ATTACHMENT-7-1-3-3
EMISSIONS IMPACT ASSESSMENT – GROUNDWATER / GROUND

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1.1 INTRODUCTION

1.1.1 Background and Objectives

Hydro-Environmental Services (HES) was commissioned by Roadstone Limited to undertake an assessment of the potential impacts of the proposed infilling of an existing limestone quarry at Midleton, Co. Cork on water aspects (hydrology and hydrogeology) of the receiving environment. It is proposed to backfill the existing pit with inert fill as extraction is completed in specific areas of the quarry. This initial assessment was included in Chapter 11 'Hydrology, Hydrogeology and Flood Risk' of the EIAR which has been included as part of this application.

The objectives of the assessment were to:

- Produce a baseline study of the existing water environment (surface water and groundwater) in the area of the proposed site.
- Identify likely potential impacts of the proposed development (positive or negative) on surface water and groundwater.
- Identify mitigation measures to avoid, remediate or reduce significant negative impacts (if any).
- Identify residual impacts post mitigation.
- Assess hydrological cumulative impacts of the proposed development along with other activities and developments in the local area.

A response to a Request for Further Information (RFI) was submitted to Cork County Council as part of the planning process (planning No. 194719) after the EIAR was submitted and included analysis of additional background baseline water quality monitoring. This document has been included in Appendix A of the Operational Report in Attachment-4-8-1-Operational Report. The results are considered in this assessment.

Hydro-Environmental also undertook a separate hydrogeological assessment which related to the proposed indirect discharge of treated stormwater runoff to ground via a full retention oil interceptor. This has been included in Attachment-6-7-3 Emissions to Ground Controls.

1.2 CHARACTERISTICS OF THE DEVELOPMENT

The proposed development comprises backfilling an area of approximately 9ha of open pit within the subject site to an average depth of 20m above floor level, and a maximum depth of approximately 34m (eastern section of pit). Imported fill will comprise inert soil and stone (EU Waste Code 17 05 04).

The definition of inert waste from Article 2 of the Landfill Directive is as follows:

> *"**Inert waste**" means waste that it does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely*

to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater".

Due to the nature of the proposed development being a relatively shallow fill over a relatively small area of ground, potential impacts on groundwater will be qualitative (water quality) rather than quantitative (i.e., levels and flows).

The proposed infill material is inert soil and stone and therefore no harmful or toxic contaminates are expected to be present. Potential impacts to groundwater at this site, which are common to all construction sites, would be from potential sources such as hydrocarbon/chemical spillage during the excavation and infilling works. The potential pathways will be via groundwater recharge and local groundwater flow.

There is no surface water flowpaths from the proposed development to local streams/rivers and therefore no direct impacts on either of these surface water body types is possible from any runoff generated on-site.

Wastewater from the welfare facilities (portaloo) is currently collected by a licensed contractor for disposal and this will continue for the proposed infill development.

Water for dust suppression and the wheel wash will be sourced from an on-site well (PW1) which is already in use for this purpose as part of the existing quarry operation. The initial volume to setup the proposed new system will be 10m^3 and then approximately 1m^3 will be required daily.

1.3 METHODOLOGY

1.3.1 Desk Study

A desk study of the proposed development site and surrounding area was largely completed prior to the undertaking of the walkover assessments and site investigations. The desk study involved collecting all relevant geological, hydrological, hydrogeological and meteorological data for the area.

1.3.2 Site Investigations

Site investigations to characterise the baseline geological, hydrological and hydrogeological environment were undertaken between November 2017 and June 2018. The investigations included the following:

- A detailed site walkover survey, water features survey, geological mapping of exposures of subsoils, including inspection and mapping of all relevant hydrological features, such as existing drainage ditches and streams.
- A topographic survey (dGPS) was undertaken whereby hydrological / hydrogeological features of interest within the site were surveyed.
- A door to door well survey of local dwellings within 500m of the proposed development site was undertaken.

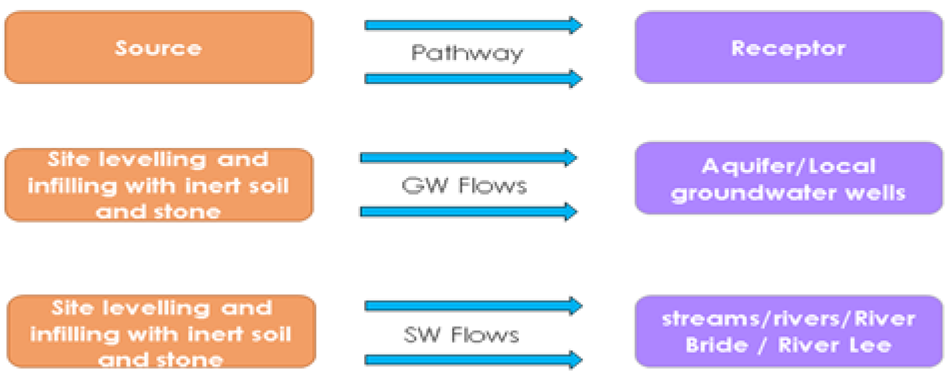
- A preliminary flood risk assessment for the proposed development site and surrounding area was also completed.
- A phase of quarry floor blast hole drilling (22 no.) was completed to investigate the geological and hydrogeological conditions below the extraction footprint (proposed infill site).
- Drilling of on-site groundwater monitoring wells (6 no. in total) up-gradient and down-gradient of the proposed infill site.
- Six months of continuous groundwater level monitoring by means of in-situ data loggers installed in the on-site monitoring wells.
- Groundwater sampling from the 6 no. on-site monitoring wells.
- Groundwater sampling from the local private wells identified within 500m of the site.
- Field hydrochemistry measurements (electrical conductivity, pH and temperature) were conducted for baseline characterisation of groundwater and surface water flows.

1.3.3 Overview of the Impact Assessment Process

The conventional source-pathway-receptor model (see graphic below) for groundwater/surface water protection was applied to assess impacts on groundwater and surface water specifically on downstream sensitive ecological receptors and local groundwater supplies. In the case of the subject site the primary source of impact is the infilling of the void with inert soil and stone whereby the primary potential hazards are suspended solids, leaching and spillages, and accidental discharges of potential pollutants to the local surface waters and groundwater causing a deterioration in water quality. It should be noted that the proposed infill material is to be inert soil and stone and therefore no harmful/toxic contaminants are expected to be present. Possible sources of potential pollutants are confined to plant and machinery.

The pathway in terms of groundwater flowpaths is via the underlying limestone aquifer. The potential pathway for surface water is via potential surface water runoff (if any) that might ultimately enter local streams. Due to the contained nature of the site however this is not expected to arise.

The primary local targets of concern are the underlying limestone aquifer, local wells and local surface water receptors.



Where potential impacts are identified, the classification of impacts in the assessment follows the descriptors provided in the Glossary of Impacts contained in the following guidance documents produced by the Environmental Protection Agency (EPA):

- *Advice Notes on Current Practice in the Preparation of Environmental Impact Statements* (EPA, 2003);
- *Guidelines on the Information to be contained in Environmental Impact Statements* (EPA, 2002) and,
- *Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2017).*

The description process clearly and consistently identifies the key aspects of any potential impact source, namely its character, magnitude, duration, likelihood and whether it is of a direct or indirect nature.

