APPENDIX 7-1 PRE-PLANNING CONSULTATION RESPONSES

07/01/2020

Uisce Éireann
Bosca OP 6000
Baile Átha Cliath 1
Éire

Irish Water
PO Box 6000
Dublin 1
Ireland

T: +353 1 89 25000
F: +353 1 89 25001
www.water.ie

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.

- 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

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.batconservationlreland.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

[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.

Hedgerows and related habitats

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

[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.

[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

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.

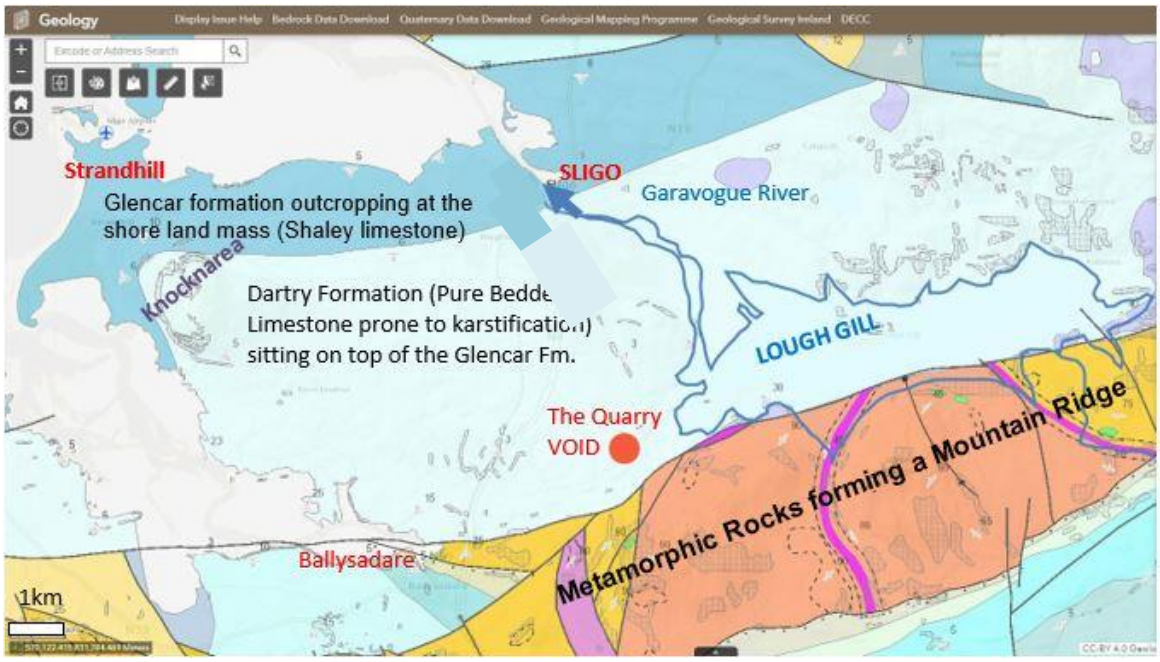
In my professional opinion, informed by more than 12 years intensive and detailed site intrusive assessments at karst limestone quarries, **the Aghamore quarry poses little or no threat to Lough Gill or the Public Water Supplies**. There are so many facts to support my assessment of the overall risk, 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.

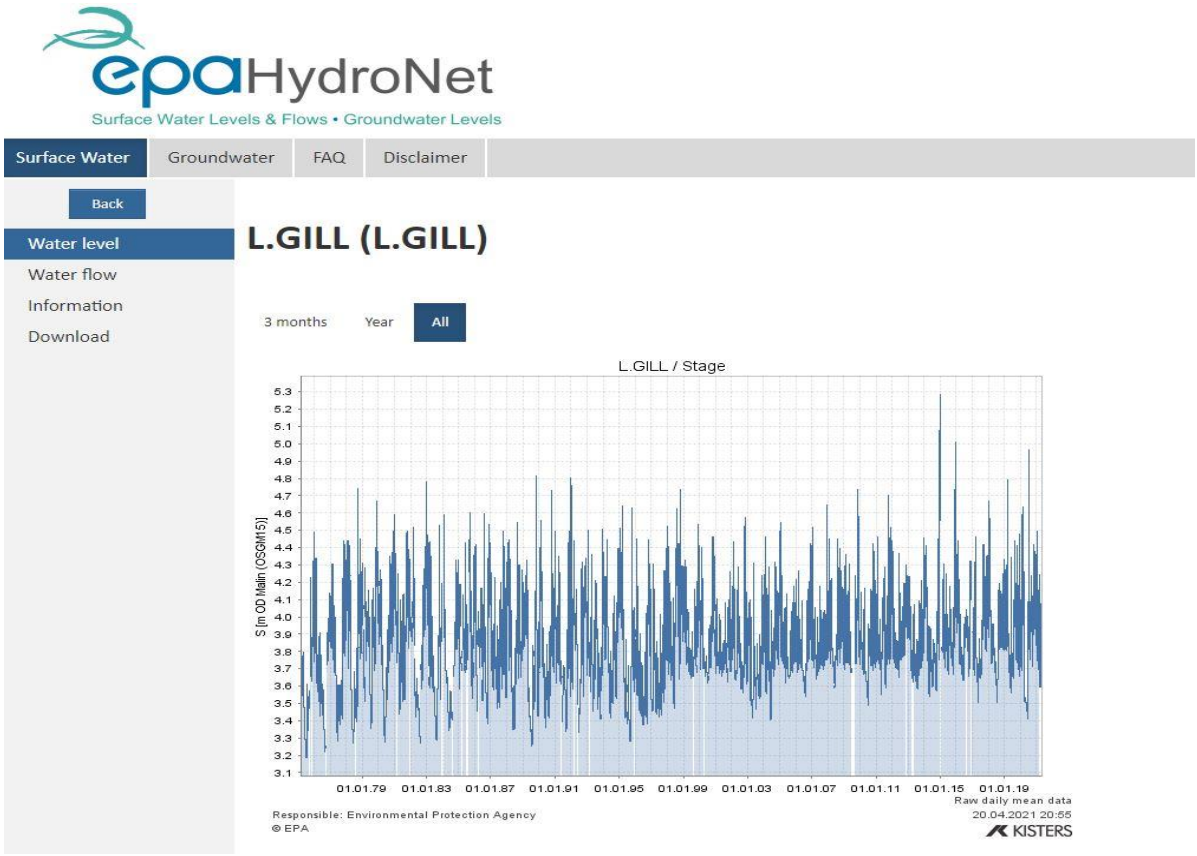
PLATE A Regional Geology (www.GSI) with Hydro-G Annotations for the purposes of communication.



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).

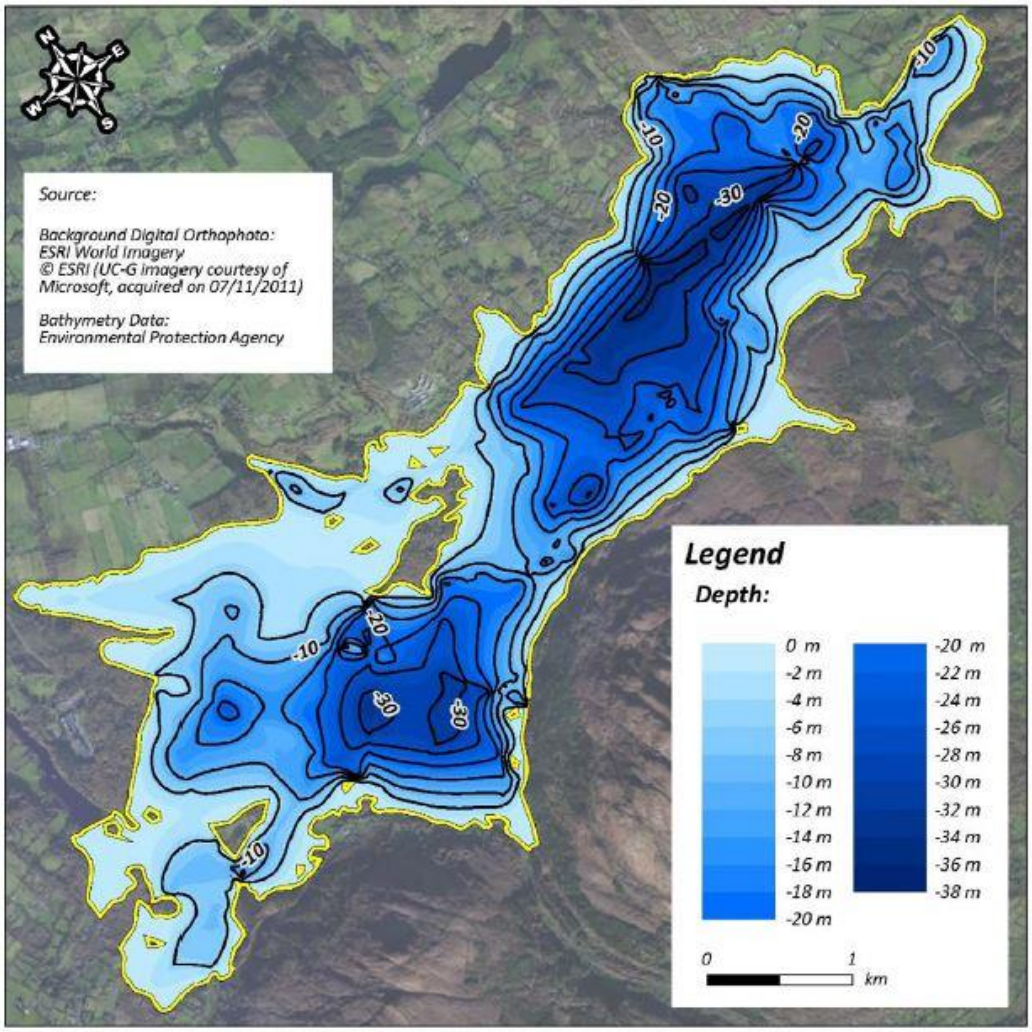
Therefore, Hydro-G offers that the integration of information from distinct geological experts and their studies outside and inside the quarry suggests no potential for hydraulic connection nor drain from Lough Gill in the proposal presented regarding bringing the floor from the current -21m OD to -50m 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)



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.

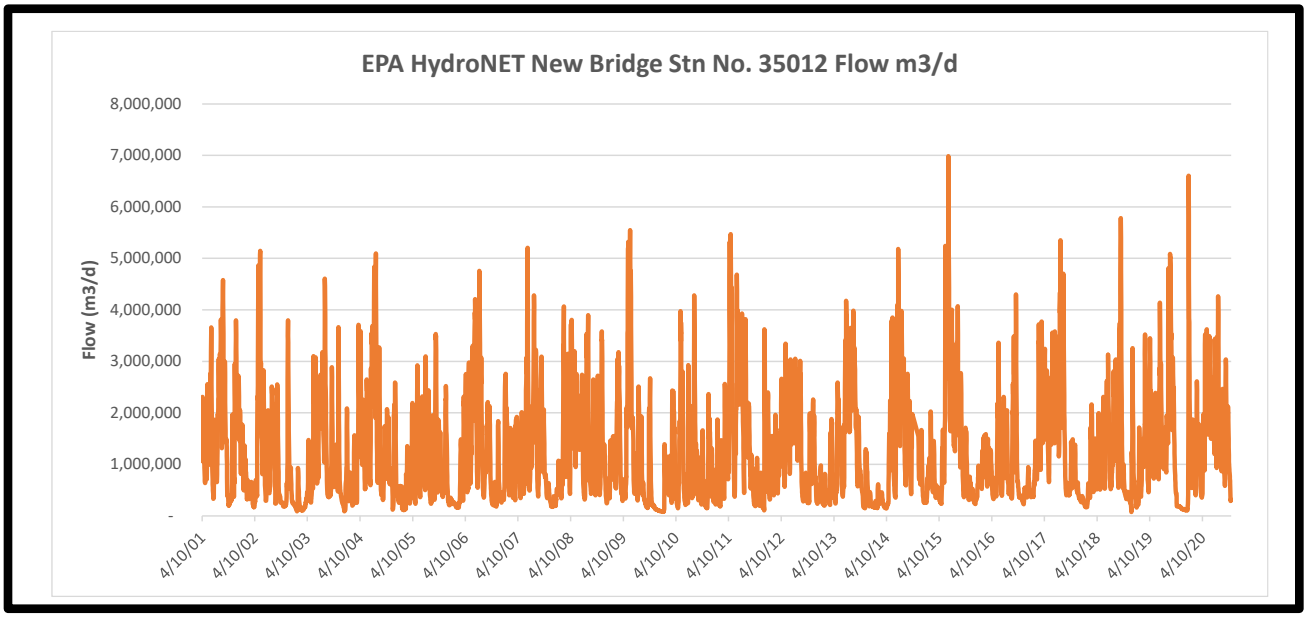
    c. This suggests that the surface area of Lough Gill 128 times bigger than the surface area of the void of the quarry.

