% of the total traffic on the L3603 during the assessment years 2022 to 2037 for scenario 1, and between 24.78% and 27.98% of the total traffic on the L3603 during the assessment years 2022 to 2037 for scenario 2.

Table 14.11: COMBINED AADT FOR EACH ASSESSMENT YEAR (L3603)- SCENARIO 1

	Assessment Year			
	2018	**2022**	**2027**	**2037**
Background Traffic	337	368	400	434
Additional Development Traffic	-	123	123	123
Combined Traffic (Background + Additional Dev. Traffic)	337	491	523	557
Additional Traffic as % of Combined Traffic	-	25.05%	23.52%	22.08%

Table 14.12: COMBINED AADT FOR EACH ASSESSMENT YEAR (L3603)- SCENARIO 2

	Assessment Year			
	2018	2022	2027	2037
Background Traffic	337	368	400	434
Additional Development Traffic	-	143	143	143
Combined Traffic (Background + Additional Dev. Traffic)	337	511	543	577
Additional Traffic as % of Combined Traffic	-	27.98%	26.34%	24.78%

R287 Regional Road

14.64 The combined background and Site Traffic volumes on the R287, outlined in Table 14.13: , and Table 14.14: for each of the assessment years, is less than the LOS D capacity of 5,000 AADT for a Type 3 Single Carriageway. It is considered that the R287 will operate within capacity for each of the assessment years. The traffic associated with the proposed development represents between 1.04% and 1.20% of the total traffic on the R287 during the assessment years 2022 to 2037 for scenario 1, and between 1.17% and 1.35% of the total traffic on the R287 during the assessment years 2022 to 2037 for scenario 2.

Table 14.13: COMBINED AADT FOR EACH ASSESSMENT YEAR (R287)- SCENARIO 1

	Assessment Year			
	2018	2022	2027	2037
Background Traffic	2,498	2,708	2,920	3,126
Additional Development Traffic	-	33	33	33
Combined Traffic (Background + Additional Dev. Traffic)	2,498	2,741	2,953	3,159
Additional Traffic as % of Combined Traffic	-	1.20%	1.12%	1.04%

Table 14.14: COMBINED AADT FOR EACH ASSESSMENT YEAR (R287)- SCENARIO 2

	Assessment Year			
	2018	**2022**	**2027**	**2037**
Background Traffic	2,498	2,708	2,920	3,126
Additional Development Traffic	-	37	37	37
Combined Traffic (Background + Additional Dev. Traffic)	2,498	2,745	2,957	3,163
Additional Traffic as % of Combined Traffic	-	1.35%	1.25%	1.17%

R284 Regional Road

14.65 The combined background and Site Traffic volumes on the R284, outlined in Table 14.15: , and Table 14.16: for each of the assessment years, is less than the LOS D capacity of 5,000 AADT for a Type 3 Single Carriageway. It is considered that the R284 will operate within capacity for each of the assessment years. The traffic associated with the proposed development represents between 0.13% and 0.15% of the total traffic on the R284 during the assessment years 2022 to 2037 for scenario 1, and between 0.15% and 0.17% of the total traffic on the R284 during the assessment years 2022 to 2037 for scenario 2.

Table 14.15: COMBINED AADT FOR EACH ASSESSMENT YEAR (R284)- SCENARIO 1

	Assessment Year			
	2018	**2022**	**2027**	**2037**
Background Traffic	3,170	3,439	3,712	3,980
Additional Development Traffic	-	5	5	5
Combined Traffic (Background + Additional Dev. Traffic)	3,170	3,444	3,717	3,985
Additional Traffic as % of Combined Traffic	-	0.15%	0.13%	0.13%

Table 14.16: COMBINED AADT FOR EACH ASSESSMENT YEAR (R284)- SCENARIO 2

	Assessment Year			
	2018	**2022**	**2027**	**2037**
Background Traffic	3,170	3,439	3,712	3,980
Additional Development Traffic	-	6	6	6
Combined Traffic (Background + Additional Dev. Traffic)	3,170	3445	3,718	3,986
Additional Traffic as % of Combined Traffic	-	0.17%	0.16%	0.15%

Junction Capacity Analysis

14.66 The capacity of the surveyed junctions was assessed using the Transport Research Laboratory's (TRL) computer programme Junctions 9.

14.67 Junction performance is measured as a ratio between the flow and capacity (RFC). The capacity analysis has been carried out for a period of 12 - hours for each of the assessment years (2022, 2027 and 2037). A rural junction with an RFC below 0.85 is considered to be operating within capacity, and an RFC of 0.85 indicates a junction operating at capacity.

14.68 The Junctions were assessed reflecting two modelling scenarios, as follows:

- Scenario 1: assessment of the traffic related impacts associated with the recommencement and deepening of the existing quarry with extraction rates of limestone in line with the previously permitted output of 300,000 tonnes per annum; and
- Scenario 2: assessment of the traffic related impacts associated with the cumulative impacts of future quarry operations in combination with the existing asphalt plant.

14.69 The detailed junction capacity analysis outputs for all of the junctions for all the future forecast assessment years are contained within Appendix 14.C to this report.

Junction 1 - R287/L3603/L36025 Crossroads

14.70 A summary of the junction capacity analysis results for the junction of the R287/L3603/L36025 Crossroads are shown in Table 14.17: and Table 14.21: . The results indicate that the junction will continue to operate within capacity for both scenarios for each of the assessment years 2022, 2027 and 2037.

