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GARRYHESTA PIT, OVENS, CO. CORK

Hydrogeological Assessment Report for the Proposed Discharge of Stormwater Runoff to Ground

FINAL REPORT

Prepared for:

ROADSTONE LTD

Prepared by:
HYDRO-ENVIRONMENTAL SERVICES

DOCUMENT INFORMATION

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1. INTRODUCTION

1.1 OVERVIEW

Hydro-Environmental Services (HES) were commissioned by Roadstone Ltd to prepare a hydrogeological assessment in relation to a further information request issued by the EPA regarding a waste management licence application (EPA Reg No. W0299-01) for a proposed facility located at Garryhesta Pit, Knockanemore, Ovens, Co. Cork.

This hydrogeological assessment relates to the proposed indirect discharge of treated stormwater runoff to ground via a full retention oil interceptor.

1.2 PROJECT BACKGROUND

The proposed development consists of restoration of part (c. 6.7 ha) of existing quarry (QR19 06/11798 & PL04.225332) by importation of up to 300,000 tonnes per annum of inert soil and stones and river dredging spoil (EWC 17-05-04 and 17-05-06). The proposed soil recovery facility will utilise the permitted quarry infrastructure including internal roads, site office, welfare facilities and other ancillaries to complete the works. A wheel wash, weighbridge and new car park will be provided as part of the proposed development and the existing workshop shed will be utilised as a quarantine area.

A new hardstand area (117m^2) with drainage outfall to a full retention oil interceptor will be provided as a designated refuelling area. As per the Cork County Council planning conditions (P. Ref 1805155), both the refuelling area and the new carpark (63m^2) will drain to the oil interceptor.

The development will be subject to the requirements of the EPA waste management licence. The EPA registration number for the waste licence application is W0299-01. The proposed site layout is shown as **Figure 1** attached at the end of this report.

This hydrogeological assessment is prepared in response to Item 1(e) of the further information request which was issued from the EPA by letter on 24th September 2019. Item 1(e) is written as follows:

> "*If proposal is to discharge to ground from the hydrocarbon interceptor, this is considered an indirect discharge to groundwater and therefore requires a technical assessment to be carried out in accordance with the 'Guidance on the Authorisation of Discharges to Groundwater', (EPA, 2011)*".

In order to comply with the above, a Tier 2 risk assessment as per EPA *Guidance on the Authorisation of Discharges to Groundwater* (2011) has been prepared.

1.3 LEGISLATION & IMPACT ASSESSMENT CRITERIA

The control of discharges to waters (aquifer in this case) is governed by S.I. No. 42 of 1999: Local Government (Water Pollution) (Amendment) Regulations, 1999.

Article 40 (2) of S.I. 42 of 1999 details the requirements of the required Hydrogeological Assessment as follows:

40 (2) The prior investigation referred to in sub-article (1) shall include —

(a) an assessment of the environmental impact of alternative methods of disposal of the harmful substance, and

(b) an examination of the aquifer to which the licence application relates in respect of the following—

(i) the extent and estimated volume of water therein,
(ii) the quality of water therein,
(iii) the estimated rate of recharge,
(iv) the identification of any existing or proposed uses of the water therein,
(v) the hydrogeological conditions of the area in which the aquifer is located,
(vi) the nature and depth of overlying soil and subsoil and its effectiveness in preventing or reducing the entry of the harmful substance to water in the aquifer,
(vii) the risk of deterioration in the quality of the water therein due to the entry of the harmful substance,
(viii) the risk of the water therein being affected by the harmful substance so as to endanger human health or water supplies, harm living resources and the aquatic ecosystem or interfere with the use of the water for agricultural, commercial, domestic, fisheries, industrial or recreational purposes, and
(ix) such other matters as the local authority may reasonably require for the purpose of establishing whether the discharge of the harmful substance to the aquifer is a satisfactory method of disposal having regard to its environmental impact and the results of the assessment referred to in paragraph (a).

A "harmful substance" means substances and groups of substances specified in the First Schedule or in the Second Schedule, except where otherwise provided (S.I. No. 271/1992: Local Government (Water Pollution) Regulations, 1992). It is noted that some of the constituents (i.e. hydrocarbons) of the treated stormwater proposed for discharge at Garyhesta Pit to groundwater may constitute definition as potential "harmful substances" under the schedules of the Local Government (Water Pollution) Regulations (1992). Therefore, this report details the alternative strategies considered and the results of the 'examination of the aquifer'.

The discharge must also be considered in the context of the Groundwater Regulations (2010), which do not specify groundwater limit concentrations but rather require no upward (improving) trend in groundwater concentrations.

EPA Guidance on the Authorisation of Discharges to Groundwater (December, 2011)[1] requires that the proposed discharge is assessed according to the risk posed, which is assigned according to the magnitude of hydraulic loading proposed and the nature of the receiving

[1] *Environmental Protection Agency (EPA) Guidance on the Authorisation of Discharges to Groundwater (2011);*

environment. The chemical/hydraulic loading and impact assessment is presented in **Section 5** of this report.

1.4 REPORT STRUCTURE

In summary, the technical assessment is aimed at examining the following:

- Demonstrating that a site has sufficient infiltration capacity to physically —accept the effluent (i.e. treated stormwater runoff), thereby avoiding surface ponding and effluent runoff;
- Demonstrating that a site has adequate attenuation potential to limit the loading of substances to groundwater;
- In certain cases, predicting an impact on groundwater quality; and,
- Where necessary, verifying predicted impacts by checking compliance with relevant groundwater quality objectives and standards.

More specifically, a Tier 2 – Environmental Risk Assessment includes the following requirements:

- Desk study/environmental setting;
- Walkover survey;
- Infiltration capacity assessment;
- Assessment of chemical composition of input;
- Calculation of minimum separation distances;
- Groundwater flow direction inferred from site specific measurement and monitoring;
- Assessment of subsoil type, texture thickness and permeability;
- Assessment of aquifer type and hydraulic properties;
- Assessment of background groundwater quality;
- Identification of relevant receptors and associated water quality standards;
- ZOCs of downgradient abstraction points/schemes where these have not yet been delineated;
- Quantification of interaction between groundwater and surface water or GWDTE where appropriate and relevant;
- Conceptual model, backed up where necessary using using basic calculation procedures; and
- Conclusions and recommendations.

2. DESK DTUDY - ENVIRONMENTAL SETTING

2.1 SITE DESCRIPTION & PROPOSED DEVELOPMENT

The proposed soil recovery facility, which is an existing sand and gravel pit, is located at ITM E552400, N569850. It is situated ~2km west of Ovens in Co. Cork where it is located immediately south of the N22.

The surrounding landscape consists of gently undulating to hummocky valley floor, in which the Bride River meanders, within the regional River Lee Catchment.

The topography in the area of the site is gently undulating with an elevation range of between approximately 45 – 65m OD (Ordnance Datum). Current pit floor levels at the application site vary between approximately 23m and 26m OD with the overall slope to the south. The ground elevation at the proposed oil interceptor and soakaway is 50.7m OD. The location of the proposed oil interceptor and soakaway is shown in **Figure 1** attached below.

Natural ground levels in the fields immediately to the west and south of the site are at approximately 54 and 52m OD respectively. The ground to the north of the site rises steadily to an elevation of over 120m OD.

Land use in the surrounding area is largely agricultural and quarrying 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.

The proposed development will utilise the permitted pit infrastructure including internal roads, site office, welfare facilities and other ancillaries to complete the works. A wheel wash, new car park and weighbridge will be provided as part of the proposed development and the existing workshop will be utilised as a quarantine area. A new hardstand with drainage outfall to an oil interceptor will also be provided as a designated refuelling area.

A site location map is shown as **Figure A**.

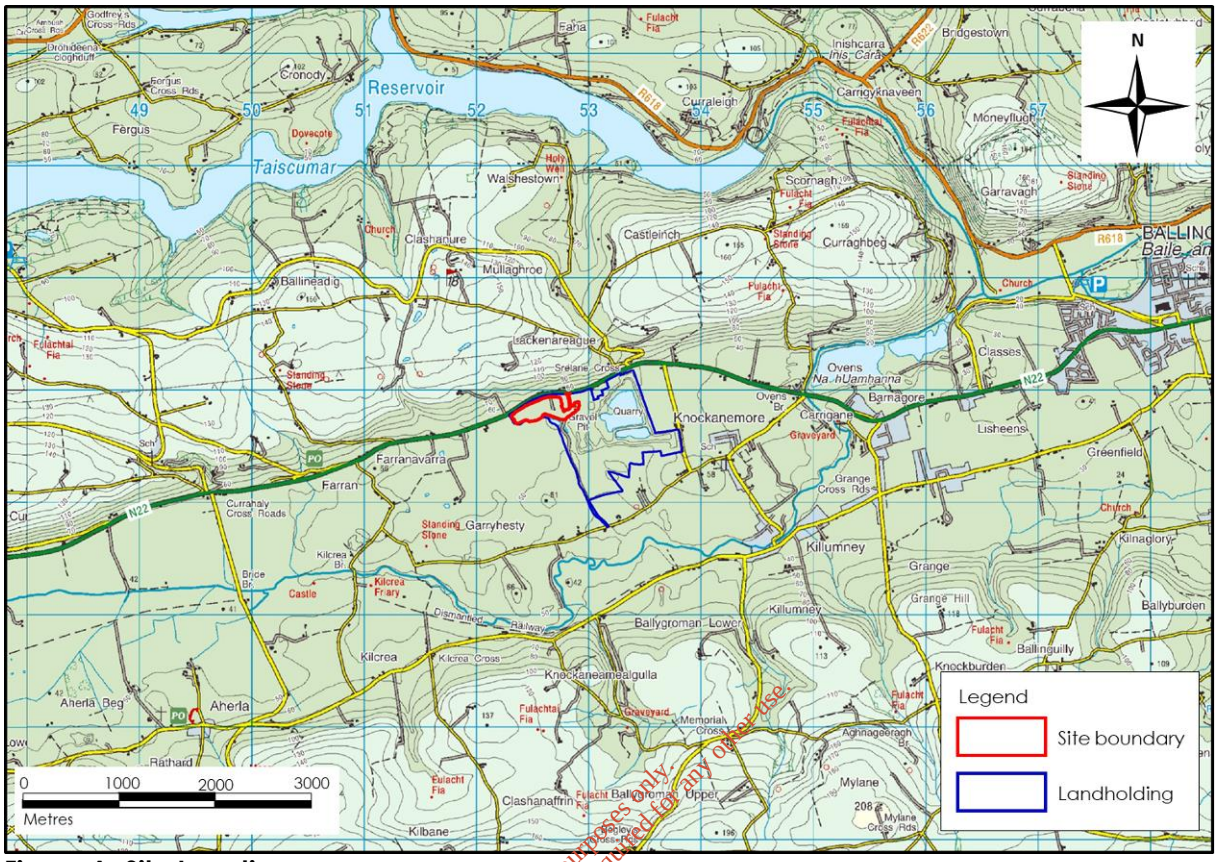


Figure A: Site Location

2.2 HYDROLOGY

2.2.1 Regional and Local Hydrology

The site is located in the catchment of the River Bride which is a sub-catchment of the River Lee within Hydrometric Area 19 (South Western River Basin District). The River Bride flows in an easterly direction approximately 1.5km to the south of the site. The River Bride then flows into the River Lee approximately 3km to the east of the site.

The local hydrology map is shown as Figure B.

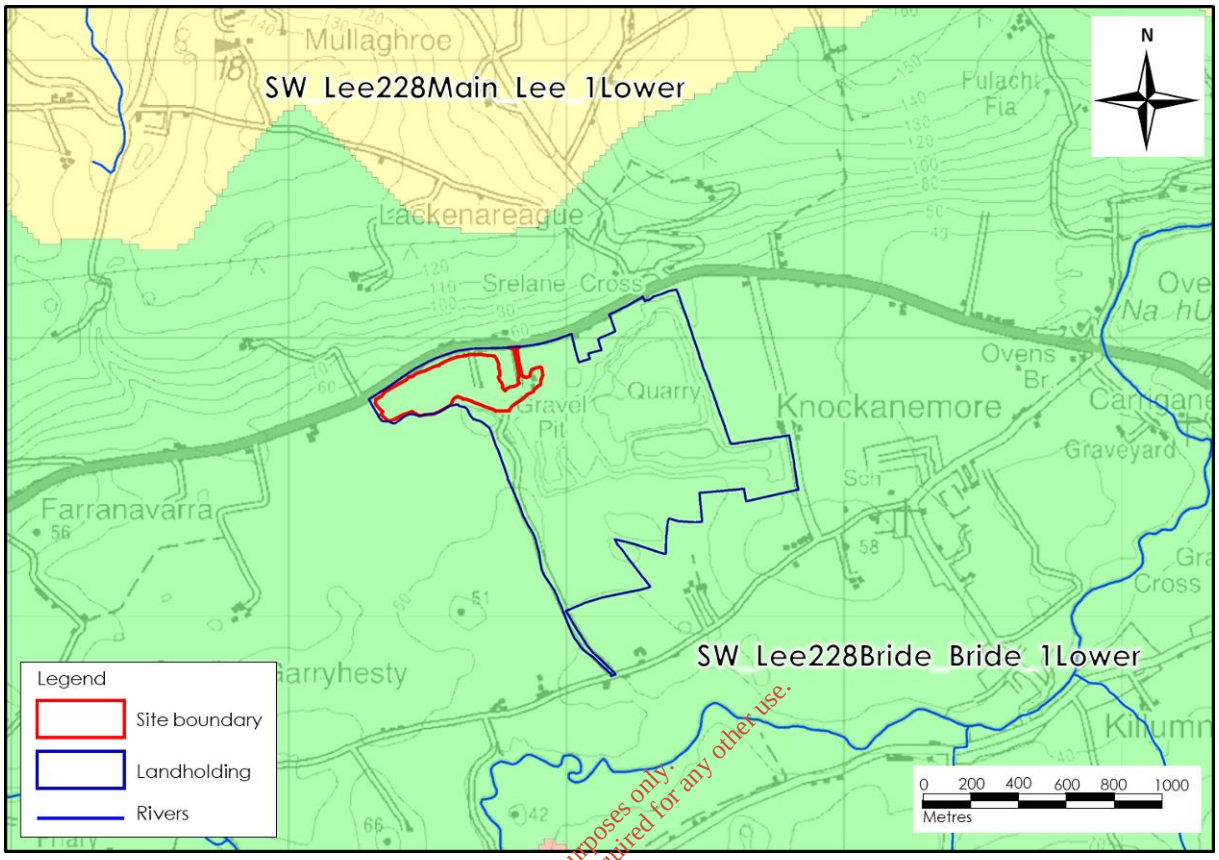


Figure B: Local Hydrology

2.2.2 Existing Site Drainage

Surface water features in the vicinity of the site include a stream and small man-made pond. The stream rises on high ground to the northwest of the site and then flows along the western and southern boundary of the application site (i.e. proposed infill area) prior to flowing into a small man-made pond which exists immediately to the southeast of the application site. A local drainage map is shown as **Figure C** below.