    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

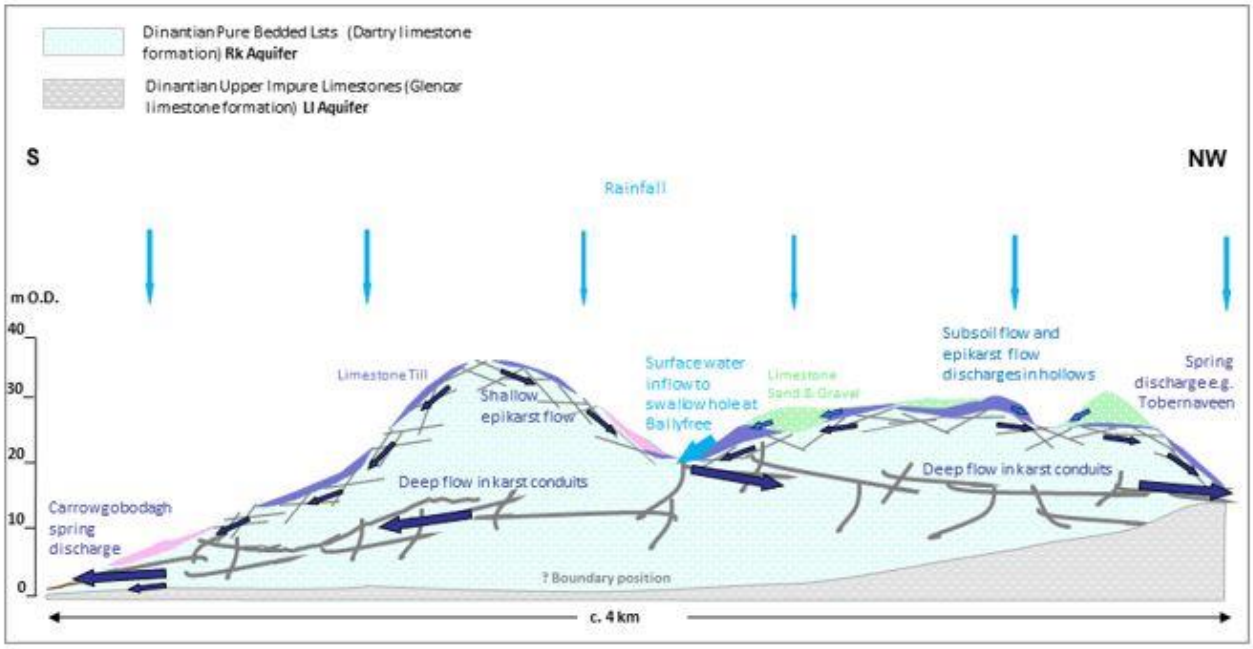


Diagram 1 Conceptual Model of Flows

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			Lagan Aghamore Sligo Quarry REGIONAL Groundwater Balance		
HYDROGEOLOGICAL WATER BALANCE: LOCAL (Carrowmore East GWB) & Regional KARST AQUIFER			**HYDROGEOLOGICAL WATER BALANCE: LOCAL (Carrowmore WEST GWB) & Regional KARST AQUIFER**		
GSI assigned area for 'Carrowmore East GWB' (km2)	58		GSI assigned area for 'Carrowmore WEST GWB' (km2)	37	
Carrowmore East Groundwater Body' (m2)	58,000,000		Carrowmore WEST Groundwater Body' (m2)	37,000,000	
GSI Stated Total **Aquifer** Area (km2)	109		GSI Stated Total **Aquifer** Area (km2)	109	
Total Aquifer Area (m2)	109,000,000		Total Aquifer Area (m2)	109,000,000	
GSI Effective Rainfall **AVERAGE over AQUIFER** (mm/yr)	800		GSI Effective Rainfall **AVERAGE over AQUIFER** (mm/yr)	800	
AVERAGE GSI Groundwater Recharge (mm/yr)	550		AVERAGE GSI Groundwater Recharge (mm/yr)	550	
AVERAGE GSI Groundwater Recharge (m/yr)	0.55		AVERAGE GSI Groundwater Recharge (m/yr)	0.55	
Groundwater Recharge to Carrowmore East GWB = [0.55m x 58,000,000m2 area] (m3/yr)	31,900,000		Groundwater Recharge to Carrowmore WEST GWB = [0.55m x 37,000,000m2 area] (m3/yr)	20,350,000	
AVERAGE Groundwater Recharge to Carrowmore East GWB = [0.55m x 58,000,000m2 area] (m3/d)	87,397		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		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		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		Annual: Lagan Sligo's Proposed SW and Groundwater Management Volume (m3/yr)	1,277,500	
Hydro-G Calculation			**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**	%	**Proportion of proposed SW & GW at the site as % of Carrowmore WEST's GWB's annual recharge amount to groundwater from rain 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		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**	%	**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 = APPROX 280mm runoff APPROX]	**101,360,000**		**Impact predicted on Ballysadare Bay SAC & SPA = <2% of flow.**		
Aghamore Quarry's Discharge as a % of Lough Gill's SW runoff input volume - NOT YET ACCOUNTING FOR RIVER INFLOWS THEMSELVES	1	%			

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 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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Irish Water (?) 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. We can reasonably assume it was written in 2019 or 2020 because they state in the document that they will complete their proposals by the end of 2021).

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Tyan, 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.

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.

Hydro-G

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.
Submitted to:	Pamela Bartley

TYNAN ENVIRONMENTAL
environmental and hydrogeological consulting

7 Hillcrest Park
Strandhill, Co. Sligo
T +353 71 9128395
F +353 71 9128395
info@tynanenvironmental.com
www.tynanenvironmental.com

Document Information	
Title:	Regional Hydrogeological Context of Lagan's quarry at Aghamore Near, Aghamore Far and Carrownamaddoo townlands, Co Sligo.
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Work Items:	All
Author(s):	Suzanne Tynan
Signed:	 Suzanne Tynan BSc., MSc (Env. Sci), MSc(Hydro), EurGeol, PGeo. Principal Tynan Environmental

CONTENTS

FIGURES

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.

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.

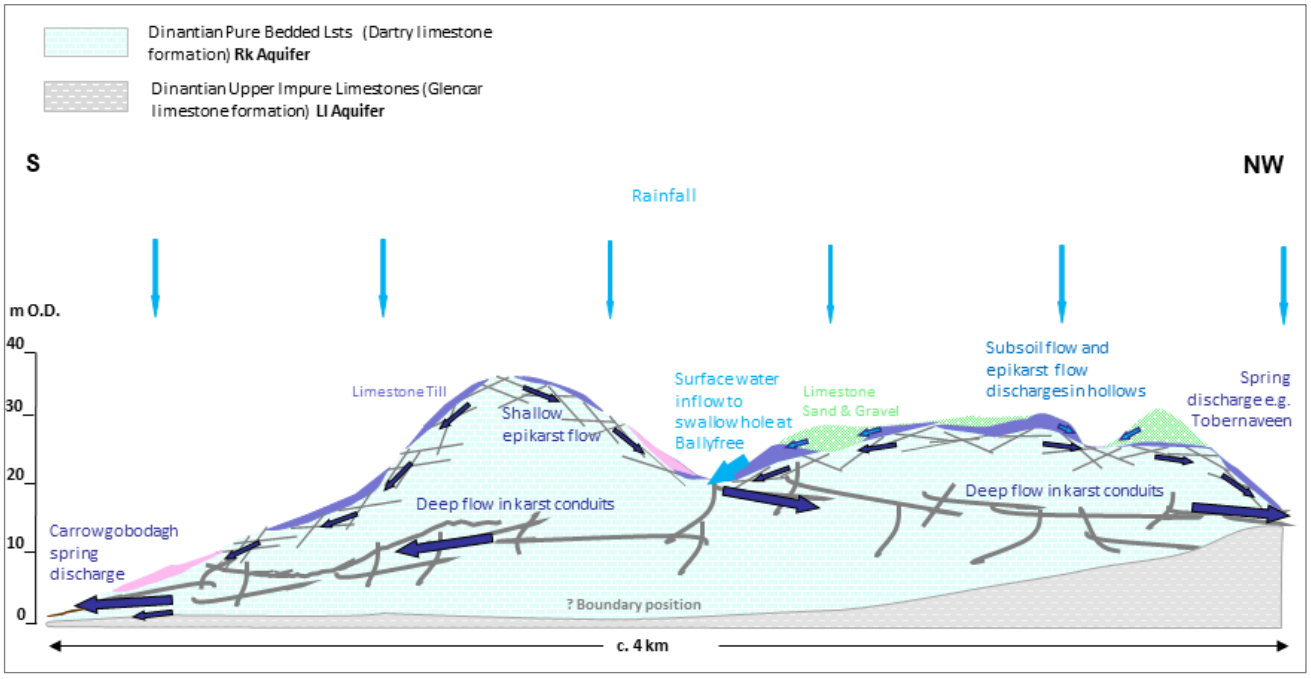

Diagram 1 Conceptual Model of Flows

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^o) to 247^o (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.

6 REFERENCES

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Teagasc/EPA, 2004. Digital maps and accompanying documentation: *EPA Soil and Subsoil Mapping Project – Summary Methodology Description for Subsoils, Land Cover, Habitat and Soils Mapping/Modelling.* Publ. Teagasc.

FIGURES

Title:
Figure 1 Regional Geology and Hydrogeology

Drawing No: 159_1

Project:
Proposed Extension of Lagan Materials Ltd. Quarry, Aghamore, Co. Sligo

Stage:

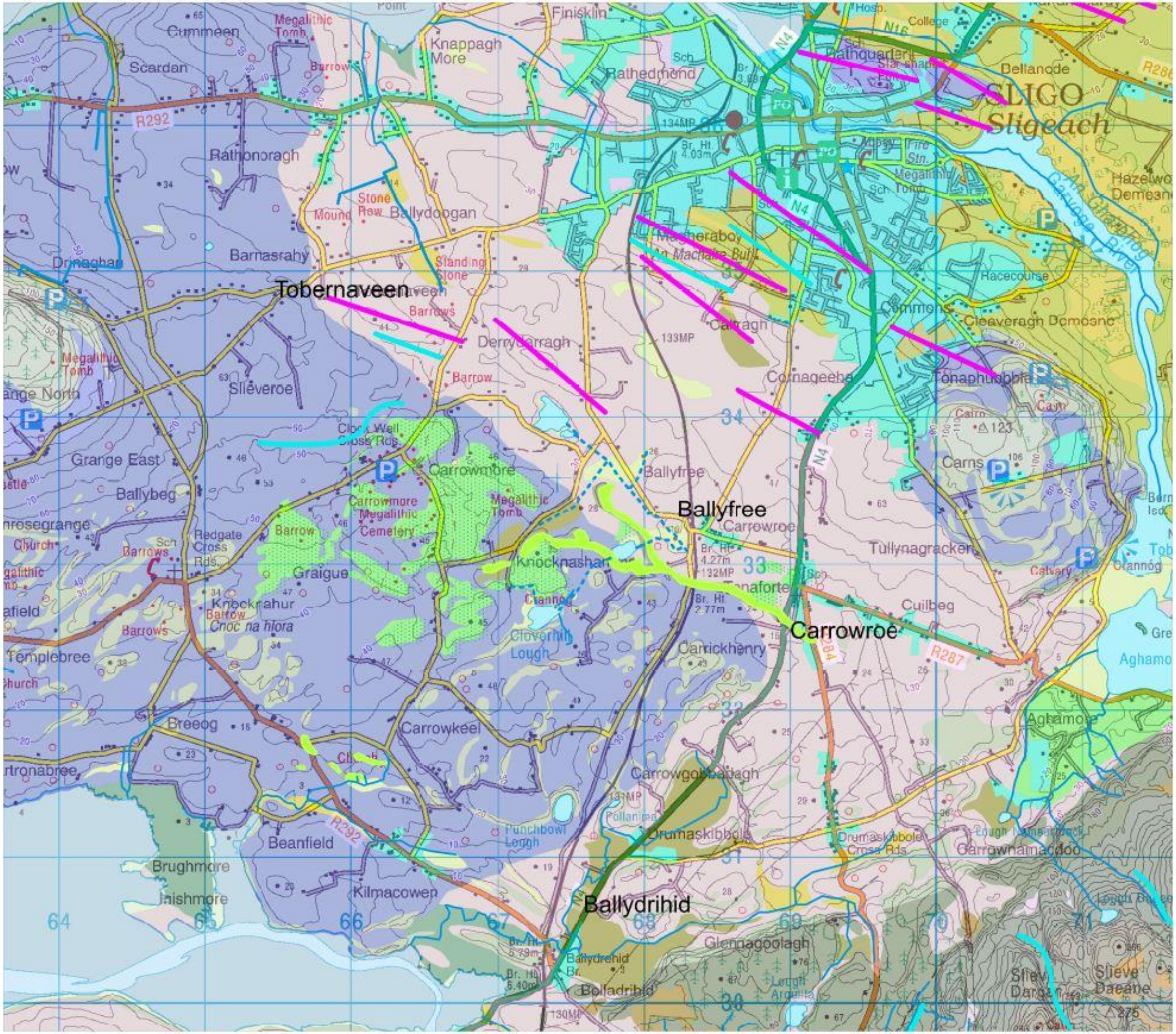
Client:
Hydro-G Ltd.

Scale: 1:30,000 @ A3

surveyed	drawn	checked	date
ST	ST	ST	22/04/2021

Revisions:

TYNAN ENVIRONMENTAL
environmental and hydrogeological consulting
7 Hillcrest Park, Strandhill, Co. Sligo
T +353 71 9128395 F +353 71 9128395
stynan@tynanenvironmental.com
www.tynanenvironmental.com



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
Revisions:	

surveyed	drawn	checked	
ST	ST	ST	22/4/21

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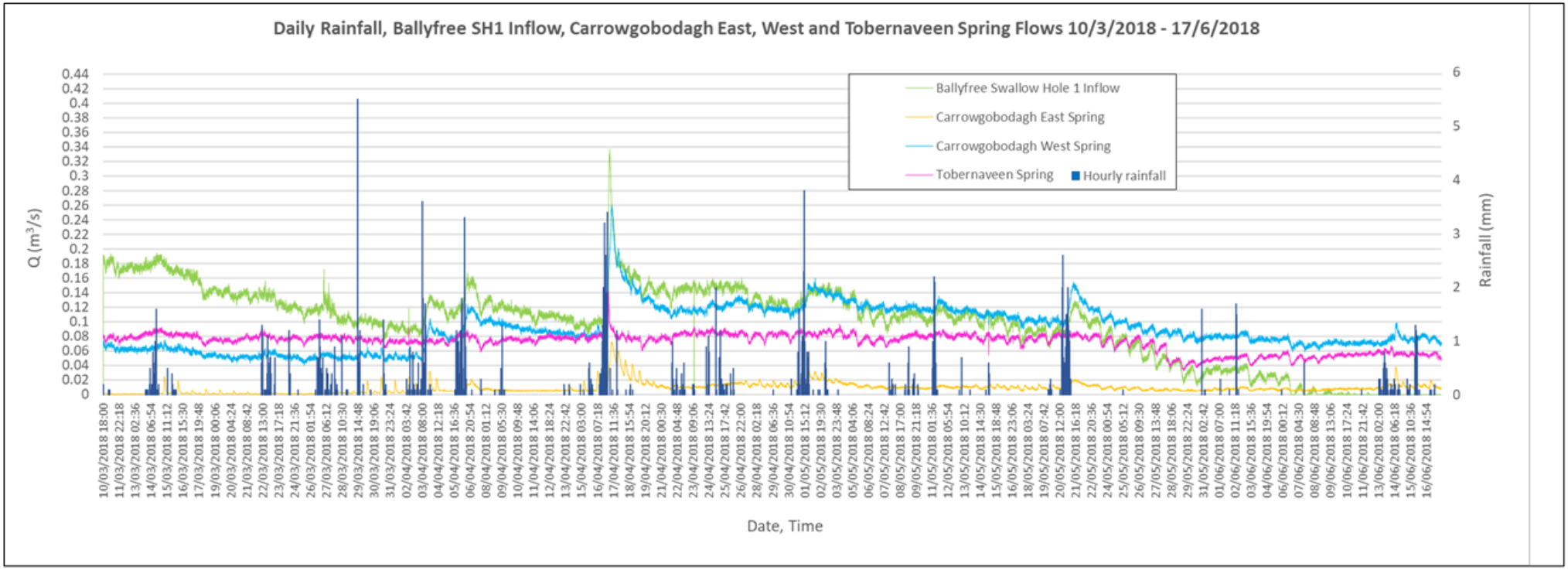
Figure 3


Daily Rainfall, Ballyfree SH1 Inflow, Carrowgobodagh East, West and Tobernaveen Spring Flows 10/3/2018 - 17/6/2018
Q (m³/s)
Rainfall (mm)
Ballyfree Swallow Hole 1 Inflow
Carrowgobodagh East Spring
Carrowgobodagh West Spring
Tobernaveen Spring
Hourly rainfall
Date, Time

Hydro-G

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.