Junction 2 - Main Access

14.71 A summary of the junction capacity analysis results for the junction of the Quarry access are shown in Table 14.18: and Table 14.22: . The results indicate that the junction will continue to operate within capacity for both scenarios for each of the assessment years 2022, 2027 and 2037.

Junction 2A- Haul Route crossing

14.72 A summary of the junction capacity analysis results for the junction of the Haul Route Crossing are shown in Table 14.19: and Table 14.23: Table 14.22: . The results indicate that the junction will continue to operate within capacity for both scenarios for each of the assessment years 2022, 2027 and 2037.

Junction 3 - R284/L3603 Crossroads

14.73 A summary of the junction capacity analysis results for the junction of the R284/L3603 Crossroads are shown in Table 14.20: and Table 14.24: . The results indicate that the junction will continue to operate within capacity for both scenarios for each of the assessment years 2022, 2027 and 2037.

Table 14.17: **JUNCTION 1 -R287/L3603/L36025 CROSSROADS (SCENARIO 1)**

	12 Hours (07:00 – 19:00)		
	Queue (Veh)	Delay (s)	RFC
Stream	**Base Year**		
L3603 - R287 (NW)/L36025	0.0	8.22	0.02
L3603 - R287 (SE)/ L36025	0.0	7.88	0.02
R287 (SE) - L3603/R287 (NW)/ L36025	0.0	5.09	0.04
L36025 - R287 (SE)/L3603	0.1	7.38	0.06
L36025 - L3603/R287 (NW)	0.0	9.21	0.02
R287 (NW) - R287 (SE)/L3603/ L36025	0.0	6.47	0.02
Stream	**Opening Year Without Development**		
L3603 - R287 (NW)/L36025	0.0	8.26	0.02
L3603 - R287 (SE)/ L36025	0.0	7.97	0.02
R287 (SE) - L3603/R287 (NW)/ L36025	0.1	5.09	0.04
L36025 - R287 (SE)/L3603	0.1	7.40	0.06
L36025 - L3603/R287 (NW)	0.0	9.30	0.02
R287 (NW) - R287 (SE)/L3603/ L36025	0.0	6.48	0.02
Stream	**+5 Without Development**		
L3603 - R287 (NW)/L36025	0.0	8.30	0.03
L3603 - R287 (SE)/ L36025	0.0	8.07	0.02
R287 (SE) - L3603/R287 (NW)/ L36025	0.1	5.10	0.04
L36025 - R287 (SE)/L3603	0.1	7.42	0.06
L36025 - L3603/R287 (NW)	0.0	9.38	0.02
R287 (NW) - R287 (SE)/L3603/ L36025	0.0	6.51	0.02
Stream	**+15 Without Development**		
L3603 - R287 (NW)/L36025	0.0	8.34	0.03
L3603 - R287 (SE)/ L36025	0.0	8.17	0.02
R287 (SE) - L3603/R287 (NW)/ L36025	0.1	5.11	0.05
L36025 - R287 (SE)/L3603	0.1	7.45	0.07
L36025 - L3603/R287 (NW)	0.0	9.47	0.02
R287 (NW) - R287 (SE)/L3603/ L36025	0.0	6.54	0.02
Stream	**Opening Year With Development**		
L3603 - R287 (NW)/L36025	0.0	8.68	0.03
L3603 - R287 (SE)/ L36025	0.0	9.89	0.04
R287 (SE) - L3603/R287 (NW)/ L36025	0.1	5.10	0.04
L36025 - R287 (SE)/L3603	0.1	7.55	0.06

	12 Hours (07:00 – 19:00)		
	Queue (Veh)	Delay (s)	RFC
L36025 - L3603/R287 (NW)	0.0	9.32	0.02
R287 (NW) - R287 (SE)/L3603/ L36025	0.0	10.00	0.03
Stream	+5 With Development		
L3603 - R287 (NW)/L36025	0.0	8.57	0.04
L3603 - R287 (SE)/ L36025	0.0	9.86	0.04
R287 (SE) - L3603/R287 (NW)/ L36025	0.1	5.11	0.04
L36025 - R287 (SE)/L3603	0.1	7.57	0.06
L36025 - L3603/R287 (NW)	0.0	9.41	0.02
R287 (NW) - R287 (SE)/L3603/ L36025	0.0	9.97	0.03
Stream	+15 With Development		
L3603 - R287 (NW)/L36025	0.0	8.50	0.04
L3603 - R287 (SE)/ L36025	0.0	9.84	0.04
R287 (SE) - L3603/R287 (NW)/ L36025	0.1	5.11	0.05
L36025 - R287 (SE)/L3603	0.1	7.60	0.07
L36025 - L3603/R287 (NW)	0.0	9.49	0.02
R287 (NW) - R287 (SE)/L3603/ L36025	0.0	9.94	0.04

Table 14.18: **JUNCTION 2 -MAIN ACCESS (SCENARIO 1)**

	12 Hours		
	Queue (Veh)	Delay (s)	RFC
Stream	Opening Year (With Development)		
ACCESS- L3603 (W)	0.0	11.89	0.01
ACCESS- L3603 (E)	0.0	13.89	0.05
L3603 (W)- L3603 (E)/ACCESS	0.0	11.28	0.00
Stream	+5 (With Development)		
ACCESS- L3603 (W)	0.0	11.90	0.01
ACCESS- L3603 (E)	0.0	13.91	0.05
L3603 (W)- L3603 (E)/ACCESS	0.0	11.28	0.00
Stream	+15 (Without Development)		
ACCESS- L3603 (W)	0.0	11.91	0.01
ACCESS- L3603 (E)	0.0	13.93	0.05
L3603 (W)- L3603 (E)/ACCESS	0.0	11.28	0.00

