SECTION 8.0 WATER

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8.0 WATER

8.1 Introduction

This section of the remedial Environmental Impact assessment Report (rEIAR) assesses the impact which the extraction and processing of aggregate has had on the hydrological and hydrogeological environment surrounding the development. The subject site lies within the catchment of the St Johnston Stream which flows into the Foyle system immediately east of St Johnston village. Where confluence of the St Johnston Stream meets the Foyle is part of the River Finn Special Area of Conservation (SAC code 002301) and River Foyle and Tributaries SAC (SAC code UK0030320).

8.1.1 Objectives

The objectives of the assessment are to:

- Identify likely significant effects of historical development at the site on surface water and groundwater.
- Produce a baseline study of the existing water environment (surface water and groundwater) in the area of the site;
- identify likely significant effects of the development on surface water and groundwater during the construction phase, operational phase and decommissioning phase of each aspect of the development;
- identify mitigation measures to avoid, remediate or reduce significant negative effects.

8.2 Methodology

The overall study components comprised of a desk study reviewing all the available relevant information on the site followed by site assessments involving inspection of site features and chemical analysis of waters. Assessment of potential impacts on sensitive receptors by the proposed development was carried out. The methodology employed was 3-stage:

- Desk study
- Site assessment and analysis
- Impact assessment

8.2.1 Desk Study

A desk study of the development site and surrounding area was completed prior to the undertaking of site walkover assessments. The desk study involved collecting all relevant geological, hydrological, hydrogeological and meteorological data for the study area. This included consultation with the following:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - National Draft Bedrock Aquifer map;
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directive Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Geology of North Donegal (Long and McConnell) Geological Survey of Ireland;
- Geological Survey of Ireland - Groundwater Body Characterisation Reports;
- OPW Indicative Flood Maps (www.floodmaps.ie);
- Environmental Protection Agency – "Hydrotool" Map Viewer (www.epa.ie);
- CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie); and,
- Department of Environment, Community and Local Government on-line mapping viewer (www.myplan.ie).
- Donegal County Council Discharge Licence Analytical Results (Personal Communication)

8.2.2 Site Investigations

A hydrological walkover survey, including detailed mapping and baseline monitoring/sampling, was undertaken by Colin Farrell of Greentrack on various dates between February and June 2022. The field assessments included a detailed site walkover survey, water features survey, and an inspection of all relevant hydrological features, such as existing drainage ditches, groundwater contributions and inflows/outflows from the site. In summary, assessments to address the water, hydrology, and hydrogeology section of the rEIAR included the following:

- Walkover surveys and hydrological mapping of the existing quarry site and the surrounding area were undertaken whereby water flow directions and drainage patterns were recorded
- A sampling and analysis of program was carried out from January to June 2022 to monitor the flow and quality of surface water in and around the site.
- Monitoring boreholes were installed on the site and groundwater levels were monitored weekly over the course of three months. Groundwater quality was assessed.
- A rudimentary assessment of the transmissivity and hydraulic conductivity of the aquifer underlying the site was carried out.

8.2.3 Impact Assessment Methodology

Section 8.2 of this rEIAR refers to the impact assessment methodology employed. In addition, the sensitivity of the water environment receptors was assessed on completion of the desk study and baseline study. Levels of sensitivity which are defined in Table 8.1 are then used to assess the potential effects that the proposal may have on the local baseline water environment (i.e. water receptors).

Table 8.1: Receptor Sensitivity Criteria (Adapted from www.sepa.org.uk)

Sensitivity of Receptor	Description
Not Sensitive	Receptor is of low environmental importance (e.g. surface water quality classified by EPA as A3 waters or seriously polluted), fish sporadically present or restricted). Heavily engineered or artificially modified and may dry up during summer months. Environmental equilibrium is stable and is resilient to changes which are considerably greater than natural fluctuations, without detriment to its present character. No abstractions for public or private water supplies. GSI groundwater vulnerability "Low" – "Medium" classification and "Poor" aquifer importance.
Sensitive	Sensitive Receptor is of medium environmental importance or of regional value. Surface water quality classified by EPA as A2. Salmonid species may be present and may be locally important for fisheries. Abstractions for private water supplies. Environmental equilibrium copes well with all natural fluctuations but cannot absorb some changes greater than this without altering part of its present character. GSI groundwater vulnerability "High" classification and "Locally" important aquifer.
Very Sensitive	Very sensitive Receptor is of high environmental importance or of national or international value i.e. NHA or SAC. Surface water quality classified by EPA as A1 and salmonid spawning grounds present. Abstractions for public drinking water supply. GSI groundwater vulnerability "Extreme" classification and "Regionally" important.

8.2.4 Relevant Guidance

The hydrological and hydrogeological descriptions and assessments in this rEIAR are carried out in line with guidance contained in the following:

- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU);
- Environmental Protection Agency (May 2022) - Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- Environmental Protection Agency (September 2015): Draft - Advice Notes on Current Practice (in the preparation on Environmental Impact Statements);
- Environmental Protection Agency (September 2015): Draft – Revised Guidelines on the Information to be Contained in Environmental Impact Statements;
- Environmental Protection Agency (2003): Advice Notes on Current Practice (in the preparation on Environmental Impact Statements);
- Environmental Protection Agency (2002): Guidelines on the Information to be Contained in Environmental Impact Statements;
- Institute of Geologists Ireland (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- National Roads Authority (2009): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Eastern Regional Fisheries Board (2016): Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters;
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) 2006: Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006);
- CIRIA 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2006;
- Environmental Protection Agency (2022): Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.
- Analysis and Evaluation of Pumping Test Data (2nd Edition, 1994) – Kruseman & de Riddler

8.3 Development

Quarrying has been undertaken at the site in various regards since the late 1700's. The general area around the townlands of Trentamucklagh, Ardagh & Glentown were said to have provided slate for roofs of most of Glasgow's houses. There are quarry pits marked on maps in the area that were drawn up between 1829 and 1841.

The current applicant acquired the site in 1978 and has been quarrying the application site since then. There has been no definite direction of extraction over the years. Stone was removed from site in the order it was easiest to access and break out. Extraction continued until the current footprint of the application site was reached. This rEIAR is to accompany a substitute consent application for the extraction and processing activities that have been carried out to date.

The extraction area is c. 7.7 hectares in size and has been developed as a stone quarry. Extraction has taken place over most of the footprint of the site. The highest point of the site is along the southeast boundary where the vegetated berms are at 136 mOD. The boundary between the application site and the quarry to the north is a rocky ridge at approximately 133 mOD. The lowest point of the site is the quarry deck at approximately 106-107 mOD. A significant promontory remains in the centre of the site at approximately 125-129 mOD. The applicant has been extracting and processing rock by drilling, blasting, crushing and screening. Blasting has only occurred at most one to two times per year when a particularly hard piece of lithology was encountered. The majority of extraction has been by mechanical means using excavators. No washing of crushed and screened product takes place on site.

A number of measures have been put in place for the protection of surface and groundwater on the site. Protection from accidental pollution has been achieved by adhering to best practice in relation to mobile re-fueling of plant and vehicles and by robust fuel and lubricant storage measures off site.

Protection of the wider surface water environment has been achieved by the use of settlement ponds to ensure discharge to natural waters has acceptable levels of suspended sediment.
The surface waters draining the extraction area within the quarry void and any groundwaters are periodically pumped to the large settlement pond for settlement treatment before flow by gravity through a secondary settlement pond and wetland area before discharge off site under licence. A water discharge licence (Lwat67) has been in place from Donegal County Council since 2009.

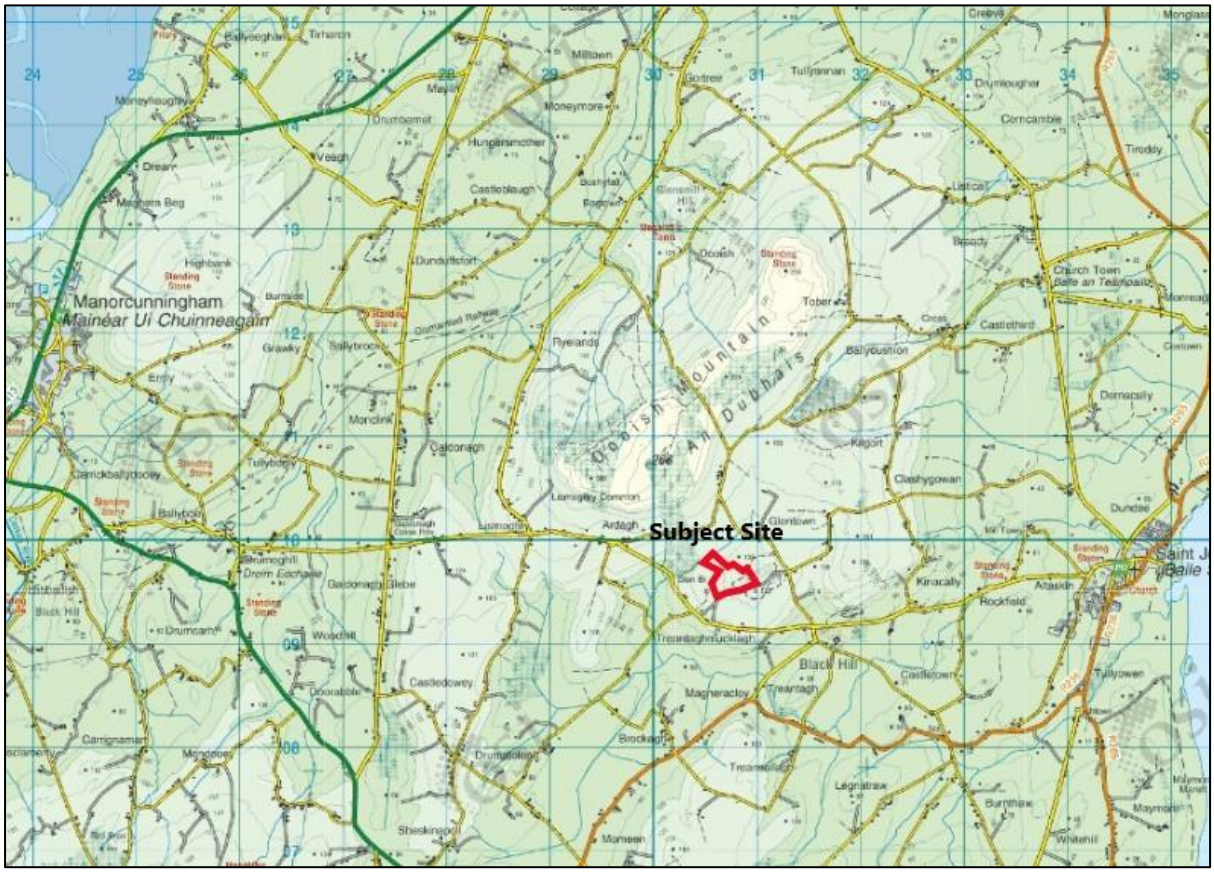
The proposed extraction and processing of rock at the site is a dry operation. There is no washing of the crushed product planned before it leaves site for market. The only requirement for water usage during the extraction and processing activities has been for dust suppression in periods of dry weather.