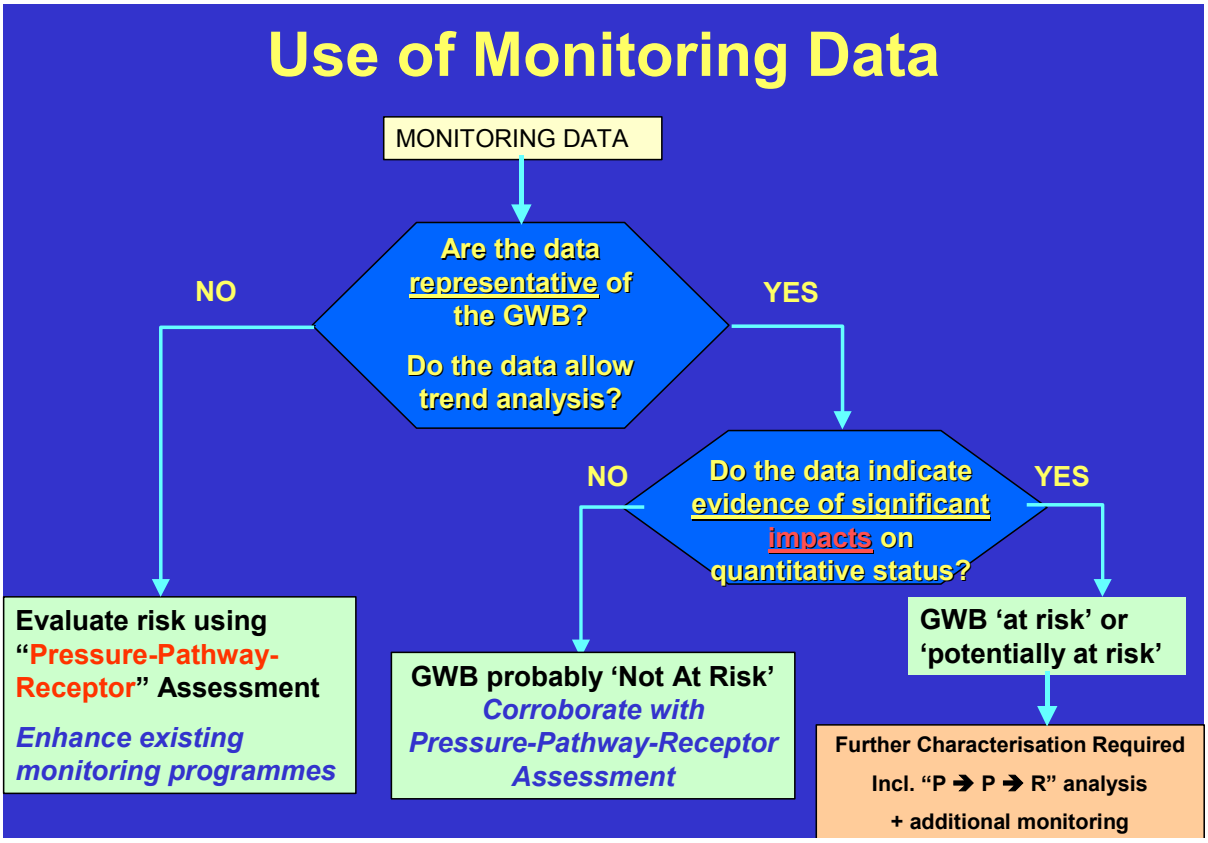


Figure 1 Flow chart indicating the use of monitoring data

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	**T**CS	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

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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.

[2] Some of these steps may be undertaken simultaneously and can be in a different order

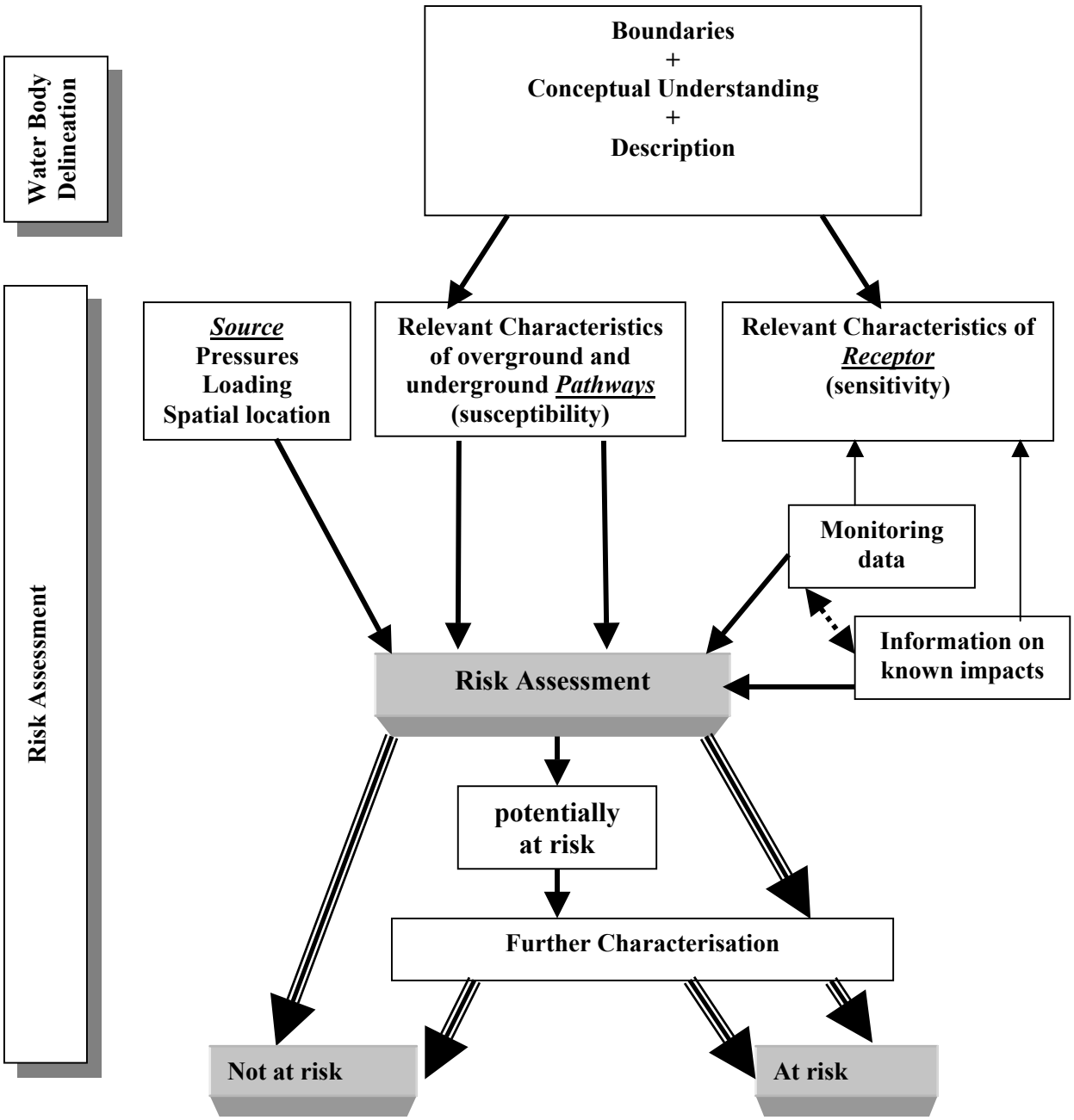


Figure A.1 Summary of risk assessment approach

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:

Abstraction or discharge

- 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

Minewater rebound (and other industrial areas where rebound is an issue) also future lowering of water table due to mine pumping

- Location (possibly including an area drawn on a map),
- Rate of rise
- Former pump locality
- Connectivity of workings (where applicable)

Changes to natural recharge

- 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

Evidence of intrusion of saline or poor quality water

- 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)

Artificial recharge

- 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

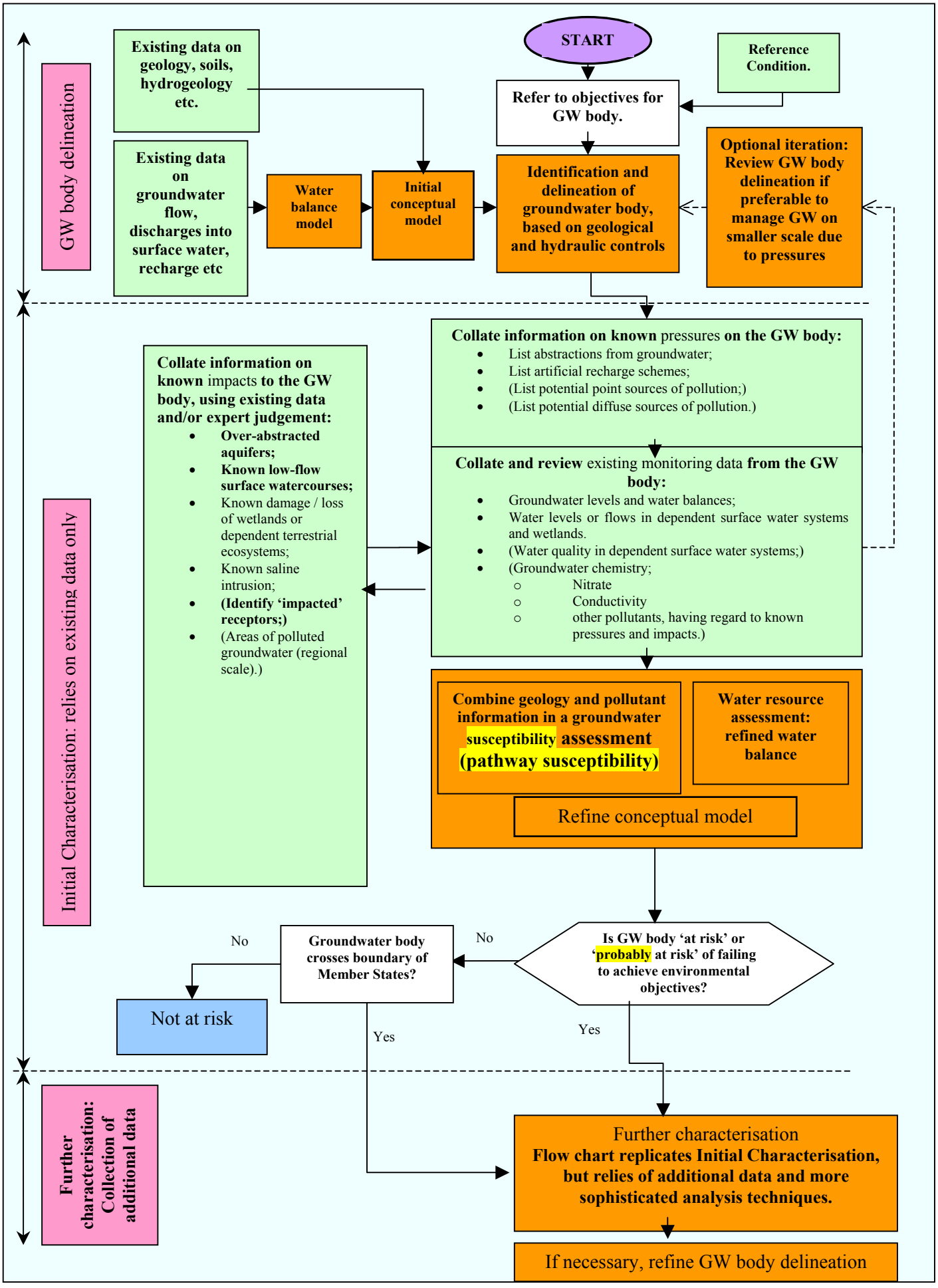
The results of pressures and impacts assessments for both for the groundwater body as a whole (7h) and for the GW dependant ecological receptors (7b and 5b) will need to be combined to determine whether the groundwater body would be considered to be at risk of failing to achieve good quantitative status 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)

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).

SLR Consulting Ireland, 7 Dundrum Business Park, Windy Arbour, Dublin 14, Ireland
T: +353 1 296 4667 F: +353 1 296 4676 www.slrconsulting.com

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	^{o}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

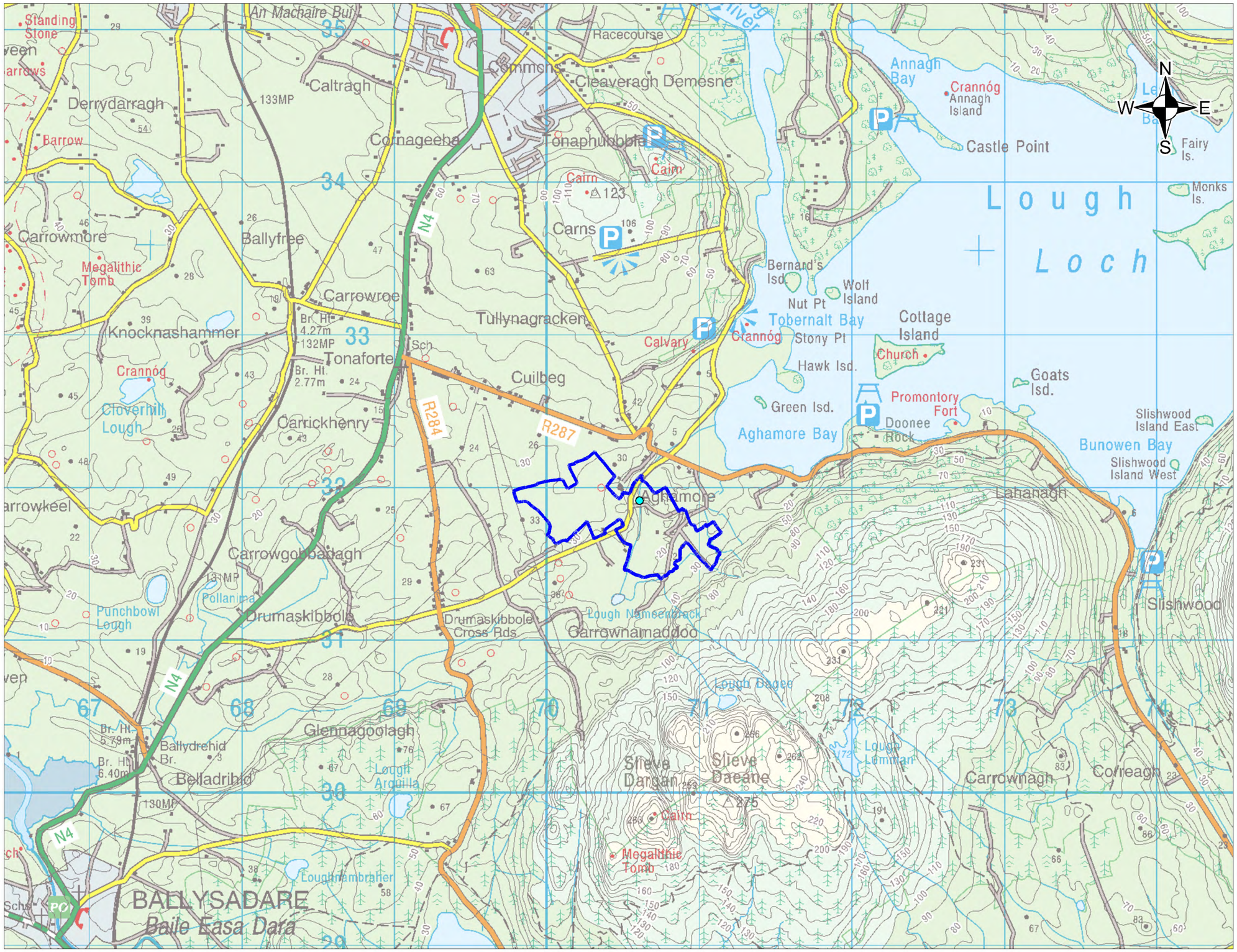
Peter Glanville
Principal

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)