Table 14.19: **JUNCTION 2A – HAUL ROUTE CROSSING (SCENARIO 1)**

	12 Hours (07:00 – 19:00)		
	Queue (Veh)	Delay (s)	RFC
Stream	**Opening Year With Development**		
PROCESSING PLANT - L3603 (W)/QUARRY	0.0	14.44	0.01
PROCESSING PLANT - L3603 (E)/ QUARRY	0.0	14.42	0.01
L3603 (E) - PROCESSING PLANT/L3603 (W)/ QUARRY	0.0	0.00	0.00
QUARRY - L3603 (E)/PROCESSING PLANT	0.0	15.42	0.01
QUARRY - PROCESSING PLANT/L3603 (W)	0.0	15.39	0.01
L3603 (W) - L3603 (E)/PROCESSING PLANT / QUARRY	0.0	0.00	0.00
Stream	**+5 With Development**		
PROCESSING PLANT - L3603 (W)/QUARRY	0.0	14.46	0.01
PROCESSING PLANT - L3603 (E)/ QUARRY	0.0	14.44	0.01
L3603 (E) - PROCESSING PLANT/L3603 (W)/ QUARRY	0.0	0.00	0.00
QUARRY - L3603 (E)/PROCESSING PLANT	0.0	15.44	0.01
QUARRY - PROCESSING PLANT/L3603 (W)	0.0	15.41	0.01
L3603 (W) - L3603 (E)/PROCESSING PLANT/ QUARRY	0.0	0.00	0.00
Stream	**+15 With Development**		
PROCESSING PLANT - L3603 (W)/QUARRY	0.0	14.48	0.01
PROCESSING PLANT - L3603 (E)/ QUARRY	0.0	14.46	0.01
L3603 (E) - PROCESSING PLANT/L3603 (W)/ QUARRY	0.0	0.00	0.00
QUARRY - L3603 (E)/PROCESSING PLANT	0.0	15.46	0.01
QUARRY - PROCESSING PLANT/L3603 (W)	0.0	15.44	0.01
L3603 (W) - L3603 (E)/PROCESSING PLANT/ QUARRY	0.0	0.00	0.00

Table 14.20: **JUNCTION 3 - R284/L3603 CROSSROADS (SCENARIO 1)**

	12 Hours (07:00 – 19:00)		
	Queue (Veh)	Delay (s)	RFC
Stream	**Base Year**		
L3603 (E) - R284 (S)/L3603 (W)	0.0	8.82	0.03
L3603 (E) - R284 (N)/ L3603 (W)	0.0	9.49	0.03
R284 (N) - L3603 (E)/R284 (S)/ L3603 (W)	0.0	6.14	0.02
L3603 (W) - R284 (N)/L3603 (E)	0.0	7.50	0.02
L3603 (W) - L3603 (E)/R284 (S)	0.0	9.75	0.03
R284 (S) - R284 (N)/L3603 (E)/ L3603 (W)	0.0	5.02	0.02
Stream	**Opening Year Without Development**		
L3603 (E) - R284 (S)/L3603 (W)	0.0	9.01	0.03
L3603 (E) - R284 (N)/ L3603 (W)	0.0	9.67	0.04
R284 (N) - L3603 (E)/R284 (S)/ L3603 (W)	0.0	6.17	0.02
L3603 (W) - R284 (N)/L3603 (E)	0.0	7.57	0.03
L3603 (W) - L3603 (E)/R284 (S)	0.0	9.87	0.04
R284 (S) - R284 (N)/L3603 (E)/ L3603 (W)	0.0	5.03	0.02
Stream	**+5 Without Development**		
L3603 (E) - R284 (S)/L3603 (W)	0.0	9.22	0.04
L3603 (E) - R284 (N)/ L3603 (W)	0.0	9.87	0.04
R284 (N) - L3603 (E)/R284 (S)/ L3603 (W)	0.0	6.19	0.02
L3603 (W) - R284 (N)/L3603 (E)	0.0	7.64	0.03
L3603 (W) - L3603 (E)/R284 (S)	0.0	10.00	0.04
R284 (S) - R284 (N)/L3603 (E)/ L3603 (W)	0.0	5.03	0.03
Stream	**+15 Without Development**		
L3603 (E) - R284 (S)/L3603 (W)	0.0	9.45	0.04
L3603 (E) - R284 (N)/ L3603 (W)	0.1	10.08	0.05
R284 (N) - L3603 (E)/R284 (S)/ L3603 (W)	0.0	6.22	0.02
L3603 (W) - R284 (N)/L3603 (E)	0.0	7.71	0.03
L3603 (W) - L3603 (E)/R284 (S)	0.0	10.13	0.04
R284 (S) - R284 (N)/L3603 (E)/ L3603 (W)	0.0	5.03	0.03
Stream	**Opening Year With Development**		
L3603 (E) - R284 (S)/L3603 (W)	0.0	9.38	0.03
L3603 (E) - R284 (N)/ L3603 (W)	0.0	10.14	0.04
R284 (N) - L3603 (E)/R284 (S)/ L3603 (W)	0.0	6.16	0.02