There is no visible surface water outfall from the pond and therefore all inflows to the pond via the stream appear to percolate down through the base of the pond into the underlying sand and gravels. The stream and pond appear to be perched on a layer of low permeability overburden (silts/clays) which overlies the sand and gravel deposits in this area. There are no pathways for runoff from the application site towards the stream or pond as there is an embankment present along the southern and western boundaries of the application site.

There is no existing stormwater drainage network at the site. Runoff from the existing roads, roofing and hardstanding areas percolates to ground nearby. The site has good natural drainage characteristic due to the area being underlain by sand and gravel.

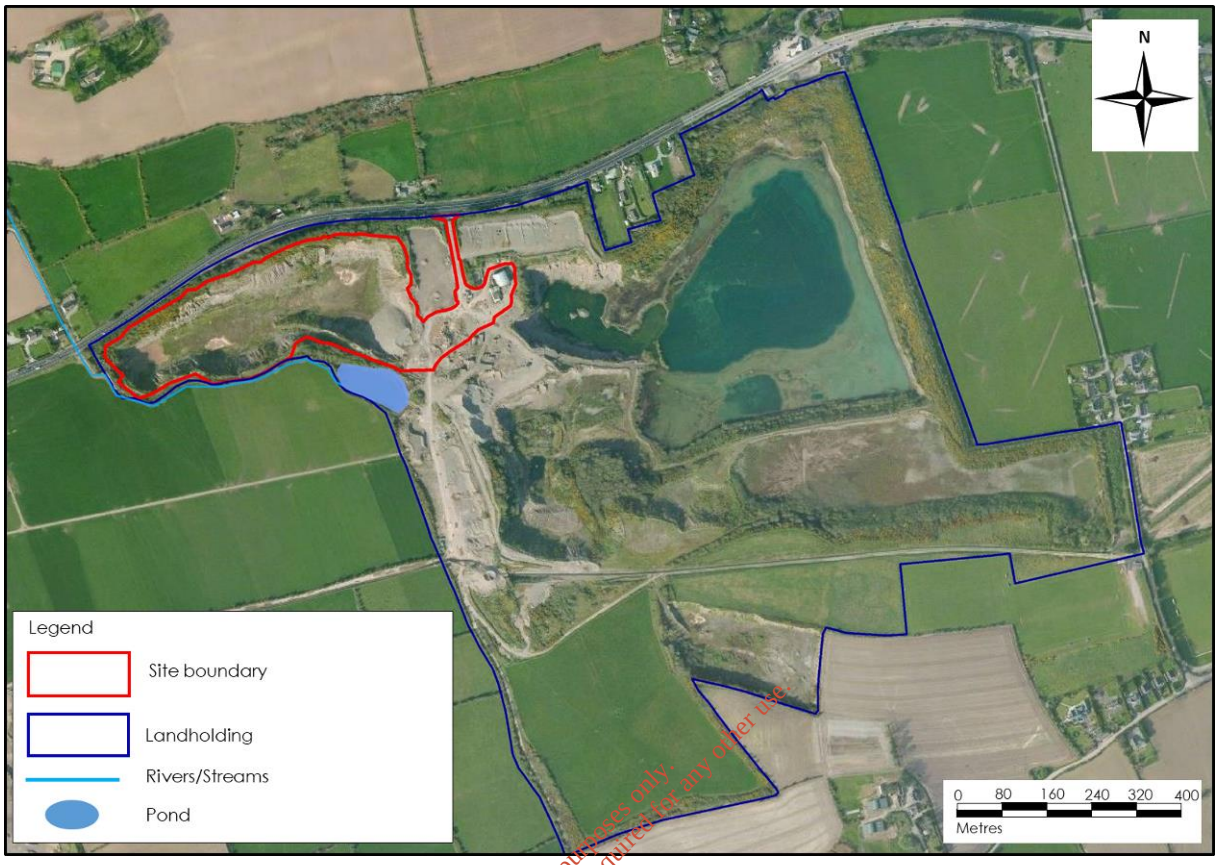


Figure C: Site Drainage Map

2.2.3 Rainfall

The SAAR (Standard Average Annual Rainfall) recorded at Inishcarra (Gen. stn), the closest rainfall station to the site (~12.5km to the northeast) with long term SAAR data, is 1,123mm (www.met.ie).

2.3 WFD SURFACE WATER BODY & STATUS

Local Surface water Body status and risk result are available from (www.catchments.ie).

The site is located, as classified by the water frame work directive, as being within the Bride (Lee)_050 surface water body, this SWB has been assigned (2010 – 2015) an overall status result of 'High Status', with an overall risk result of "Not At Risk".

2.4 LOCAL GEOLOGY

A brief review of the local geology is provided in this section in order to put the description of the local hydrogeological regime into perspective. Please refer to **Section 3** below for a detailed review of the site geology.

The published soils map (www.epa.ie) for the area shows that shallow well drained soils (AminSW) are mapped in the area of the site. The majority of soils within the site and the overall landholding have been removed to facilitate sand and gravel extraction.

The GSI subsoils map (www.gsi.ie) for the area shows that sands and gravels (Devonian) are mapped at the site and over much of the surrounding area.

Up to 30m depth of silty sand and gravels are exposed in the pit faces. The profile is dominated by alternating units of cross-bedded sands and rounded to sub-rounded, pebble to cobble sized gravels. Sand beds are up to 0.35m thick, and some silt beds of up to 80mm thick are also present.

Based on the GSI bedrock map of the area the application site is underlain by two separate bedrock formations. The southern half of the site is mapped to be underlain by Dinantian mudstones and sandstones while the northern half is mapped to be underlain by Devonian Old Red Sandstones (ORS). The remaining area of the overall landholding to the south of the site is mapped to be underlain by Dinantian pure unbedded limestones.

The GSI subsoil mapping and bedrock mapping is shown as **Figure D** and **Figure E** below.

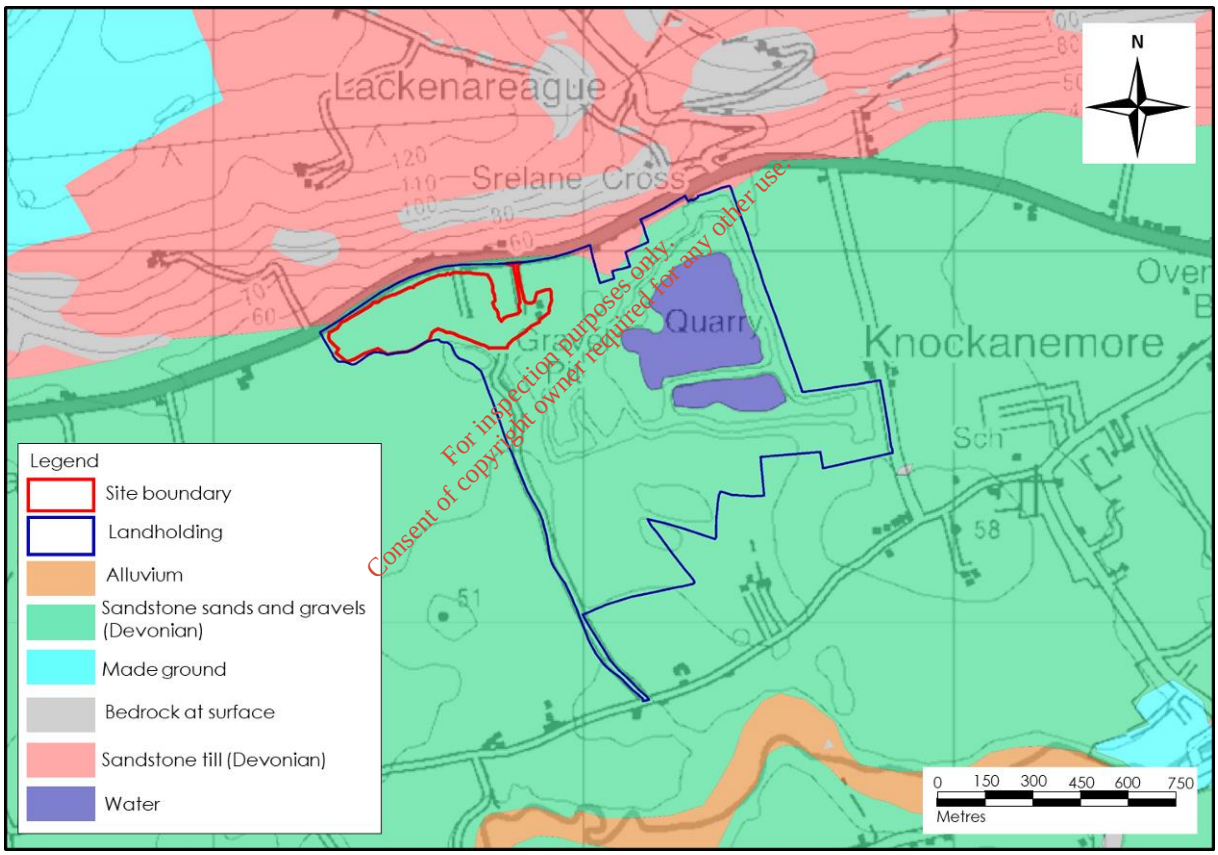


Figure D: GSI Mapped Subsoils

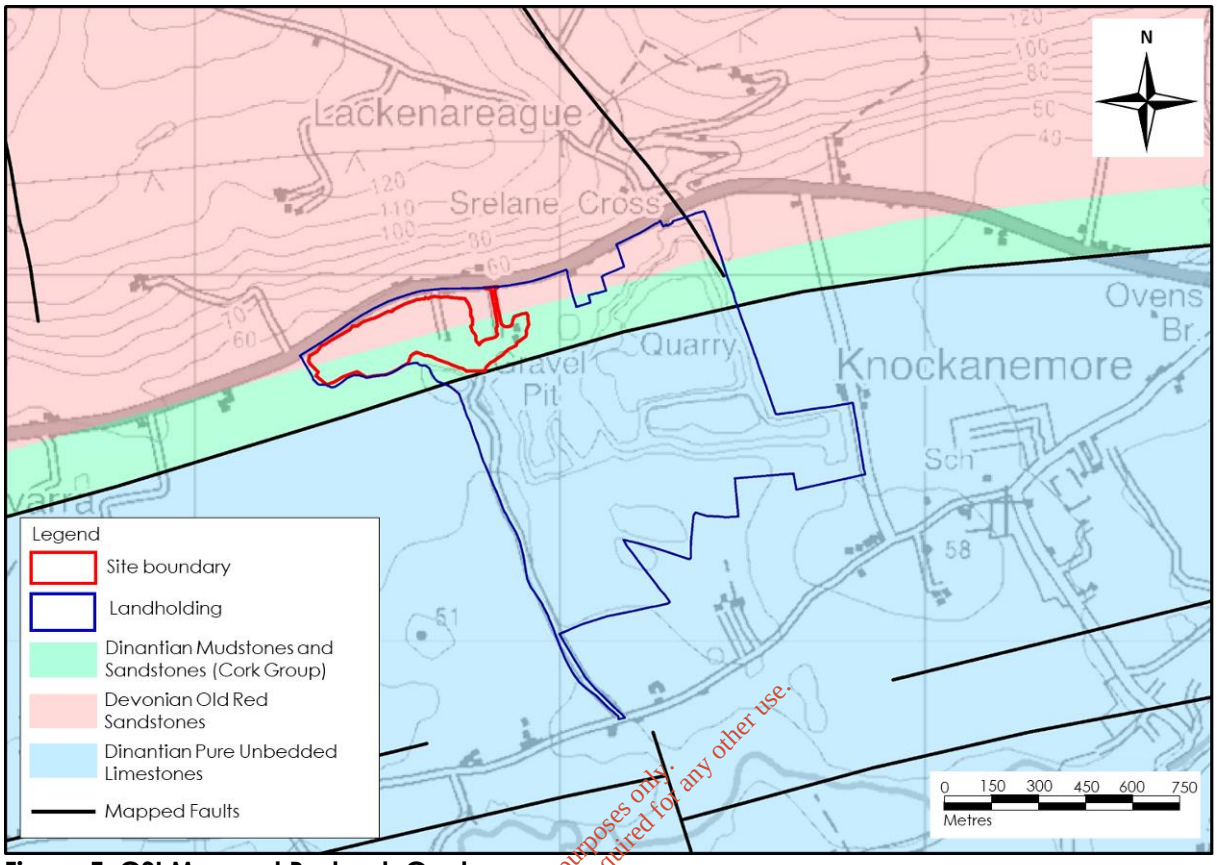


Figure E: GSI Mapped Bedrock Geology

2.5 LOCAL HYDROGEOLOGY

The Groundwater Body (GWB) in which the site is located is called the Ballincollig GWB. In the vicinity of the site the GWB comprises the following bedrock aquifer types:

- The Geological Survey of Ireland (GSI) has classified the pure unbedded limestones which are mapped to the south of the site, as a Regionally Important Karstified Aquifer (RKd). Faults and joints were enlarged by karstification as groundwater moved through the limestones (GSI, 2004); and,
- The mudstones and sandstones and Devonian Old Red Sandstones, which are mapped to underlie the application site itself, are mapped as a Locally Important Aquifer - Ll (bedrock which is moderately productive only in local zones).