0 800m 2000

Metres 1:25,000

NOTES

1. EXTRACT FROM 1:50,000 O.S DISCOVERY MAP NO. 25

2. ORDNANCE SURVEY IRELAND LICENCE NO. SU 0000719 (C) ORDNANCE SURVEY & GOVERNMENT OF IRELAND

LEGEND

LANDHOLDING

DISCHARGE POINT TO THE AGHAMORE STREAM

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

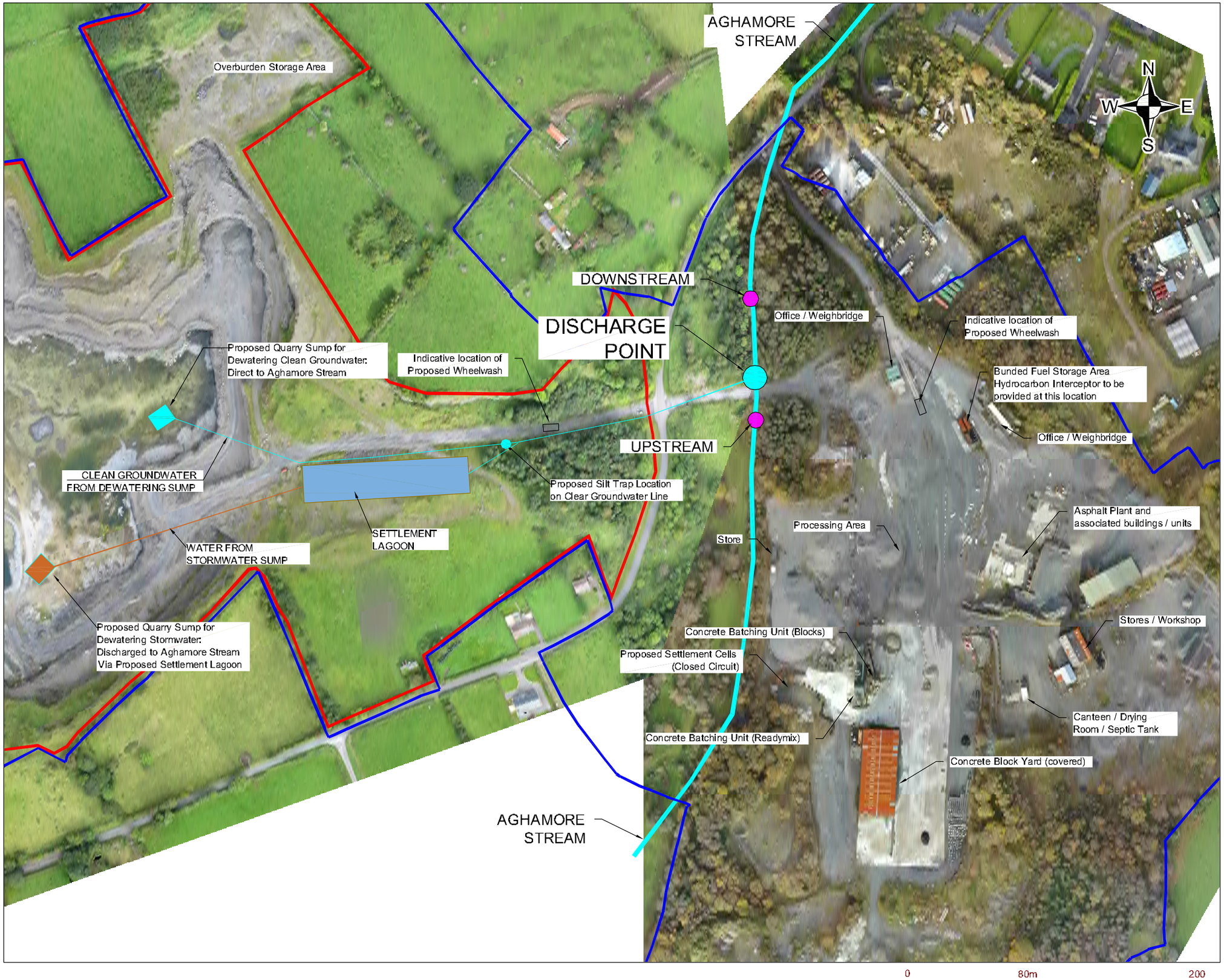
AGHAMORE NEAR AND CARROWNAMADDOO
TOWNLANDS, CO. SLIGO

SITE LOCATION

FIGURE 1

Scale	Date
1:25,000 @ A3	JULY 2019

501.00396.00038.DL Site Location.Rev.0.dwg



0 80m 200

Metres 1:2500

NOTES

1. ORDNANCE SURVEY IRELAND LICENCE NO. SU 0000719 (C) ORDNANCE SURVEY IRELAND & GOVERNMENT OF IRELAND
2. AERIAL PHOTOGRAPHY CARRIED OUT BY SLR CONSULTING SEPTEMBER 2016 AND NOVEMBER 2018

LEGEND

- LAGAN LAND OWNERSHIP (c. 47.2 Ha.)
- SECTION 34 PLANNING APPLICATION AREA (c. 18 Ha.) - PLANNING Reg. Ref.02/271
- DISCHARGE POINT TO AGHAMORE STREAM
- SAMPLE LOCATIONS AGHAMORE STREAM

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

EXISTING SITE LAYOUT PROCESSING AREA

DRAWING 2

Scale	Date
1:2,500 @ A3	JULY 2019

501.00396.00038.DL Site Layout.Rev.0.dwg

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 – DECLARATIONS & SIGNATURES

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 Bowes **Date:** 06/08/2019

(provide signature of the Applicant)

Signed: Peter Clarke **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	✓

PART II – GENERAL DETAILS

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.*

PART III – EFFLUENT DETAILS

B. Effluent Details	
PART III – Section 1 B is 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 – EFFLUENT DETAILS

PART III – Section 2

<table>
<tr><th colspan="3">A. Effluent Treatment</th></tr>
<tr><td colspan="3"><u>PART III – Section 2 A</u> is to be completed where the effluent is to be treated prior to discharge.</td></tr>
<tr><td>Operator of Treatment System:</td><td colspan="2">Where the treatment system is to be maintained and operated by a third part please provide the following:</td></tr>
<tr><td></td><td>Contact Name</td><td>n/a</td></tr>
<tr><td></td><td>Company Name</td><td></td></tr>
<tr><td></td><td>Address</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td>Phone Number (day)</td><td></td></tr>
<tr><td></td><td>Phone Number (night)</td><td></td></tr>
<tr><td></td><td>Fax</td><td></td></tr>
<tr><td></td><td>e-mail</td><td></td></tr>
<tr><td></td><td>Registered Company Details</td><td></td></tr>
<tr><td>Waste Water Treatment System Overview</td><td colspan="2">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.</td></tr>
<tr><td colspan="3">Provide copies of the treatment system process drawings.</td></tr>
</table>

PART III – EFFLUENT DETAILS

B. Effluent Treatment	
PART III – Section 2 B 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

PART III – EFFLUENT DETAILS

B. Pollution Control		
<u>PART III – Section 3 B</u> 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 – DISCHARGE TO SURFACE WATER

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 95^{th}%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***	

PART IV – DISCHARGE TO SURFACE WATER

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 ºC	
	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.*

PART IV – DISCHARGE TO SURFACE WATER

B. (ii) 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.		
Receiving water background chemical data.	**Parameter**	**Result (mean)**
	Chlorophyll a µg/l	
	Transparency Secchi depth	
	Salinity psu	
	Temperature ºC	
	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.

APPENDICES

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

APPENDICES

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**

APPENDICES

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							

APPENDICES

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[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 HRTP

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 HRTA

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 PAID FULL | 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

REGIST... - 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. 3 MAR 1998

Presenter's Name Address

Telephone Number Reference

Appendix E -
Newspaper Notice: Irish Times 30 July 2019

Different Strokes

Philip Reid

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 final round en route to winning his first WGC, at the St Jude Invitational in Memphis

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 win in the Barracuda Championship. Morikawa, ranked 1,039th in the world after making his professional debut in the Canadian Open last month, has jumped to 90th in the updated rankings.

Séamus in need of powerful performance

Séamus Power will need to produce the best performance of his season at this week's Wyndham Championship –

There is a comfort blanket of sorts for Power should he fail to make it, as he will re-enter into the Korn Ferry Tour

Allianz Irish Times Officers' Challenge

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

Perhaps there's something in the air around Kilkenny these days; for, although they travelled the highways and byways from many parts of the south-east and Munster for the latest Allianz Irish Times Officers' Challenge qualifier at Mount Juliet, it was those golfing Cats who (technically) claimed all three places on offer.

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 name, and no question of where their county leanings lie, the club is actually rooted on Kilkenny terrain.

Capturing

Kilkenny Golf Club, with no disputed territory, claimed third place on 75 points.

Waterford, for sure, gave it a good shot at capturing top honours with a total of 79 points and, ultimately, would reflect on the par five 17th as being their undoing.

In a competition with two scores from three to count on each hole, the Waterford team of Eamon Cleary, Maria Mooney and Mick Nevin only managed one point on the hole which has water down the left off the tee. Cleary's bogey six was as good as it got there for them.

Mount Juliet qualifiers

80 pts
Mount Juliet (Kevin McCartan, 12; Freda Mullen, 12; Anette Hogan, 26).
79 pts
Waterford GC (Eamon Cleary, 15; Maria Mooney, 28; Mick Nevin, 15).
75 pts
Kilkenny GC
(Mark Grant, 7; Eithne Murphy, 17; Séamus Rochford, 10).

Happy

As if to show the fine lines between winning and finishing runner-up, Mount Juliet were only too happy to take the grand total of one point managed between them on the par three 14th. Remember, this is the hole where John Daly once used a putter during the pro-am of the Irish Open and successfully found the green.

On this occasion, however, the downhill par three proved a tough encounter and Hogan's double-bogey five for one point was all they walked away with.

It was to prove crucial in the long run, while McCartan's brace of birdies – a two on the par three third for a nett eagle and a four on the eighth – were the highlights.

The final qualifier of the series takes place at Galway Bay on August 13th, while the grand final is set for The K Club on September 3rd when those teams who have already emerged from events in Portmarnock Links, Cork and Malone as well as the latest three from Mount Juliet will compete for national honours.

■ **Peter Kilcullen, Allianz (left) with the winning Mount Juliet team (from left): Freda Mullen (Lady Captain); Kevin McCartan (Captain) and Annette Hogan.** PHOTOGRAPH: DYLAN VAUGHAN

regular season, before the FedEx Cup playoffs – if he is to retain his full tour card for the 2019-20.

Power finished tied-25th in the Barracuda Championship but still dropped in the latest FedEx Cup standings to 144th . . . he needs to leapfrog up into the top-125 after this week's tour stop in North Carolina if he is to keep his card. Pádraig Harrington is also in the field.

final series which will also offer tour cards to next season's PGA Tour.

With no event on the European Tour this week, Gavin Moynihan returns to the Challenge Tour for the Finnish Challenge in Vierumaki where Stuart Grehan, Daniel Peacock, Cormac Sharvin, Robin Dawson and Ruaidhrí McGee are the other Irish players competing.

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 penalty. In this situation, and because a player is allowed to start each hole with any conforming ball (Rule 6.3a), it should be determined that the balls were exchanged before play on that hole began, unless there is evidence to the contrary.

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 Forged (50, 52 and 58 degrees)
Putter – Ping Sigma 2 ZB2
Ball – Titleist ProV1

Rankings and money winners

World rankings

1	Brooks Koepka (USA)	12.68
2	Dustin Johnson (USA)	9.43
3	**Rory McIlroy** (N Ire)	8.48
4	Justin Rose (Eng)	8.08
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)	3,444,879

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

PLANNING APPLICATIONS

DUBLIN CITY COUNCIL - Mater Misericordiae University Hospital, Eccles Street, Dublin 7 is seeking planning permission for the construction of a single storey Ophthalmology Operating Theatre Department and Acute Medical Observation Unit (to include 2 Operating Theatres, 13 Observation bays and support accommodation) and other minor associated works including 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.

CLASSIFIED EXTRA

PUBLIC NOTICES

DISCHARGE OF EFFLUENT TO WATERS- LICENCE REVIEW

Notice is hereby given that Lagan Bitumen Ltd. intends to apply to Sligo 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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MAYO

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SHOPPING & SERVICES GUIDE

PETS

NORTH CO. DUBLIN SPCA Friendly, playful, 16 week old., Black and White, male Border Collie - seeks home with genuine dog lover(s); lovely, settled, four year old, neutered male, Golden Labrador Cross - in urgent need of nice new home: Phone: 01 - 8375630 or 086 3695051 or email ncdspca@gmail.com.

PIANOS

PETROF PIANO for sale Phone 087 6036544.

POSTS IN EDUCATION

UCC VACANCIES

Applications are invited for the following posts:

DIRECTOR OF ADVANCEMENT SERVICES
DEVELOPMENT & ALUMNI RELATIONS
Specified Purpose Whole Time Post
(anticipated duration of 5 Years)
Senior Admin IV
Salary Scale:
€79,957 – €95,601 (Scale B)

LECTURESHIPS IN ACCOUNTING & FINANCE
DEPARTMENT OF ACCOUNTING & FINANCE
CORK UNIVERSITY BUSINESS SCHOOL
Whole Time Posts (Multiple Appointments)
Lectureship Salary Scale:
€33,481 – €59,132/
€64,627 – €83,069
(Scale B)

The hours of work are those prescribed under Public Sector Agreements in respect of Academic staff.

For an information package including full details of the posts, selection criteria and application process see www.ucc.ie/hr/vacancies.

The University, at its discretion, may undertake to make an additional appointment(s) from the relevant competition following the conclusion of the process.

UNIVERSITY COLLEGE CORK IS AN EQUAL OPPORTUNITIES EMPLOYER

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ATTENTION ALL SCHOOLS Flanagan Kerins will give that staff room a new makeover with made to measure sofas and chairs. Call Peter on 01 2813338 or 086 8318289 Bray & Mt. Merrion flanagankerins.ie

LEGAL NOTICES

Record No. 2019 No 279 COS
THE HIGH COURT
COMMERCIAL
IN THE MATTER OF VANGUARD FUNDS PUBLIC LIMITED COMPANY
AND
IN THE MATTER OF SECTIONS 450 (3) AND 450 (5) OF THE COMPANIES ACT 2014
AND
IN THE MATTER OF THE COMPANIES ACT 2014

NOTICE is hereby given that by an Order dated 22 July 2019 made in the above proceedings, the High Court of Ireland has directed the summoning of a meeting of the holders of Scheme Shares (as defined in a proposed Scheme of Arrangement between Vanguard Funds Public Limited Company (the "Company") and the holders of Scheme Shares (the "Scheme")) for the purpose of their considering, and voting on, a resolution proposing that the Scheme in its original form or with or subject to any modification(s), addition(s) or condition(s) approved or imposed by the High Court be agreed to (the "Scheme Meeting").