In order to provide an understanding of the phased impact assessment process applied, we firstly present in **Table 1.1** below a summary guide that defines the phases or steps (1 to 7) taken in each element of the impact assessment process. The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

Using this defined approach, this impact assessment process was then applied to all proposed levelling and infilling activities which have the potential to generate a source of adverse impact on the geological and hydrological/hydrogeological (including wells, streams and water quality) environments.

Table 1-1: Impact Assessment Step-Wise Process

Step No.	Title	Process
Step 1	Identification and Description of Potential Impact Source	This section presents and describes the activity that brings about the potential impact or the potential source of pollution. The significance of effects is briefly described.
Step 2	Pathway / Mechanism:	The route by which a potential source of impact can transfer or migrate to an identified receptor. In terms of land infilling developments, surface water and groundwater flows are the primary pathways.
Step 3	Receptor:	A receptor is a part of the natural environment which could potentially be impacted upon, *e.g.* human health, plant / animal species, aquatic habitats, soils/geology, water resources, water sources. The potential impact can only arise as a result of a source and pathway being present.
Step 4	Pre-mitigation Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.
Step 5	Proposed Mitigation Measures:	Control measures that will be put in place to prevent or reduce all identified significant adverse impacts. These measures are generally provided in two types: (1) mitigation by avoidance, and (2) mitigation by best practice engineering design.
Step 6	Post Mitigation Residual Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impacts after mitigation is put in place.
Step 7	Significance of Effects:	Describes the likely significant post mitigation effects of the identified potential impact source on the receiving environment.

1.4 RECEIVING ENVIRONMENT

1.4.1 Site Description and Topography

The site, situated approx. 2.1km southeast of Midleton town centre, has an area of 15.7Ha (within which approx. 9ha of extraction area will be backfilled) within a total landholding area of 46.6Ha in the ownership of the applicant. As the quarrying activity will be ongoing at the same time as the infill, the whole landholding area is described below in order to consider potential interaction with current operations.

The quarry has been worked extensively in the past, and the site includes large excavated areas (to circa. 9mOD), an open first bench which is currently being quarried (top level at approx. 21mOD) (Zone B), quarry workings are predominately in the centre and northeast of the site. The site also contains undeveloped sections which remain densely vegetated in the far north and north-western corner of the site (Zone C).

The boundaries of the quarry site have an elevation range of 36-38m OD on the eastern boundary, reflecting an approximately natural elevation of the pre-development site.

There is also a smaller separate extraction area on the southwest of the site which is accessed through a separate site entrance from the public road. This smaller extraction area has an area of 1.3ha and a current floor level of 22 - 23m OD (Zone A), extraction is completed in this area.

Within the overall landholding to the southeast of the site there is a separate quarry which is referred to as Coppingerstown Quarry. Coppingerstown Quarry has an extraction area of approximately 27Ha with the current floor level at 8 - 9m OD. A small aggregate processing plant is located to the south of the extraction area.

The floor levels of all the extraction areas within the site and overall landholding of the applicant are above the local groundwater table. There are no discharges from the site or overall landholding.

Landuse in the surrounding area is largely agricultural with scattered rural pattern of residential dwellings along the N22 which runs immediately to the north of the site and along other local roads to the south and east of the site.

1.4.2 Local Mapped Geology

A brief review of the local geology is provided in this section in order to put the description of the local hydrological and hydrogeological regime into perspective. Please refer to **Chapter 10** (Land, Soils and Geology Chapter of the EIAR) for a detailed review of the site geology and the extraction history.

The GSI soils map (www.gsi.ie) for the site area indicates that the majority of the surrounding lands are overlain by Shallow well-drained mineral soils derived from mainly basic parent material (BminSW). There are also areas of deep well-drained mineral soils derived from mainly basic parent materials (BminDW) on the southeast of the site and in the land surrounding the landholding on the northern and eastern sides.

The GSI subsoils map for the area (www.gsi.ie) shows that the site is located in an area of bedrock outcrop or subcrop (Rck) with the surrounding area being overlain by limestone tills and sandstone tills. A local subsoil geology map is shown below as **Figure 1.1**.

In terms of bedrock geology, the Little Island formation composed of massive and crinoidal fine limestone underlies the site. A section of the applicant's landholding to the southeast of the site (area comprising part of Coppingerstown Quarry) is mapped to be underlain by the Clashavodig Formation which comprises oolitic, peloidal, cherty, fine limestone. Both bedrock types are susceptible to karstification. A local bedrock geology map is shown as **Figure 1.2** below.

Karstified limestone is visible on outcropping bedrock located approximately 500m to the north and northwest of the site (refer to **Figure 1.1**). The GSI karst database has 3 no. karst features mapped within 1km of the overall landholding. This includes a cave approximately 100m to the north, an enclosed depression approximately 700m to the northwest and another cave 1km to the southeast. In addition, there is a spring (not mapped by the GSI) which emerges within the applicant's landholding at its most south-eastern corner (This is outside of the application site and is discussed further below). All mapped karst features are shown on **Figure 1.2**.

There are no GSI mapped faults within the site or overall landholding. Although north-south trending faults are mapped immediately to the east and west of the landholding. Also, local fractures and joints are visible in the walls of both the Midleton and Coppingerstown extraction areas.