	12 Hours (07:00 – 19:00)		
	Queue (Veh)	Delay (s)	RFC
L3603 (W) - R284 (N)/L3603 (E)	0.0	7.71	0.03
L3603 (W) - L3603 (E)/R284 (S)	0.0	9.94	0.04
R284 (S) - R284 (N)/L3603 (E)/ L3603 (W)	0.0	5.02	0.02
Stream	+5 With Development		
L3603 (E) - R284 (S)/L3603 (W)	0.0	9.56	0.04
L3603 (E) - R284 (N)/ L3603 (W)	0.1	10.31	0.05
R284 (N) - L3603 (E)/R284 (S)/ L3603 (W)	0.0	6.19	0.02
L3603 (W) - R284 (N)/L3603 (E)	0.0	7.80	0.03
L3603 (W) - L3603 (E)/R284 (S)	0.0	10.07	0.04
R284 (S) - R284 (N)/L3603 (E)/ L3603 (W)	0.0	5.03	0.03
Stream	+15 With Development		
L3603 (E) - R284 (S)/L3603 (W)	0.0	9.77	0.04
L3603 (E) - R284 (N)/ L3603 (W)	0.1	10.50	0.05
R284 (N) - L3603 (E)/R284 (S)/ L3603 (W)	0.0	6.22	0.02
L3603 (W) - R284 (N)/L3603 (E)	0.0	7.89	0.03
L3603 (W) - L3603 (E)/R284 (S)	0.0	10.21	0.04
R284 (S) - R284 (N)/L3603 (E)/ L3603 (W)	0.0	5.03	0.03

Table 14.21: JUNCTION 1 -R287/L3603/L36025 CROSSROADS (SCENARIO 2)

	12 Hours (07:00 – 19:00)		
	Queue (Veh)	Delay (s)	RFC
Stream	**Base Year**		
L3603 - R287 (NW)/L36025	0.0	8.22	0.02
L3603 - R287 (SE)/ L36025	0.0	7.88	0.02
R287 (SE) - L3603/R287 (NW)/ L36025	0.0	5.09	0.04
L36025 - R287 (SE)/L3603	0.1	7.38	0.06
L36025 - L3603/R287 (NW)	0.0	9.21	0.02
R287 (NW) - R287 (SE)/L3603/ L36025	0.0	6.47	0.02
Stream	**Opening Year Without Development**		
L3603 - R287 (NW)/L36025	0.0	8.26	0.02
L3603 - R287 (SE)/ L36025	0.0	7.97	0.02
R287 (SE) - L3603/R287 (NW)/ L36025	0.1	5.09	0.04
L36025 - R287 (SE)/L3603	0.1	7.40	0.06
L36025 - L3603/R287 (NW)	0.0	9.30	0.02
R287 (NW) - R287 (SE)/L3603/ L36025	0.0	6.48	0.02
Stream	**+5 Without Development**		
L3603 - R287 (NW)/L36025	0.0	8.30	0.03
L3603 - R287 (SE)/ L36025	0.0	8.07	0.02
R287 (SE) - L3603/R287 (NW)/ L36025	0.1	5.10	0.04
L36025 - R287 (SE)/L3603	0.1	7.42	0.06
L36025 - L3603/R287 (NW)	0.0	9.38	0.02
R287 (NW) - R287 (SE)/L3603/ L36025	0.0	6.51	0.02
Stream	**+15 Without Development**		
L3603 - R287 (NW)/L36025	0.0	8.34	0.03
L3603 - R287 (SE)/ L36025	0.0	8.17	0.02
R287 (SE) - L3603/R287 (NW)/ L36025	0.1	5.11	0.05
L36025 - R287 (SE)/L3603	0.1	7.45	0.07
L36025 - L3603/R287 (NW)	0.0	9.47	0.02
R287 (NW) - R287 (SE)/L3603/ L36025	0.0	6.54	0.02
Stream	**Opening Year With Development**		
L3603 - R287 (NW)/L36025	0.0	10.31	0.04
L3603 - R287 (SE)/ L36025	0.0	10.49	0.04
R287 (SE) - L3603/R287 (NW)/ L36025	0.1	5.10	0.04
L36025 - R287 (SE)/L3603	0.1	7.57	0.06

	12 Hours (07:00 – 19:00)		
	Queue (Veh)	**Delay (s)**	**RFC**
L36025 - L3603/R287 (NW)	0.0	9.33	0.02
R287 (NW) - R287 (SE)/L3603/ L36025	0.0	11.54	0 .04
Stream	**+5 With Development**		
L3603 - R287 (NW)/L36025	0.0	10.15	0.04
L3603 - R287 (SE)/ L36025	0.0	10.40	0.04
R287 (SE) - L3603/R287 (NW)/ L36025	0.1	5.11	0.04
L36025 - R287 (SE)/L3603	0.1	7.59	0.06
L36025 - L3603/R287 (NW)	0.0	9.42	0.02
R287 (NW) - R287 (SE)/L3603/ L36025	0.0	11.50	0.04
Stream	**+15 With Development**		
L3603 - R287 (NW)/L36025	0.0	9.97	0.04
L3603 - R287 (SE)/ L36025	0.0	10.33	0.04
R287 (SE) - L3603/R287 (NW)/ L36025	0.1	5.12	0.05
L36025 - R287 (SE)/L3603	0.1	7.62	0.07
L36025 - L3603/R287 (NW)	0.0	9.51	0.02
R287 (NW) - R287 (SE)/L3603/ L36025	0.1	11.45	0.04

Table 14.22: JUNCTION 2 -MAIN ACCESS (SCENARIO 2)