8.4 Site Description

8.4.1 Site Location

The application site is located approximately 4 km west of the town of St Johnston in east Co. Donegal (Eircode: F93 KC04). The site is in the townland of Trentamucklagh and is served by the local road, L-5414. Access to the quarry is off this local road via a concrete and hardcore access road.
The site is surrounded by agricultural land on all sides apart from to the east where a quarry face separates the site and a separate quarry operated by a different owner. An extensive area of commercial forestry lies to the north and northwest of the site, flanking the slopes of Dooish Mountain. The subject site location is outlined in Figures 8.1 below and the site layout is detailed in Figure 8.2 below.

Figure 8.1: Location of Subject site



CYAL50244901 © Ordnance Survey Ireland/Government of Ireland

8.4.2 Site Services in Water & Wastewater

There are no longer welfare facilities provided on site. In the past a canteen and toilet facilities were made available near the entrance to the site. Wastewater was treated in a septic tank and associated percolation area. These have since been made redundant and the septic tank has been removed from site. The containers used for the office, canteen and toilet remain on the site in a state of disrepair. For the past number of years, toilet and canteen provision for the family business is made at the applicants dwelling approximately 200 m southwest of the quarry entrance.

8.4.3 Current Land Use

Current land use for the application site is as a working quarry. Extraction and processing take part in the central part of the site on the quarry deck within the main quarry void. Large parts of previous quarry workings within the site are partially recolonised with pioneer vegetation, especially along the western boundary and northwest portion of the site. The large settlement pond represents a large part of the site occupying a footprint of approximately 0.87 hectares. Other ponds and wetland areas throughout the site account for approximately 0.38 hectares of land use.

8.4.4 Historical Land Use

The Ordnance Survey of Ireland historical map series was examined for land use on the application site. In the series mapped between 1829-1841 the site is seen as partially excavated ground. The main excavation seen is northeast of the site in the townland of Glentown, however the collection of excavations is labelled as Glentown Slate Quarries and appears to cover quarry pits in the townlands of Trentamucklagh and Ardagh. The earliest published record of quarrying in the general area is in 1786. Quarrying activity on the site has been sporadic since the mid 1840's and the current applicant started excavation and processing on the site in 1978.

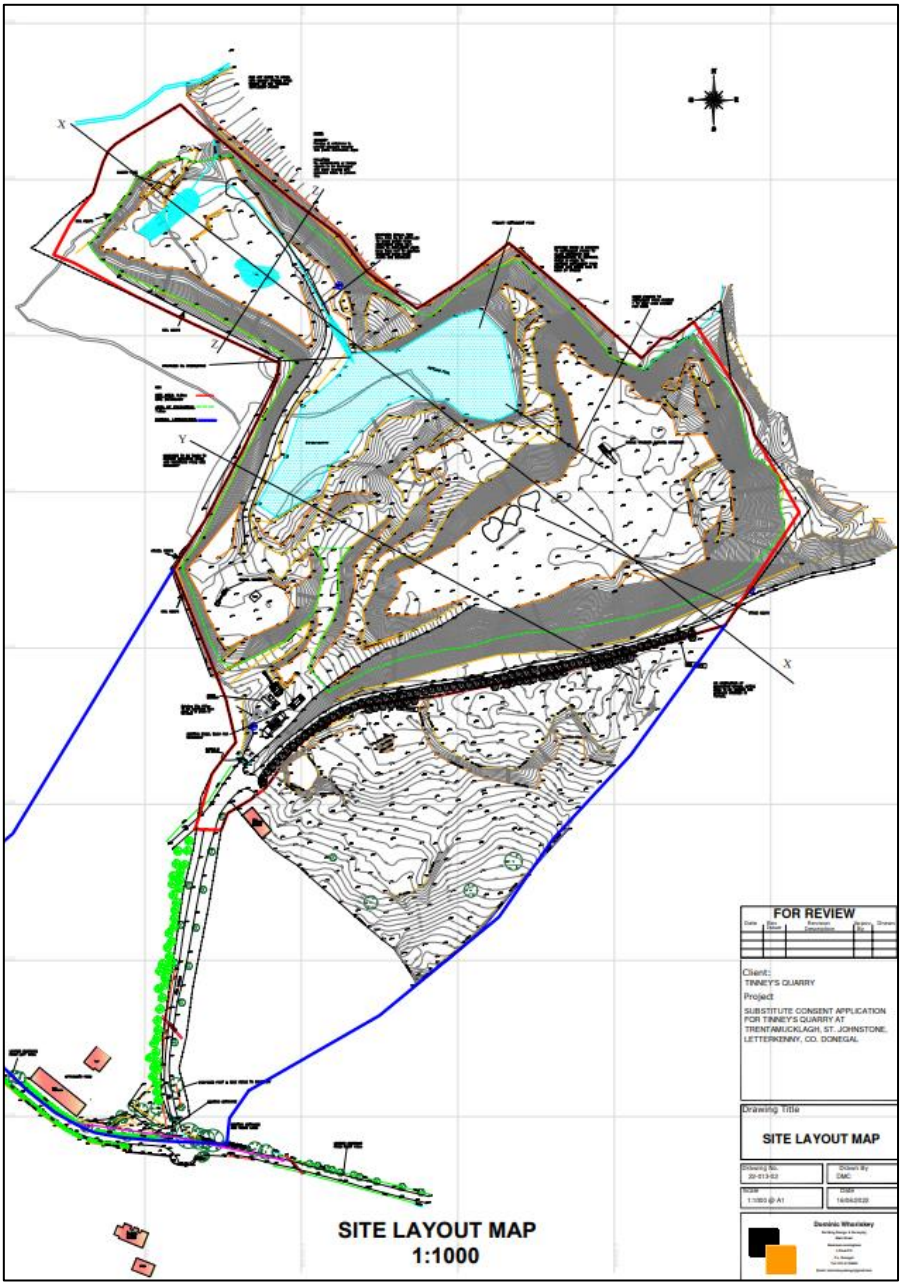
8.4.5 Topography

The site is c. 9.9 hectares in size and has been developed as a stone quarry. Extraction has taken place over most of the footprint of the site (7.7 ha). The entire site is located on the upper western slopes of a small hill, the summit of which lies immediately south of the site at approximately 140 mOD. The highest point of the site is along the southeast boundary where the vegetated berms are at 136 mOD. The boundary between the application site and the quarry to the north is a rocky ridge at approximately 133 mOD. The lowest point of the site is the quarry deck at approximately 106-107 mOD. A significant promontory remains in the centre of the site at approximately 125-129 mOD.

8.4.6 Site Layout

The historical development of quarrying at the site has resulted in a significant quarry void. There is a one distinct entrance into the quarry void from the southern side. A hardcore and concrete access road links the quarry entrance with the local road, L-5414. The main items of site infrastructure on the site are the redundant office buildings and weighbridge at the entrance to the quarry, redundant screening plant in the western portion of the site and the large settlement pond (Settlement Pond 1) and secondary settlement pond (Settlement Pond 2) in the northern portion of the site. All of the other plant on site is mobile. The location of this site infrastructure is shown on the main site layout drawing in Figure 8.2 below.

Figure 8.2: Site Layout Drawing



(Map supplied by Dominic Whoriskey Architects)

8.4.7 Extraction

Extraction at the site was well advanced prior to the applicant taking control of the site but was not carried out in a coordinated fashion and the applicant states many distinct separate quarry pits were on the application site when control was taken of the lands. Extraction was then continued chasing the rock of easiest access and that could be broken out easily. As a result, an ad hoc extraction direction was taken until all areas of the site footprint had been extracted to some degree. Processing activities have historically followed extraction and been based on the quarry deck as close as practicable to the extraction areas.