The sand and gravel deposits which overlie the bedrock in this area are classified by the GSI as a Locally Important Gravel Aquifer (Lg). The total area of the gravel aquifer is a mapped at approximately ~10.3km^2. The gravel aquifer extends approximately 11km to the west of Ballincollig and has a width of up to 2km.

The GSI Ballincollig initial groundwater body characterisation report states that the permeability of the sand and gravel aquifer is in the order of 50m/day.

The sand and gravel aquifer is the main groundwater body receptor with respect this assessment and this aquifer is shown in **Figure F** below.

Site specific hydrogeological details are outlined in **Section 3** below.

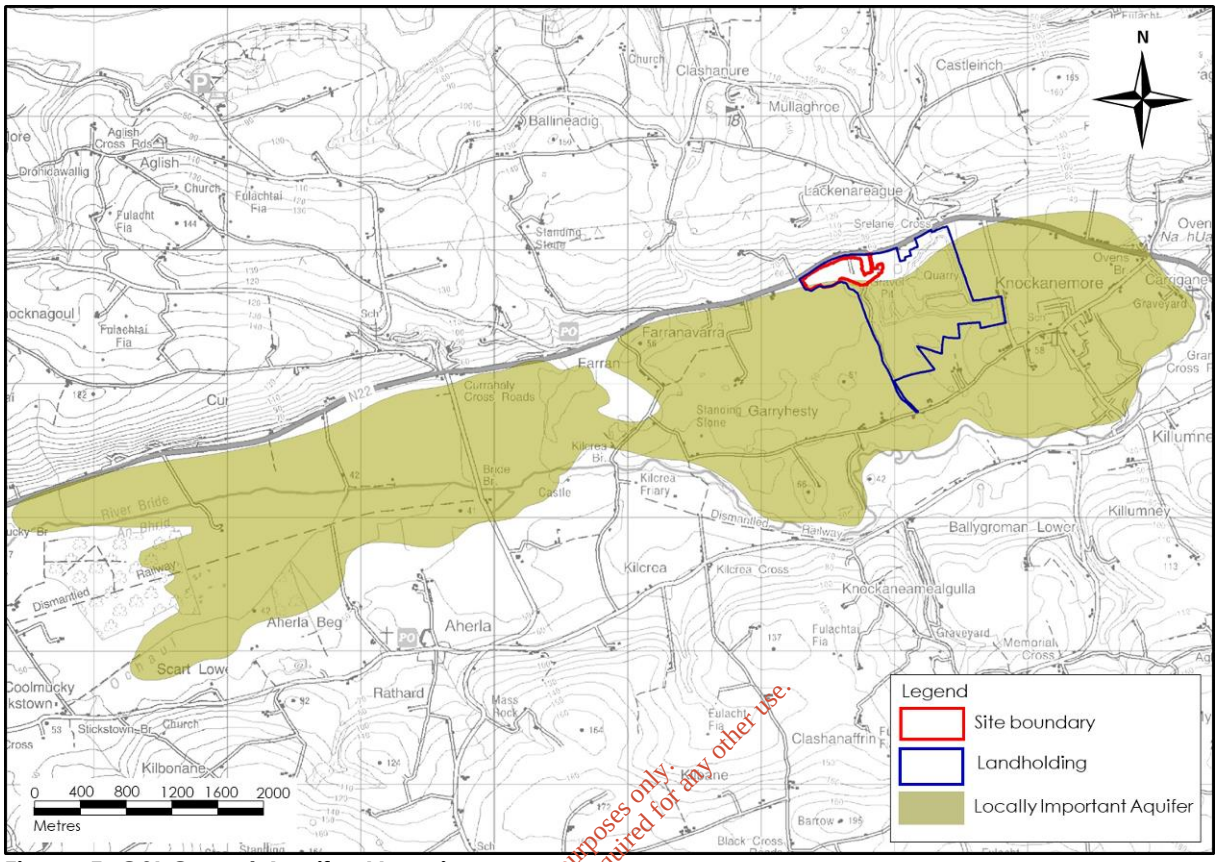


Figure F: GSI Gravel Aquifer Mapping

2.6 GROUNDWATER VULNERABILITY

Based on the GSI mapping, the site has a "High" groundwater vulnerability rating (see GSI hydrogeological conditions in **Figure G** below). The vulnerability rating for the site has not changed with the previous extraction (of sand and gravel) that has been completed, as there is still >3m of unsaturated material above the groundwater table.

The type and depth of unsaturated material above the groundwater table at the proposed discharge location is discussed in **Section 3** below.

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.

Figure G: GSI Groundwater Vulnerability Rating

2.7 GROUNDWATER RECHARGE

The GSI estimate the average groundwater recharge to be 654mm/year. This is for a hydrogeological setting of sand & gravels aquifer, overlain by well drained soil.

2.8 WFD GROUNDWATER BODY & STATUS

Local Groundwater Body status and risk result are available from (www.catchments.ie).

In terms of groundwater bodies (GWB), the proposed site is located within the Ballincollig GWB and this groundwater body has been assigned a Good Status. This groundwater body is reported to be "Not at Risk".

2.9 WATER RESOURCES

Based on the GSI mapping there are no groundwater protection zones for existing public water or group water schemes mapped within 7km of the proposed development site. The closest public supply to the site is the Coachford PWS (Public Water Supply) which exists approximately 7.5km to the northwest (up-gradient) of the site. The site is not located within the Zone of Contribution (ZOC) of this source. The Farran GWS (group water scheme) is located approximately 4.1km west-northwest of Garryhesta Quarry which is also up-gradient of the site.

According to the GSI private well database there is only 1 no. registered well within 500m of the proposed site and this well is located to the northeast (upgradient) of the site. GSI mapped wells with an accuracy of <50m are shown on **Figure H** below. This well is located on the valley side and therefore its groundwater catchment is likely to be elevated ground to the north of the well. There is likely to be no groundwater flow from the proposed side or proposed soakaway towards this source.

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 (300m of site boundary) was carried out on 27th January 2017. Only 1 no. private well was identified during the well survey and this is a farm which is located approximately 280m to the west (up-gradient) of the site.

The groundwater gradient (discussed below) is to the east. There are no private dwelling houses within 1.3km of the proposed soakaway to the east. Due to the fact that the lands to the east (as far as the N22) are used/or proposed for sand and gravel no future dwelling or wells are likely either.

Therefore, for the purposes of impact assessment (**Section 5** below) it is assumed that the closet private well is 1.3km downstream of the site. This location is used as a downstream Assessment Point (AP2) with respect the proposed discharge. This is discussed in **Section 5** below.

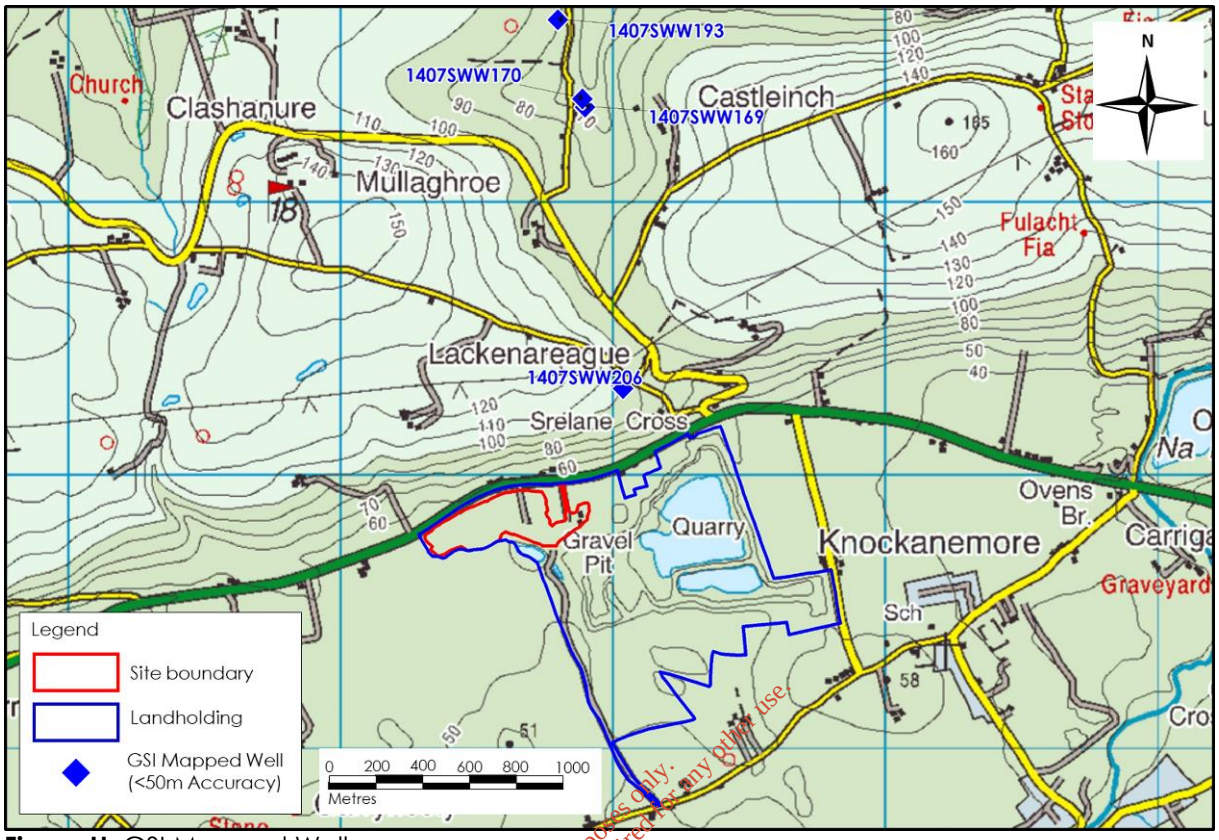


Figure H: GSI Mapped Wells

2.10 DESIGNATED SITES & GROUNDWATER DEPENDANT ECOSYSTEMS

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

The proposed development site is not located within any designated site (*i.e.* SAC, NHA, SPA etc). Cork Harbour SPA is located approximately 20km to the east of the proposed development site.

However, as there are no surface water outlets from the site, the indirect pathway is firstly via groundwater to the River Bride, and then via surface water to the downstream designated site.

There are no Groundwater Dependent Terrestrial Ecosystems (GWDTE) in the area of the proposed development.

3. FIELD DATA COLLECTION AND INTERPRETATION

3.1 WALKOVER SURVEY

Site walkover surveys were completed by David Broderick of Hydro-Environmental Services in January 2017 and in October 2019.

This involved a 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. As discussed above a private well survey was also completed.

3.2 TRIAL PITS

A total of 2 no. trial pits were excavated at the area of the proposed stormwater soakaway on 11th October 2019 to assess ground conditions.

A summary of the trial pit logs are shown in **Table A** below. The locations of the trial pits are shown in **Figure I** below.

Both trial pits intercepted firm, brown, sandy, very gravelly SILT/CLAY down to the maximum depth of the trial hole which was approximately 2.4m. No topsoil layer was encountered as it would have been removed during previous extraction workings. Both trial pits were dry with no evidence of water logging or mottling and the subsoil type would suggest good drainage.