	12 Hours		
	Queue (Veh)	**Delay (s)**	**RFC**
Stream	**Opening Year (With Development)**		
ACCESS- L3603 (W)	**0.0**	11.92	0.01
ACCESS- L3603 (E)	**0.0**	13.94	0.05
L3603 (W)- L3603 (E)/ACCESS	**0.0**	11.29	0.00
Stream	**+5 (With Development)**		
ACCESS- L3603 (W)	**0.0**	11.92	0.01
ACCESS- L3603 (E)	**0.0**	13.96	0.05
L3603 (W)- L3603 (E)/ACCESS	**0.0**	11.29	0.00
Stream	**+15 (Without Development)**		
ACCESS- L3603 (W)	**0.0**	11.93	0.01
ACCESS- L3603 (E)	**0.0**	13.98	0.05
L3603 (W)- L3603 (E)/ACCESS	**0.0**	11.29	0.00

Table 14.23: JUNCTION 2A – HAUL ROUTE CROSSING (SCENARIO 2)

	12 Hours (07:00 – 19:00)		
	Queue (Veh)	Delay (s)	RFC
Stream	**Opening Year With Development**		
PROCESSING PLANT - L3603 (W)/QUARRY	0.0	14.44	0.01
PROCESSING PLANT - L3603 (E)/ QUARRY	0.0	14.42	0.01
L3603 (E) - PROCESSING PLANT/L3603 (W)/ QUARRY	0.0	0.00	0.00
QUARRY - L3603 (E)/PROCESSING PLANT	0.0	15.42	0.01
QUARRY - PROCESSING PLANT/L3603 (W)	0.0	15.40	0.01
L3603 (W) - L3603 (E)/PROCESSING PLANT/ QUARRY	0.0	0.00	0.00
Stream	**+5 With Development**		
PROCESSING PLANT - L3603 (W)/QUARRY	0.0	14.46	0.01
PROCESSING PLANT - L3603 (E)/ QUARRY	0.0	14.44	0.01
L3603 (E) - PROCESSING PLANT/L3603 (W)/ QUARRY	0.0	0.00	0.00
QUARRY - L3603 (E)/PROCESSING PLANT	0.0	15.44	0.01
QUARRY - PROCESSING PLANT/L3603 (W)	0.0	15.41	0.01
L3603 (W) - L3603 (E)/PROCESSING PLANT/ QUARRY	0.0	0.00	0.00
Stream	**+15 With Development**		
PROCESSING PLANT - L3603 (W)/QUARRY	0.0	14.49	0.01
PROCESSING PLANT - L3603 (E)/ QUARRY	0.0	14.46	0.01
L3603 (E) - PROCESSING PLANT/L3603 (W)/ QUARRY	0.0	0.00	0.00
QUARRY - L3603 (E)/PROCESSING PLANT	0.0	15.46	0.01
QUARRY - PROCESSING PLANT/L3603 (W)	0.0	15.44	0.01
L3603 (W) - L3603 (E)/PROCESSING PLANT/ QUARRY	0.0	0.00	0.00

Table 14.24: JUNCTION 3 - R284/L3603 CROSSROADS (SCENARIO 2)

	12 Hours (07:00 – 19:00)		
	Queue (Veh)	Delay (s)	RFC
Stream	**Base Year**		
L3603 (E) - R284 (S)/L3603 (W)	0.0	8.82	0.03
L3603 (E) - R284 (N)/ L3603 (W)	0.0	9.49	0.03
R284 (N) - L3603 (E)/R284 (S)/ L3603 (W)	0.0	6.14	0.02
L3603 (W) - R284 (N)/L3603 (E)	0.0	7.50	0.02
L3603 (W) - L3603 (E)/R284 (S)	0.0	9.75	0.03
R284 (S) - R284 (N)/L3603 (E)/ L3603 (W)	0.0	5 02	0.02
Stream	**Opening Year Without Development**		
L3603 (E) - R284 (S)/L3603 (W)	0.0	9.01	0.03
L3603 (E) - R284 (N)/ L3603 (W)	0.0	9.67	0.04
R284 (N) - L3603 (E)/R284 (S)/ L3603 (W)	0.0	6.17	0.02
L3603 (W) - R284 (N)/L3603 (E)	0.0	7.57	0.03
L3603 (W) - L3603 (E)/R284 (S)	0.0	9.87	0.04
R284 (S) - R284 (N)/L3603 (E)/ L3603 (W)	0.0	5.03	0.02
Stream	**+5 Without Development**		
L3603 (E) - R284 (S)/L3603 (W)	0.0	9.22	0.04
L3603 (E) - R284 (N)/ L3603 (W)	0.0	9.87	0.04
R284 (N) - L3603 (E)/R284 (S)/ L3603 (W)	0.0	6.19	0.02
L3603 (W) - R284 (N)/L3603 (E)	0.0	7.64	0.03
L3603 (W) - L3603 (E)/R284 (S)	0.0	10.00	0.04
R284 (S) - R284 (N)/L3603 (E)/ L3603 (W)	0.0	5.03	0.03
Stream	**+15 Without Development**		
L3603 (E) - R284 (S)/L3603 (W)	0.0	9.45	0.04
L3603 (E) - R284 (N)/ L3603 (W)	0.1	10.08	0.05
R284 (N) - L3603 (E)/R284 (S)/ L3603 (W)	0.0	6.22	0.02
L3603 (W) - R284 (N)/L3603 (E)	0.0	7.71	0.03
L3603 (W) - L3603 (E)/R284 (S)	0.0	10.13	0.04
R284 (S) - R284 (N)/L3603 (E)/ L3603 (W)	0.0	5.03	0.03
Stream	**Opening Year With Development**		
L3603 (E) - R284 (S)/L3603 (W)	0.0	9.67	0.03
L3603 (E) - R284 (N)/ L3603 (W)	0.0	10.56	0.04
R284 (N) - L3603 (E)/R284 (S)/ L3603 (W)	0.0	6.16	0.02