8.4.8 Water Requirements

Water requirements for the office, canteen and toilet facilities were supplied by pump from the nearest groundwater sump. There are currently no requirements for welfare water on site. Welfare facilities are provided offsite. There is no washing of quarry product. Water is required for dust suppression in periods of prolonged dry weather and water is required for the proposed wheel wash.

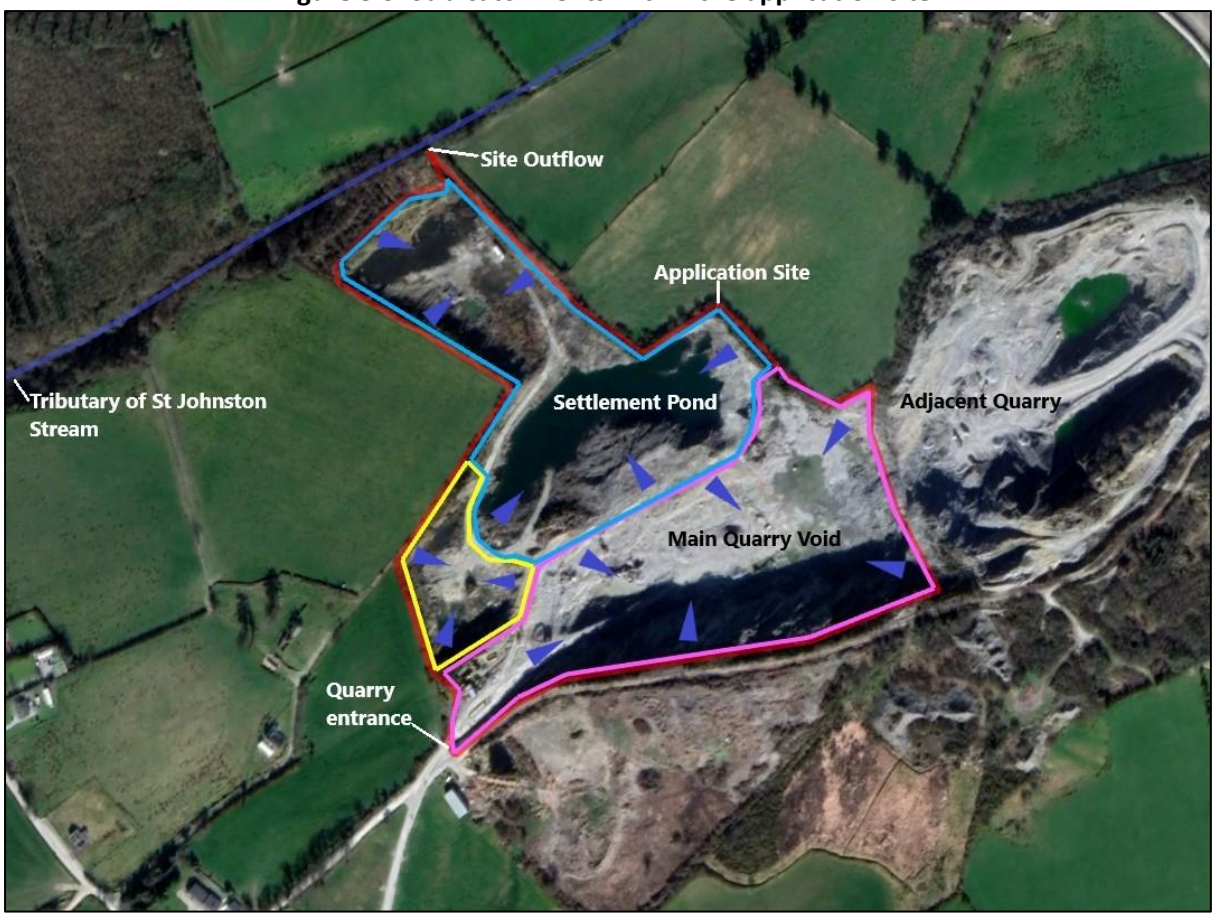
Dust suppression water and water for the proposed wheel wash is supplied from the settlement ponds within the site.

8.4.9 Site Drainage & Surface Water Runoff on Site

The current drainage flow directions for the site and surrounding areas were examined and 3 sub-catchments identified within the site. These are the main quarry void which captures the majority of the incident rainfall on the site, the catchment around the large settlement pond (Settlement Pond 1) and wetland area (Settlement Pond 2) which have a significant catchment area and thirdly, a smaller catchment in the western part of the site.

There is no outflow from the quarry void catchment or the western catchment. There is an outflow from the settlement pond/wetland catchment to a tributary of the St Johnston Stream. This is the only outflow of surface water from the site. The sub-catchments are indicated on Figure 8.3 below. As is seen in Figure 8.3, because the site is located at the top of a hill there is no runoff directed into the site from outside the site boundary. Also indicated on Figure 8.3 is the direction of surface water flow within each of the sub catchments.

Figure 8.3: Sub-catchments within the application site

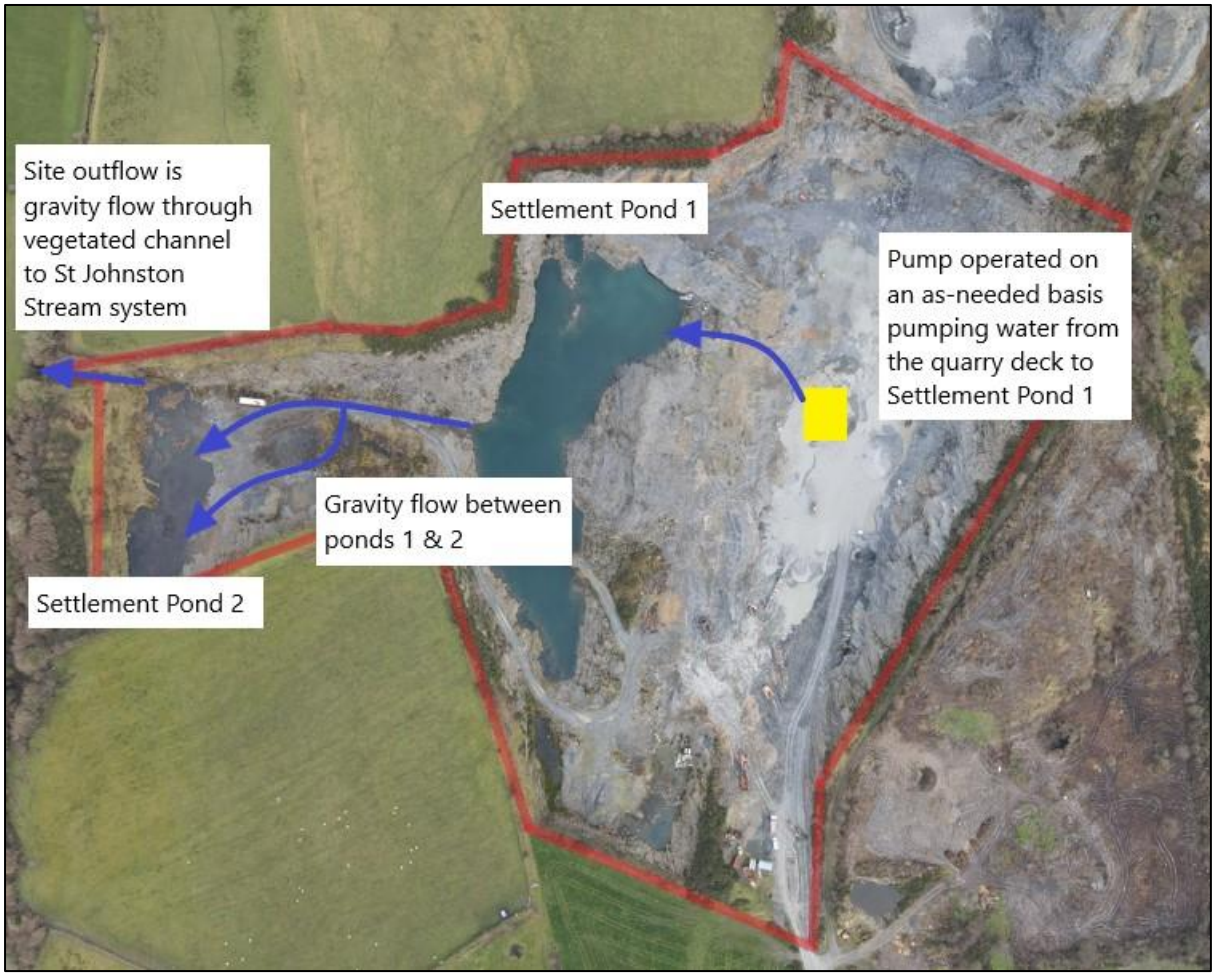


Base Image supplied by Google Earth Pro ™

Site drainage, surface water runoff and water management within the current site are schematically represented in Figure 8.4. There is a single outflow from the site to a tributary of the St Johnston Stream on the northern boundary of the site. The outflow is through a vegetated channel from the permanent wetland area/secondary settlement pond in the northern portion of the site. The wetland area is supplied by an overland flow from the large primary settlement pond. This overland flow is unregulated at present and takes several flow paths on route from the primary to secondary settlement ponds. The primary settlement pond is supplied by a mixture of groundwater flow, incident rainfall and associated surface water flow and effluent pumped from the quarry floor. The location of

the primary settlement pond and the secondary settlement pond/wetland area is in a redundant area of the site which has partially recolonised with vegetation.
There is a mobile 6'' pump situated on the quarry deck. The pump is engaged on an as-needed basis. Information from the applicant indicates that in a period of wet weather the pump may be turned on for an average of an hour each morning, and in a period of dry weather the pump may not be turned on for over two weeks. The applicant states that the use of the pump is directly related to the amount of preceding incident rainfall.
The flow regime within the site is complex due to the interaction between surface water and groundwater. Many of the lying pools of water are likely to be sourced from a mixture of groundwater and surface water. Conductivity testing of these water samples in Section 8.4.14.1 is consistent with this view. These surface water/ groundwater interactions are explored further in section 8.4.14.