Figure 1.1: Local Subsoils Map

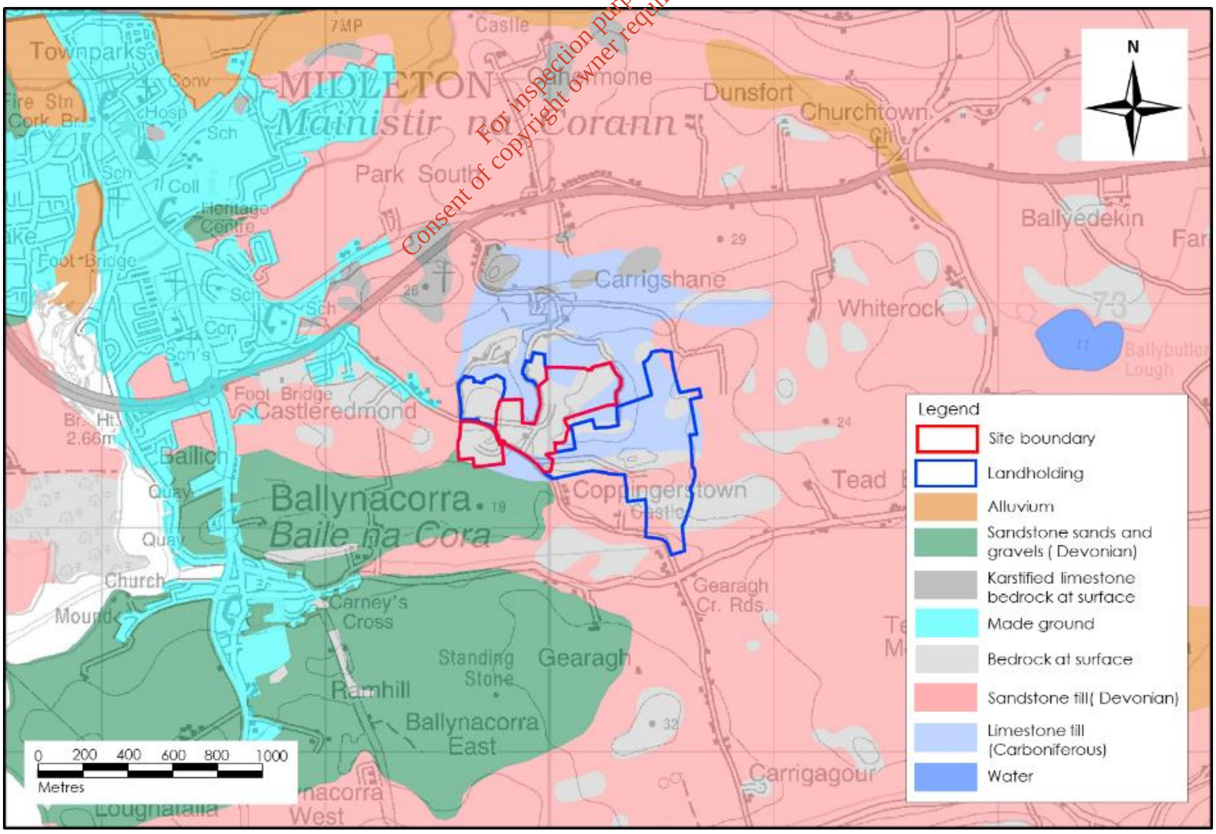
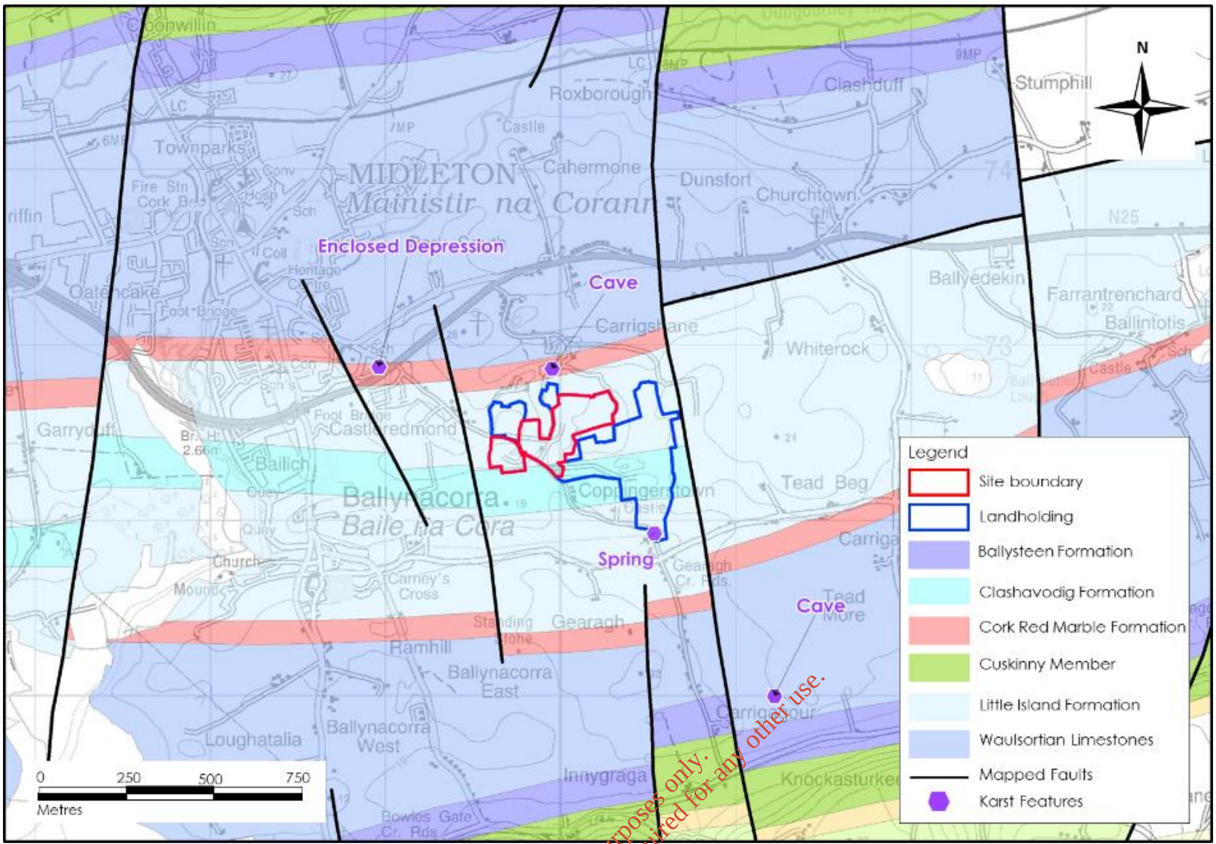


Figure 1.2: Local Bedrock Geology Map



1.4.3 Site Geology

From inspections of the quarry faces, the exposed rock is relatively clean and with no significant weathering except for the upper 5 -7 metres.

However, north-south veining and joint sets are visible in the vertical faces of the quarry, with some fractures evident also. Some of the fractures are clay filled.

To investigate the geological and hydrogeological conditions below the existing quarry floor, 22 no. 4" blast hole drilling investigation points were completed between 15th and 16th November 2017.

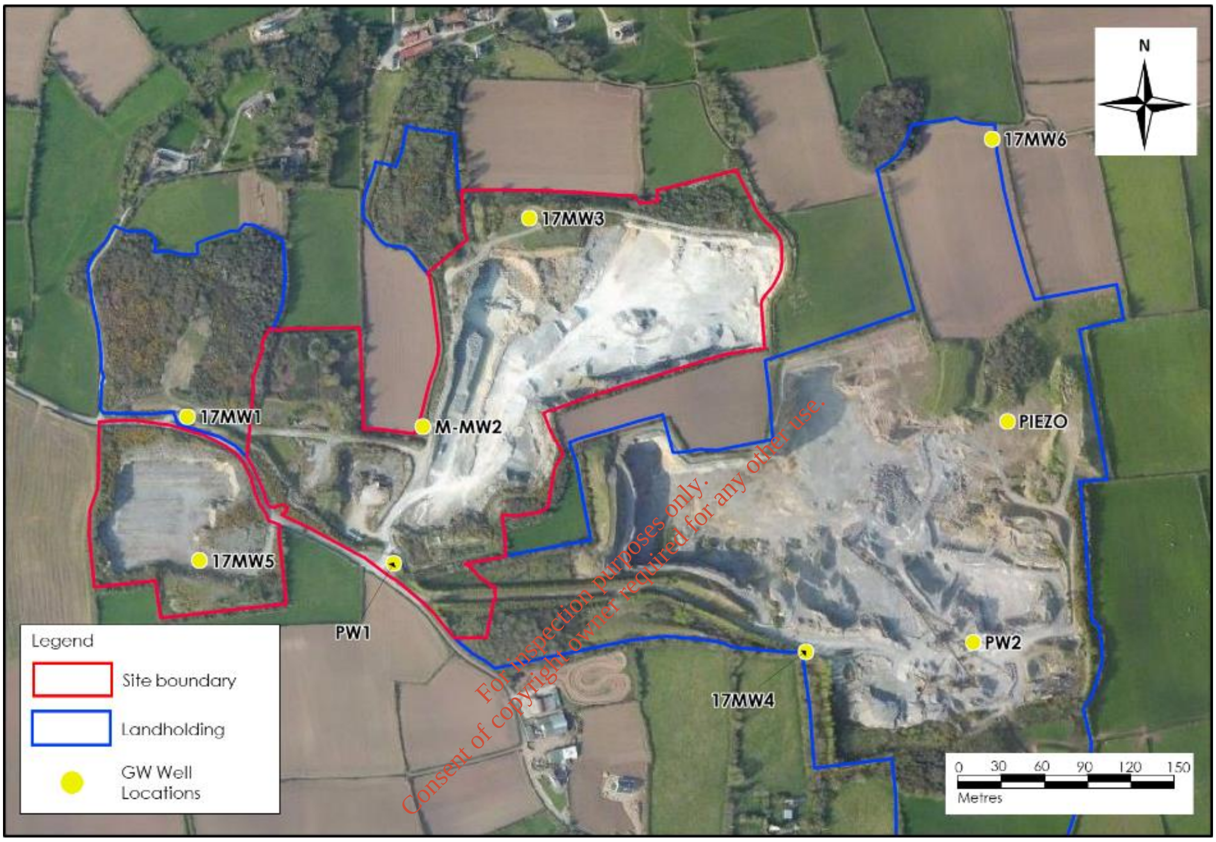
The drilling results are variable. While many holes show solid limestone, and dust returns, with little fracturing, there are also several holes that suggest there are larger discrete fractures/conduits beneath the quarry floor.