The High Court of Ireland has directed that the Scheme Meeting be summoned for Tuesday, 20 August 2019 at 3.00 p.m. (Irish time) at the offices of the company secretary, Matsack Trust Limited, 70 Sir John Rogerson's Quay, Dublin 2, Ireland (the "Company Secretary").
The entitlement to attend and vote at the Scheme Meeting or at any adjournment thereof shall be determined by reference to the register of members of the Company as at 7.00 a.m. (Irish Standard Time) on Monday, 19 August 2019.

In addition to the approval to be sought at the Scheme Meeting, the Scheme will require the passing of a resolution at a separate Extraordinary General Meeting of the Company (the "EGM") to be convened at the same location on 20 August 2019 at 3.10 p.m. (Irish Standard Time) (or, if later, as soon thereafter as the Scheme Meeting shall have been concluded).

The High Court of Ireland has directed that, subject to the approval of the resolution proposed at the Scheme Meeting and the resolution to be proposed at the EGM, the Company may apply to the High Court of Ireland on Tuesday, 27 August 2019 for directions in respect of the hearing of the application to sanction the Scheme.
A copy of the Scheme (incorporated as Part 2 of the definitive proxy statement) has been despatched to the Scheme Shareholders (as defined in the Scheme). Shareholders and creditors of the Company may obtain free copies of the definitive proxy statement (including the Scheme) from the Company Secretary.

MATHESON
Solicitors for the Company
Ref: BC/KR 5959/159
70 Sir John Rogerson's Quay
Dublin 2
Ireland

22 July 2019

This notice is placed at the Order of the High Court of Ireland dated 22 July 2019.

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

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.

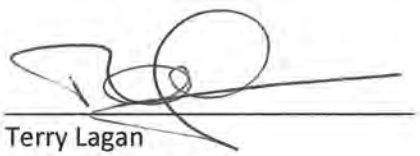
Implementation of this policy is the responsibility of every member of staff, starting with the Managing Director who takes policy decisions, which enable the correct action to be implemented throughout the company. The Technical Manager is responsible for maintaining the implementation of the Environmental 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.

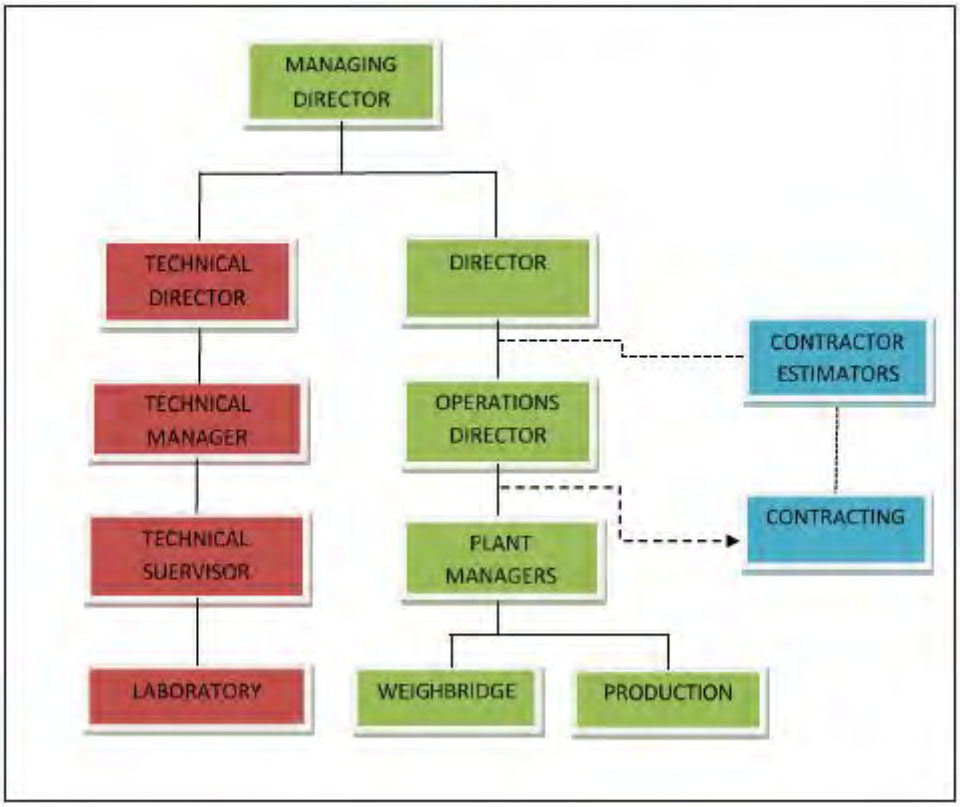
The Technical Supervisor will liaise on a regular basis with the Technical Manager and will report on the effectiveness of its operation.

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 disposal 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.

<u>Management & site control</u>

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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AUGHAMORE

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 surface 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 any 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 statistical 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 storage 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 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 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 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.

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 and 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 present, 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 and 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 result 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 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.

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 environmental 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 are 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 for 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 nature 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.

When 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. The 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

1.1 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 ;

1.3 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)

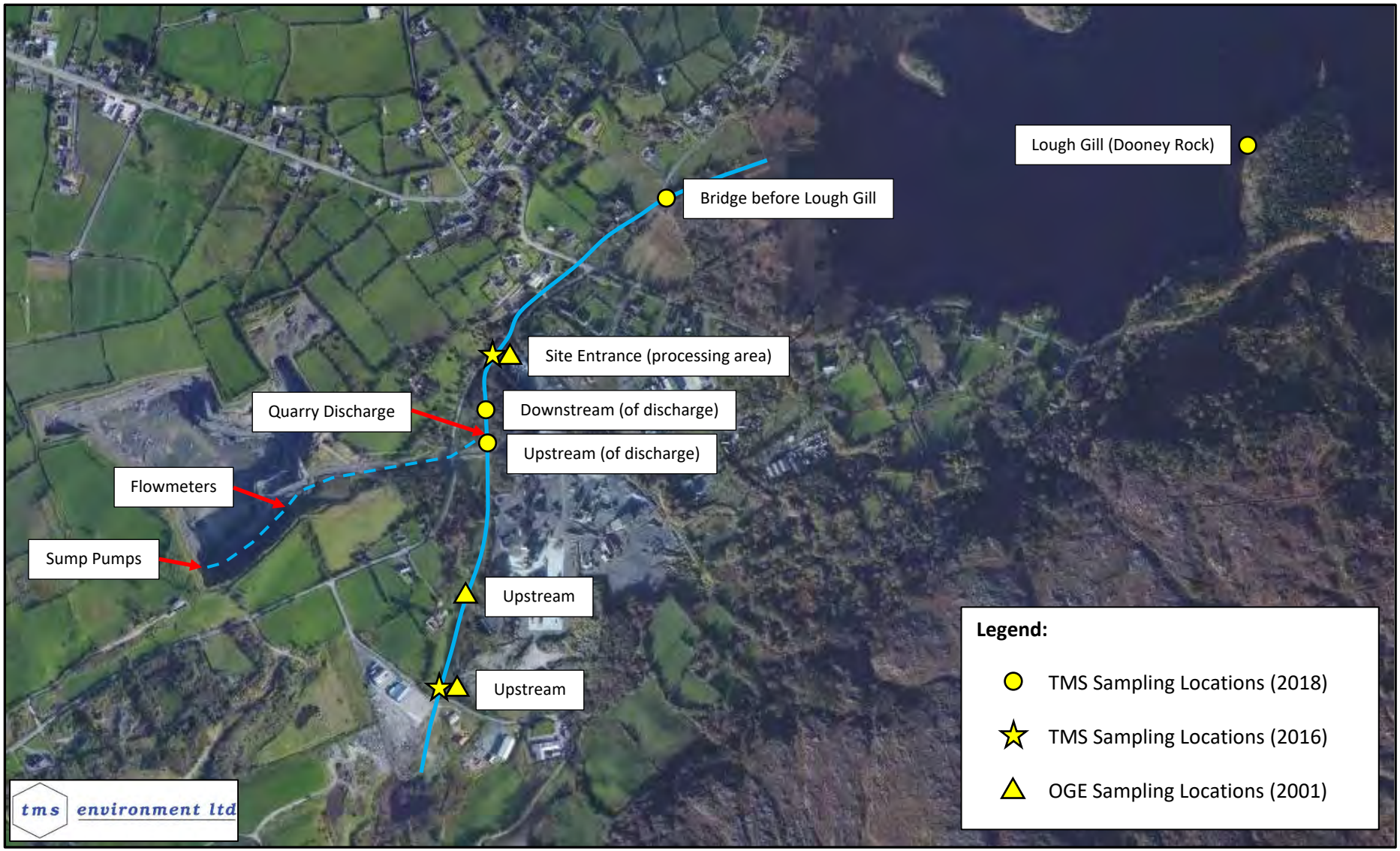

Fig 2 Surface Water Sampling Locations Map (Bing Maps)

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

Lagan Bitumen
A Lagan Company

LAGAN BITUMEN

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	

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 corrective 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			
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**				
		YES	**NO**	**DETAILS**	**CPA REF**
(i) Is the area generally tidy and waste stored in appropriate containers? If no initiate corrective action.					
(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 *			Additional information
	Location	Upwind or downwind of plant (state whether north, south, east or west of plant)	
	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 C d	HA ARDO S NON HA ARD	METHOD OF DISPOSAL	ANTIT
					R L d	

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)

Evaluation 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: _____**

Depot	

Date	**Time**	**Complaint from**	**Contact details**	**Nature of complaint**	**Complaint taken by**	**Complaint notified to**	**Date notified**	**Follow up**

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**

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

Surface Water Samples

	Parameter	Units	Upstream				Discharge (W) [4]				Discharge (E) [4]	Downstream				Bridge before Lough Gill				Lough Gill (Dooney Rock)				Surface Water Environmental Quality Standards [5]	Salmonid Water Quality Standard [6]	Drinking Water Parametric Value [7]
			30/01/2018	27/02/2018	27/03/2018	23/04/2018	30/01/2018	27/02/2018	27/03/2018	23/04/2018	30/01/2018	30/01/2018	27/02/2018	27/03/2018	23/04/2018	30/01/2018	27/02/2018	27/03/2018	23/04/2018	30/01/2018	27/02/2018	27/03/2018	23/04/2018			
Field	Temperature	°C	6.3	3.9	8.7	11.6	7.1	3.3	8.4	11.9	7.3	6.8	3.5	8.8	11.8	6.8	4	8.3	11.7	6.3	4.2	6.9	9.9	≤ 1.5 rise outside mixing zone	≤ 1.5 rise outside mixing zone [12]	-
	Conductivity (field)	µS/cm @ 25°C	ND [3]	557	212	209	630	654	697	548	660	430	630	441	415	427	638	449	499	177.6	210	201	205	-	-	2750 [14]
	pH	-	7.72	8.21	7.32	7.81	7.96	8.39	8.18	8.03	7.9	7.78	8.23	7.96	7.85	7.74	8.21	8.1	7.87	7.81	8.17	8.11	7.9	> 6 and < 9 (hard water)	≥ 6 and ≤ 9	≥ 6.5 and ≤ 9.5
	Dissolved Oxygen	% sat	93.8	102.5	95.7	95.6	99.3	109.5	101	100.7	100.2	94.6	102.1	99	95.7	96.2	114	97.3	97	95	110.1	102.8	96	> 80% and < 120% (95%ile)	-	-
	Dissolved Oxygen	mg/l O_2	11.57	13.15	11.14	11.78	12.03	14.71	11.92	12.16	12.06	11.52	13.35	11.51	11.91	11.7	15.36	11.41	11.99	11.76	13.05	12.45	11.83	-	50% ≥ 9	-
Whole Sample	Conductivity (lab) [1]	µS/cm @ 25°C	405	551	209	299	591	614	580	662	648	425	620	436	559	424	629	458	551	180	210	195	209	-	-	2750 [14]
	Total Suspended Solids	mg/l	< 3	< 3	3.1	< 3	< 3	< 3	< 3	< 3	< 3	3.5	3	3.5	3.2	< 3	3	4.4	3.7	< 3	< 3	13.4	< 3	-	≤ 25	-
	Turbidity	NTU	1.4	1	0.98	2.09	0.53	0.84	0.72	1.02	0.32	0.87	0.66	0.91	2.48	1.59	0.66	1.21	1.65	0.86	0.65	0.98	0.81	-	-	NAC [15]
	Biological Oxygen Demand	mg/l O_2	1	< 2	4	< 1	< 1	< 2	< 1	< 1	< 1	< 1	< 2	< 1	< 1	< 1	< 2	2	< 1	< 1	< 2	< 1	< 1	≤ 1.5 (mean) or ≤ 2.6 (95%ile) [8]	≤ 5	-
	Total Organic Carbon	mg/l	0.45	4	8.4	6.2	< 0.3	3	< 0.3	< 0.3	< 0.3	0.4	2.6	5.9	3.2	0.8	2.4	6	3.9	1.1	6.8	8.7	6.2	-	-	NAC [15]
	Total Hardness	mg/l $CaCO_3$	169	217	66.5	112	248	277	285	259	278	174	261	161	215	165	267	167	211	57.1	78.2	70.9	77.6	-	-	-
Major Constit	Calcium	mg/l	50.9	68.2	19.7	34.7	72.5	81.7	80.6	71.4	80.9	52.2	77.8	46.2	60.5	49.8	80.2	47.9	59.6	18.1	25.7	23.1	25.3	-	-	-
	Magnesium	mg/l	10.2	11.4	4.2	6.1	16.4	17.8	20.4	19.6	18.4	10.7	16.1	11.2	15.6	9.9	16.3	11.6	15.2	2.9	3.4	3.2	3.5	-	-	-
	Chloride	mg/l	33.2	41.2	24	23.5	38.7	43.7	56.5	59	41.2	30.8	44.2	39	47.5	30.8	43.7	42.7	45.9	20.8	17.4	19	19.5	-	-	250
	Sulphate	mg/l	3.05	< 2	< 2	< 2	24	3	3.8	2.5	24.6	4.34	28.4	24.3	22.7	5.75	30	27.3	24.2	< 2	5.35	< 2	< 2	-	-	250
Minor Constituents	Nitrate	mg/l NO_3	4.76	5.38	3.69	3	6.53	6.54	7.05	2.84	6.98	4.89	6.34	7.11	4.07	5.08	6.26	7.01	4.05	4.43	2.78	5.27	2.95	-	-	50
	Nitrite	mg/l N	0.006	0.008	0.004	0.003	0.007	0.003	0.003	0.005	0.003	0.006	0.004	0.003	0.003	0.008	0.005	0.005	0.004	0.002	0.006	0.004	0.004	-	0.015 [13]	0.152 [13]
	Total Ammonia	mg/l N	0.03	0.03	0.03	0.05	< 0.02	< 0.02	< 0.02	0.02	< 0.02	0.02	< 0.02	0.02	0.04	0.02	0.2	0.04	0.03	< 0.02	< 0.02	0.02	0.03	≤ 0.065 (mean) or ≤ 0.14 (95%ile) [8]	0.778 [13]	0.23 [13]
	Total Nitrogen	mg/l N	1.4	< 1	< 1	< 1	1	< 1	1.5	< 1.0	1	< 1	5.1	4.6	3.2	2.1	< 1	1.5	< 1	1.7	< 1	1.2	< 1	-	-	-
	Orthophosphate	mg/l P	< 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	0.02	0.03	< 0.02	< 0.02	< 0.02	< 0.02	≤ 0.035 (mean) or ≤ 0.075 (95%ile) [8]	-	-
	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	-	-	-
Trace Metals	Aluminium (Total)	µg/l	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	-	-	200
	Arsenic (Total)	µg/l	< 1	< 1	< 2	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 2	< 1	< 1	< 1	< 2	< 1	< 1	< 1	< 2	< 1	25 (AA)	-	10
	Boron (Total)	µg/l	< 230	< 230	330	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	< 230	-	-	1000
	Cadmium (Dissolved) [2]	µg/l	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.09 - 0.25 (AA), 0.6 - 1.5 (MAC) [9]	-	5
	Chromium (Total)	µg/l	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	4.7 (AA), 32 (MAC) [10]	-	50
	Copper (Total)	µg/l	10	< 9	< 9	< 9	< 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
	Lead (Dissolved) [2]	µg/l	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	14 (MAC)	-	10
	Mercury (Dissolved) [2]	µg/l	< 0.01	< 0.01	< 0.01	< 0.01	0.015	< 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
	Nickel (Dissolved) [2]	µg/l	< 3	< 3	17	< 3	5	6	6	4	7	< 3	< 3	< 3	6	< 3	3	< 3	5	< 3	< 3	6	< 3	20 (AA)	-	20
	Selenium (Total)	µg/l	< 0.8	< 0.8	< 0.8	< 0.8	1.45	1.2	1.21	1.3	1.07	< 0.8	< 0.8	< 0.8	1.07	< 0.8	1.09	1.22	1.06	< 0.8	< 0.8	< 0.8	< 0.8	-	-	10
	Zinc (Total)	µg/l	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	< 18	50 or 100 [11]	200 or 300 [11]	-
Hydrocarb	Total Petroleum Hydrocarbons	µg/l	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 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	-	-	-
	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	< 0.1	< 0.1	< 0.1	-	-	0.1
Micro	Total Coliforms	mpn/100ml	345	238	50 cfu/100ml	167	17	178	0 cfu/100ml	15	20	132	68	60 cfu/100ml	67	240	68	30 cfu/100ml	137	57	41	0 cfu/100ml	21	-	-	0
	Faecal Coliforms	mpn/100ml	64	40	172	129	3	32	0	3	3	23	21	70	40	39	21	46	22	22	9	0	9	-	-	-
	E. coli	mpn/100ml	32	26	50 cfu/100ml	119	1	82	0 cfu/100ml	1	1	24	15	60 cfu/100ml	58	32	13	30 cfu/100ml	43	5	4	0 cfu/100ml	12	-	-	0