Table A: Summary of Trial Pit Logs

Location	Total Depth (mbgl)*	Easting	Northing	Summary Subsoil Description
TP01	2.4	152910	69865	Sandy, very gravelly SILT/CLAY
TP02	2.4	152905	69843	Sandy, very gravelly SILT/CLAY

***mbgl – metres below ground level**

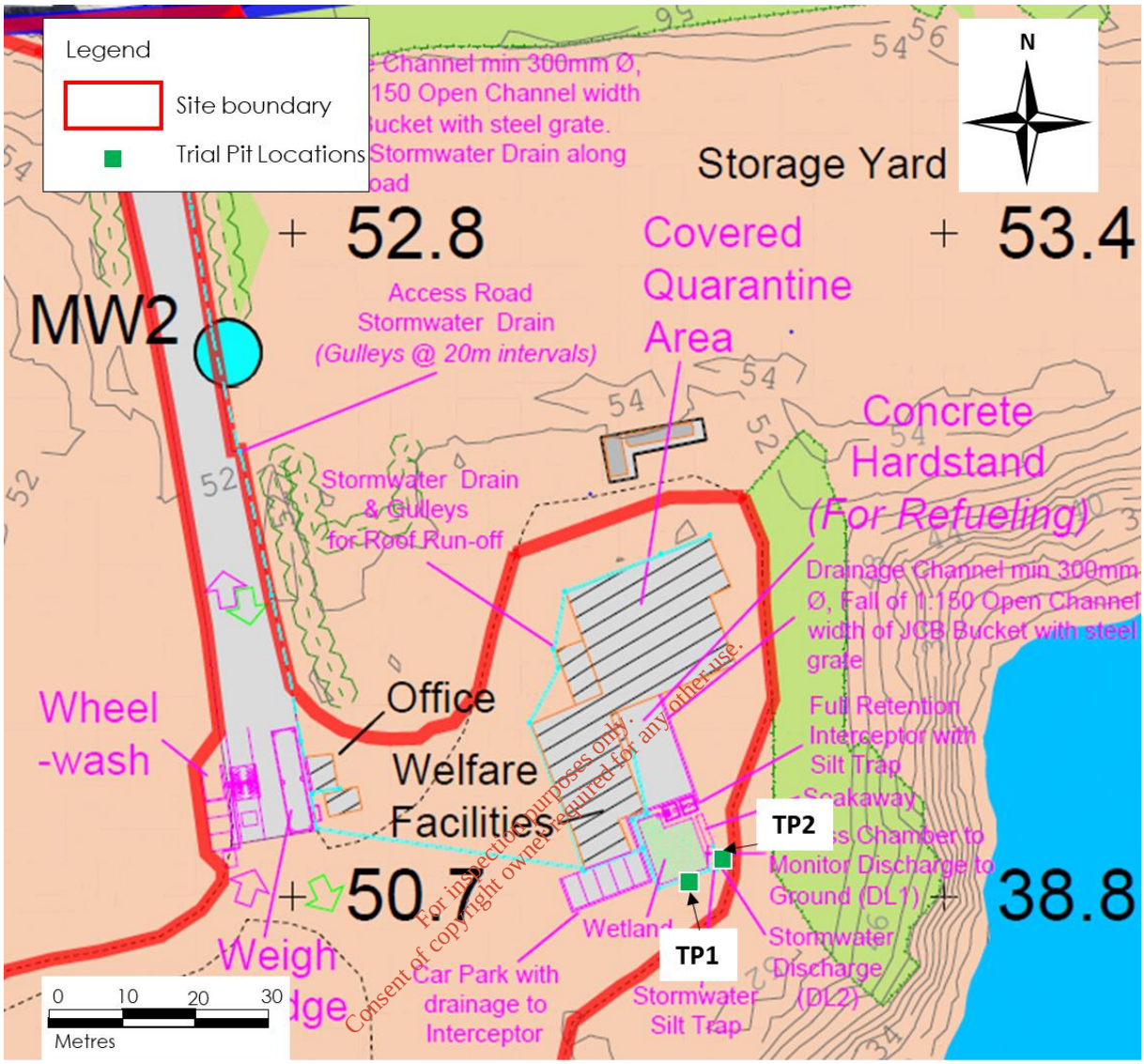


Figure I: Trial Pit Locations (in relation to proposed site layout)

3.3 INFILTRATION TEST

In order to demonstrate that the proposed discharge area has sufficient infiltration capacity to physically accept the treated stormwater and also to design the soakaway size, an Infiltration test, which carried out in accordance with BRE Digest 365, was undertaken on TP01. The infiltration test on TP02 was stopped as the hole collapsed during filing with water. However, the subsoil lithology in both trial holes was the same and a similar infiltration rate would be expected for each hole.

TP01 was filled to the required effective depth (water level) with clean water using a tanker. Water level monitoring was undertaken both manually (dip tape) and with the use of a datalogger which was installed in the trial hole for the duration of the infiltration test.

An infiltration test water level plot for TP01 is shown as **Figure J** below and infiltration calculation sheets are shown in **Appendix I.**

An infiltration rate of 3.9 x 10^{-4}m/s was calculated for TP01 which would be typical of the subsoil type (moderate permeability).

The proposed design of the soakaway based on the infiltration rate is detailed in **Section 4** below.

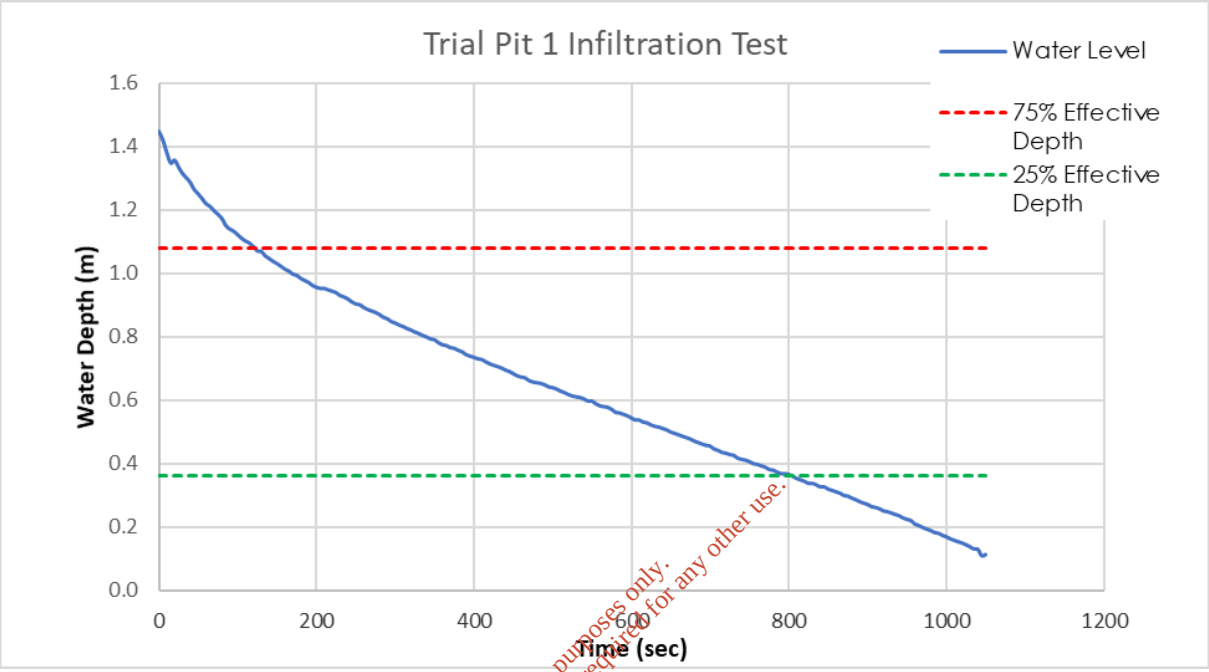


Figure J: Infiltration Test Plot

3.4 MONITORING WELL DRILLING

As part of the 2018 planning application/EIAR, monitoring well drilling at the site was completed by Southern Pumps Drilling between 11th and 25th October 2017 when 4 no. monitoring wells were installed at the site (MW1 – MW4). MW01 and MW02 are closest to the proposed soakaway area and are discussed below as they are expected to reflect the geology below the discharge area. The locations of the wells are shown in **Figure K** below. Monitoring well drilling logs are attached below as **Appendix II**.

MW01 is located approximately 250m to the southwest of the proposed soakaway area and MW02 is located approximately 100m to the northwest.

An upper layer of gravelly till (similar to that encountered at TP01 and TP02) comprising dark brown, gravelly, sandy SILT/CLAY was found to overlie the sands and gravels in the area of MW1 and MW2. The depth of the till was approximately 16m at MW01 and 7m at MW02. Given the slope of the ground to the south and the approximate location of the soakaway between the two wells, the total depth of the tills below the proposed soakaway area is likely to be somewhere between 10 and 12m.

The sand and gravel encountered below the tills could typically be described as brown, dense, silty, sandy GRAVEL. The gravel was fine to medium in size while the sand was mainly course. The sand and gravel was typically found to be a mixture of coarse sands and gravels/cobles of mainly sandstone and siltstone.

No bedrock was encountered in either MW01 or MW02 which were drilled to a maximum depth of 40.25 and 38.4 metres below ground level (mbgl) respectively. This is then taken as an accurate indication of the minimum depth of overburden (38-40m) below the proposed soakaway. Groundwater levels are discussed below.

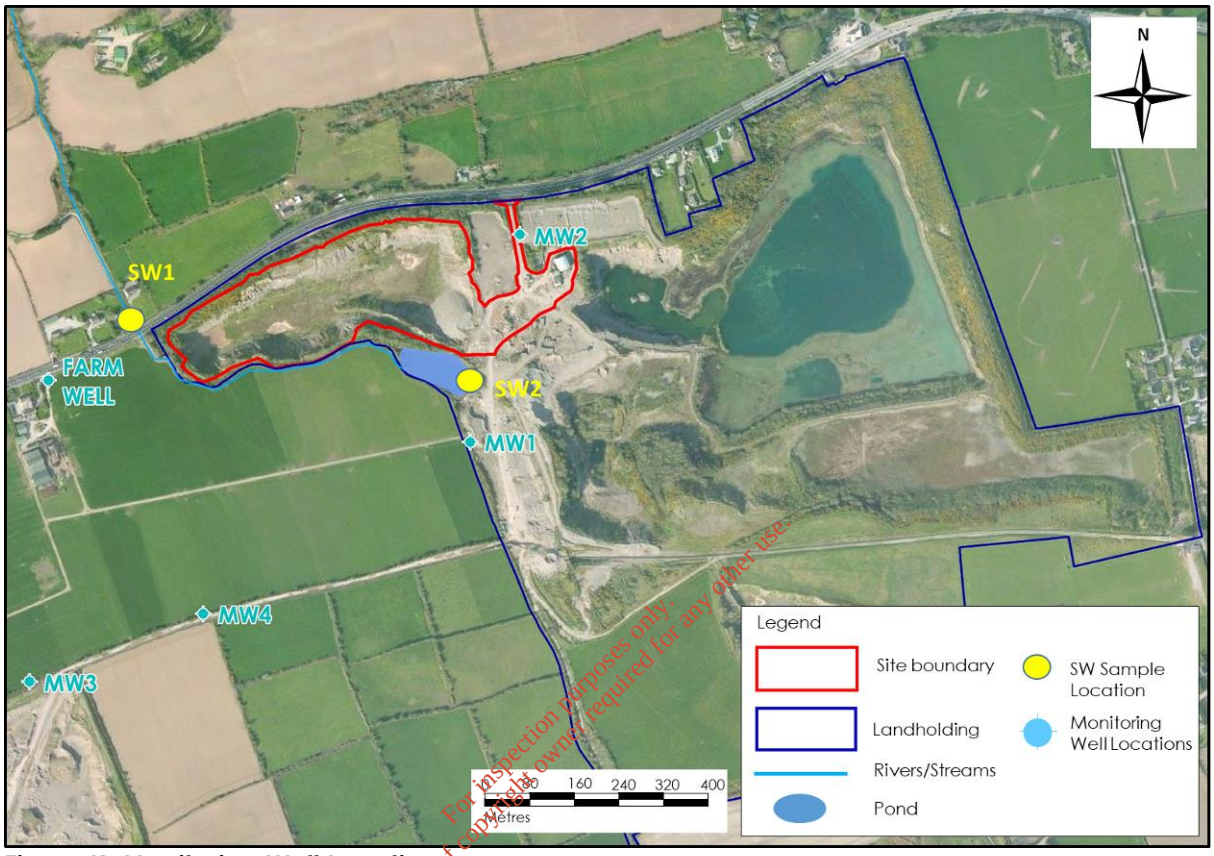


Figure K: Monitoring Well Locations

3.5 GROUNDWATER LEVELS & GRADIENTS

Groundwater level monitoring data for the on-site monitoring wells measured on 27th October 2017 and 11th October 2019 are shown in **Table B** below.

Groundwater levels at the site on 11th October 2019 varied between 27.802mbgl (23.824m OD) and 31.381mbgl (21.066m OD).

Based on the groundwater level elevations (mOD), the groundwater flow direction is down the valley in an easterly direction towards the River Bride as shown in **Figure L** below. The groundwater gradient at the site is calculated to be approximately 0.003.

Based on the measured groundwater levels and the gradient, the groundwater level below the proposed soakaway area is expected to be approximately 30mbgl which is a significant depth of unsaturated material above the groundwater table.