There is a large area with clay filled fractures/cavities in the center of the quarry floor at drill locations EH4, EH6, and EH15. These clay filled fractures/cavities were encountered between 5-15mbgl and 22-28mbgl (meters below ground level). The eastern half of the quarry floor comprises relatively solid and dry limestone.

In addition, a total of 6 no. monitoring wells were drilled around the perimeter of the extraction area within the overall landholding (refer to **Figure 1.3** below). The drilling encountered weak to strong grey limestone which was found to be either slightly weathered or fractured to some extent in the majority of the wells. Soft brown clay infill was noted at many of the weathered/fractured sections.

The locations of the monitoring wells are shown on **Figure 1.3** below.

Figure 1.3: Site Investigation Map



1.4.4 Surface Water Quality

EPA biological Q-rating data is available for the Dungourney River which flows to the north and west of the site. The Dungourney River is reported to be Q4 (Good Status) upstream of Midleton but reduces to Q2 – Q3 (Poor Status) at Midleton town. There is no Q-rating data available for the Ballynacorra River or the West Ballynacorra Stream.

1.4.5 Regional Hydrogeology

The different bedrock units which underlie the site (see **Figure 1.2**) are mapped by the GSI as part of the same Regionally Important Karstified (diffuse) Aquifer.

These rocks are devoid of intergranular permeability. Groundwater flow occurs in the many faults and joints, enlarged by karstification. Past depression of the sea level enabled karstification at depth, which further enhances the permeability of these rocks. Because of the high frequency of fissures in this region, overall groundwater flow is thought to be diffuse, although solutionally enlarged conduits and cave systems occur (GSI, 2014).

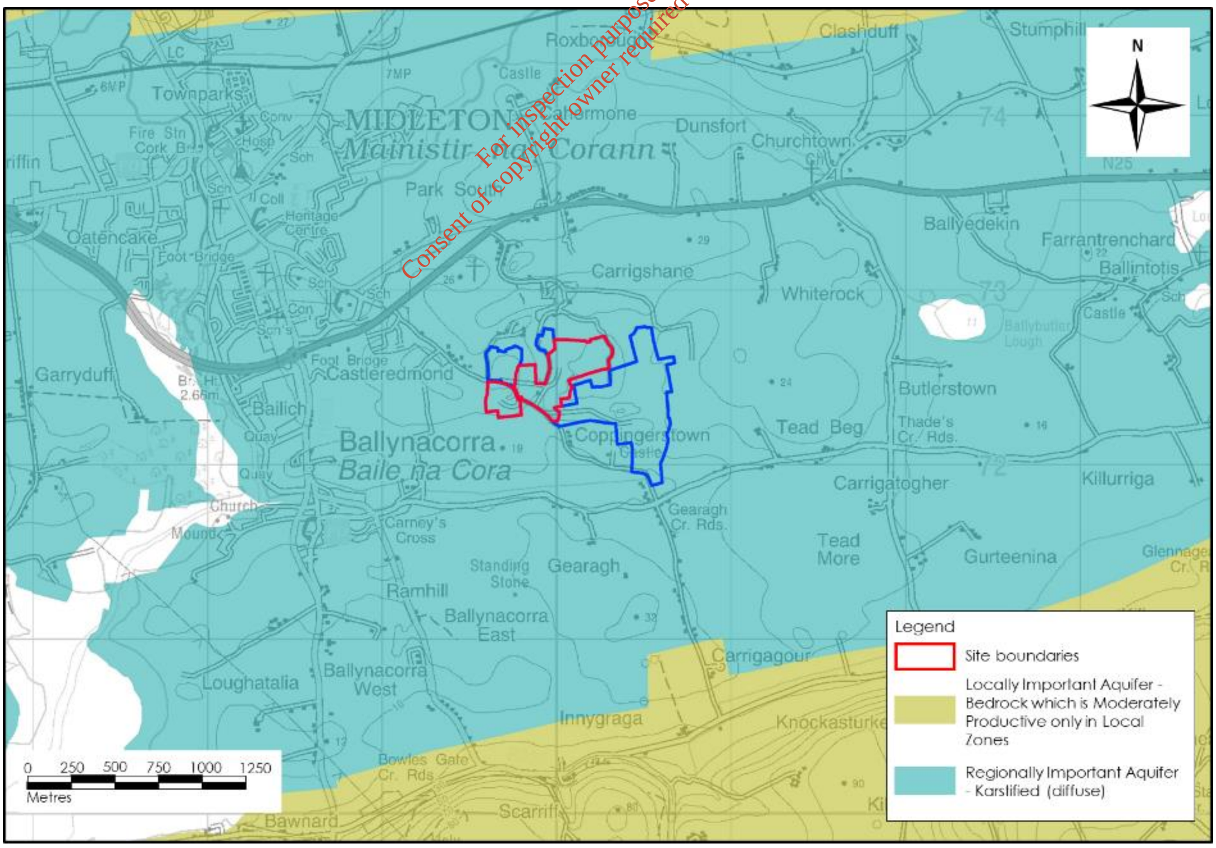
Groundwater flow occurs in an upper shallow highly karstified weathered zone in which groundwater moves quickly in rapid response to recharge.

Below this is a deeper zone where there are two components to groundwater flow. Firstly, groundwater flows through interconnected, solutionally enlarged conduits and cave systems that are controlled by structural deformation. Secondly, groundwater is generally unconfined. The highly permeable aquifer supports a regional scale flow system. Groundwater flow paths can be up to several kilometers long but may be significantly shorter in areas where the water table is very close to the surface.

As stated above there are 4 no. known karst features within 1km of the site. The feature on the south of the applicant's landholding is a karst spring which is a source of the West Ballynacorra Stream.

The GSI bedrock aquifer map for the area is shown as **Figure 1.4** below.

Figure 1.4: GSI Bedrock Aquifer Map



1.4.6 Site and Local Hydrogeology

As stated above, the site is underlain by a Regionally Important karstified Aquifer (Rkd). There are no significant karstified rock features/weathering in the quarry walls of the site. The main karst feature within the vicinity of the site is a small spring in the southern corner of the landholding.

As noted above, to investigate the geological and hydrogeological conditions below the existing quarry floor, 22 no. 4" blast hole drilling investigation points were completed. In addition, 6 no. monitoring wells were drilled around the periphery of the current extraction areas within the overall landholding.

The drilling results were variable, and while many holes show solid rock, with little water inflow, there are also several holes with significant groundwater strikes that suggest there are larger discrete pathways of groundwater flow beneath the quarry. Clay in-filled fractures and cavities with large inflows would be consistent with karstified limestone.