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)
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

Concentration shaded where standard/limit value exceeded

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Attachment III: Recent Surface Water Samples (BOD and Orthophosphate)

		Upstream								Surface Water Environmental Quality Standards [2]	Salmonid Water Quality Standard [3]	Drinking Water Parametric Value [4]
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			
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]	Surface Water Environmental Quality Standards [2]	Salmonid Water Quality Standard [3]	Drinking Water Parametric Value [4]
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			
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								Surface Water Environmental Quality Standards [2]	Salmonid Water Quality Standard [3]	Drinking Water Parametric Value [4]
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			
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								Surface Water Environmental Quality Standards [2]	Salmonid Water Quality Standard [3]	Drinking Water Parametric Value [4]
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			
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)								Surface Water Environmental Quality Standards [2]	Salmonid Water Quality Standard [3]	Drinking Water Parametric Value [4]
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			
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

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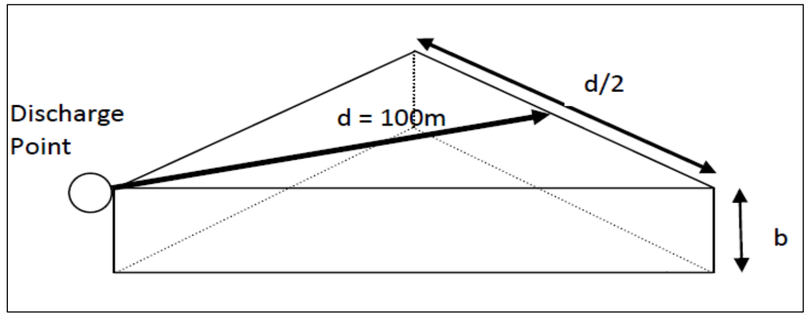
Appendix H -
Assimilative Capacity Assessment and Mass Balance Calculation for Receiving Waters (Aughamore Stream & Lough Gill) – TMS Report

Assimilative Capacity Analysis

EPA Simple Assimilative Capacity Model:



Assumptions:

1. The given distance from the discharge point to estimate the number of dilutions available is 100m
2. The forward rate of the discharge plume is an assumed velocity (s = 0.1m/s)
3. The lateral dispersion is taken to be half the forward velocity
4. Assumes no buoyancy effects
5. Assumes full vertical mixing in the plume
6. Assumes the receiving water is static

Formulae:

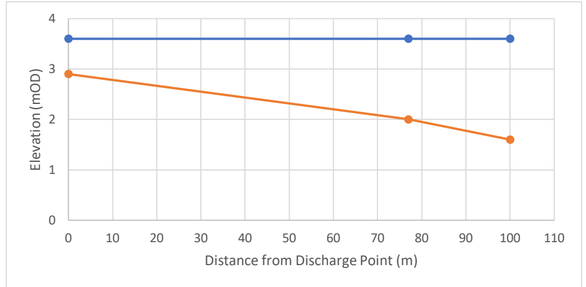
Dilutions Available = 8930b/F, where b = average depth and F = max hourly flow rate

C = Cb + ((Ce - Cb)/ (1 + D)), where C = concentration in receiving water, Ce = background concentration in receiving water and Ce = concentration in trade effluent

Average Depth in Receiving Water:

From the bathymetric survey undertaken 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



Low lake water level used for worst case (lowest dilution)

Average depth over the first 100m = 1.3m

Dilutions Available:

Parameter	Value	Units	Notes
b	1.3	m	From above
F	146	m3/hr	From licence
D	79.513699	-	Dilutions available

For Orthophosphate (Median Concentrations):

Parameter	Value	Units	Notes
Cb	0.011	mg/l	Median concentration detected by EPA WFD monitoring in Lough Gill
Ce	0.015	mg/l	Median concentration detected in discharge samples
C	0.0110497	mg/l	
Change	0.45	%	Increase in background concentration in zone 100m from discharge point

For Total Ammonia (Median Concentrations):

Parameter	Value	Units	Notes
Cb	0.01	mg/l	Median concentration detected by EPA WFD monitoring in Lough Gill
Ce	0.015	mg/l	Median concentration detected in discharge samples
C	0.0100621	mg/l	
Change	0.62	%	Increase in background concentration in zone 100m from discharge point

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

BASIS OF REPORT

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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.

[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

[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*

[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.

---

[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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Websites

Sligo County Council Planning Portal
http://www.kildare.ie/CountyCouncil/OnlineServices/OnlinePlanningEnquiries/

National Parks and Wildlife Services Protected Sites

https://www.npws.ie/protected-sites

Google Maps

https://www.google.ie/maps

Bing Maps

http://www.bing.com/maps/

Environmental Protection Agency

http://gis.epa.ie/

FIGURES

N

LEGEND

SITE BOUNDARY

2 KM BOUNDARY

SPECIAL AREAS OF CONSERVATION

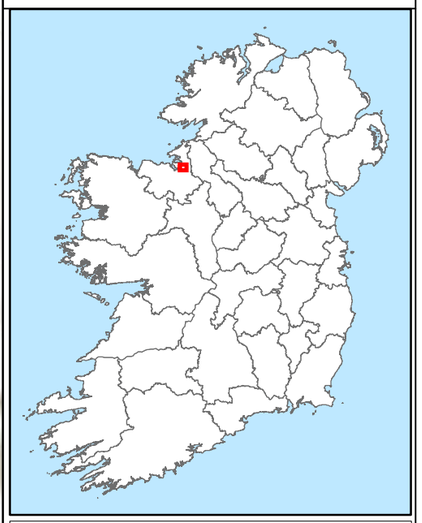
LOUGH GILL SAC

Cornageeha
Oakfield
Derrydarragh
Carraroe
Ballyfree
Tonafortes
Carrickhenry
Aghamore Near
Tullynagracken South
Cuilbeg
Slishwood
Aghamore Far
Carrownamaddoo
Carrowgobbadagh
Carrowkeel
Drumiskabole
Gleannagollagh
Glennagoolagh
Belladrihid
Ballydrehid
Union
Springfield

0 0.25 0.5 1 1.5 2

Kilometers

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community



SLR global environmental solutions

7 DUNDRUM BUSINESS PARK
WINDY ARBOUR
DUBLIN
IRELAND

T: +353 (0)1 296 4667
www.slrconsulting.com

LAGAN BITUMEN LTD

REQUEST FOR FURTHER INFORMATION, AGHAMORE QUARRY, CO. SLIGO

NATURA IMPACT SCHEDULE NATURA 2000 SITES

FIGURE 1.

Scale	Date
1:20,000 @ A3	APRIL 2019

501.00396.0007_FIGURE 1. NATURA 2000 SITES

EUROPEAN OFFICES

United Kingdom

AYLESBURY
T: +44 (0)1844 337380

BELFAST
T: +44 (0)28 9073 2493

BRADFORD-ON-AVON
T: +44 (0)1225 309400

BRISTOL
T: +44 (0)117 906 4280

CAMBRIDGE
T: + 44 (0)1223 813805

CARDIFF
T: +44 (0)29 2049 1010

CHELMSFORD
T: +44 (0)1245 392170

EDINBURGH
T: +44 (0)131 335 6830

EXETER
T: + 44 (0)1392 490152

GLASGOW
T: +44 (0)141 353 5037

GUILDFORD
T: +44 (0)1483 889800

LEEDS
T: +44 (0)113 258 0650

LONDON
T: +44 (0)203 691 5810

MAIDSTONE
T: +44 (0)1622 609242

MANCHESTER
T: +44 (0)161 872 7564

NEWCASTLE UPON TYNE
T: +44 (0)191 261 1966

NOTTINGHAM
T: +44 (0)115 964 7280

SHEFFIELD
T: +44 (0)114 245 5153

SHREWSBURY
T: +44 (0)1743 23 9250

STAFFORD
T: +44 (0)1785 241755

STIRLING
T: +44 (0)1786 239900

WORCESTER
T: +44 (0)1905 751310

Ireland

DUBLIN
T: + 353 (0)1 296 4667

France

GRENOBLE
T: +33 (0)4 76 70 93 41

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 FI 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 FI 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.

Appendix K -
Details of proposed wheel wash

0 10 20 30 40m 60 80 100

Metres 1:1000

NOTES

1. ORDNANCE SURVEY IRELAND LICENCE NO. SU 0000719 (C) ORDNANCE SURVEY IRELAND & GOVERNMENT OF IRELAND
2. AERIAL PHOTOGRAPHY CARRIED OUT BY SLR CONSULTING SEPTEMBER 2016 AND NOVEMBER 2018

LEGEND

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

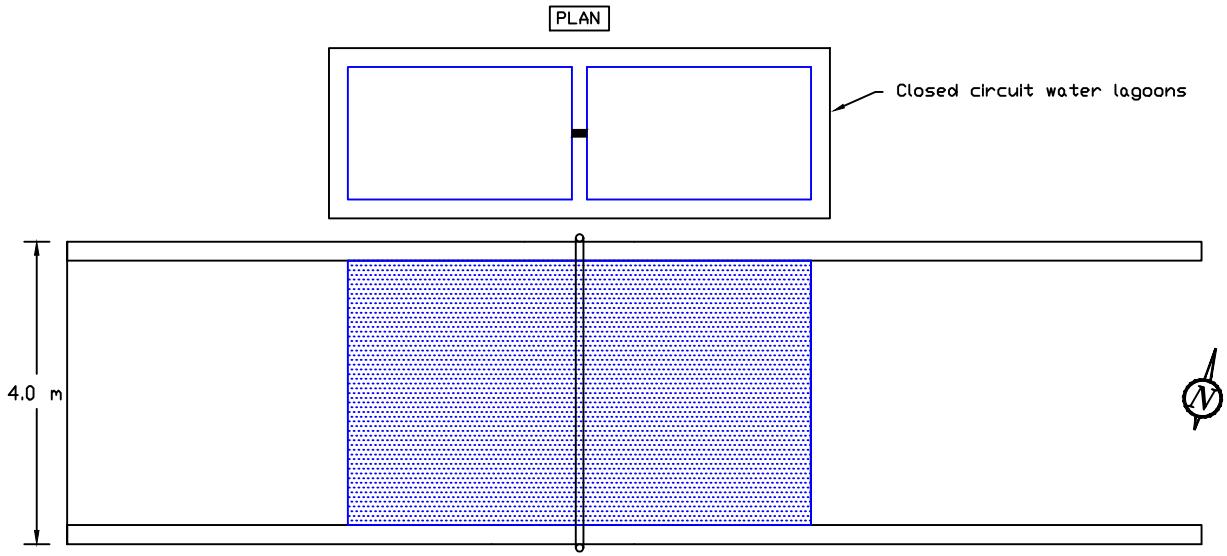
PROPOSED WHEELWASH LOCATIONS

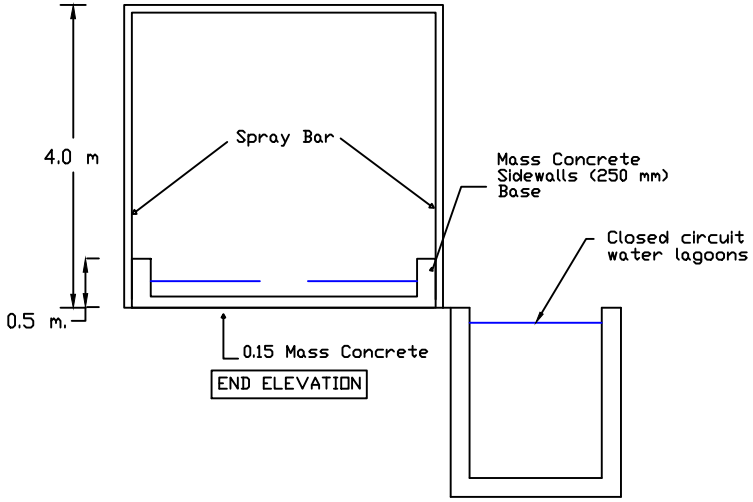
DRAWING CFI 4

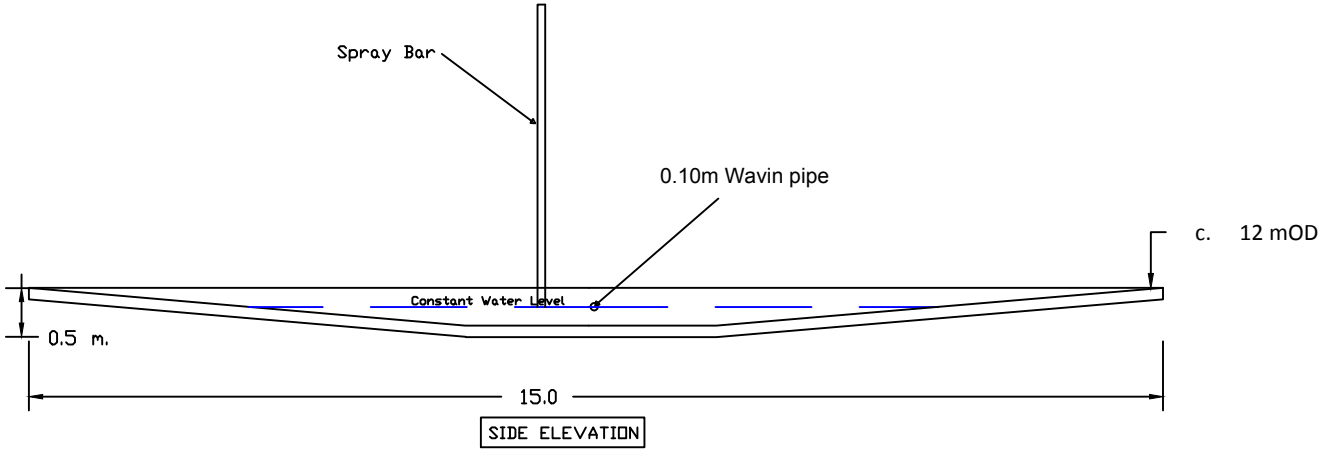
Scale	Date
1:1,000 @ A3	JULY 2019

501.00396.00007.DRAWING CFI 4 PROPOSED WHEELWASH LOCATIONS.Rev.0.dwg

REFER TO DRAWING CFI 4 FOR PROPOSED LOCATIONS







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.