Figure 8.4: Existing water movement on site



Historically over the recent extraction period, water movement through the site has remained broadly similar. Within the quarry void, over time the point of extraction has changed, and with it the point to which surface waters naturally flow. This has meant that different areas of the quarry void have required pumping and waters have always been pumped to the large pond for settlement and discharge has been through the secondary settlement pond and the same outflow point.
Between Settlement Ponds 1 & 2, flow is by gravity through unregulated surface channels. Part of the flow is direct to Settlement Pond 2 through a meandering channel following the route of a redundant haul road, and part of the flow is diverted through a naturalised wetland area to Settlement Pond 2.

8.4.10 Existing Water Balance Estimations

Flow rate measurements have been taken from the outflow from the site to assess water balance for the area. The outflow rate was calculated at several intervals over the study period taking in periods when the pump in the quarry void was active and during periods when it was inactive and had been for several days. Flow rate was estimated using the velocity area method for a suitable section of the outflow channel.

Measurements for the outflow are presented in Appendix 8.1.

Average flow rate for the site discharge was 2.03 L/s when the pump was off. Average flow rate observed when the pump was turned on or had been turned off within 4 hours of measurement was 6.44 L/s. A weighted average of site discharge was estimated attempting to account for average weather conditions. Over the course of a year, it is assumed that the pump was active for approximately one hour per day on an average of four days per week throughout the year.

The weighted average discharge rate is calculated at **3.13 L/s**

This catchment area of the main extraction and processing area of the site is represented by the blue, pink and yellow polygons in Figure 8.3. The total catchment area is estimated at 79,975 m^2. The catchment excludes water which falls on the outside of screening berms which will be directed away from the site and excludes the area surrounding the access road from the L-5414.

To calculate average runoff rates the annual effective rainfall is assessed against the amount of rainfall that will percolate into the groundwater system. Effective rainfall (ER) is the average amount of incident rainfall minus the amount of Actual Evapotranspiration (AE). AE is usually calculated as 82% of Potential Evapotranspiration (PE). (The 82% figure has been used in recent studies and will calculate a higher ER rate than the customary 95% calculation rate which has been traditionally used). PE figures are available from Met Eireann for Malin Head. Malin Head is the nearest Met Eireann synoptic recording station located approximately 50 km to the north of the application site. Annual mean PE is 527.3 mm.

AE = PE * 82% ***AE = 432.4 mm***

Average annual rainfall (AAR) can be taken from long term data sets produced by Met Eireann (1981-2010). The figure from Malin Head is 1,076 mm. A more representative average annual rainfall figure is obtained from the Met Eireann Carrigans metrological station, 6 km east of the application site. The average annual rainfall for the last available 5 years (2019 - 2015 inclusive) is 1,054 mm.

The effective rainfall represents the water available for runoff and groundwater recharge. The effective rainfall for the site is calculated as follows:

Effective rainfall = AAR – AE
ER = 1054 mm - 432.4 mm
ER = 621.6 mm

However, in reality the Annual Evapotranspiration at the site is likely to be considerably less than estimated due to the nature of the site. Between 80% and 90% of the site is bare rock and overall, the site will have limited AE. Conservatively the annual AE may be estimated at 50mm, which would leave the Effective Rainfall on site to be 1,004mm.

Effective rainfall = AAR – AE
ER = 1054 mm - 50 mm
ER = 1004 mm

The catchment area of the main application site is estimated at 79,975m^2, the average daily effective rainfall is calculated at 2.75mm which equates to a daily potential runoff figure of 220m^3. A proportion of runoff will percolate into the ground and become groundwater. The calculations for this site are based on most of the site being stripped of topsoil and effectively bare rock. Bare rock runoff

coefficients vary between 0.82 and 0.94. The figure of 0.94 is used because of the observations regarding the low transmissivity of the slate bedrock (Section 8.4.12.4). This means that of the 220m^3 potential runoff, 207m^3 will become runoff and 13m^3 will percolate to groundwater.
In addition to the site outflow, and losses to evapotranspiration there is a small abstraction to be accounted for. A small pump is located on the western bank of Settlement Pond 1 and is used to abstract water for domestic use in the applicant's nearby family home and farmyard. Abstraction amounts are small compared with the overall outflow and are estimated at a maximum of 4m^3 per day.

Water balance:
Inputs = Outputs
Inputs = effective rainfall, groundwater contribution Outputs = site discharge, abstraction

107m^3 average daily effective rainfall + (167m^3) groundwater contribution = 4m^3 abstraction + 270m^3 average outflow

There is an average of 167m^3/day more water leaving the site than incident rainfall draining into the site. Some of the difference may be due to drainage from the agricultural land immediately to the northwest of the site discharge channel. The actual channel that conveys the site discharge is steeply sided and heavily vegetated, so it is possible that there is some small contribution coming over or through the banks of the discharge channel. Most of the difference is likely to be accounted for by a significant groundwater contribution to the overall outflow from the site. The surface water groundwater interactions on site are explored in further detail in Section 8.4.15.

8.4.11 Existing Surface Water Quality

The outflow from the site has been sampled and analysed for surface water quality several times over the study period. The flow was sampled leaving the site immediately before reaching the tributary of the St. Johnston Stream. The location of the sampling point is shown in Figure 8.5 below. In addition, the receiving stream was sampled above and below the site discharge point and then approximately 450 m downstream in the stream above the Glen Bridge. The location of the sampling points is shown on Figure 8.5 below. The results of the chemical analysis are presented in Table 8.2 below. The certificates of analysis are presented in Appendix 8.2.

Table 8.2: Water Quality Analysis of Site Discharge

Sampling Date	Sample Point	Parameter							
		pH	SS mg/L	Total Phophorus (as P) mg/L	Conductivity µS/cm	Ammonia mg/L	Dissolved TON mg/L	Orthophosphate (as P) mg/L	BOD mg/L
Discharge Licence Limits		6-9	<20						
18.01.2022	**1**	7.84	<5						
21.03.2022	**1**	7.80	<5						
20.04.2022	**1**	7.92	<5	<0.05	329	0.02	<0.1	<0.01	1.84
13.05.2022	**1**				274				
13.05.2022	**2**	8.13	<5		263				
13.05.2022	**3**	7.98	<5		265				
20.04.2022	**4**				259				
22.06.2022	**1**	8.04	<5		355				
22.06.2022	**2**				258				
22.06.2022	**3**				308				

An examination of these results shows that the outflow from the site is of high quality. BOD, Phosphorus and Ammonia values are in the category of 'high' ecological status as defined in the Environmental Objectives Surface Water Regulations values (S.I. 272 of 2009). The values for pH are within the accepted range of 6-9, and suspended sediment values are below laboratory detection levels and lower than the 25 mg/L threshold specified in the Freshwater Fish Directive (2006/44/EC).

Conductivity results confirm the likelihood of a groundwater influence from the site outflow (Section 8.4.15.1).

Figure 8.5: Monitoring points for flow rate and water quality

CYAL50244901 © Ordnance Survey Ireland/Government of Ireland

8.4.11.1 Trade Discharge Licence

Tinney's Quarry Ltd applied for and received a licence to discharge trade effluent to waters from Donegal County Council. The licence (Lwat67) was issued on 25.09.2009. Samples of the outflow and receiving waters have been sampled and analysed by both the applicant, through Aqualab, and independently by Donegal County Council. All of the available results of these analyses are presented in Table 8.3 below.

Table 8.3: Discharge Licence Monitoring Results

Sampling Date	Sample Point	Parameter						
		pH	SS mg/L	Total Phophorus (as P) mg/L	COD mg/L	Ammonia mg/L	Orthophosphate (as P) mg/L	BOD mg/L
Discharge Licence Limits		6-9	<20					
**23.05.2016	**1**	8.49	<1	<0.01	16	0.01	0.03	<1
**23.05.2016	**4**	8.36	<1	0.17	<16	0.05	0.03	1.04
*25.10.2011	**1**	7.35	0.50					
*16.11.2012	**1**	7.49	0.75					
*16.11.2012	**1**	7.50	0					
*22.05.2014	**1**	7.18	<6					
*23.03.2015	**1**	7.68	<6					
*25.11.2015	**1**	7.45	<6					
*10.10.2017	**1**	7.30	<6					
*29.11.2018	**1**	7.66	<6					
*19.09.2019	**1**	7.80	<6					
*11.10.2021	**1**	7.87	6					

**sampled by applicant and analysed by Aqualab *sampled and analysed by Donegal County Council

The discharge licence conditions are for pH to be between 6 and 9 units and for Suspended Solids to be below 20 mg/l.

As can be seen from Tables 8.2 & 8.3 site discharge over the study period for this rEIAR and historically available monitoring results from Donegal County Council all show compliance with the discharge licence conditions.

8.4.12 Flow rates and hydrological capacity of the receiving waters

8.4.12.1 Discharge Flow Rates

Flow rate measurements have been taken from the outflow from the site and from receiving waters. The outflow rate was calculated at several intervals over the study period taking in periods when the pump in the quarry void was active and during periods when it was inactive and had been for several days. Flow rate was estimated using the velocity area method for a suitable section of the discharge channel.