Groundwater levels measured in the on-site monitoring wells are shown in **Table 1.2** below. Based on the reduced groundwater levels (m OD), the groundwater flow direction in the area of the quarry is to the west / southwest. This is consistent with the local hydrology of the area which is towards the estuary of Ballynacorra River/estuary which exists to the southwest of the site. Shown on **Figure 1.5**.

Groundwater levels for the on-site monitoring wells are shown as **Figure 1.6** below and a summary of the water levels and variations between January to June 2018 are shown in **Table 1.4** below.

The variation in groundwater levels at the site during the monitoring period (January – June 2018) was between 1.5 – 2m which would be typical of high productive Regionally Important Aquifer where gradients would be typically more subdued.

Table 1-2: Groundwater Level Measurements

Monitoring Well No.	WL (mbgl)	WL (mOD)	WL (mbgl)	WL (mOD)
	07/03/2018		30/04/2018	
17-MW01	27.294	6.809	27.074	7.029
17-MW02	14.006	6.884	13.571	7.319
17-MW03	15.266	7.169	14.766	7.669
17-MW04	15.283	7.067	14.513	7.837
17-MW05	16.984	7.1	16.834	7.25
17-MW06	16.09	7.667	15.64	7.955
Well	10.63	7.505	10.18	8.20

Table 1-3: Summary of Groundwater Level Monitoring (Jan - June 2018)

Monitoring Well No.	Maximum WL (m OD)	Minimum WL (m OD)	WL Range (m)
17-MW01	7.628	5.899	1.729
17-MW02	7.660	6.053	1.607
17-MW03	7.935	6.369	1.566
17-MW04	7.688	6.412	1.276
17-MW05	7.738	6.220	1.518
17-MW06	8.936	6.782	2.154

Figure 1.5: Groundwater Flow and Direction

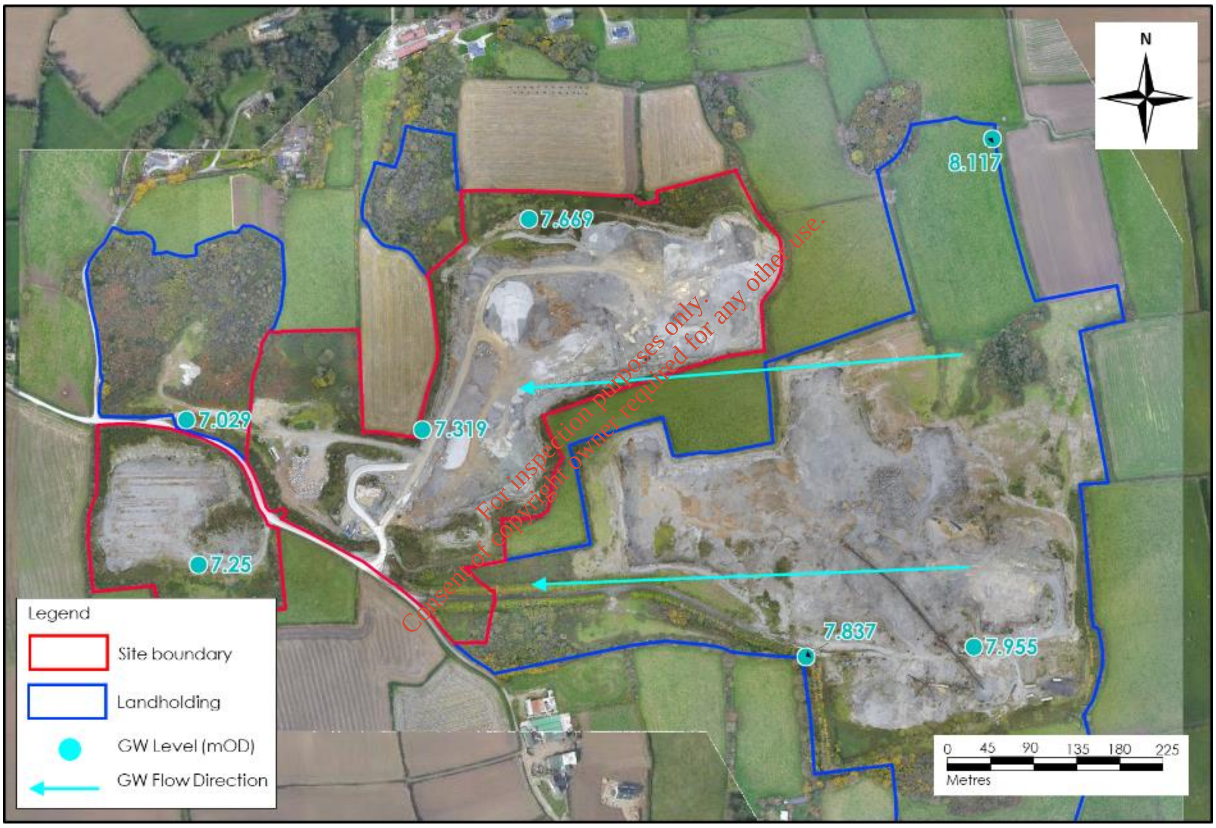


Figure 1.6: Groundwater Level Plots

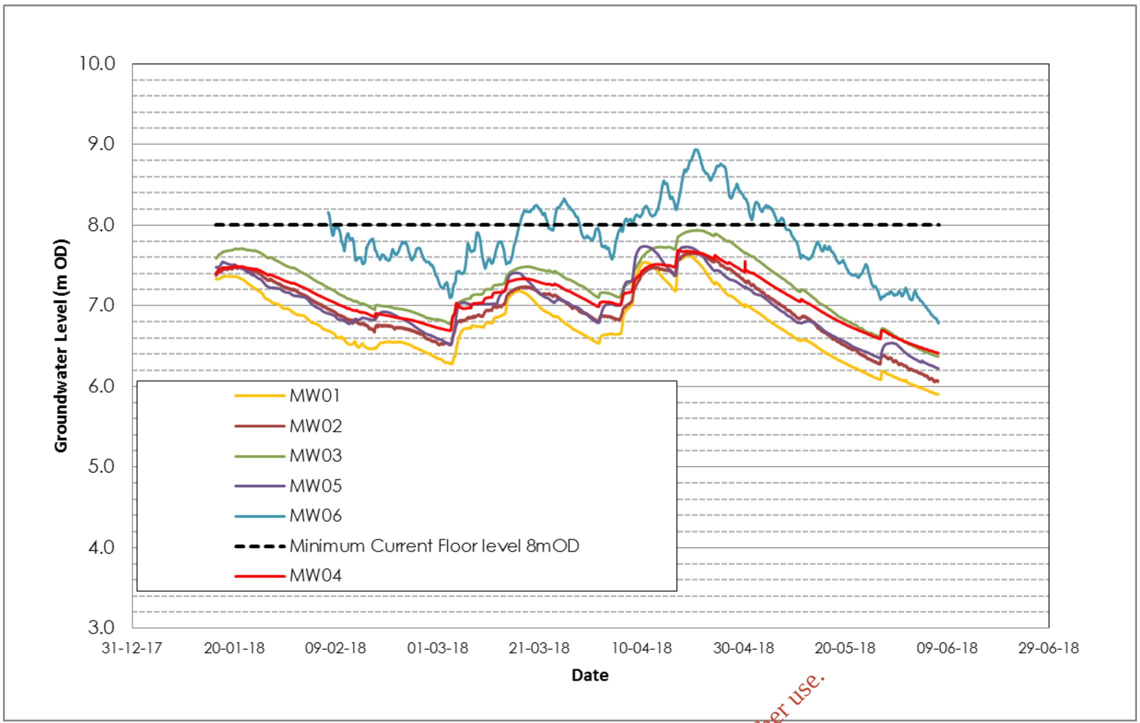


Table 1-4: GSI Groundwater Vulnerability (GSI, 1999)