	12 Hours (07:00 – 19:00)		
	Queue (Veh)	Delay (s)	RFC
L3603 (W) - R284 (N)/L3603 (E)	0.0	7.81	0.03
L3603 (W) - L3603 (E)/R284 (S)	0.0	10.00	0.04
R284 (S) - R284 (N)/L3603 (E)/ L3603 (W)	0.0	5.02	0.02
Stream	**+5 With Development**		
L3603 (E) - R284 (S)/L3603 (W)	0.0	9.83	0.04
L3603 (E) - R284 (N)/ L3603 (W)	0.1	10.70	0.05
R284 (N) - L3603 (E)/R284 (S)/ L3603 (W)	0.0	6.19	0.02
L3603 (W) - R284 (N)/L3603 (E)	0.0	7.90	0.03
L3603 (W) - L3603 (E)/R284 (S)	0.0	10.12	0.04
R284 (S) - R284 (N)/L3603 (E)/ L3603 (W)	0.0	5.03	0.03
Stream	**+15 With Development**		
L3603 (E) - R284 (S)/L3603 (W)	0.0	10.03	0.04
L3603 (E) - R284 (N)/ L3603 (W)	0.1	10.87	0.05
R284 (N) - L3603 (E)/R284 (S)/ L3603 (W)	0.0	6.22	0.02
L3603 (W) - R284 (N)/L3603 (E)	0.0	7.99	0.03
L3603 (W) - L3603 (E)/R284 (S)	0.0	10.26	0.04
R284 (S) - R284 (N)/L3603 (E)/ L3603 (W)	0.0	5.03	0.03

Road Safety

Site Access

14.74 The site access has a paved width of 25m at the mouth of the junction with the L3603. The existing pavement at the access has recently been renewed (which is not reflected in the adjacent photo).

14.75 There are no warning signs on the L3063 approaches to the quarry access. Warning signs on both approaches to the main quarry access and haul route access will be provided to advise approaching drivers of the upcoming quarry access.

14.76 In relation to Planning Application 18/345 and, in particular, items 18 & 19 of the subsequent Request for Further Information (RFI), a representative from the applicant's team (PMCE Ltd) met with the Area Engineer, Mr Conor McCann, on site on the 30th November 2018 to discuss the roads/traffic related RFI items.

14.77 Following discussions with Mr. McCann, it was agreed that vegetation will be cut back to ensure sufficient visibility is achieved at the existing haul route crossing location and that the verge levels would be reduced to ensure adequate shedding of surface runoff from the carriageway.

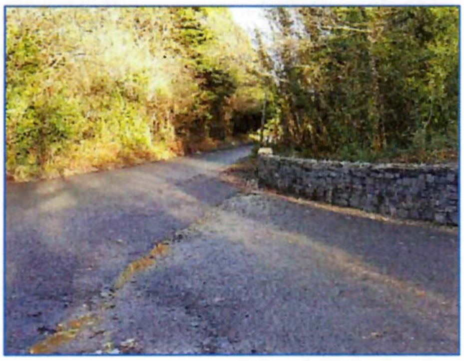
14.78 Mr. McCann confirmed that RFI 19 was raised on the understanding that the existing quarry crossroads access would be used for vehicles entering/exiting the quarry. The applicant advised that this access would only be used for machinery crossing the road, and not for access onto, or from, the road. On this basis, it was agreed with Mr. McCann that warning signage would be provided on the approaches to the crossing to alert approaching drivers of crossing machinery.

14.79 The measures agreed with Mr. McCann are included on drawing P20-114-DG-002, which were submitted to Mr. McCann for his review, who subsequently confirmed that they accurately reflect the measures agreed during the site visit on the 30th November 2018.

Sightlines

Main access

14.80 At present the sightlines at the quarry access are insufficient for a posted speed limit of 80kph due to existing vegetation within the southern verge of the L3603 on both sides of the access.



14.81 Drawing P20-114-DG-001 confirms that the required sightlines of 160m can be achieved to the south, at a set-back of 3.0m from the carriageway edge as per TII DN-GEO-03060 for a posted speed limit of 80kph, by cutting back the existing vegetation on lands within the applicant's ownership.

14.82 Sightlines of 100m will be achieved to the north, at a set-back of 3.0m from the carriageway edge by cutting back existing vegetation. These sightlines, to the north, are considered acceptable as approach speeds are passively limited by the location of the R287/L3603/L36025 crossroad junction within 220m of the site access, which will constrain prevailing vehicle speeds as they approach the access.

Haul Route crossing

14.83 Drawing P20-114-DG-001 demonstrates sightlines of 160m can be achieved, at a set-back of 3.0m from the carriageway edge as per TII DN-GEO-03060 for a posted speed limit of 80kph, on the eastern side at the haul route crossing for both directions.

14.84 On the western side of the L3603 at the haul route crossing, visibility of 160m can be achieved to the north and 140m to the south. These will be achieved by cutting back existing vegetation within land in the applicant's ownership and is considered acceptable as approach speeds are passively limited due to the close proximity of a high demand horizontal alignment on the L3603.