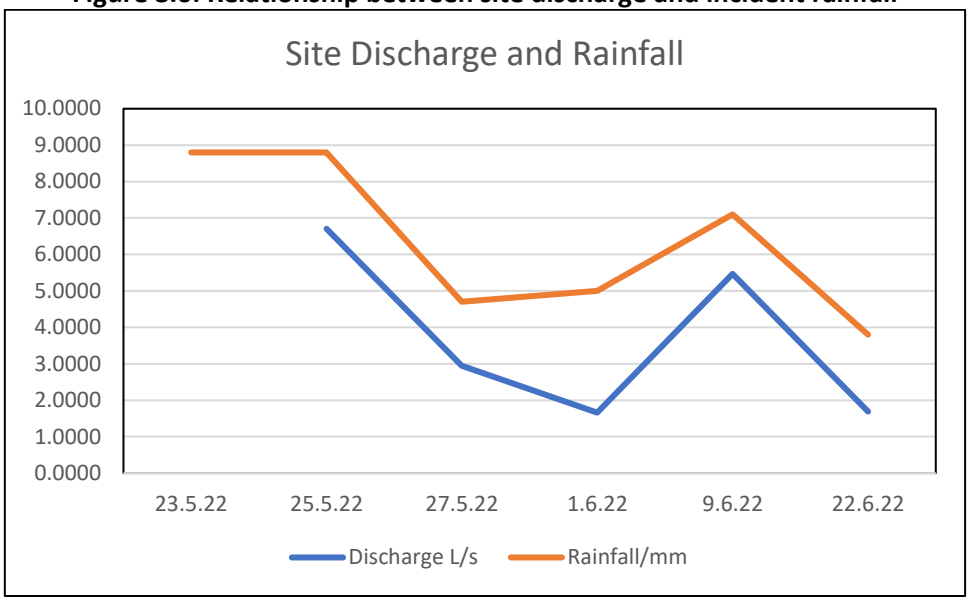
Measurements for the outflow and receiving waters are presented in Appendix 8.1.

Average flow rate for the site discharge was 2.03 L/s when the pump was off. Average flow rate observed when the pump was turned on or had been turned off within 4 hours of measurement was 6.44 L/s. A weighted average of site discharge was estimated attempting to account for average weather conditions. Over the course of a year, it is assumed that the pump was active for approximately one hour per day on an average of four days per week throughout the year.

The weighted average discharge rate is calculated at 3.13 L/s.

The requirement for activation of the pump is directly related to the amount of incident rainfall. The flow rate of the site discharge can be seen to be related to the amount of incident rainfall. Figure 8.6 below shows the relationship between the site discharge flow rate in L/sec and the amount of incident rainfall in the previous 72 hours in mm.

Figure 8.6: Relationship between site discharge and incident rainfall



Photograph 8.1 below shows the discharge channel on the site with heavily vegetated steep banks and vegetated channel.

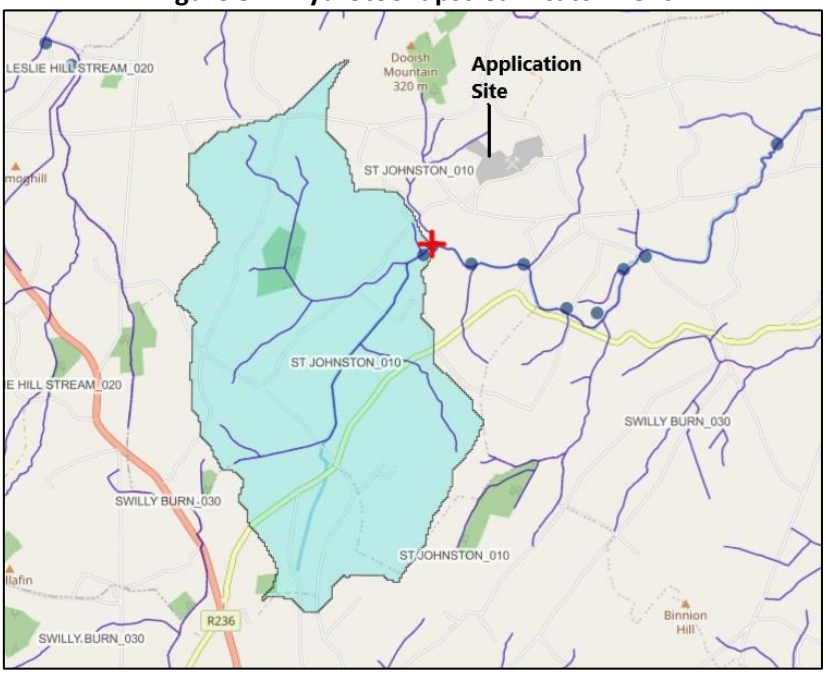
Photograph 8.1: Discharge channel

8.4.12.2 Hydrological capacity

The Hydrotool function on the EPA's website was utilised to attempt to estimate the flow in the receiving waters. Two monitoring points were situated approximately 1 km southwest of the application site. By examining the data for the monitoring point downstream and subtracting the upstream portion of the catchment, the smaller catchment flows involving the application site could

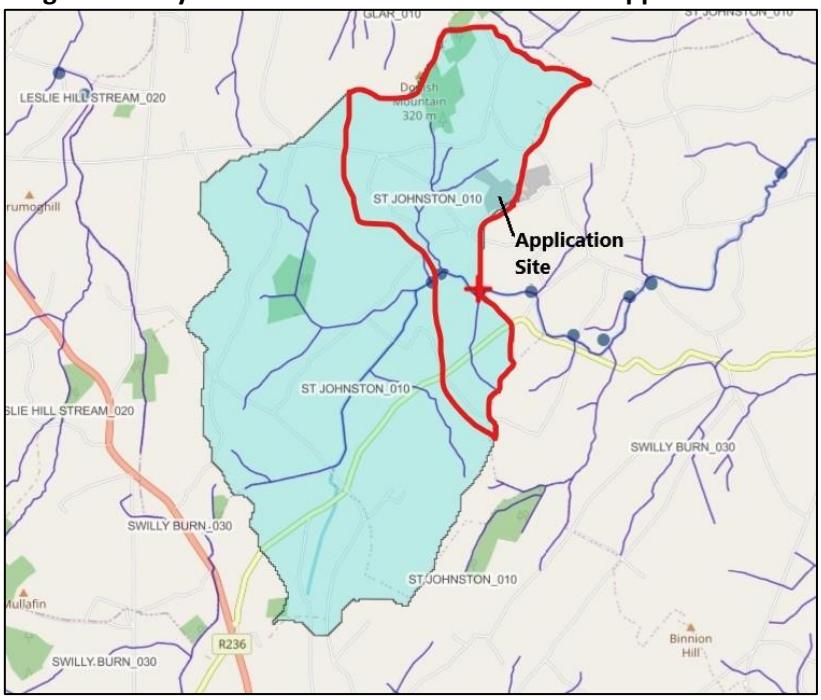
be deduced. The catchments are depicted in Figure 8.7 and 8.8 below. The catchment relevant to the application site is outlined approximately in red in Figure 8.8.

Figure 8.7: Hydrotool upstream catchment



(Produced using the EPA's Hydrotool function)

Figure 8.8: Hydrotool catchment relevant to the application site



(Produced using the EPA's Hydrotool function)

Within the EPA's Hydrotool program the flow rates for catchments are estimated. These are done for a range of percentile flows and also for the Naturalised Mean Monthly Flow (NMMF) rates. The 95 %ile, 50 %ile and 5 %ile flow rates for the catchment shown in red in Figure 8.8 are 0.004 m^3/sec, 0.066 m^3/sec and 0.396 m^3/sec respectively. The size of this catchment is approximately 3.625 km^2.
The NMMF rates for May and June for the catchment shown in red in Figure 8.8 are 0.087 m^3/sec and 0.058 m^3/sec respectively. Average flow rates measured in the receiving waters that the application site discharges to, measured immediately upstream of Glen Bridge on the L-5414, in May and June is

0.012 m^3/sec (Appendix 8.1). The catchment flow rate of this tributary represents approximately 16% of the flow in the catchment delineated in red in Figure 8.8.

To assess the hydrological capacity of this tributary receiving discharge from the application site, some assumptions are made with regard to the proportionality of flow rates. The 50 %ile for the catchment in red (Figure 8.8) from Hydrotool is 0.066 m^3/sec, so the 50 %ile flow rate for the tributary receiving discharge from the application site is assumed to be 0.011 m^3/sec. The 50 %ile flow rate represents the flow that is exceeded 50% of the time so may be assumed to represent average conditions. The average flow rate for the application site discharge is 3.13 L/sec (Section 8.4.10). Average discharge represents approximately 30% of the flow in the tributary receiving the discharge.

Flow rate for the tributary at 1 %ile represents high flow and is estimated at 0.104 m^3/sec. The maximum flow rate measured from the application site was 6.7 L/sec (0.0067 m^3/sec). The maximum flow rate occurred when the pump situated on the quarry deck was operated to lower water levels on the quarry floor. The water was pumped to Settlement Pond 1 where it then flowed by gravity through Settlement Pond 2 to the discharge point. Attenuation is provided by storage of water on the quarry floor before pumping. Maximum discharge rate represents approximately 6 % of the total flow rate of the tributary at 1 %ile flow.