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Karst Features
	High permeability (sand/gravel)	Moderate permeability (e.g. Sandy subsoil)	Low permeability (e.g. Clayey subsoil, clay, peat)	(Sand/gravel aquifers only)	(<30 m radius)
Extreme (E)	0 - 3.0m	0 - 3.0m	0 - 3.0m	0 - 3.0m	-
High (H)	>3.0m	3.0 - 10.0m	3.0 - 5.0m	>3.0m	N/A
Moderate (M)	N/A	>10.0m	5.0 - 10.0m	N/A	N/A
Low (L)	N/A	N/A	>10.0m	N/A	N/A

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

1.4.7 Groundwater Quality

Two rounds of groundwater sampling were completed at the on-site monitoring wells (MW1 – MW6) and also at a production well (PW1) in the Coppingerstown Quarry during March 2018 and May 2019.

The groundwater flow direction at the site is to the west / southwest and therefore monitoring well MW6 is directly up-gradient of the site, while MW1, MW2 and MW5 are directly down-gradient of it. MW3, MW4 and PW1 are either to the north or south and are across gradient to the site.

As part of the assessment undertaken as part of the EIAR, the results were compared with the relevant groundwater regulation values (S.I. No. 9 of 2010) and drinking water regulation values (S.I. No. 122 of 2014); the results from March 2018 are shown in **Table 1** of **Appendix D.3** of the EIAR, the results from June 2019 are included in Attachment-6-3-7-Response to RFI (Item 2).

Overall, the results were quite variable, particularly with respect to nutrients and this is likely due to the heterogeneous nature of groundwater flows in a karst aquifer.

There were three exceedances with respect to the drinking water regulation values and these were for Total Coliforms in MW1, Enterococci in MW5 and a minor exceedance of Nitrate in MW4 (53.16mg/l). There were two exceedances with respect to the groundwater regulation values and this was for nitrate in MW3 in both sampling events, which exists to the north (across-gradient) of the site.

Nitrate was also relatively elevated in MW6 which is also likely due to agricultural practices such as fertiliser / slurry spreading on the lands surrounding the site. Ortho-phosphate was also elevated in MW3 and MW4 which suggests a fertilizer/slurry source. The presence in enterococci in MW5 also suggests a slurry source (animal waste).

The elevated level of Total Coliforms at MW1 suggests that this particular sample point was contaminated shortly before sampling as nitrate was also slightly elevated in MW1. There was no detection of coliforms in any of the other samples which might indicate a chemical fertilizer rather than manure/slurry or it may indicate that the groundwater vulnerability is not overly high locally.

Overall the groundwater quality is typical of a karstified aquifer where the main landuse is agriculture. Variable groundwater quality is often a characteristic of this aquifer type.

1.4.8 Hydrological Conceptual Site Model

There are abundant visible geological structures in all vertical quarry faces around the quarry floor. These include faulting, jointing, and vertical clay filled weathered zones.

From inspections of the quarry faces, the upper exposed rock is relatively weathered with some clay infill on the upper 5 – 7m but becomes more competent with depth.

Based on the investigative drilling, the limestone bedrock varies from weak/weathered to competent/strong across the landholding. The weak/weathered limestone, which is regularly clay infilled, is typically in the upper 10 – 15m of rock. The heterogeneous nature of rock is typical of karstified limestone.

The limestone bedrock underlying the site is a Regionally Important karstified Aquifer (Rkd) where the regional groundwater flow direction is to the west / southwest towards the Ballynacorra River estuary.

Based on investigative drilling at the site, the groundwater flow regime below the site appears to be via discrete fracture networks in otherwise competent bedrock.

The groundwater level is 1 – 2m below the existing quarry floor.

The variation in groundwater levels at the site during the monitoring period (January – June 2018) was 1.5 – 2m which would be typical productive Regionally Important karstified Aquifer. During this period the groundwater level remained below the existing quarry floor.

Overall the groundwater quality is typical of a karstified aquifer where the main landuse is agriculture. Variable groundwater quality is often a characteristic of this aquifer type due to the heterogeneous nature of groundwater flows.

The local hydrological and hydrogeological regime can be considered to have a very high importance.

1.4.9 Groundwater Body Status

The Midleton GWB (IE_SW_G_058) is assigned Good status under the 2010-2015 WFD round (www.catchments.ie).

1.4.10 Surface Water Body Status

The Dungourney_020 waterbody (IE_SW_19D070700) which drains the northern sections of the site has a Poor ecological status under the 2010-2015 WDR round (www.catchments.ie).

The Knocknamadderee_010 waterbody (IE_SW_19K630910) which drains the lands to the south of the landholding has an unassigned ecological status under the 2010-2015 WFD round. (This watercourse is referred to as the West Ballynacorra Stream by the EPA).

1.4.11 Water Resources

Based on the GSI mapping there are no groundwater protection zones for existing public water or group water schemes mapped in the area of the quarry.

According to the GSI well database there is only 1 no. registered well within 1km of the proposed site and this well is located to the south of the site. GSI mapped wells with an accuracy of <50m are shown on **Figure 1.7** below. As discussed in Section 1.4.6 above, the groundwater flow direction in the area of the site is in a west / south-west direction and therefore this mapped GSI well is not down-gradient of the proposed site.

As the GSI well database is not exhaustive in terms of the locations of all wells in the area (as the database relies on the submission of data by drillers and the public etc.) a door to door well survey of dwellings in close proximity (500m of site boundary) was carried out on 30th April 2018.