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AGHAMORE NEAR AND CARROWNAMADDOO

TOWNLANDS, CO. SLIGO

PROPOSED WHEELWASH: DESIGN DRAWINGS

DRAWING CFI 5

Scale	Date
1:100 @ A4	JULY 2019

501.00396.00007.DRAWING CFI 5 WHEELWASH.REV.0.dwg

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 combination of 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 95th percentile concentration quality standard at the 95th percentile flow 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.

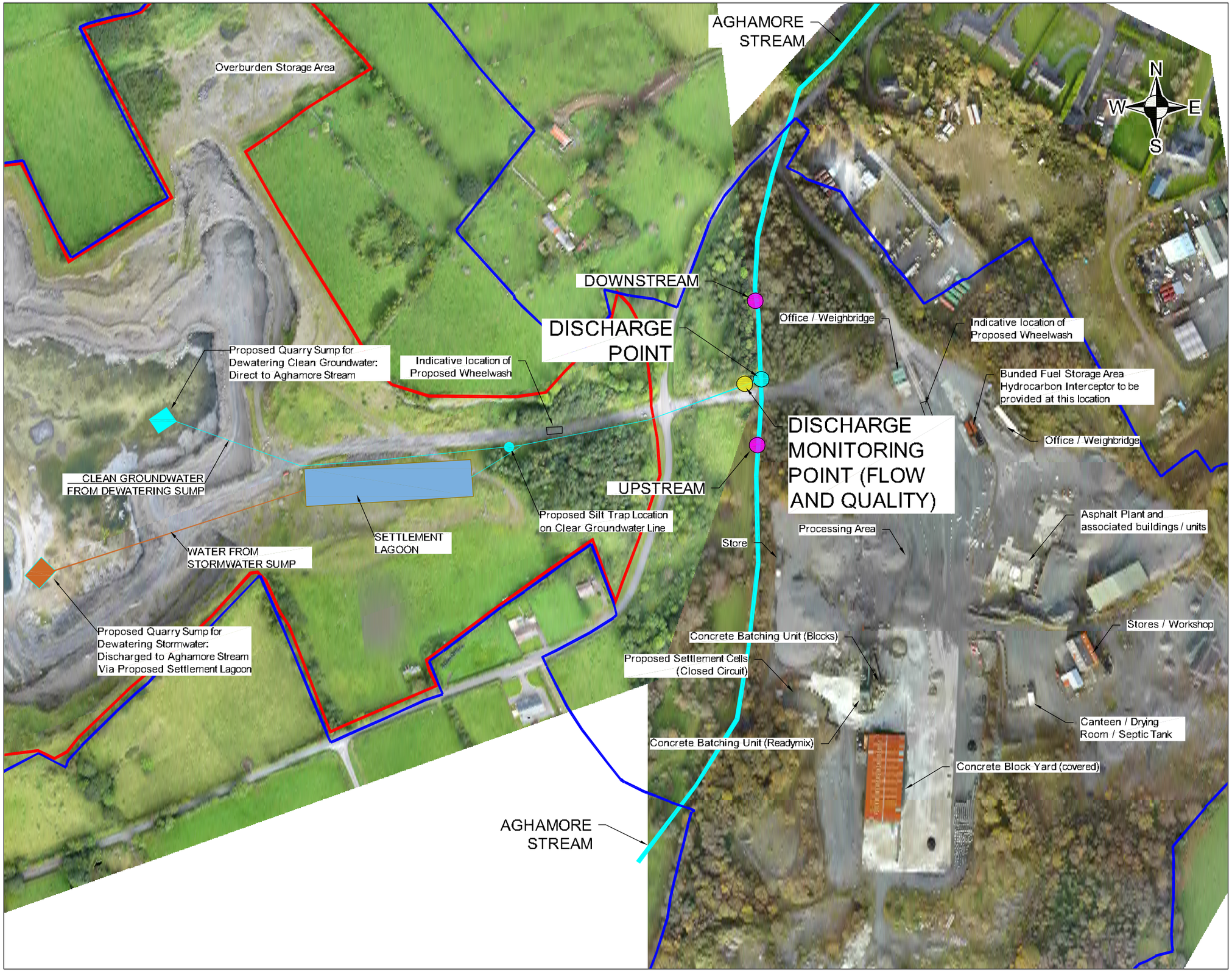
The sensors and telemetry system can be provided by Xylem, see Appendix FI-B, who can install, commission, calibrate and maintain the discharge monitoring system under an installation and maintenance contract.

Yours sincerely
SLR Consulting Ireland Ltd

Peter Glanville
Principal

FIGURE

Figure FI-1
Site Layout and Monitoring Locations



0 80m 200

Metres 1:2500

NOTES

1. ORDNANCE SURVEY IRELAND LICENCE NO. SU 0000719 (C) ORDNANCE SURVEY IRELAND & GOVERNMENT OF IRELAND
2. AERIAL PHOTOGRAPHY CARRIED OUT BY SLR CONSULTING SEPTEMBER 2016 AND NOVEMBER 2018

LEGEND

- LAGAN LAND OWNERSHIP (c. 47.2 Ha.)
- SECTION 34 PLANNING APPLICATION AREA (c. 18 Ha.) - PLANNING Reg. Ref.02/271
- DISCHARGE POINT TO AGHAMORE STREAM
- DISCHARGE MONITORING POINT (TURBIDITY AND pH)
- SAMPLE LOCATIONS AGHAMORE STREAM

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
AGHAMORE NEAR AND CARROWNAMADDOO
TOWNLANDS, CO. SLIGO

SITE LAYOUT PROCESSING AREA

FIGURE FI1

Scale 1:2,500 @ A3

Date NOVEMBER 2019

501.00396.00038.DL Further Information Site Layout.Rev.01.dwg

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)** **071 9171111**
  (The Mall, Rathquarter, Sligo, F91 H684)
- **INLAND FISHERIES IRELAND (BALLINA)** **096 22788**
  (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)

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

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.

left: SensoLyt® 700 IQ;
right: seawater model
SensoLyt® 700 IQ SW

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

IQ 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/SET 1	SensoLyt® 700 IQ including SensoLyt® PtA ORP electrode and 7 m connecting cable	109174

WTW
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**

999252US August 2018

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 SiO_2 TS	0.05 … 4000 0.1 … 4000 mg/l 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

xylem
Let's Solve Water

Xylem Analytics Germany Sales GmbH & Co. KG, WTW · Dr.-Karl-Slevogt-Straße 1 · 82362 Weilheim · Germany
Tel +49 881 183-0 · Fax +49 881 183-420 · Info.WTW@Xyleminc.com · **www.WTW.com**

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

tms environment ltd

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

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

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

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

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

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

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

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

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

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

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

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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Dublin Road, Dromiskin, Dundalk, Co. Louth.
E-Mail: info@dunnesdrilling.com website: www.dunnesdrilling.com
Tel: +353 42 9372188 Fax: +353 42 9372714

DRILLERS LOG

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

DRILLERS LOG

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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

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

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

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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW10A**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
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Engineer: TMS Environmental

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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
0.00	0 (-) -	NA			(12.00)	0.00 - 12.00 : 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	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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW10A**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
17-SO-101	12-08-17 17-07-17		

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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
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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW10A**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
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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
	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)*		
25.00										
	28 (8) 0									
28.00					28.00					
								BH terminated at 28.00m 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 (%)	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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW10B**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
17-SO-101	17-07-17 17-07-17		

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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
0.00						0.00 - 22.00 : overburden.		Open hole drilling - no recovery.		
	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 (%)
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

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DRILLHOLE LOG

Project	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW10B**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
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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
	(-) -	NA			(22.00)			Open hole drilling - no recovery. *(continued)*		
22.00					22.00					

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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW10B**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
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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
								BH terminated at 22.00m 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

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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW10C**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
17-SO-101	18-07-17 21-07-17		

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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
0.00	0 (-) -	NA			(3.00)	0.00 - 3.00 : overburden.	Open hole drilling - no recovery.		
3.00					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.		
	100 (95) 89	5							
		5				4.80 - 4.95 Joint, subvertical dip, stepped, rough, with 0.5mm thick grey silt smear, open.			
7.00		6							
	100 (98) 91	6							
		4							
10.00		6							
		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

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DRILLHOLE LOG

Project	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW10C**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
17-SO-101	18-07-17 21-07-17		

Engineer	Sheet	Rev.
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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
	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)*		
		4								
13.00								13.00m: carried out packer test.		
		3								
	100 (98) 96	4								
		3								
16.00										
		5								
	100 (98) 94	4								
		5								
19.00										
		1								
	100 (98) 97	3								
		2								
22.00										

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 (%)

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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW10C**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
17-SO-101	18-07-17 21-07-17		

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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
		3				22.35 - 22.50 Joint, vertical dip, undulating, tight.	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 (95) 92	4				22.85 - 23.00 Joint, vertical dip, stepped, tight, open as drilling induced?	22.00m: carried out packer test.		
		2				23.60 - 23.75 Joint, subvertical dip, stepped, rough, with 0.5mm thick milky white calcite crystal veneer, open as drilling induced?			
25.00						24.40 - 24.47 Joint, subvertical dip, stepped, rough, with orange brown and dark orange brown iron stain and powder, open.			
		8					25.90m to 25.95m: vuggy as 20mm deep 1 to 3mm milky white calcite crystal assemblage.		
	100 (97) 87	4					25.91m to 67.00m: vuggy as 10 to 20mm deep vugs with 1 to 3mm milky white calcite crystal assemblages.		
		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.	26.45m to 26.60m: vuggy as 25 to 1mm deep 1 to 3mm milky white calcite crystal assemblage.		
28.00									
		3					28.40m to 28.42m: vuggy as 1 to 4mm milky white calcite crystal assemblage.		
	100 (98) 94	4					29.00m to 29.06m: vuggy as 1 to 4mm milky white calcite crystal assemblage.		
		3					29.80m to 29.82m: vuggy as 1 to 4mm milky white calcite crystal assemblage.		
31.00									
		3				30.80 - 30.90 Joint, dipping 60°, stepped, rough, with 0.5 to 1mm thick grey silt smear, open.	31.00m: carried out packer test.		
	100 (98) 92	2				31.00 - 31.15 Joint, subvertical dip, stepped, rough, with 0.5mm thick grey silt smear, open to 31.10m, then tight.			

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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW10C**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
17-SO-101	18-07-17 21-07-17		

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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
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)*		
	100 (93) 75	3				34.10 - 34.30 Joint, vertical dip, stepped, rough, with 0.5mm thick grey silt smear, open.			
		5				34.45 - 34.55 Joint, dipping 60°, stepped, rough, clean, open as drilling induced?			
37.00		4				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.		
	100 (97) 79	6				37.35 - 37.55 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick brown silt smear, open.			
		3							
40.00		6					39.48m to 39.51m: vuggy as 20mm deep 1 to 3mm milky white calcite crystal assemblage. 40.00m: carried out packer test.		
	100 (98) 88	5				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.			
		3			(77.00)				
43.00		6							
		5				42.95 - 43.35 Joint, vertical dip, stepped, tight. 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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW10C**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
17-SO-101	18-07-17 21-07-17		

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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
	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							
49.00		4				47.60 - 47.70 Joint, dipping 60°, stepped, smooth, with 0.5mm thick grey silt smear, open.	49.00m: carried out packer test.		
		4							
	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.	51.70m to 51.76m: orange brown with no obvious reduction in strength.		
		4				51.85 - 52.15 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick grey silt smear, open.	51.90m to 51.93m: orange brown calcite crystal assemblage.		
	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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW10C**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
17-SO-101	18-07-17 21-07-17		

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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
	100 (94) 86	2 3 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)*		
58.00										
	100 (91) 80	3 4 5						58.00m: carried out packer test.		
61.00										
	100 (85) 58	5 6 18				60.85 - 61.15 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick orange brown clay smear, open. 63.30 - 64.25 Joint, vertical dip, stepped, rough, with 0.5 to 4mm thick grey silt smear, open to moderately wide.				
64.00										
	100 (85) 49	12 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

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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old galway road
loughrea

DRILLHOLE LOG

Project	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW10C**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
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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
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.		
	100 (90) 57	5							
		8					68.80m to 68.85m: black coal.		
70.00		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.			
		5							
	100 (87) 35	9				70.80 - 71.30 Joint, subvertical dip, stepped, rough, with 0.5mm thick orange brown clay smear, open.			
73.00		26				71.85 - 73.05 2 No parallel joints, subvertical dip, stepped, rough, with 0.5 to 2mm thick grey silt smear, open.			
		3							
	100 (97) 79	9							
76.00		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

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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW10C**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
17-SO-101	18-07-17 21-07-17		

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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
	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)*		
		6								
79.00										
	100 (95) 61	7								
80.00					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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW11**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
17-SO-101	08-08-17 15-08-17		

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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
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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW11**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
17-SO-101	08-08-17 15-08-17		

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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
	100 (97) 68	10				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)*		
13.00		8								
	100 (97) 74	7								
		6				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.		
16.00		9						16.00m: carried out packer test.		
	100 (88) 43	8								
		8				17.75 - 18.15 Joint, subvertical dip, stepped, rough, with .05 to 1mm thick grey silt smear, open.				
19.00		15				18.50 - 19.00 Joint, subvertical dip, stepped, rough, with 0.5 to 2mm thick grey silt smear, open.				
	100 (92) 50	5								
		10				20.45 - 21.10 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick grey silt smear, open.				
22.00		10				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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW11**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
17-SO-101	08-08-17 15-08-17		

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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
		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)*		
	100 (94) 66	6				22.70 - 23.30 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick grey silt smear, open.			
25.00		9				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.	24.30m to 24.35m: vuggy as 10mm deep 1 to 3mm milky white calcite crystal assemblage. 25.00m: carried out packer test.		
		8							
	100 (96) 84	3							
28.00		4							
		6							
	100 (97) 94	3							
31.00		3							
		3							
	100 (98) 97	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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW11**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
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Engineer: TMS Environmental