It is concluded that there is sufficient hydrological capacity in the tributary to assimilate the flow from the application site. The tributary of the St Johnston Stream forms a small but steep sided valley on its route from Dooish Mountain past the application site and for several kilometres south of the site. Photograph 8.2 below illustrates the typical channel structure of this tributary.

Photograph 8.2: Tributary of St Johnston Stream immediately south of site discharge point

8.4.13 Hydrogeology, Groundwater Levels and Gradient

To assess the current hydrogeological regime on site, four monitoring boreholes were drilled and installed in February 2022. The position of the four wells (BH01, BH02, BH03 & BH04) is shown in Figure 8.9 below.

The boreholes were 100 mm in diameter drilled to 25 mbgl, 50 mm diameter standpipe installed, slotted at the bottom 12 m, gravel packed, and bentonite sealed. The drilling crew reported no water strikes encountered in any of the four monitoring boreholes and that drilling dust remained dry throughout the drilling process. No drilling logs were made available.

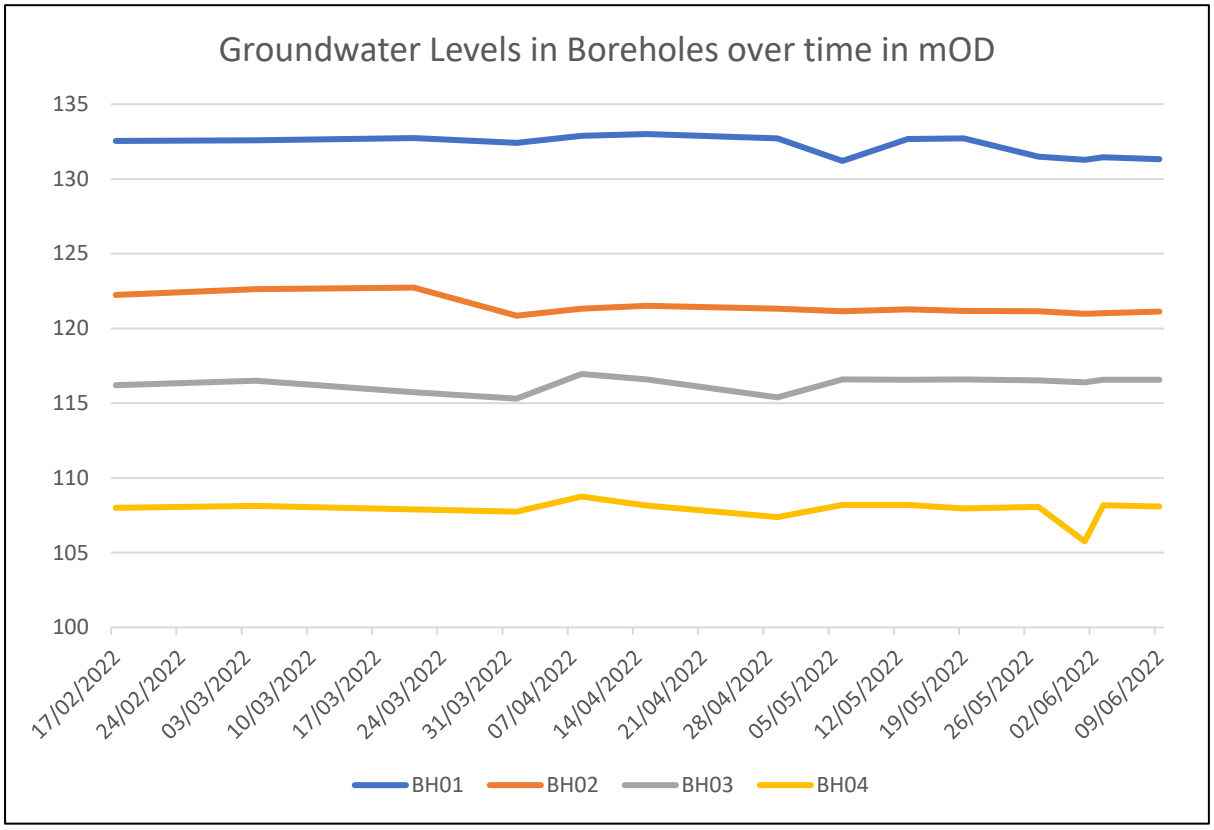
Figure 8.9: Position of monitoring boreholes, BH01, BH02, BH03 & BH04

BH01 is located on the southeast boundary of the application site outside of the berms at approximately 134.43 mOD. BH02 is located in the upper western edge of the site close to the site entrance at 125.38 mOD. BH03 is located in the worked out northern portion of the site at 117.35 mOD. BH04 is situated in the southeast part of the quarry void at 109.421 mOD.

8.4.13.1 Groundwater Levels

Groundwater levels were recorded with an electronic dip meter approximately weekly at each of the boreholes over the course of a 3-month study period of March, April and May 2022. It is noted that at the start of the study period groundwater levels are likely to have been at their highest. Plots of the groundwater level variation over time are given below for the four monitoring boreholes in Figure 8.10 below. The groundwater level readings are presented in Appendix 8.3.

Figure 8.10: Groundwater levels at BH01, BH02, BH03 & BH04



The groundwater levels at BH01 varied between 131 mOD and 133 mOD over the study period.
The groundwater levels at BH02 varied between 121 mOD and 123 mOD over the study period.
The groundwater levels at BH03 varied between 115 mOD and 117 mOD over the study period.
The groundwater levels at BH04 varied between 107.4 mOD and 108.8 mOD over the study period.

Most of the boreholes showed a seasonal variation in level of almost 2 m. BH04 near the quarry deck showed the least variation in groundwater levels. The dip in groundwater level in BH04 observed around 2.6.2022 was related to the slow recovery of levels following an aquifer test on 27.5.2022 where groundwater was removed from the borehole. Sections 8.4.13.5 & 8.4.13.6 contains more details of the aquifer testing.

8.4.13.2 Groundwater Gradient

The groundwater gradient has been significantly affected by the excavation of the quarry void. The excavated area has had the effect of a large diameter borehole creating a vast cone of depression in the water table on the site. It appears the groundwater level is currently at or slightly below the existing quarry deck level at approximately 107 mOD. The cone of depression created by excavation is observed to be steep sided due to the lack of significant permeability in the bedrock. Groundwater levels are observed to average around 132 mOD at BH01 which is between 8 and 10 m horizontally from the top of the southeast quarry face.

Settlement Pond 1 is likely to be largely groundwater sourced. Water level in Pond 1 is at 117.14 mOD, some 10 m above the groundwater levels of 107-108 mOD on the nearby quarry floor. Part of the outcrop of rock which acts as the banking surrounding Settlement Pond 1 has been drilled in preparation for blasting. While not lined for monitoring purposes and cognisant of the possible errors associated with the water levels in these boreholes, groundwater dip readings were taken on this promontory to help inform the overall groundwater regime.
Groundwater levels are assumed to be near to the surface water level of Settlement Pond 1 at 117 mOD and groundwater levels are assumed to be approximately 107 mOD on the quarry deck approximately 50 m distant horizontally from Pond 1. The promontory averages 125 mOD. Dip readings show groundwater levels around 111 mOD and 112 mOD in the centre of the ridge dropping to 109 mOD near the face next to the quarry void.

Groundwater levels throughout the site are noted on the aerial photograph presented as Figure 8.11. Inferred, rather than measured, groundwater levels are presented in brackets. It is noted that there is likely to be a variation in levels of up to 2 m due to seasonal effects.

Figure 8.11: Measured and Inferred groundwater levels

It can be seen from Figure 8.11 above that groundwater movement will follow the local topography and be to the northwest towards the tributary of the St Johnston stream.
Regionally groundwater movement will be to the east discharging to the Foyle system.
Although the groundwater table has been lowered by excavation, the zone of influence of the quarry depression does not extend for any significant distance beyond the site boundaries. The cone of depression created is steep sided due to the nature of the aquifer.

8.4.13.4 Aquifer properties

Hydraulic conductivity (K) defines the rate of movement through the aquifers on site and can be expressed in units of metres per day (m/day) or metres per second (m/s). Table 8.4 below gives a description of typical Hydraulic conductivity rates and expected ranges for several different rock types. The rock type on site is a blue-black slate with no obvious bedding with occasional fine-grained bedded units. The upper weathered zone may permit a small amount of water movement but generally water movement will be minimal through the site. Photograph 8.3 below is typical of the quarry face encountered on the site and illustrates the lack of groundwater pathways through the rock.

Table 8.4: Hydraulic Conductivity Rates

Description	Hydraulic conductivity (m/d)	Rock Type	Range of Hydraulic conductivity (m/d)
Extremely slow	0.000001	Slate	10^{-8}-10^{-5}
Very slow	0.0001	Granite	0.0003-0.03
	0.001	Basalt	0.0003-3
Slow	0.01	Sandstone	10^{-3}-1
Moderate	1	Fine grade unconsolidated sand	1-5
Fast	10	Medium grade unconsolidated Sand	5-20
Very Fast	100	Gravel	100-1000

Photograph 8.3: Typical quarry face

Measurement of hydraulic conductivity is problematic on site due to the likely transport mechanism within the rock types. Groundwater movement through the slate is likely to be confined to fracture flow within small cracks and joints. There is not expected to be any intergranular flow on site. There is likely to be a high degree of variability through the site with the amount and orientation of the cracks and fractures dictating the flow regime. Complex folding of the lithologies in the eastern part of the quarry will also add to the variability in groundwater flow. Hydraulic conductivity is expected to decrease with increasing depth due to the decreasing number of cracks and fractures at depth.