Table B: Monitoring well water levels

Location	27/10/2017		11/10/2019	
	Water Level (mbgl)	Water Level (m OD)	Water Level (mbgl)	Water Level (m OD)
MW01	28.372	22.709	28.572	22.509
MW02	31.161	21.286	31.381	21.066
MW03	27.622	24.004	27.802	23.824
MW04	28.505	23.587	28.685	23.407

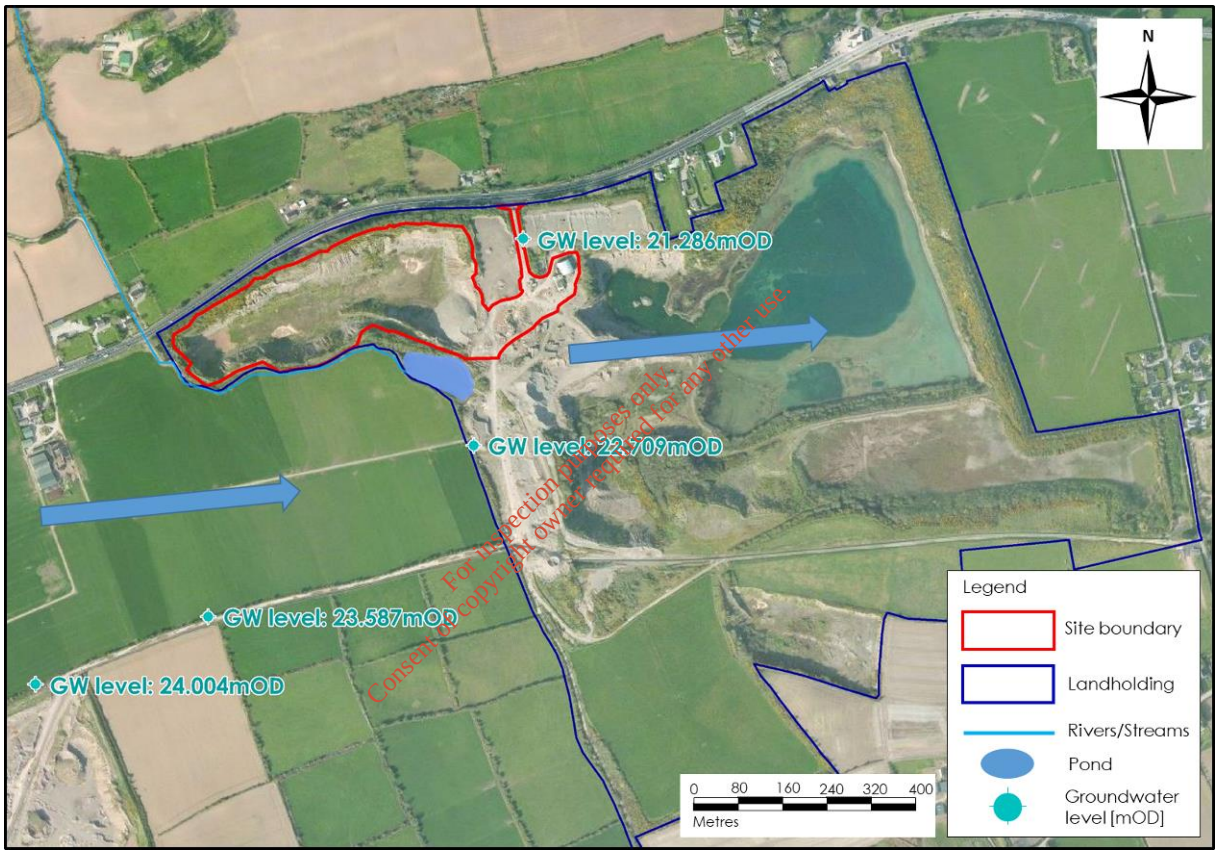


Figure L: Groundwater Levels and Flow Direction

3.6 GROUNDWATER QUALITY MONITORING

Groundwater quality monitoring was completed at the on-site monitoring wells (MW1-MW2) on 27th October 2017 for the purpose of the planning application and EIAR.

Original laboratory reports are attached as **Appendix III**.

The samples were tested for a full suite of parameters, most of which are not relevant to this assessment as the proposed discharge is stormwater runoff (rainfall). The parameter of relevance to this assessment is hydrocarbons. All results are discussed below regardless.

All metals (dissolved) were below the relevant groundwater threshold values with the exception of manganese in MW2 and this likely due to a variation in local geology or

groundwater flow from the bedrock on the valley side to the north of the well location. Manganese is a naturally occurring groundwater mineral and dissolves readily in groundwater where DO levels are low.

Nitrate is relatively elevated in MW2 and this is likely due agricultural practices such as fertiliser / slurry spreading on the lands surrounding the site. Ammonia is also slightly elevated in MW2 compared to the other wells and the only obvious local source is possibly private septic tanks / wastewater treatment units at houses to the north of the site (upslope).

All water samples recorded a BOD of less than 1mg/L which indicates an acceptable level of water quality.

There was no detection of hydrocarbons in MW01 or MW02 which are the wells closet to the proposed percolation area.

4. STORMWATER SYSTEM LAYOUT & DESIGN

4.1 OIL INTERCEPTOR DESIGN

The refuelling yard and car park that will be contributing runoff to the full retention oil interceptor have areas of 117m^2 and 63m^2 respectively. Using a design 100 -year 24-hour rainfall depth of 95.8mm, the peak flow will be in the order of 17.2m^3/day (0.2L/s). Only runoff from refuelling yard and car park will go through the oil interceptor. Runoff from the roofing and access road/entrance will go direct to the soakaway via a stormwater silt trap.

The proposed full retention oil interceptor model is a FR-NS-40-CC (Molloy Precast) which has a hydraulic capacity of 40L/s which is well in excess of the actual runoff requirement. The oil interceptor design detail is attached as **Appendix IV.**

The interceptor is required to achieve a maximum concentration of 5 mg/L of total hydrocarbons in the final discharge as per the EN858-2002 standard (separator system for light liquids). This hydrocarbon concentration will be the assumed chemical loading value (see **Section 5** below).

The oil interceptor will be discharged to ground via a soakaway pit which is detailed below. The proposed location of the oil interceptor is shown on the site layout drawing (**Figure 1** attached).

4.2 SOAKAWAY DESIGN

The soakaway is sized to accommodate runoff from the refuelling yard and car park (180m^2 in total), the site access road/entrance (1,700m^2) and the roofing of the covered quarantine area (772m^2) which is a total hardstand area of 2,652m^2. Using a 100 -year 24-hour rainfall depth, the peak flow will be approximately 254m^3/day (2.9L/s).

Based on a measured subsoil infiltration capacity of 3.9 x 10^{-4}m/s, the total hardstand area of 2,652m^2 and the 100-year 24-hour rainfall depth (95.8mm), a soakaway of the following dimension, 1m(W) x 1.5m (Effective Depth) x 4m (L) would be sufficient from a hydraulic design perspective. However, the proposed soakaway that will be installed at the discharge location will be oversized to 5m in length for conservative purposes.

The proposed location of the soakaway is shown on the site layout drawing (**Figure 1** attached).

The soakaway design calculations are shown in **Appendix V.**

5. HYDROGEOLOGICAL IMPACT ASSESSMENT

This section follows the general principles of a Tier 2 risk assessment which are rooted in the source-pathway receptor model of environmental risk assessment, as per EPA guidance (2011) and which result in a determination of risk and compliance of a discharge activity against relevant water quality standards and objectives.

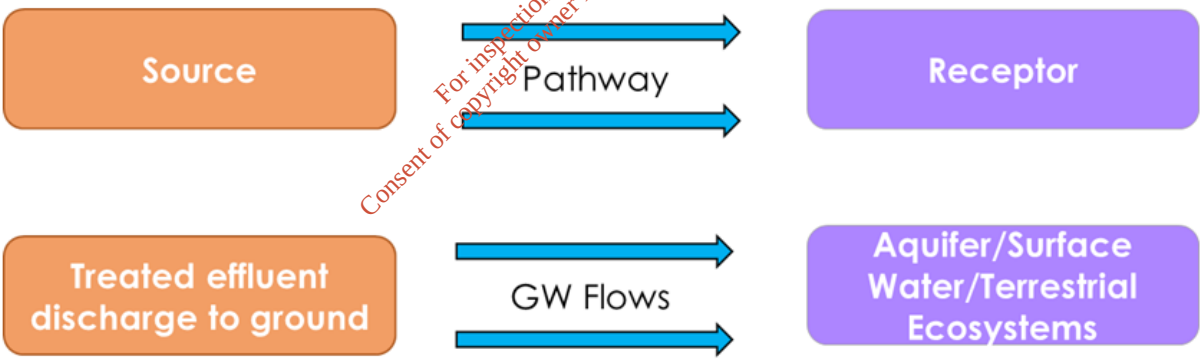
5.1 SOURCE – PATHWAY – RECEPTOR

The conventional source-pathway-target model (see below) for groundwater / surface water protection was applied to assess impacts on the groundwater body and downstream sensitive receptors such as potential wells and GWDTEs.

In the case of the subject site the primary source of impact is from discharge of treated stormwater from the soakaway whereby the primary potential hazard is leaching of residue levels of hydrocarbons to the local groundwater body causing a potential deterioration in groundwater quality.

The pathway in terms of groundwater flow paths is via the saturated sand and gravels which exists at depth below the soakaway.

The primary targets of concern is the underlying gravel aquifer, the River Bride and potential local wells (there are no GWDTEs present locally).



A Conceptual Site Model – hydrogeological schematic of the proposed discharge and associated risks, as discussed above, is attached as **Figure 2.**

Based on the identified groundwater flow paths, a detailed Tier 2 hydrogeological assessment was developed and carried out at the site.

Based on this site specific hydrogeological information, various assessments, as required under the regulations (Refer to **Section 1.3**), are completed below.

5.2 COMPLIANCE WITH EPA GUIDANCE ON DISCHARGE ASSESSMENT

EPA (2011) Guidance on the Authorisation of Discharges to Groundwater outlines the risk based approach and required level of field investigation required in the evaluation of a site's potential to accept a discharge of treated stormwater: This approach has been applied by HES in this case.
EPA (2011) Guidance on the Authorisation of Discharges to Groundwater States that "A technical assessment of a proposed discharge to groundwater activity has to address these basic questions (our responses are provided in bullet point format after each question):

1. ***What are the primary Source Pathway Risk factors associated with the site and discharge activity?***

    - **Source:** stormwater soakaway with hydrocarbon residues likely to be present in the final discharge.
    - **Pathway:** The pathway is vertical percolation down through approximately 30m of unsaturated overburden followed by lateral groundwater movement (to the east) via saturated sand and gravel deposits.
    - **Receptor:** Receptors within the site include the underlying sand and gravel aquifer with potential downstream receptors including local wells (the closet downstream dwelling is 1.3km and it is assumed a well is present) and the River Bride (approximately 2.2km downstream).

2. ***What is the probable risk and predicted impact to groundwater quality and associated receptors?***

    - Given the relative small surface area of the refuelling yard (and small loading volume), the appliance of best standard practice in terms of a full retention oil interceptor, the groundwater protection afforded by the large depth of unsaturation overburden (30m), the permeable nature of the deeper gravels from a dilution perspective and the large downstream distance to off-site receptors such as wells (1.3km) and the River Bride (2.2km), the probably risk and impact is Low. Impacts are addressed in **Section 5.4.**

3. ***What level of technical assessment is required to adequately define and verify risk factors?***

    - A 'Tier 2' level of assessment was carried for this site even though the EPA (2011) guidance states that "Tier 2 assessments generally cover moderate risk activities. A Tier 2 site assessment must demonstrate sufficient infiltration capacity and adequate attenuation potential. Tier 2 assessments also involve the prediction of an impact on groundwater quality using basic calculation procedures. A Tier 2 assessment also requires subsoil characterisation, and besides lithological information and establishing depths to bedrock, the subsoil characterisation should provide estimates of subsoil permeability which can subsequently be used to estimate (calculate) infiltration capacity. All of the above have been completed in this report.

4. ***Is the site hydraulically suitable for effluent disposal?***

    - As assessed in **Section 3.3** and **Section 4.2** above, the presence of moderate permeability subsoils at the proposed discharge means a more than adequately sized soakaway can be installed to accommodate discharge from the oil interceptor and the other hardstand areas.

5. ***Does the site provide for adequate attenuation of pollutants?***

    - The site provides ample opportunity for attenuation of pollutants. The attenuation of pollutants is assessed in **Section 5.4** below.

6. ***What hydraulic and chemical loading may be acceptable such that groundwater quality objectives are not contravened, and harmful effects to human health or the status of aquatic or terrestrial ecosystems are avoided?***

    - The loadings and concentrations of the proposed discharge are presented in **Sections 5.3** below.

7. ***How should a source and groundwater monitoring system be designed and implemented to verify that the impact to groundwater quality and receptors is either negligible or acceptable?***

    - Regular monitoring of the performance of the oil interceptor will be sufficient to ensure groundwater quality effects are negligible.

The required impact assessments are presented below.

5.3 STORMWATER AND ENVIRONMENTAL LOADINGS

The total volumetric loading to the groundwater system is based on a combination of output from the oil interceptor (i.e. refuelling yard and car park runoff) and also "clean" surface water runoff from roofing and the site access road and entrance (it's assumed no hydrocarbons will be present in this runoff water). The initial chemical loading (i.e. hydrocarbons residues) is based on discharge from the oil interceptor only (i.e. 5mg/L).

The mixing of the "clean" surface water runoff with the treated water from the oil interceptor means any potential hydrocarbons residues in the oil interceptor discharge will be diluted down prior to being released to ground via the soakaway.

For environmental impact assessment purposes (i.e. groundwater quality), the volumetric loading is based on long term rainfall averages for the wettest month rather than a once off 100-year rainfall event. Based on the 30-year averages for Inishcarra, the wettest month is October where the monthly average is 129mm which works out as a daily average of 4.2mm/day. Based on the hardstand area of the refuelling yard and car park (180m^2), the average daily discharge to the soakaway is calculated to be 0.75m^3/day during the wettest month.

Based on a road hardstand/roofed area of 2,472m^2, the "clean" surface water runoff component being released to the soakaway is 10.4m^3/day during the wettest month.

Therefore, this is a dilution factor of approximately 14 fold when the discharge from the oil interceptor is mixed with the "clean" surface water runoff.

Based on maximum hydrocarbon concentration 5 mg/L in the oil interceptor discharge, the final concentration of the hydrocarbons in the water being released would be approximately 0.36mg/L after mixing with the "clean" surface water runoff. The total volume being released (clean + oil interceptor water) would be 11.15m^3/day.

Prior to release into the soakaway it is then proposed to pass the discharge through a constructed wetland for further treatment (hydrocarbon removal) where concentrations can be reduced by between 50 and 85% (EPA 2006)[2]. Using an average value of 65% reduction, the above hydrocarbon concentration from the proposed interceptor (0.36mg/L) will be reduced to 0.126mg/L when discharged to the soakaway. The proposed location of the constructed wetland is shown on the site layout drawing (**Figure 1** attached).

The constructed wetland will be designed to have a retention time of 48 hours (17.2m^3/day/24 x 48 = 34.5m^3) (Refer to Figure 1).

After release into the soakaway, the effluent must percolate down through some 30m of unsaturated overburden which will treat the effluent and reduce further the hydrocarbons concentrations.