Parking

14.85 Adequate car parking provision for employees and visitors is provided at the existing weighbridge office.

Pedestrians & Cyclists

14.86 There are no pedestrian or cyclist provisions along the L3603. No pedestrians or cyclists were observed along the L3606 during the site visit.

Conclusions

14.87 An assessment has been undertaken of the link capacity for the L3603, R287 and the R284 and the junction capacity of the quarry access, the R287/L3603 junction, the haul route crossing and the R284/L3603/L36025 junction. These assessments have concluded that the links and junctions will operate within capacity for each of the assessment years.

14.88 Warning signs on both approaches to the main quarry access will be provided to advise approaching drivers of the upcoming quarry access.

14.89 The required sightlines at the quarry access will be achieved by cutting back of existing vegetation.

LAGAN
Part of the Breedon Group

15. Interactions Summary

15. Interactions Summary

CHAPTER 15

INTERACTIONS SUMMARY

INTERACTIONS SUMMARY 15

CONTENTS

INTRODUCTION

15.1 All of the reasonably predictable significant impacts of the existing and proposed development and the measures in place to mitigate them have been outlined in the EIAR. However, for any development with the potential for significant environmental impact there is also the potential for interaction amongst these impacts. The result of these interactions may either exacerbate the magnitude of the impact or ameliorate it. The interaction of impacts on the surrounding environment needs to be addressed as part of the Environmental Impact Assessment process.

15.2 This Environmental Impact Assessment Report was prepared by SLR Consulting on behalf of Lagan Materials Ltd. as an integrated document, rather than a collection of separate reports. The impacts that arise as a result of the interaction between several aspects of the development have therefore been addressed in the main body of each EIAR section.

The Interaction of the Foregoing

15.3 The interaction between the various environmental topics has been covered within each of the EIAR Sections, 4 through to 14, where relevant. For example, the interaction of geology and groundwater has been addressed in EIAR **Chapter 7**.

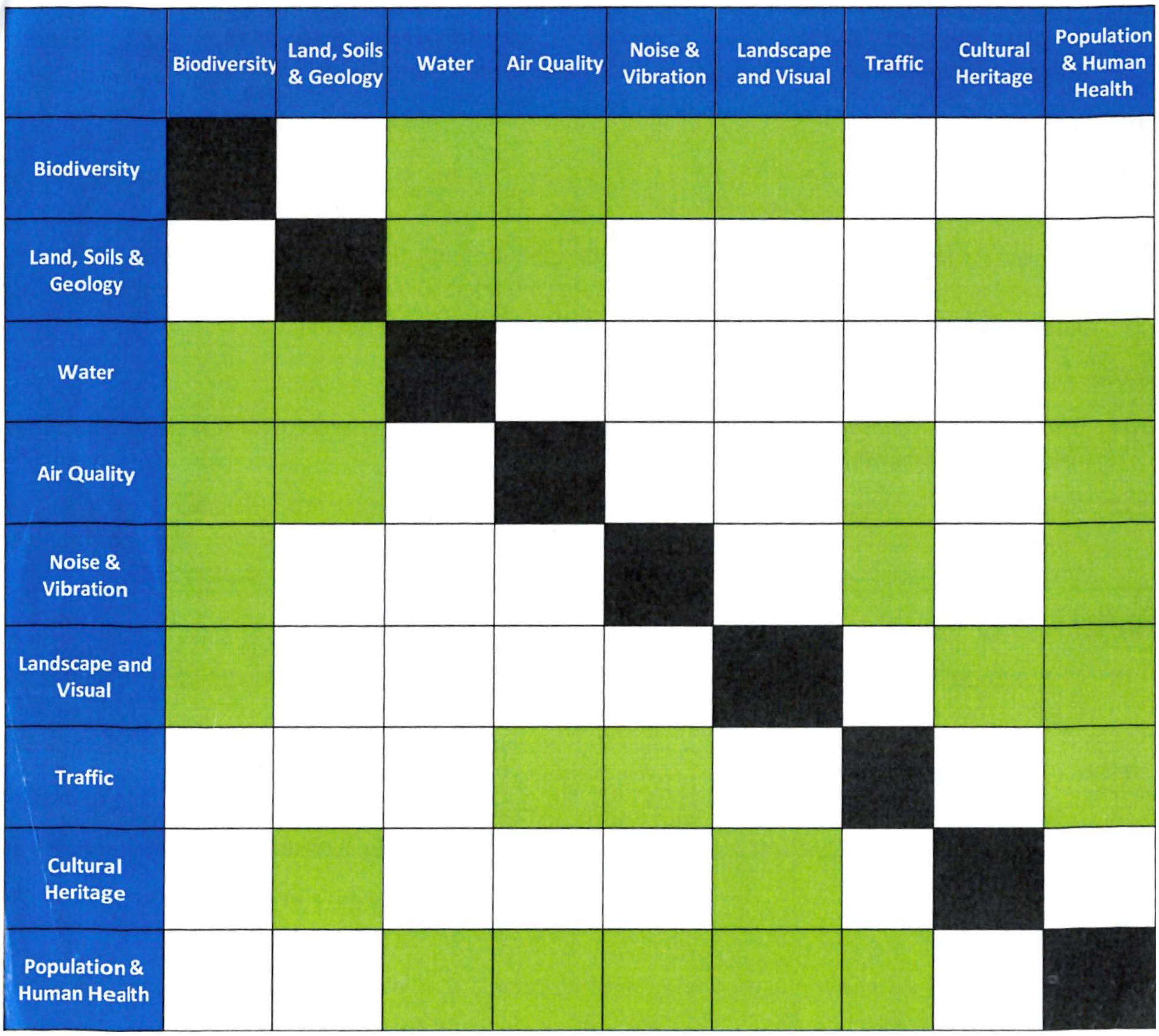
15.4 The environmental components which might potentially be impacted by a development of this kind and at this location have been identified through the site assessment as follows:

- Effects on land use and amenity;
- Impacts on local sensitive receptors;
- Loss of natural heritage and wildlife habitats and disturbance to flora and fauna;
- Impacts on groundwater, soils and bedrock geology;
- Nuisance potential and or public health effects due to noise, dust, odour or lighting emissions;
- Impacts on local archaeology;
- Change in visual character;
- Impacts on material assets such as infrastructure or local utilities.

15.5 A matrix method has been used, in which the environmental components addressed in the previous sections of this EIAR have been placed on both axes of a matrix, these interactions are summarised in **Table 15-1** below.

15.6 The purpose of the effects matrix is to identify potential interactions. Actual interactions and their significance are dealt with in the relevant chapter of the EIAR with a brief overview of some of the more pertinent interactions provided in this chapter.

Table 15-1
Impact Interaction and Interrelationships Matrix



	Biodiversity	Land, Soils & Geology	Water	Air Quality	Noise & Vibration	Landscape and Visual	Traffic	Cultural Heritage	Population & Human Health
Biodiversity	⬛		🟩	🟩	🟩	🟩			
Land, Soils & Geology		⬛	🟩	🟩				🟩	
Water	🟩	🟩	⬛						🟩
Air Quality	🟩	🟩		⬛			🟩		🟩
Noise & Vibration	🟩				⬛		🟩		🟩
Landscape and Visual	🟩					⬛		🟩	🟩
Traffic				🟩	🟩		⬛		🟩
Cultural Heritage		🟩				🟩		⬛	
Population & Human Health			🟩	🟩	🟩	🟩	🟩		⬛

POTENTIAL INTERACTIONS

Biodiversity

15.7 Potential interaction associated with the proposed landscape mitigation and restoration proposals are discussed in Chapter 4 (Biodiversity), Chapter 13 (Landscape) and Figure 2.2 (Landscape Mitigation and Restoration).

Water

15.8 The potential impact of the recommencement of quarry activities and the aggregate processing area in relation to water and the potential interactions with other environmental topics are discussed in Chapter 4 (Biodiversity), Chapter 6 (Land, Soils and Geology) and Chapter 7 (Water).

Air Quality

15.9 The interaction of Climate (Chapter 9), Air Quality (Chapter 8) and Population and Human Health (Chapter 4) are discussed in the relevant chapters of the EIAR.

15.10 The Air Quality Chapter presented in EIAR **Chapter 8**, indicates that with the implementation of industry standard air quality mitigation measures, no residual impacts will result from the proposed development. Therefore, the interaction is considered to be acceptable.

Noise & Vibration

15.11 The interaction between noise / vibration and population and human health is discussed in the relevant chapters of the EIAR.

15.12 The Noise and Vibration assessment, presented in EIAR **Chapter 10**, indicates that with the implementation of industry standard noise mitigation measures, no residual impacts will result from the proposed development. Therefore, the interaction is considered to be acceptable.

Landscape & Visual

15.13 The potential interaction with Biodiversity are discussed in Chapter 4 (Biodiversity), Chapter 13 (Landscape) and Figure 2.2 (Landscape Mitigation and Restoration).

Traffic

15.14 Potential interactions associated with traffic movements from the existing operational quarry development with the general population and air quality are addressed in the preceding sections of this chapter.

Cultural Heritage

15.15 The proposed development area is an existing quarry that has previously been assessed under Planning Application Reg. No. 02/271 (see Plate 12-2, 12-3 and Fig. 12-1).

15.16 Potential interactions with other environmental topics (e.g. Land, Soils & Geology and Landscape & Visual) are limited as there will be no topsoil stripping required as part of the proposed development. In addition, direct changes to this landscape would be very limited as the nature of the proposal comprises, for the most part, the proposed deepening of the existing quarry void. Visual effects at a selection of viewpoint locations were assessed and judged to be not significant.

Population and Human Health

15.17 According to the relevant guidelines, human health should be considered in the context of the relevant environmental topics addressed by the EIAR. Also, effects on human health should be considered in relation to relevant pathways (such as air, soil and water) and should be considered in the context of accepted standards for exposure, dose or risk.

15.18 Human health is considered in the context of the relevant pathways, such as noise, air, soil and water in the context of acceptable doses or limits. The EIAR shows that the quarry would operate within acceptable limits for noise and dust and potential effects on soil and water would be addressed through good practice and mitigation measures to avoid accidental spillages of fuel, etc. Water would be discharged from the site in accordance with the existing discharge licence.

15.19 The key matters in relation to amenity are water, noise, dust, vibration, landscape and traffic. As stated above, the EIAR shows that the quarry would operate within acceptable levels for water, noise, dust and vibrations. From many locations, the changes to the landscape would not be visible or would not be significant. The restoration of the quarry would be beneficial when compared against the existing baseline. The traffic assessment shows that the existing road junctions have sufficient capacity to accommodate the quarry traffic to 2037 and beyond.