No measurable groundwater seeps through any of the extensive quarry faces were observed on any site visits and the applicant states that there has never been any groundwater flow through the faces.

Photograph 8.4 below shows the maximum observed groundwater flow through the quarry faces. The face pictured is on the southern quarry boundary and the water movement appears to be between bedded units but the quantities of groundwater involved are minimal. It is noted that this is the only water movement through any of the exposed rock faces through the entire application site.

Photograph 8.4: Slow groundwater seep between bedded slate units

From Table 8.4 hydraulic conductivity can be seen to vary greatly between and within rock types. Slate would be assumed to have K values which are variable due to the bedding/fracture density present but generally be of extremely low hydraulic conductivity.

8.4.13.5 Hydraulic Conductivity Calculations – Slug test

To further assess the aquifer properties specific to the site, crude slug tests were carried out at each of the boreholes on 15.4.2022. A 2L slug of water was removed from each borehole with a manual bailer and then the recovery of groundwater levels was measured at various time intervals with an electronic dip meter. Using the Bouwer-Rice method with the data from the drawdown and recovery of each borehole, an estimation of the hydraulic conductivity was made. Further details of the slug test and calculations made are contained in Appendix 8.4.

Calculations were conducted with the limited data to enable a figure for hydraulic conductivity to be estimated for each of the boreholes:

Hydraulic Conductivity

- **BH01: K = 4.93 x 10^{-5} m/s**
- **BH02: K = 6.36 x 10^{-5} m/s**
- **BH03: K = 5.92 x 10^{-5} m/s**
- **BH04: K = 1.52 x 10^{-7} m/s**

Although these tests were limited in nature, a similar recharge response is demonstrated in boreholes 1,2 & 3. The aquifer in BH04 is situated deeper at 109 mOD than the other boreholes which may explain the decrease in hydraulic conductivity observed. The K value for BH04 is two orders of magnitude lower than the other boreholes.

8.4.13.6 Transmissivity Calculations – Mini-pump & recovery test

A crude mini pump & recovery test was carried out at each of the boreholes on 27.5.2022. Each borehole was bailed out until the groundwater level had dropped significantly. The rate of abstraction was noted, and recovery of groundwater levels monitored over time with an electronic dip meter.
Using the limited data from the mini-pump tests on each of the boreholes a crude estimate of transmissivity was made. The recharge data following abstraction shut off was examined and calculations based on Theis's recovery method used to estimate KD (transmissivity m^2/day) on the site. The data and calculations are presented in Appendix 8.5.
The results are treated with caution as the pump test was of short duration and many assumptions have been made regarding the aquifer properties. Irish aquifers tend to be generally heterogeneous, anisotropic and not aerially infinite so there is likely to be a high degree of error associated with these calculations. However, the results obtained are broadly in line with what is expected:

Transmissivity

- **BH01: KD = 0.4 m^2/day**
- **BH02: KD = 0.08 m^2/day**
- **BH03: KD = 0.08 m^2/day**
- **BH04: KD = 0.0014 m^2/day**

It is seen that the slate has variable and extremely low transmissivity. This is evident in the lack of seeps and groundwater flows through the existing quarry faces and the relatively long recharge response times to the mini-pump tests. The GSI list poorly productive aquifers (Pl, Pu & Ll) as having transmissivity values of less than 10 m^2/day.
The results of the mini pump & recovery test are broadly consistent with those of the slug test.

8.4.13.6 Conceptual Hydrogeology

A conceptual site model has also been generated for the hydrogeology of the site and is shown in Figures 8.13 & 8.14. Figure 8.13 is a cross sectional conceptual model showing the site across a north-south axis. Figure 8.14 is a cross sectional conceptual model showing the site across an east-west axis. Neither conceptual model is shown to scale. The cross-section lines are depicted on Figure 8.12 below.

Figure 8.12: Lines of cross section for conceptual hydrogeological models

Figure 8.13: Conceptual Hydrogeological model across north south axis

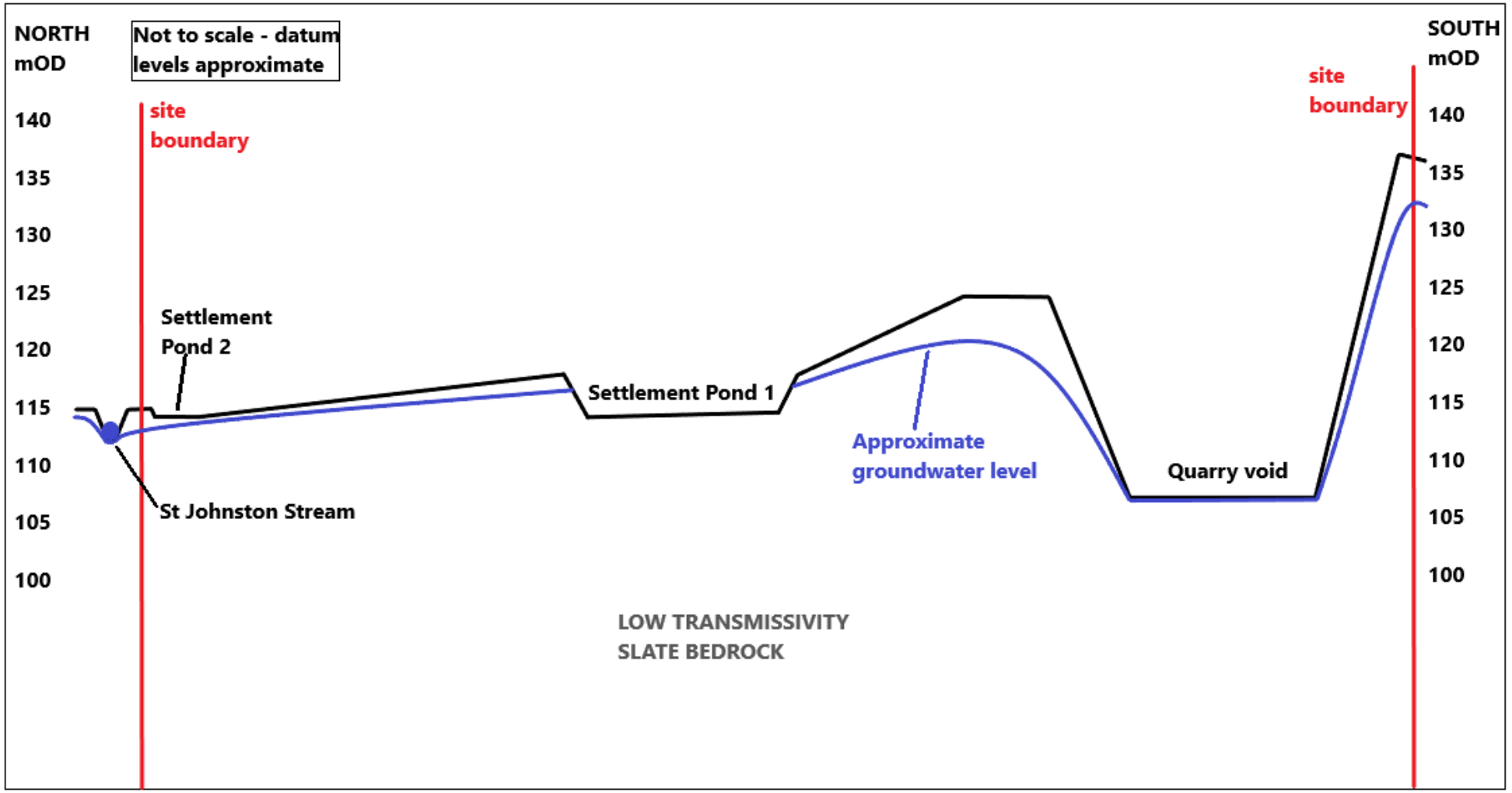
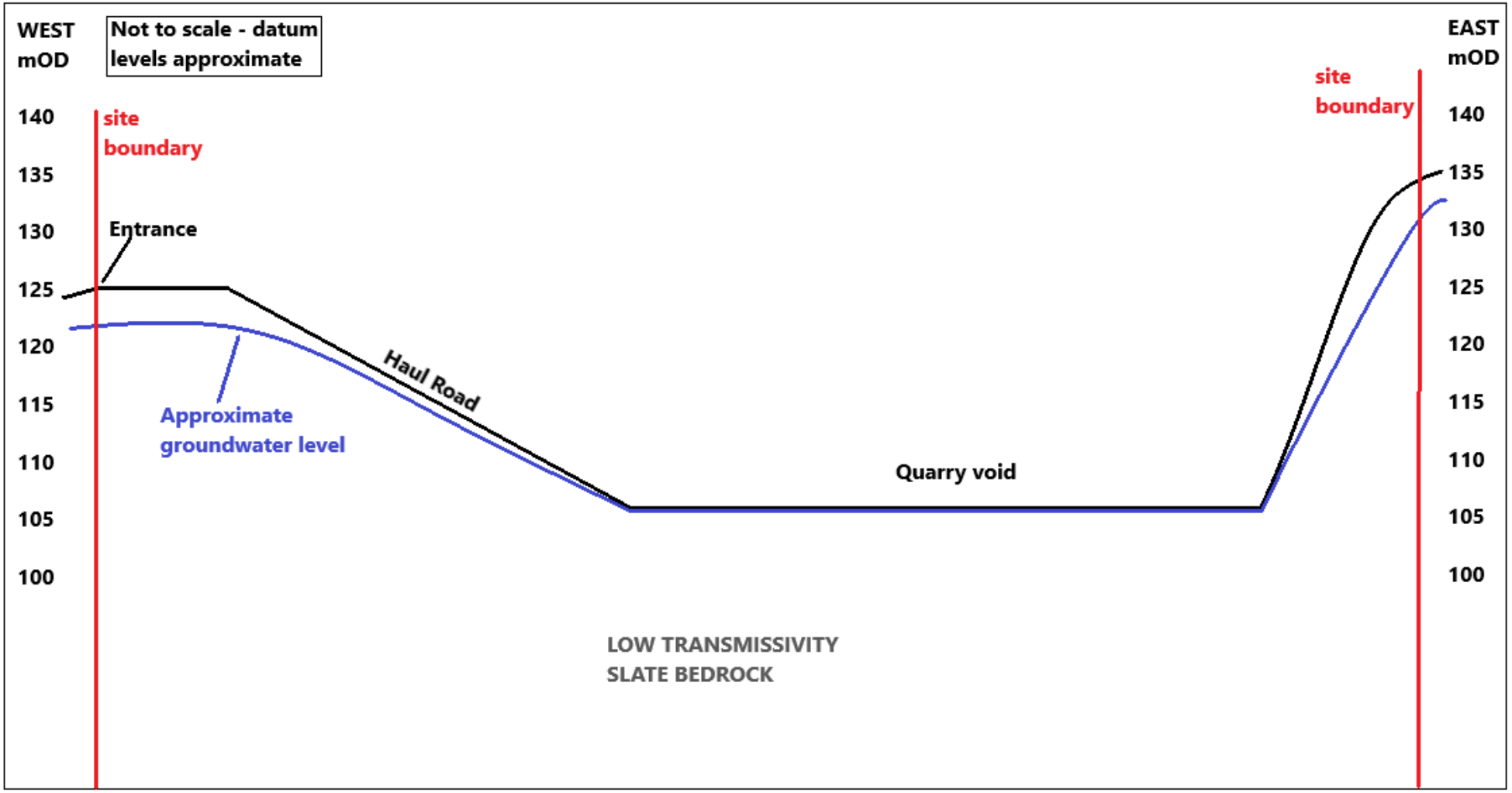