EPA (2006) states that for a 3m depth of unsaturated overburden, hydrocarbons reductions of between 70 and 90% can be achieved. There by applying an average reduction of 80% to the post wetland effluent hydrocarbon concentration (i.e. 0.126mg/L), a hydrocarbon concentration of at least 0.025mg/L will be achieved before it reaches the groundwater table below the site. This value can be taken as very conservative, as some 30m of unsaturated overburden exists below the soakaway location rather than just 3m.

5.4 RESULTANT GROUNDWATER CONCENTRATIONS

The risk of deterioration in the quality of groundwater from hydrocarbon residues was assessed by calculation based on adopting EPA (2011) Guidance on the Authorisation of Discharges to Groundwater. Effluent flow rate, groundwater flow rate, background groundwater concentrations and the concentrations in the final effluent are simulation inputs.

$$Cgw = [(Cin \times Qin) + (Cgwu \times Qgw)]/(Qin + Qgw)$$

Where,

Cgw = resulting concentration in downstream groundwater after mixing (mg/L)
Cin = concentration in the effluent water (0.025mg/L)
Qin = volumetric rate of effluent water (11.15m^3/day)
Qgwu = concentration in the aquifer from upgradient areas (Zero mg/L)
Qgw = groundwater flow rate through the sand and aquifer (30m^3/day – see below)

The groundwater flow rate through the sand and gravel aquifer is estimated using the GSI reported permeability of the aquifer which is 50m/day (5.79 x 10^{-4}m/s), the measured groundwater gradient of 0.003 and an estimated groundwater mixing zone width and depth of 20m and 10m respectively downstream of the proposed discharge location. This results in a groundwater flow/flux of 30m^3/day below the soakaway discharge point.

Therefore, based on the above criteria and equation the resultant hydrocarbon concentration immediately downstream of the proposed soakaway discharge point after mixing is calculated to be ~0.007mg/L.

To estimate the hydrocarbon concentration at a further downstream Assessment Point – AP1 (we have taken this to be the eastern boundary of the quarry landholding which is 580m downstream of the soakaway location, refer to **Figure 2**), the groundwater mixing zone width

[2] *Impact Assessment of Highway Drainage on Surface Water Quality – 2000-MS-13-M2 – Main Report ERTD 149 (EPA, 2006)*

(20m) is extended to the eastern boundary which is a plan area of 11,600m^2 (20m x 580m). Further dilution of residual hydrocarbons will occur at this point due recharge of rainfall (reduction in hydrocarbon concentrations will also occur due to groundwater mixing itself, but due to the mathematical complexity of this mixing and the lack of data downstream of the site this has not being allowed for, therefore the below estimated hydrocarbon concentration at eastern boundary will be very conservative indeed).

The rainfall recharge (654mm/yr) occurring within the mixing zone footprint area (upstream of eastern boundary) is calculated to be 0.654m/year/365=0.0018m/day x 11,600m= 20.8m^3/day.

Therefore, when mixing of the groundwater flow/flux of 30m^3/day (with a conservative hydrocarbon concentration of 0.007mg/L) and the recharge rainfall, the resultant conservative concentration at the downstream eastern boundary (AP1) is calculated (using the above equation) to be 0.004mg/L.

A further downstream Assessment Point (AP2) is assessed at the closest downstream private dwelling which is located on the N22 approximately 1.3km downstream of the soakaway (refer to **Figure 2**). For assessment purposes it is assumed that a groundwater well is located at this dwelling (but not confirmed).

As stated above, there are no private dwelling houses within 1.3km of the proposed soakaway to the east. Due to the fact that the lands to the east (as far as the N22) are used/or proposed for sand and gravel no future dwelling or wells are likely either.

By extending the mixing zone to this point (AP2) the footprint area available for recharge increases to 26,000m^2 (20m x 1300m). The total recharge volume amounts to 46.6m^3/day. Therefore, when mixing of the groundwater flow/flux of 30m^3/day (with a conservative hydrocarbon concentration of 0.004mg/L in the groundwater) and the recharge rainfall, the resultant concentration is 0.002mg/L. Again, no groundwater mixing is allowed for, therefore the actual value is likely to be significantly lower.

5.5 COMPLIANCE WITH GROUNDWATER QUALITY STANDARDS

The key legislative standards with respect groundwater quality are the Groundwater Regulations (S.I. No. 2010) and the Drinking Water Regulations (S.I. No. 122 of 2014). However, there is no threshold value provided for total hydrocarbons in these standards. The EPA Interim Guideline Value (IGV) is 0.01mg/L.

The conservative calculations carried out above for the three groundwater assessment points, Discharge Point, AP1 and AP2, shown that concentrations of hydrocarbons in the groundwater downstream of the discharge point will comply with the IGV.

5.6 CULMULATIVE IMPACTS

With respect to the requirement to consider Cumulative Impacts (Section 3.7, EPA, 2011), there are no other significant stormwater discharges in the area. As such cumulative impacts are considered to be negligible.

5.7 IMPACT ON SURFACE WATER QUALITY

The closet downstream surface water body is the River Bride which exists 2.2km downstream of the site. As demonstrated above, negligible groundwater quality effects are expected downstream of the discharge point.

5.8 REQUIRED SEPARATION DISTANCES

The closet potential downstream well is 1.3km or greater. Therefore, all required separation distances are adhered to.

5.9 MONITORING

Due to the very conservative nature of this assessment and the very low level of expected impacts, regular monitoring of the performance of the oil interceptor will be sufficient to ensure groundwater quality effects are negligible.

6. CONCLUSIONS

- The hydrogeological assessment relates to the proposed indirect discharge of treated stormwater runoff to ground via a full retention oil interceptor;
- A Tier 2 Hydrogeological Assessment is presented in this report and demonstrates the site geology and hydraulic capacity of local subsoils to receive the proposed discharge. An assessment of likely resulting groundwater quality is completed also;
- From a design and site suitability assessment perspective (discharge acceptance), the peak loading will be approximately 254m^3/day (100 -year 24-hour storm event);
- Infiltration tests and the follow on soakaway design demonstrate that the site is capable of hydraulically accepting the proposed discharge;
- For environmental impact assessment purposes, the volumetric loading is based on long term rainfall averages for the wettest month rather than a once off 100-year rainfall event. An average volumetric loading of 11.15m^3/day is taken to reflect the wettest month;
- A very conservative assessment with respect groundwater quality impacts was carried out and this indicates that negligible groundwater quality effects downstream of the proposed discharge point will occur, with all values being compliant with the EPA IGV for hydrocarbons; and,
- Due to the very conservative nature of this assessment, the relatively low loading rate and the very low level of expected impacts, regular monitoring of the performance of the oil interceptor will be sufficient to ensure groundwater quality effects are negligible.

****

7. REFERNECES

Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities (DoEHLG, 2009).

EPA (2006) Impact Assessment of Highway Drainage on Surface Water Quality – 2000-MS-13-M2 – Main Report ERTD 149.

European Communities (Quality of Salmonid Waters) regulations, S.I. No 84 of 1988.

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

Local Government (Water Pollution) Act, 1977.

Local Government (Water Pollution) Regulations, 1978.

Local Authority Services National Training Scheme Group (2011) - Guidance, Procedures and Training on Licensing of Discharges to Surface Waters and to Sewers.

Local Authority Services National Training Scheme Group (WSTG) - Discharge to Surface Waters, Guidance to the Applicant (August, 2011)

DoELG, EPA, and GSI (1999). Groundwater Protection Schemes. Department of the Environment and Local Government (DOELG), Environmental Protection Agency (EPA) and the Geological Survey of Ireland (GSI).

EPA (2010). Classification of Hazardous and non-hazardous substances in groundwater. Dr. Matthew Craig, Hydrometric and Groundwater Section, Aquatic Environment, Office of Environmental Assessment. Environmental Protection Agency, Wexford, Ireland.

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

European Community Directive 2006/118/EC of the European Parliament and the Council of 12 December 2006 of the Protection of Groundwater against Pollution and Deterioration.

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

Geological Survey of Ireland (2008b) Interactive Groundwater Maps www.gsi.ie

FIGURES

SITE NOTICE LOCATION

Drainage Channel min 300mm Ø, Fall of 1:150 Open Channel width of JCB Bucket with steel grate. Drain to Stormwater Drain along access road

57.5

52.8

Storage Yard

53.4

MW2

Access Road Stormwater Drain *(Gulleys @ 20m intervals)*

Covered Quarantine Area

Concrete Hardstand *(For Refueling)*

Stormwater Drain & Gulleys for Roof Run-off

Drainage Channel min 300mm Ø, Fall of 1:150 Open Channel width of JCB Bucket with steel grate

Full Retention Interceptor with Silt Trap

Soakaway

Access Chamber to Monitor Discharge to Ground (DL1)

Stormwater Discharge (DL2)

Wetland

Stormwater Silt Trap

Car Park with drainage to Interceptor

Wheel -wash

Office

Welfare Facilities

Weigh -bridge

Temporary 4m x 8m sump to allow recharge of rainwater to ground. Relocate as necessary.

40.0

50.7

38.8

Skips for removal of deleterious material associated with Backfilling. Relocate as necessary.

Quarry Processing Area

Legend

- Applicants Ownership
- Application Area (c. 7.9 ha)
- Pit Area
- Scrubland
- Agricultural Land
- Rough Pasture
- Restored Silt Beds
- Final Profile of lands to be restored using imported inert Soil & Stones.
- Concrete Surface
- Track
- Quarry Stockpiles
- Ponds
- Recolonisation of Shallow Ponds
- Residential Property *(within 250m)*
- Buildings/Structures
- Backfill Phasing
- Contours *(mAOD)*
- 40.0 Spot Levels *(mAOD)*
- Irish Transverse Mercator (ITM) geographic coordinates
- 5m Buffer Strip to Surface Water Course
- Direct Surface Water Runoff to Temporary Sump
- Traffic In
- Traffic Out
- Hedgerow
- Fence
- Gate
- D1 Dust Monitoring Points
- N1 Noise Monitoring Points
- MW1 Groundwater Monitoring Points
- SW1 Surface Water Monitoring Points
- 21.7 Water Level *(mAOD)* on 27/01/2017

Monitoring Point	ITM		Irish National Grid	
	Easting	Northing	Easting	Northing
Discharge Point				
DL1	552864	569906	152903	69844
DL2	552865	569906	152904	69843

Map Series:
==========
1:5000

6424
REVISION DATE = 27-Mar-2015
SURVEY DATE = 31-Jul-2000

6379
REVISION DATE = 27-Mar-2015
SURVEY DATE = 31-Jul-2000

Projection:
==========
ITM

Figure 1

Scale 1:1,000

0m 20m 40m

NOTES:

1. All Dimensions in metres (m)
2. Elevation Levels - metres Above Ordnance Datum (mAOD)
3. For Planning Purposes Only. Do not scale for setting out.
4. Survey derived from point-cloud survey (03/2016)
5. Waste Management Infrastructure to be provided shown in purple

JSPE
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J SHEILS PLANNING & ENVIRONMENTAL LTD

CLIENT	Roadstone Ltd
DRAWING	Site Layout - Infrastructure
LOCATION	Garryhesta Pit, Knockenamore, Ovens, Co. Cork

Drawn by	John Sheils	Scale	1: 1,000
Checked by	John Sheils	Job No.	JSPE 255
Date	31/10/19	Figure No.	D13
		Rev.	02

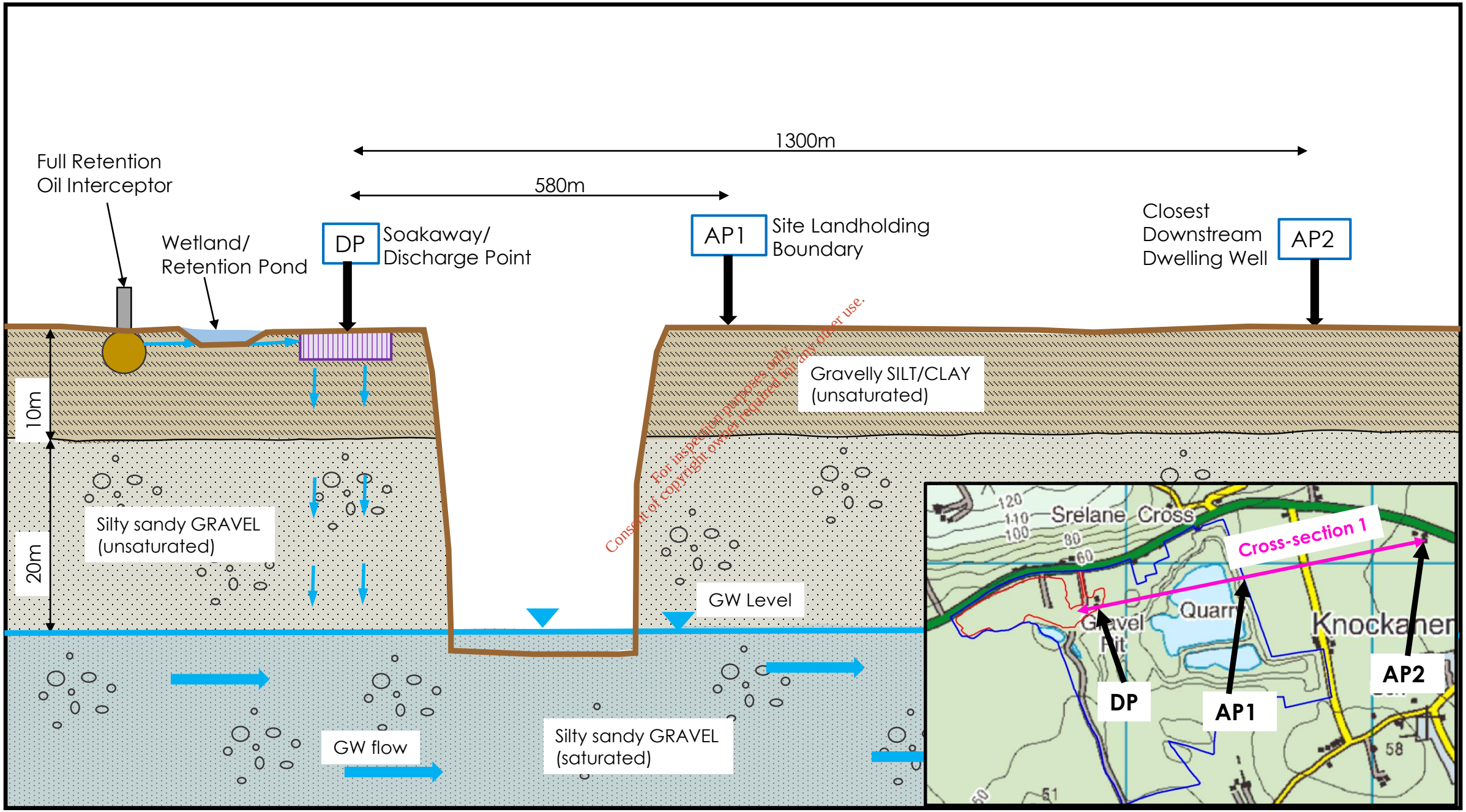


Figure 2: Hydrogeological CSM of Garyhesta

APPENDIX I: BRE365 INFILTRATION CALCULATION SHEET

Project: Roadstone, Garyhesta, Co. Cork
Appendix I: BRE365 Infiltration Test Sheet