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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
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.		
	100 (98) 82	4								
		4								
		5								
37.00										
		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								
		8				39.50 - 39.85 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick greenish grey silt smear, open.				
40.00										
		6				40.60 - 40.70 Joint, dipping 60°, stepped, smooth, with 0.5mm thick grey silt smear, open.				
	100 (94) 69	7								
		8								
43.00					(74.00)			43.00m: carried out packer test.		
		4								

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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW11**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
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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
	100 (97) 86	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)*		
		7				45.10 - 45.40 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick grey silt smear, open.				
46.00										
	100 (98) 85	4								
		5								
		6				48.00 - 48.25 Joint, subvertical dip, stepped, rough, with 0.5mm thick grey silt smear, open.				
49.00										
	100 (97) 86	6								
		6								
		6								
52.00								52.00m: carried out packer test.		
	100 (96) 77	6								
		9								
		6								
55.00										

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 (%)

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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW11**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
17-SO-101	08-08-17 15-08-17		

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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
	100 (98) 82	6 8 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)*		
58.00										
	100 (97) 86	4 8 6								
61.00								61.00m: carried out packer test.		
	100 (98) 95	9 4 5								
64.00										
	100 (98) 82	6 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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW11**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
17-SO-101	08-08-17 15-08-17		

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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
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						70.00m: carried out packer test.		
		6				70.20 - 70.35 Joint, subvertical dip, stepped, rough, with 0.5 to 1mm thick grey silt smear, open.				
	100 (98) 96	5				70.90 - 71.00 Joint, dipping 60°, stepped, smooth, with 0.5 to 1mm thick grey silt smear, open.				
73.00		5								
		4								
	100 (98) 96	5								
76.00		5								
		4								

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	Location	DRILLHOLE No
Aghamore Quarry	Co Sligo	**MW11**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
17-SO-101	08-08-17 15-08-17		

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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
	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								
79.00										
	100 (97) 94	5								
80.00					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

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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

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 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 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 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

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 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

DRILLERS LOG

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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 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

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 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

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 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

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 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 GL m TO 10.5 m

BOREHOLE NO. MW 20

DRILLER B. THOMPSON

BORED FROM GL m TO 12 m

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			
FIRM BROWN SANDY 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	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 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		
Water level after 20 mins.	6m		
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: 17-9-2020 HOURS PER SHIFT:

RIG: DANDO 2000

BOREHOLE COMPLETE: YES/~~NO~~

CASED FROM _____ m TO _____ m

BORED FROM _____ m TO _____ m

BOREHOLE NO.	DRILLER B. THOMPSON
MW 20	ASSISTANT R. LOSERS

DESCRIPTION OF STRATA					DEPTH to base of STRATA m
Soft/Firm/ Stiff	Colour	Clayey Silty Sandy etc.	SOIL TYPE	Sand bands Cobbles etc.	
Loose/Dense	Fine - Coarse Medium				
Start of days drilling					
STEEL COVER CONCRETE 50mm SOLID 6m-GL BACKFILL BENTONITE SEAL 5m-4m GRAVEL 12m-5m 50mm SLOTTED PIPE 12m-6m					
End of days drilling					

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

REMARKS HELPED D. DUANE CUT WELLHEAD STEEL COVER - INSTALLED STANDPIPE THEN RIG SERVICED BY D. DUANE

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

DATE: 17.9.2020 HOURS PER SHIFT:

RIG: DANDO 6000

BOREHOLE COMPLETE: ~~YES~~/NO

CASED FROM GL m TO 4 m

BORED FROM GL m TO 4 m

BOREHOLE NO.	DRILLER B. THOMPSON
MW21	ASSISTANT R. LOSEVI

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	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	GL	1m								
B2	2m									
B3	3m									
B4	4m									

REMARKS

STANDPIPE DETAILS/SKETCH

CHISELLING: MA 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		
Water 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.	DRILLER B. THOMPSON
MW21	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			
FINE GREY BROWN SANDS					5·5
FINE GREY SANDS					8·9
FIRM GREEN BROWN ORGANIC SILT/CLAY (DRIFT)					9·6
MEDIUM GRAVELS COBBLES					10·5
		End of days drilling			10·5

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
B5	5m									
6	6m									
7	7m									
8	8m									
9	9m									
10	10m									
11	10·50									

REMARKS PULLED CASING MOVED AND SET UP.

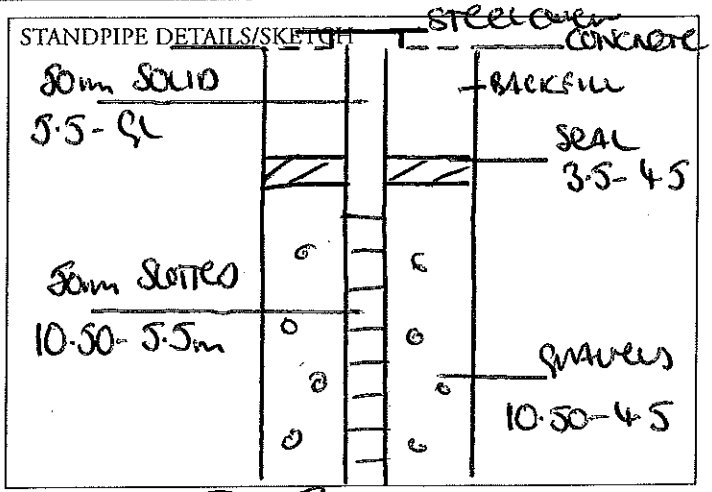
CHISELLING:

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

BOREHOLE NO. MW22

DRILLER B. THOMPSON

BORED FROM GL m TO 11 m

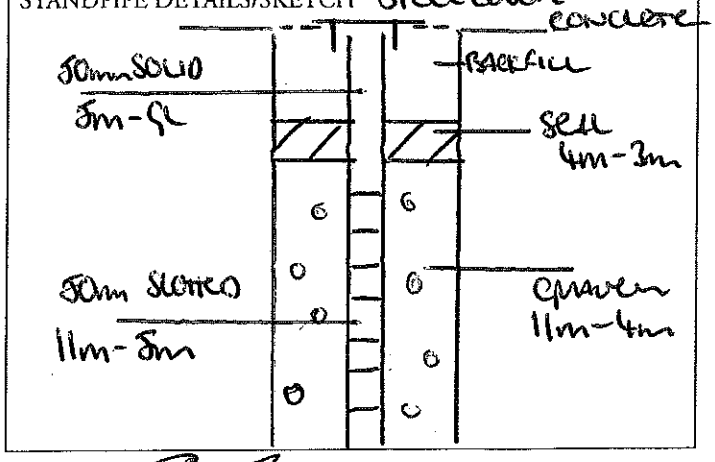
ASSISTANT R. LOSEWS

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 STONE FILL CONCRETE					2·5
BROWN SANDY CLAYEY COBBLES CLAY BANDS					4·7
FINE BROWN SANDS (BECOMING WET)					8·5
SMALL GRAVEL COBBLES					11m
		End of days drilling			11m

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									
B8	8m									
B9	9m									
B10	10m									
B11	11m									

REMARKS ILM CUTTING MACHINE DRIVER ON SITE TO CLEAR UP TO POSITION

STANDPIPE DETAILS/SKETCH STEEL COVER



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.	8m		
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 GL m TO 4 m

BORED FROM GL m TO 4 m

BOREHOLE NO.	DRILLER B. THOMPSON
MW23	ASSISTANT R. LOSEWS

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 CLAY COBBLES					3.5
FINE BROWN SAND					
		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	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: B

IRISH DRILLING LTD., LOUGHREA, CO. GALWAY.

CABLE PERCUSSIVE LOG SHEET

SITE: SLIGO QUARRY

DATE: 21.9.2020 HOURS PER SHIFT:

RIG: DANDO 2000

BOREHOLE COMPLETE: YES/NO

CASED FROM 0 m TO 12 m

BORED FROM 4 m TO 12 m

BOREHOLE NO.	DRILLER B. THOMPSON
MW 23	ASSISTANT R. LOSER

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 BROWN SANDS					5.1
GREY SANDS LAMINATED CLAY/SILT BANDS					9.2
FIRM GREY LAMINATED CLAYS					12m
End of days drilling					12

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
B5	5m									
B6	6m									
B7	7m									
B8	8m									
B9	9m									
B10	10m									
B11	11m									
B12	12m									

REMARKS PULLED CASING MOVED AND SET UP.

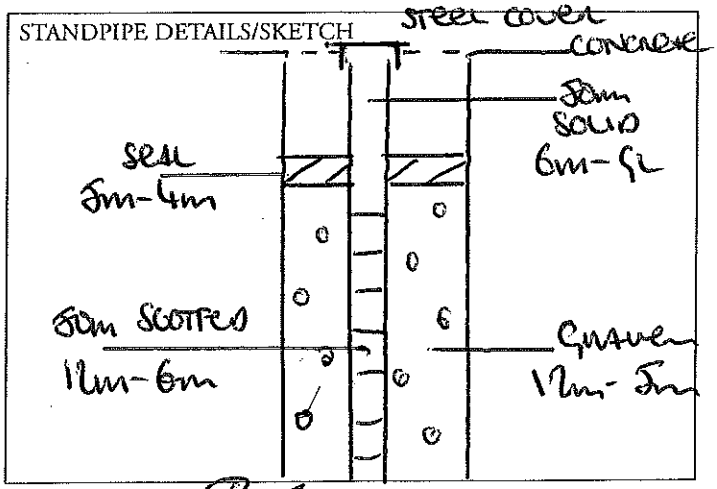
CHISELLING:

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			
Water level after 20 mins.			
Was water sealed?	YES/NO	YES/NO	YES/NO
Depth sealed?			

STANDPIPE DETAILS/SKETCH



Signed - Engineer for client _____ Signed: BJ

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.	DRILLER B. THOMPSON
MW 24C	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 - GRAVEL COBBLES					
		End of days drilling			6

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									
B2	2m									
B3	3m									
B4	4m									
B5	5m									
B6	6m									

REMARKS R. LOSENS MAKES TO YARD LOUGHREA TO REPAIR UNDER SIZED SHELL AND ROPE ENDS

CHISELLING: 1m 0.8-1.3 1m 1.3-1.8

STANDPIPE DETAILS/SKETCH

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?			

Signed - Engineer for client _____ Signed: _____

IRISH DRILLING LTD., LOUGHREA, CO. GALWAY.

CABLE PERCUSSIVE LOG SHEET

SITE: SLIGO QUARRY

DATE: 24 · 9 · 2020 HOURS PER SHIFT:

RIG: DANDO 2000

BOREHOLE COMPLETE: YES/NO

CASED FROM 6 m TO 11 m

BORED FROM 6 m TO 11 m

BOREHOLE NO.	DRILLER B. THOMPSON
MW 24C	ASSISTANT R. LOGAN

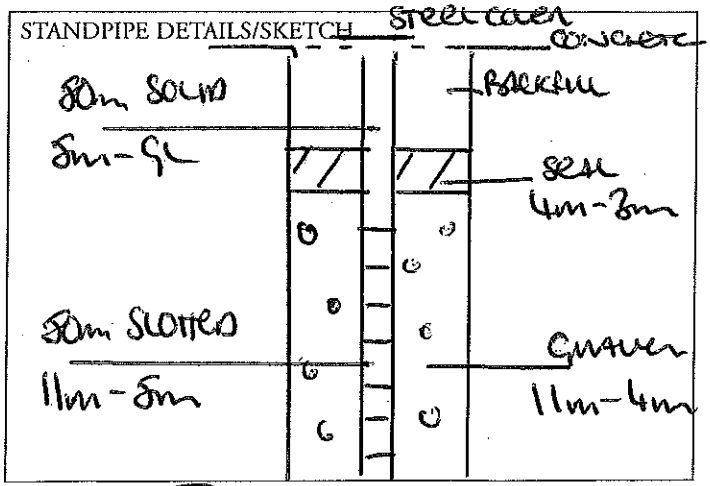
DESCRIPTION OF STRATA					DEPTH to base of STRATA m
Soft/Firm/ Stiff / Loose/Dense	Colour / Fine - Coarse Medium	Clayey Silty Sandy etc.	SOIL TYPE	Sand bands Cobbles etc.	
		Start of days drilling			
BROWN SANDS GRAVELS COBBLES					9.7
GREY SANDS LAMINATED CLAY					10.8
DENSE GRAVEL					11m
		End of 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 RUBBER CASING MARKS SET UP

STANDPIPE DETAILS/SKETCH



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			
Water level after 20 mins.			
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

DATE: 24.9.2020 HOURS PER SHIFT:

RIG: DANDO 2000

BOREHOLE COMPLETE: YES/NO

CASED FROM GL m TO 7 m

BOREHOLE NO. MW25

DRILLER B THOMPSON

BORED FROM GL m TO 7 m

ASSISTANT R. LOSERS

DESCRIPTION OF STRATA					DEPTH to base of STRATA m
Soft/Firm/ Stiff	Colour	Clayey Silty Sandy etc.	SOIL TYPE	Sand bands Cobbles etc.	
Loose/Dense	Fine - Coarse Medium				
		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.	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									
B5	5m									
B6	6m									
B7	7m									

REMARKS

STANDPIPE DETAILS/SKETCH

CHISELLING: 1m 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?			

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.	DRILLER B. THOMPSON
MW25	ASSISTANT R. LOSER

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 BROWN STNDS					7m
GREY BROWN STNDY CLAYS					7.9
FINE GREY STNDS					10.50
FINE GREY STNDS SMALL GRAVELS					11.50
		End of days drilling			11.5

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
B8	8m									
B9	9m									
B10	10m									
B11	11m									

REMARKS PULLED CASING LEADER ALL EQUIPMENT REMOVED TO N4 COLLONEY SITE.

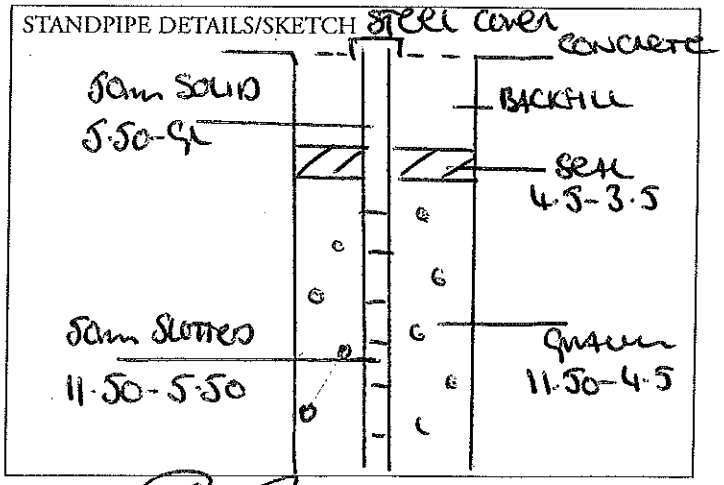
CHISELLING:

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			
Water level after 20 mins.			
Was water sealed?	YES/NO	YES/NO	YES/NO
Depth sealed?			

STANDPIPE DETAILS/SKETCH



Signed - Engineer for client ____ Signed: ____