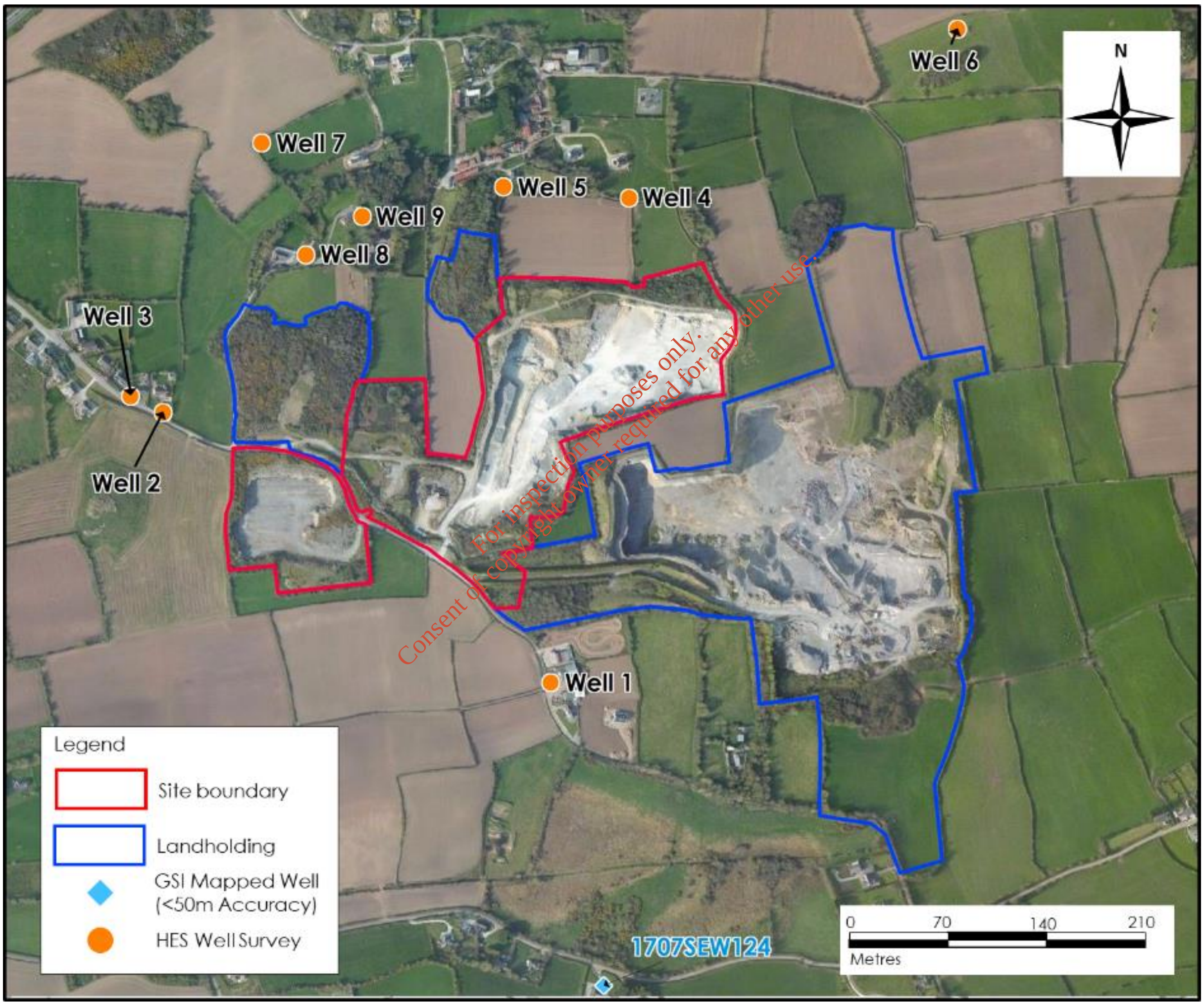
A total of 9 no. private wells were identified within 500m of the site boundary. These are also shown on **Figure 1.7**. The wells are mainly located to the north and west of the site. Well 2 and Well 3 are located to the west and directly down-gradient of the proposed site. The wells to the north and south are located across gradient to the site. Third party wells have a high importance locally.

Groundwater sampling was completed at a number of local wells (Well 1 – Well 9 as denoted on Figure 1.7 below) on June 6th 2019. Raw water samples were taken from garden taps.

Total coliforms were detected in all wells except Well 7, E.Coli and/or Enterococci was detected in Well 2, Well 5, Well 8 and Well 9, with contamination in Well 2 being significant. Elevated chloride was present is some wells, although neither the Drinking Water nor Groundwater Regulations were exceeded. The natural background concentration in this area will be elevated due to the proximity of the coast. Nitrate is elevated (exceeding the Groundwater Regulations) in Well 2, Well 3, Well 4 and Well 7 which is likely due to agricultural practices.

The better groundwater quality within the Quarry site (in terms of microbial contamination in particular) suggest that the contamination in the local wells derives from septic or other local sources of contamination.

Figure 1.7: Local Groundwater Supplies



1.5 POTENTIAL IMPACTS

1.5.1 Receptor Sensitivity

Groundwater (Regionally Important Limestone Aquifer) and local wells are the primary receptors in respect of the proposed development. Based on the criteria in **Table 1.1** above, both receptors can be considered sensitive to impact. However, due to the inert nature of the proposed fill, significant impacts on groundwater quality are not anticipated.

Local surface waters can also be considered sensitive, however as stated above there is no proposed discharges to surface waters.

Given the existing site conditions, no sensitivity in respect of flooding is identified at the site.

1.5.2 Construction / Operational Phase

1.5.2.1 Impacts on Groundwater Vulnerability Rating due to Change of Subsoil Thickness

As discussed above it is proposed to import soil and stone and fill the pit over an area of approx. 9ha to an average depth of 20m. The total infill is in the order of 1.4Mm^3. The groundwater vulnerability rating after the voids are filled will be improved as the additional fill will provide additional aquifer protection at the site.

Potential Pathway: Recharge.

Receptor: Groundwater vulnerability.

Pre-Mitigation Potential Impact: Direct, positive, slight, permanent, likely, impact on groundwater vulnerability.

Potential Impact Assessment: In terms of impacting on the groundwater vulnerability of the site, the importing of the inert fill will have a positive effect on the site in that the groundwater vulnerability rating will be lower.

Backfilling the site with inert material could be viewed as a good approach as it will provide better aquifer protection in the long term.

1.5.2.2 Impacts on Groundwater Quality due to Inert Fill Material

The proposed development comprises importing approximately 1.4Mm^3 of inert soil and stone (EU Waste Code 17 05 04). Infilling of the site with inert soil should pose a low risk to groundwater quality regardless of the vulnerability rating as no harmful contaminants will be present. In addition, inert soil and stone will not contain either organic matter or liquids that will form a source of organic contaminants of microbial pathogens, nor provide a substrate to feed microbial pathogens. Therefore, no significant groundwater quality impacts are anticipated.

Potential Pathway: Groundwater flow.

Potential Receptor: Groundwater quality.

Pre-Mitigation Potential Impact: Indirect, negative, imperceptible, long term, unlikely, impact on groundwater quality.

Potential Impact Assessment: Infilling of the site with inert soil will pose a low risk as no harmful contaminants should be present.

1.5.2.3 Impacts on Local Well Supplies

As assessed in Section 1.4.11 above, the 2 no. wells identified to the west of the site are located down-gradient of the proposed development.

Potential Pathway: Groundwater flow.

Potential Receptor: Local Well.

Pre-Mitigation Potential Impact: Indirect, negative, imperceptible, long term, unlikely, impact on local wells.

Potential Impact Assessment: Infilling of the site with inert soil will pose a low risk as no harmful contaminants should be present.

Furthermore, while the site investigation did identify potential fractures below the quarry floor these fractures are more than 5m below the quarry floor with no opening on the quarry floor itself. Therefore, the risk of vertical washout of fines into possible underlying fractures is low. Also, all fractures present on the quarry faces are enclosed and tight and therefore the potential for lateral washout is also low.

1.5.2.4 Impacts on Surface Water Quality due to Site Runoff

During infilling there will no pathway for surface water to leave the site other than by recharging into groundwater. There could be potential for indirect impact on surface water outside of the site boundaries by reason of impact on groundwater. The probability of this however is very low.

Potential Pathway: Surface water runoff.

Potential Receptor: Local surface waters.

Pre-Mitigation Potential Impact: Indirect, negative, significant, short term, low probability impact on local surface water quality.

1.5.2.5 Oils and Fuel Spillages

Accidental spillage during refuelling of construction/excavation plant with petroleum hydrocarbons is a contamination risk to soils, groundwater, and associated ecosystems, and to terrestrial and aquatic ecology. The accumulation of small spills of fuels and lubricants during routine plant use can also be a contamination risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in death of aquatic organisms.

Pathway: Groundwater flow (no surface water link available).

Receptor: Groundwater quantity.

Pre-Mitigation Potential Impact: Indirect, slight, short term, low probability, impact on groundwater and surface water quality.