q = soil infiltration rate

$q = V_{p75-25}/a_{p50} \times t_{p75-25}$

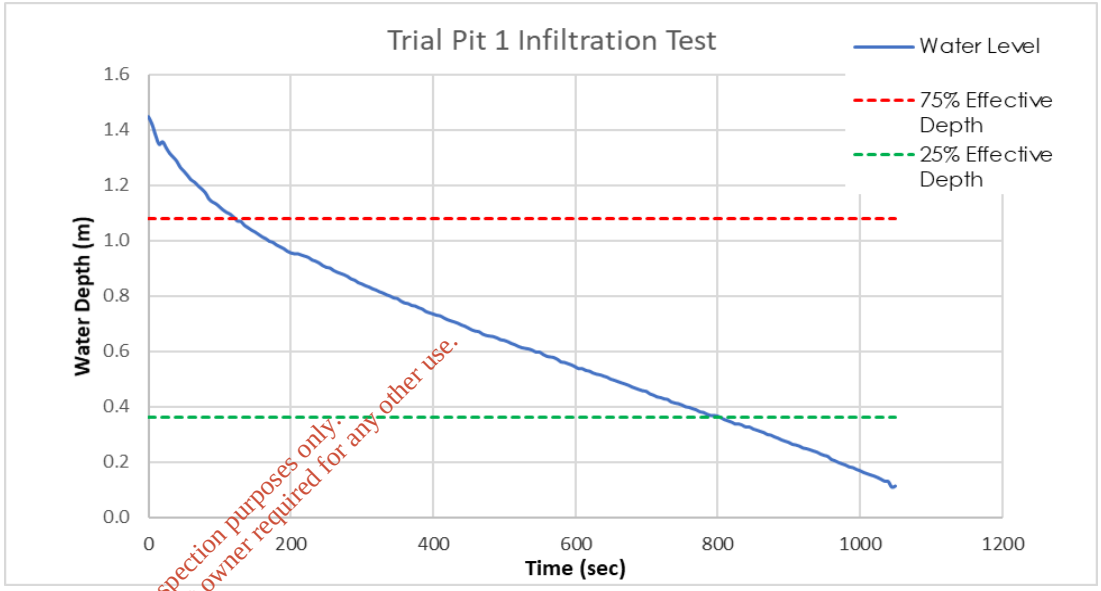
Test Pit Dimensions

Test Hole		Length	Width	Max Eff Depth
TP01		2.8	1.2	1.45

Formula	**Data**		
t_{p75-25}	11.5	mins	*(From graph)*
V_{p75-25}	2.436	m^3	*(From above)*
a_{p50}	9.16	m^2	*(From above)*

Final Result

q	3.9E-04	m/s



APPENDIX II: MONITORING WELL DRILLING LOGS

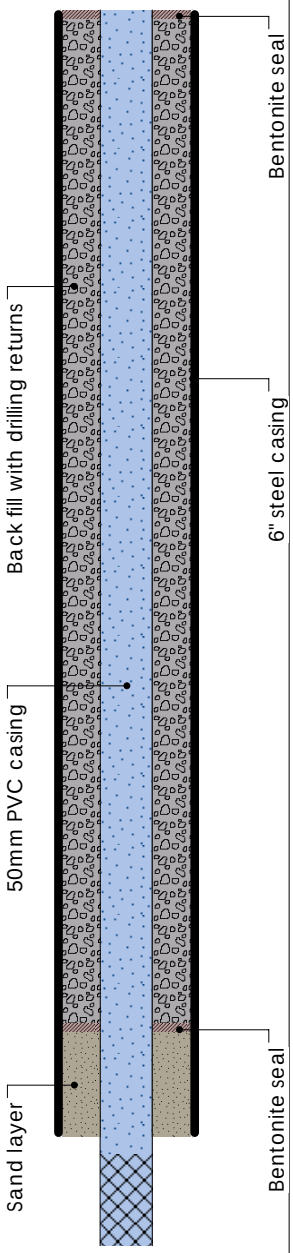
MONITORING WELL DRILLING LOG

WELL NUMBER: MW1

PROJECT NUMBER: P1380-1
SITE: Garryhesta Quarry, Co. Cork
CLIENT: Roadstone Ltd.
DRILLING CONTRACTOR: Southern Pumps Ltd.

DATE STARTED: 10/10/2017
DATE FINISHED: 11/10/2017
LOGGED BY: Brian Coffey (HES)
FLUSH: Air Rotary

EASTING: 552717
NORTHING: 569673
ELEVATION: 51.081mOD



Flush Colour	H2O Inject.	Water Strikes	Fractures	Airlift Q (gal/hr)	Comments	Elevation	Meters Below Ground Surface	Lithology	Formation Description
						51.08	0		Ground Surface
									Dark brown, slightly gravelly, sandy SILT/CLAY
							5		
							10		
							15		
						35.08			Brown, dense, silty sandy GRAVEL (notes:fine to medium gravel, coarse sand, sub-rounded to sub-angular gravel comprising mainly sandstone and siltstone)
							20		
							25		
							30		
							35		
						10.83	40		E.O.H. 40.25mbgl
						9.08			

REMARKS:

Casing (datum) elevation = 51.789mOD
Groundwater level on 27/10/17 - 22.709mOD

PAGE 1 of 1

SCALE As shown

HYDRO-ENVIRONMENTAL SERVICES 22 Lower Main Street Dungarvan Co. Waterford Tel: 058-44122 Fax: 058-44244 Email: info@hydroenvironmental.ie

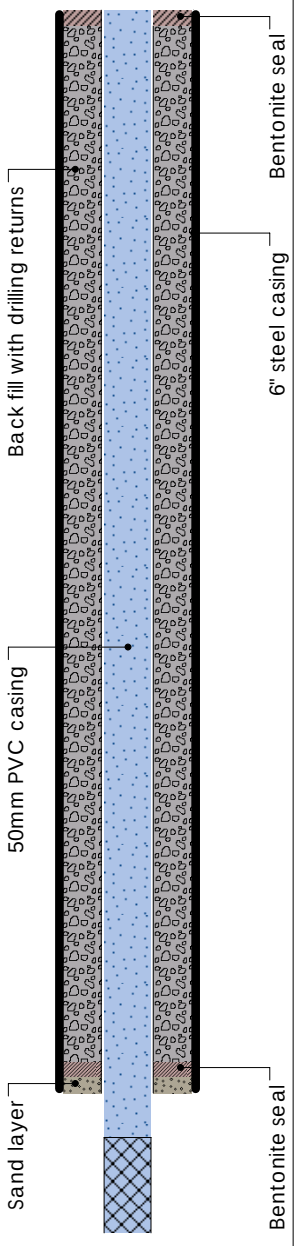
MONITORING WELL DRILLING

WELL NUMBER: MW2

PROJECT NUMBER: P1380-1
SITE: Garryhesta Quarry, Co. Cork
CLIENT: Roadstone Ltd.
DRILLING CONTRACTOR: Southern Pumps Ltd.

DATE STARTED: 11/10/2017
DATE FINISHED: 12/10/2017
LOGGED BY: Brian Coffey (HES)
FLUSH: Air rotary

EASTING: 552790
NORTHING: 569982
ELEVATION: 52.447mOD



Flush Colour	H2O Inject.	Water Strikes	Fractures	Airlift Q (gal/hr)	Comments	Elevation	Meters Below Ground Surface	Lithology	Formation Description
						52.45	0		Ground Surface
									Dark brown, slightly gravelly, sandy SILT/CLAY
						45.45	5		
							10		Brown, dense, silty sandy GRAVEL (notes: Fine to coarse gravel, coarse sand, sub-rounded to sub-angular gravel comprising mainly sandstone and siltstone)
							15		
							20		
							25		
						22.45	30		Brown, very dense, silty, sandy GRAVEL (notes: sub-description as above).
							35		
						14.05			E.O.H. 38.4mbgl
						11.95	40		

REMARKS:

Casing (datum) elevation = 53.286mOD
Groundwater level on 27/10/17 - 21.286mOD

PAGE 1 of 1

SCALE As shown

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MONITORING WELL DRILLING LOG

WELL NUMBER: MW3

PROJECT NUMBER: P1380-1
SITE: Garryhesta Quarry, Co. Cork
CLIENT: Roadstone Ltd.
DRILLING CONTRACTOR: Southern Pumps Ltd.

DATE STARTED: 12/10/2017
DATE FINISHED: 13/10/2017
LOGGED BY: Brian Coffey (HES)
FLUSH: Air Rotary

EASTING: 552069
NORTHING: 569322
ELEVATION: 51.626mOD

Well Completion Description	Flush Colour	H2O Inject.	Water Strikes	Fractures	Airlift Q (gal/hr)	Comments	Elevation	Meters Below Ground Surface	Lithology	Formation Description
							51.63	0		Ground Surface
Back fill with drilling returns Bentonite seal 6" Steel casing 50mm PVC casing Bentonite seal								5 10 15 20		Brown, dense, silty, sandy GRAVEL (notes: fine to medium gravel, coarse sand, sub-rounded to angular gravel comprising mainly sanstone and siltstone)
							27.63	25 30		Brown, very dense, silty sandy GRAVEL (notes: fine to medium gravel, coarse sand, sub-rounded to angular gravel comprising mainly sanstone and siltstone)
							16.63	35		Bedrock (notes: slightly weathered with thin layer of silt on top. No bedrock returns)
							13.03			
							11.13	40		E.O.H. 38.6mbgl

REMARKS:

Casing (datum) elevation = 52.294mOD
Groundwater level on 27/10/17 - 24.004mOD

PAGE 1 of 1

SCALE As shown

HYDRO-ENVIRONMENTAL SERVICES 22 Lower Main Street Dungarvan Co. Waterford Tel: 058-44122 Fax: 058-44244 Email: info@hydroenvironmental.ie

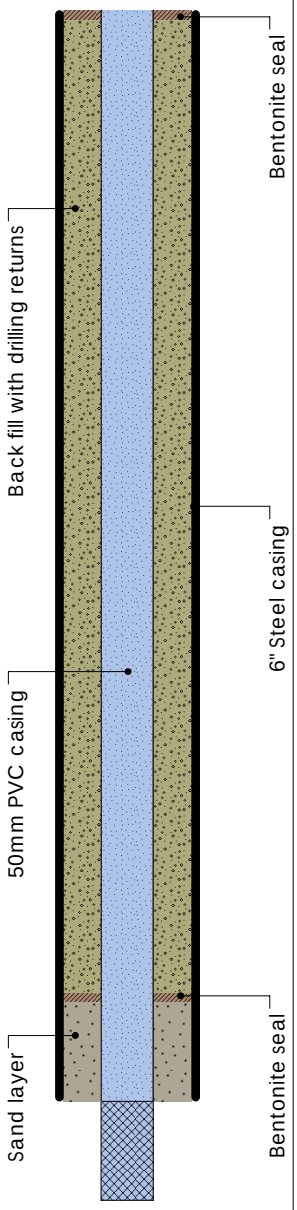
MONITORING WELL DRILLING LOG

WELL NUMBER: MW4

PROJECT NUMBER: P1380-1
SITE: Garryhesta Quarry, Co. Cork
CLIENT: Roadstone Ltd.
DRILLING CONTRACTOR: Southern Pumps Ltd.

DATE STARTED: 16/10/2017
DATE FINISHED: 17/10/2017
LOGGED BY: Brian Coffey (HES)
FLUSH: Air rotary

EASTING: 552325
NORTHING: 569421
ELEVATION: 52.092mOD



Elevation	Meters Below Ground Surface	Lithology	Formation Description
52.09	0		Ground Surface
			Brown, dense, silty sandy GRAVEL (notes: fine to medium gravel, coarse sand, sub-rounded to angular gravel comprising mainly sanstone and siltstone)
44.09	5		
42.09	10		Brown, silty SAND (fine)
			Brown, dense, silty sandy GRAVEL (notes: fine to medium gravel, coarse sand, sub-rounded to angular gravel comprising mainly sanstone and siltstone)
	15		
	20		
	25		
	30		
16.09	35		E.O.H. 36.0mbgl
13.09			

REMARKS:

Casing (datum) elevation = 52.787mOD
Groundwater level on 27/10/17 - 23.587mOD

PAGE 1 of 1

SCALE As shown

HYDRO-ENVIRONMENTAL SERVICES 22 Lower Main Street Dungarvan Co. Waterford Tel: 058-44122 Fax: 058-44244 Email: info@hydroenvironmental.ie

APPENDIX III: ORIGINAL LABORATORY REPORTS

ENVIRONMENTAL LABORATORY SERVICES
EXCELLENCE THROUGH ACCREDITATION

ENVIRONMENTAL LABORATORY SERVICES
Acorn Business Campus
Mahon Industrial Park,
Blackrock,
Cork
Ireland
Tel: +353 21 453 6141
Fax: +353 21 453 6149
Web: www.elsltd.com
email:info@elsltd.com

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 111T

Contact Name	David Broderick	**Report Number**	**119040 - 1**
Address	Hydro-Environmental Services 22 Lower Main Street, Dungarvan,	**Sample Number**	119040/003
		Date of Receipt	27/10/2017
		Date Started	27/10/2017
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	Per Batch	**Date of Report**	06/11/2017
Quotation No	QN007097	**Sample Type**	Ground Waters
Customer Ref	Garyhesta MW 1		

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
BOD									
	BOD		EW001	1.0		<1.0	mg/L	INAB	
Coliforms									
	Total Coliforms		MIC133	0		21	MPN/100ml	INAB	
Gallery Plus-Suite A									
	Ammonia as N		EW175	0.005		<0.005	mg/l N	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		4.7	mg/l N	INAB	
	Nitrate as N		EW175	0.15		4.7	mg/l N	INAB	
	Phosphate (Ortho/MRP) as P		EW175	0.005		0.006	mg/l P	INAB	
GCFID TPH Split									
	TPH >C10 - C20 (DRO)		EO063	10		<10	ug/L		
	TPH >C6 - C10 (PRO)		EO063	10		<10	ug/L		
	TPH >C6-C40 (TPH)		EO063	10		<10	ug/L		
Metals-Dissolved									
	Iron-Dissolved		EW188	20		<20	ug/L	INAB	
	Manganese-Dissolved		EW188	1.0		1.2	ug/L	INAB	
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Copper-Dissolved		EW188	0.003		<0.003	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		10.2	mg/L	INAB	
	Nickel-Dissolved		EW188	0.5		0.8	ug/L	INAB	
	Zinc-Dissolved		EW188	1.0		8.0	ug/L	INAB	
Titralab									
	pH		EW153	0.0		7.6	pH Units	INAB	
Total Dissolved Solids (TDS)									
	Total Dissolved Solids (TDS)		EW046	15		254	mg/L	INAB	
Total Kjeldahl Nitrogen-TKN (CalcGallery)									
	Total Kjeldahl Nitrogen-TKN (CalcGallery)		EW010	1.0		<1.0	mg/l N		
Total Nitrogen									
	Total Nitrogen		EW140	1.0		4.6	mg/L	INAB	

Signed : 06/11/2017

Domenico Giliberti-Technical Manager

NOTES
1.This Report shall not be Reproduced except in full, without the permission of the laboratory and only relates to the items tested.
2.SPEC= Allowable limit or parametric value
3.OOS=Result which is outside specification highlighted as OOS-A
4.LOQ=Limit of Quantification or lowest value that can be reported
5.ACCRED=Indicates matrix accreditation for the test,a blank field indicates not accredited
6."*" Indicates sub-contract test

ENVIRONMENTAL LABORATORY SERVICES
EXCELLENCE THROUGH ACCREDITATION

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Web: www.elsltd.com
email:info@elsltd.com

ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 111T

Contact Name	David Broderick	**Report Number**	**119040 - 1**
Address	Hydro-Environmental Services 22 Lower Main Street, Dungarvan,	**Sample Number**	119040/002
		Date of Receipt	27/10/2017
		Date Started	27/10/2017
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	Per Batch	**Date of Report**	06/11/2017
Quotation No	QN007097	**Sample Type**	Ground Waters
Customer Ref	Garyhesta MW 2		

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
BOD									
	BOD		EW001	1.0		<1.0	mg/L	INAB	
Coliforms									
	Total Coliforms		MIC133	0		240	MPN/100ml	INAB	
Gallery Plus-Suite A									
	Ammonia as N		EW175	0.005		0.097	mg/l N	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		7.3	mg/l N	INAB	
	Nitrate as N		EW175	0.15		7.3	mg/l N	INAB	
	Phosphate (Ortho/MRP) as P		EW175	0.005		<0.005	mg/l P	INAB	
GCFID TPH Split									
	TPH >C10 - C20 (DRO)		EO063	10		<10	ug/L		
	TPH >C6 - C10 (PRO)		EO063	10		<10	ug/L		
	TPH >C6-C40 (TPH)		EO063	10		<10	ug/L		
Metals-Dissolved									
	Iron-Dissolved		EW188	20		140	ug/L	INAB	
	Manganese-Dissolved		EW188	1.0		180	ug/L		
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Copper-Dissolved		EW188	0.003		<0.003	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		12.5	mg/L	INAB	
	Nickel-Dissolved		EW188	0.5		3.4	ug/L	INAB	
	Zinc-Dissolved		EW188	1.0		11	ug/L	INAB	
Titralab									
	pH		EW153	0.0		6.9	pH Units	INAB	
Total Dissolved Solids (TDS)									
	Total Dissolved Solids (TDS)		EW046	15		201	mg/L	INAB	
Total Kjeldahl Nitrogen-TKN (CalcGallery)									
	Total Kjeldahl Nitrogen-TKN (CalcGallery)		EW010	1.0		<1.0	mg/l N		
Total Nitrogen									
	Total Nitrogen		EW140	1.0		8.1	mg/L	INAB	

Signed : 06/11/2017

Domenico Giliberti-Technical Manager

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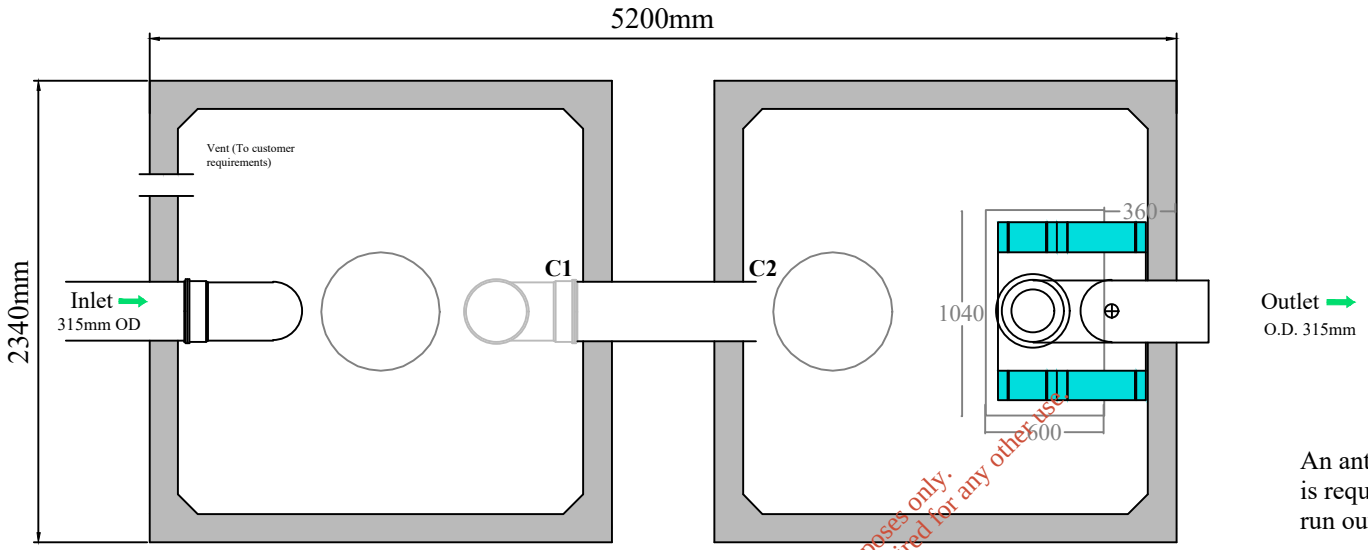
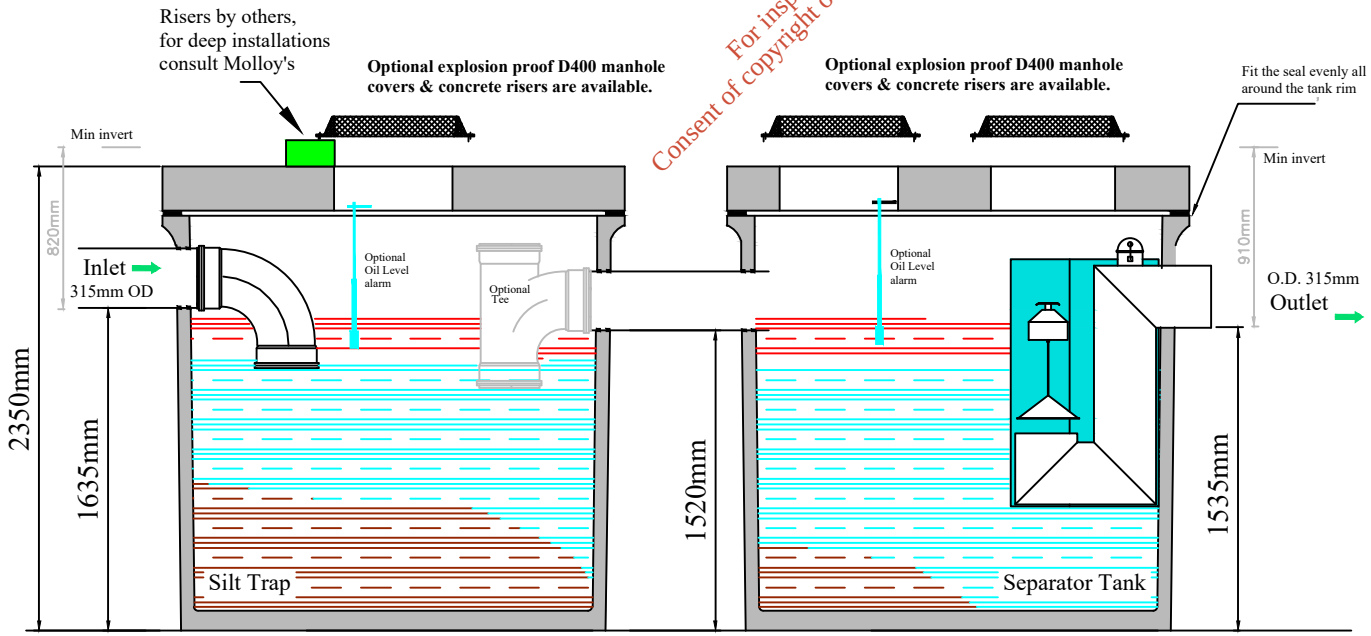
6."*" Indicates sub-contract test

APPENDIX IV: OIL INTERCEPTOR DESIGN

Full Retention Class 1 EN 858 Ortner FR-NS-40-CC Volume 16,000 lit



An anti-syphon vent is required for long run outflows



A good firm, rock free, perfectly level base is required. Soil conditions must be checked by the site engineer. See installation recommendations for guidance.

Notes:

Note: Observe all safety regulations in regard to excavation and lifting requirements. Never leave opening uncovered or unattended at any time.

Note: Specify any specific requirements prior to ordering. All civil works by customer.

Note: Do not scale from this drawing. Only for illustration purposes.

Tank Type: 2CFull Retention Interceptor

Tank Size: 4900mm x 2340mm

Height: 2350mm

Volume: 16000 liters

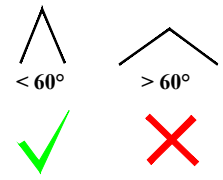
Weight: 4500kg (Each, Ex. Lid)

(**Tank Dim:** ± 20mm. **Weight:** ± 30Kg.)

40 l/s nominal flow @ 65mm/hr rain intensity
2,222m sq. coverage
5,000 lit. silt capacity
2,000 oil capacity
4,000 lit. emergency oil retention.

Accidental damage caused by incorrect lifting is the responsibility of the client.

Lifting limitations:
Max Chain Angle < 60°



CE

Aswa MOLLOY PRECAST Environmental Solutions
Clara Road, Tullamore, Co. Offaly, Ireland
Tel: 057 9326000 info@molloyprecast.com
Fax: 057 9326060 www.molloyprecast.com

Title: FR-NS-40-CC
Full Retention Interceptor

Date: Mar 2014

Drg. No.: D08 (NTS)

Drawn By: MC

ortner

APPENDIX V: SOAKAWAY DESIGN CALCULATION SHEET

Project Roadstone Ltd, Garyhesta Pit, Co. Cork
Appendix V BRE365 Soakaway Design

Site specific info: Green
Storm specific info: Orange
Required input in Red
Result in Blue

A50=	7.5		**Site Area** =	**2652**	m*2
V =	1.8	m*3	**f=**	**3.90E-04**	m/s
O =	252.47	m*3	**Storm Duration =**	**86400**	s
I =	254.1	m*3	**Rainfall** =	**95.8**	mm
S = I - O =	1.6	m*3			
S = V	0.2				
T50 =	0.0854	hours			

%FREE V= **0.3**
Effective Depth = **1.5** m
Width = **1** m
L = **4.00** m

For a valid design the time for the soakway to half empty from fulll should be less than 24hours

DESIGN OK