This is assessed further in a separate hydrogeological assessment which related to the proposed indirect discharge of treated stormwater runoff to ground via a full retention oil interceptor. This has been included in Attachment-6-7-3 Emissions to Ground Controls.

1.5.3 Post Restoration Phase

It is proposed that the site will be used for mainly agricultural purposes after the restoration is complete. The proposed end landuse is consistent with the landuse locally which is predominately agricultural. No impacts on groundwater quality or quantity (flows or levels) are anticipated post restoration phase.

1.5.4 Cumulative Impact

Other landuse activities visible in the immediate area include quarries, existing farming operations and single dwelling houses. It is proposed that the nearby Coppingerstown Quarry will be extended (subject to planning permission) but since there are no proposed discharges at either the Midleton Quarry or the Coppingerstown Quarry, no hydrological cumulative effects are anticipated.

Several other projects and plans in the wider area have been identified (refer to Chapter 2 of the EIAR) but none of these are expected to contribute to hydrological cumulative effects.

There will be no significant in combination hydrological and hydrogeological impacts resulting from this project, and other local existing developments, quarries, projects and plans as set out in Chapter 2 pf the EIAR.

1.6 MITIGATION MEASURES

1.6.1 Construction / Operational Phase

1.6.1.1 Groundwater Vulnerability Rating due to Change of Subsoil Thickness

The primary mitigation measure to minimise potential impact on groundwater vulnerability is to minimise potential for fill contamination. This will be achieved by:

- Only accepting material that is proven to be inert prior to delivery to the site.
- Pre-agreed source sites for inert material ensuring no pollutants, unauthorised material, invasive species as per the waste acceptance procedures.
- The site will operate under an Environmental Management System.
- All required pollution prevention measures will be implemented at the site.
- The operator will prepare and implement an Emergency Response Procedure.
- The operator will complete environmental monitoring, including local groundwater water monitoring.

- A phased restoration of the site will be implemented, with an agricultural use implemented following restoration for the majority of the site.
- The operator will have a documented waste recording procedure for all material entering the site.
- No unauthorised dumping of waste will be allowed at the site.

1.6.1.2 Groundwater Quality due to Inert Fill Material

The mitigation measures set out at section 1.6.1.1 above apply.

Mitigation measures relating to potential for hydrocarbon/chemical spills and leaks to impact on groundwater are dealt with further below in **Section 1.6.1.6**.

1.6.1.3 Local Well Supplies

No direct mitigation is required in relation to inert fill and potential impacts on the local wells.

Mitigation measures relating hydrocarbon/chemical spills and leaks are dealt with further below.

1.6.1.4 Surface Water Quality due to Site Runoff

The mitigation measures set out at section 1.6.1.1 above will minimise potential for impact on surface water quality.

1.6.1.5 Water Quality Impacts on Great Island Channel SAC

Backfilling of the quarry void will be completed using inert fill, and this will ensure limited potential for impact on groundwater and surface water quality.

This will be achieved by the measures set out at section 1.6.1.1 above.

1.6.1.6 Oils and Fuel Spillages

Proposed mitigation measures are as follows:

- There will be no on-site storage of fuels permitted at the site.
- All on-site refuelling will be completed in a designated area and from a mobile double skinned fuel bowser.
- The designated refuelling area will be located in a hardstanding area with surface water drainage collected and passed through a class 1 full retention oil interceptor (with silt trap) and constructed wetlands.
- All plant and machinery will be serviced before being mobilised to site, and regular leak inspections will be completed during the backfilling works.
- No substantial plant maintenance will be completed on site, any broken down plant will be removed from site to be fixed.

- An emergency spill kit with oil boom, absorbers etc. will be kept on site for use in the event of an accidental spill.

1.6.2 Post Restoration Phase

No potential impacts on the water environment are identified post-restoration, and accordingly no specific mitigation measures are proposed. Groundwater monitoring post restoration is outlined in **Section 1.7** below.

1.7 PREDICTED RESIDUAL MEASURES

1.7.1 Construction / Operational Phase

1.7.1.1 Groundwater Vulnerability Rating due to Change of Subsoil Thickness

In terms of impacting on the groundwater vulnerability of the site, the importing of the inert fill will have an overall positive effect on the site in that the groundwater vulnerability rating will be lower.

Residual Impact: Direct, positive, slight, permanent, likely, impact on groundwater vulnerability.

Significance of Effects: No significant residual impacts on groundwater vulnerability are expected.

1.7.1.2 Groundwater Quality due to Inert Fill Material

Overall, Infilling of the site with inert soil will pose a low risk as no harmful contaminants should be present.

Residual Impact: Indirect, negative, imperceptible, long term, unlikely, impact on groundwater quality.

Significance of Effects: No significant residual impacts on groundwater quality are expected.

1.7.1.3 Local Well Supplies

Due to the distance of fractures below the quarry floor and the absence of any opening in the quarry floor itself the risk of vertical washout of fines into possible underlying fractures is low. In addition, all fractures present on the quarry faces are enclosed and tight and therefore the potential for lateral washout is also low. Combined with this, the inert soil which will be placed in the voids will pose a low risk as no harmful contaminants should be present. No significant residual impacts on wells are therefore identified.

Residual Impact: Indirect, negative, imperceptible, long term, unlikely impact on local wells.

Significance of Effects: No significant residual impacts on local wells are expected.

1.7.1.4 Surface Water Quality due to Site Runoff

No significant residual impacts on the surface water environment are expected. The potential for impacts arising on the surface water environment are very low in the first instance. Combined with the mitigation measures outlined for surface water runoff management residual impacts on surface water is unlikely.

Post-Mitigation Residual Impact: Indirect, slight, temporary, unlikely impact on local surface waters.
Significance of Effects: No significant residual impacts on the surface water environment are expected.

1.7.1.5 Water Quality Impacts on Great Island Channel SAC

Backfilling of the quarry void will be completed using inert fill, and this will ensure limited potential for impact on groundwater and surface water quality.

For these reasons and additional on-site controls outlined in the Mitigation Measures at **Section 1.6** above, no impacts on the downstream Great Island Channel SAC are anticipated.

Residual Impact: No impacts on Great Island Channel SAC.
Significance of Effects: No significant residual impacts on Great Island Channel SAC are anticipated.

1.7.1.6 Oils and Fuel Spillages

With regard to the mitigation measures set out above, there are no predicted residual impacts of any significance identified due to oils and fuel spillages.

Post-Mitigation Residual Impact: Direct/Indirect, imperceptible, short term impact on groundwater quality.
Significance of Effects: No significant residual impacts on the water environment.

1.7.2 Post Restoration Phase

No residual impacts on surface or groundwater are predicted post-restoration.

1.8 MONITORING AND REINSTATEMENT

1.8.1 Groundwater Monitoring

There is a network of new monitoring wells at the site identified in Figure 1.3 above. It is proposed to undertake regular monitoring for groundwater levels and groundwater quality at locations MW1 – MW6.

1.8.2 Additional Monitoring

In addition, it is proposed to undertake monitoring of the discharge point from the class 1 full retention oil interceptor and the discharge of stormwater to the soakaway. The locations of GW1 and GW2 are shown on Drawing Ref. CP17028WL0008 and Drawing Ref. CP17028WL0017. Coordinates to Irish National Grid reference are outlined below:

Table 1-5: Coordinates of Proposed Stormwater Discharge monitoring points

Ref.	Easting	Northing
GW1	189978	72277
GW2	189953	72288