Figure 8.14: Conceptual Hydrogeological model across east west axis



In the conceptual site model, the cone of depression created by the existing quarry void is seen to be steep and does not appear to extend for any significant distance beyond the edge of the quarry faces. This is likely to be due to the low transmissivity properties of the aquifer concerned.

8.4.14 Existing Groundwater Quality

After installation of boreholes, BH01, BH02, BH03 & BH04, groundwater was allowed to settle for several weeks. The boreholes were purged and samples taken with a manual bailer on 20.4.2022, 13.5.2022 & 22.6.2022. A fresh bailer was used for each borehole sample. The samples were analysed for a range of parameters and a summary of the analysis provided in Table 8.5 below. Certificates of analysis are presented in Appendix 8.1.

Table 8.5: Groundwater chemical analysis

Sample	Date	Parameter					
		pH	SS mg/L	Conductivity µS/cm	Ammonia mg/L	Total N mg/L	Orthophosphate mg/L
BH01	20.04.22	7.11	6		0.06	2.05	<0.01
	13.05.22			511			
	27.05.22			1017			
	22.06.22			701			
BH02	20.04.22	6.36	<5		<0.01	2.69	<0.01
	13.05.22			325			
	27.05.22			437			
	22.06.22			373			
BH03	20.04.22	7.41	<5		0.03	1.96	<0.01
	13.05.22			211			
	27.05.22			316			
	22.06.22			168			
BH04	20.04.22	7.87	22		<0.01	2.13	0.02
	13.05.22			319			
	27.05.22			356			
	22.06.22			330			

Overall, groundwater quality in all four monitoring boreholes is very good. There were no exceedances of any of the Environmental Quality Standards set in the Drinking Water Regulations (S.I. 122 of 2014) or of the Groundwater Regulations (S.I. 9 of 2010), or no exceedances of any of the EPA's Interim Guideline Values set in the Interim Report of 2003 – 'Towards setting guideline value for the protection of groundwater in Ireland.'

8.4.15 Surface Water-Groundwater Interactions

Due to the previous quarrying activity that has taken place on site a significant quarry void has been created. The quarry void has an approximate datum level of 107 mOD. There are also numerous ponds within the void, most of which are located near the base of the various quarry faces. There was no lateral water movement observed in any of these ponds. Any ponding of water near where extraction and processing activities are located is periodically pumped out. The level of water in the central quarry void was seen to rise in periods of wet climactic conditions. The water level rise is likely to come from surface water runoff captured within the quarry void and seasonal variations in the underlying water table.

Information supplied by the applicant details that pumping only occurs after a period of rainfall. During a wet week, typically the pump is required to be activated first thing in the morning for approximately an hour. In periods of relatively dry weather the pump is not required at all.

The pump is a mobile Hilta TW HyDry C150 with a 150 mm flexible pipe and directs water to Settlement Pond 1. Settlement Pond 1 is a large body of water contained within a previously excavated area in the northern portion of the site. It is elevated compared with the quarry void and the water level is surveyed at 117.17 mOD. Historically the excavation areas have moved within the quarry void and subsequently the ponds that have formed have moved position with the extraction areas. Photograph 8.5 below shows the pipe from the pump leading to Settlement Pond 1. The photograph was taken from the quarry void looking northwest.

Photograph 8.5: Pumping from the quarry void to Settlement Pond 1

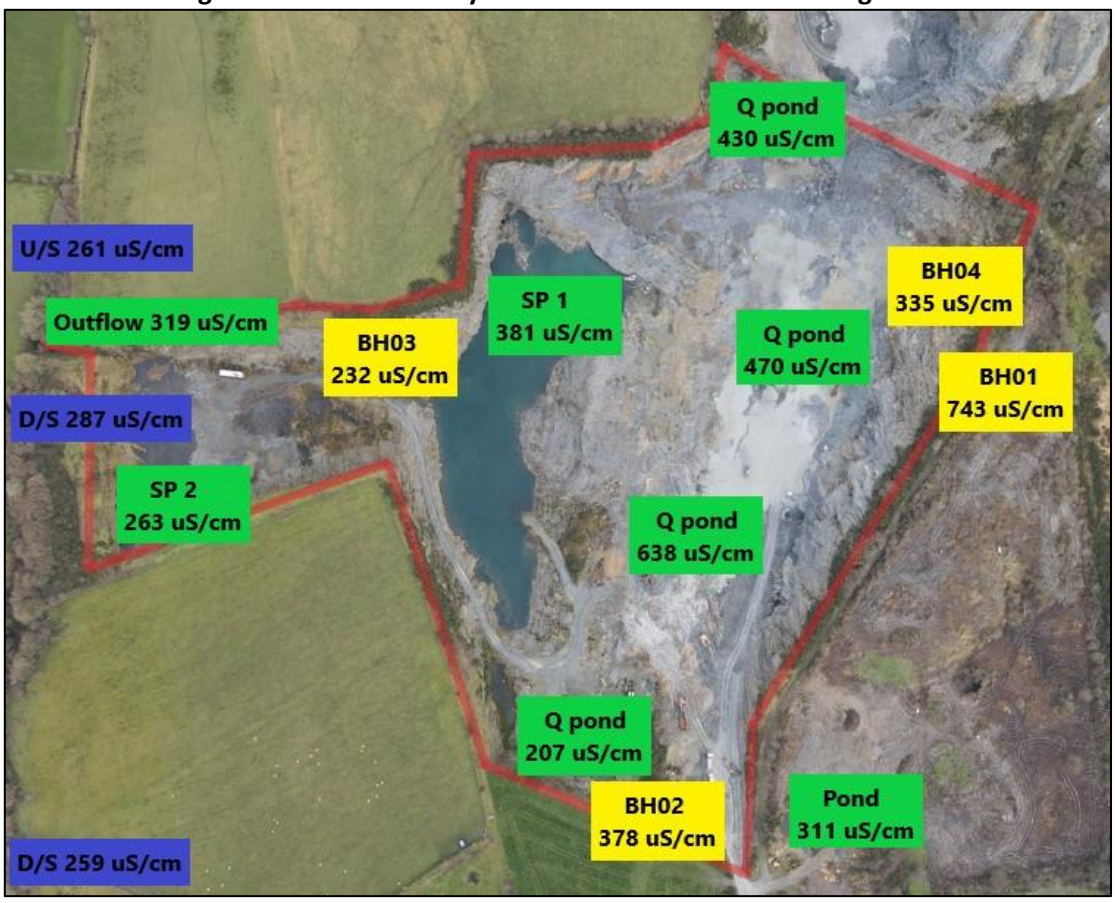
Many of the pools of water on site are likely to be surface representations of the groundwater table that have been exposed due to excavation.
The water pooling in the central part of the quarry void is likely to be groundwater mixed with surface water runoff. As demonstrated by the slug tests and recovery tests on the boreholes (Sections 8.4.13.5 & 8.4.13.6) groundwater flow is expected to be extremely slow, particularly in the deepest part of excavations within the quarry void. This is consistent with the observations made on site and information supplied by the applicant regarding when waters rise in the quarry void and when pumping is required.

8.4.15.1 Conductivity

To assess the surface water and groundwater contributions to the standing and flowing water on site, a series of conductivity measurements were taken. The measurements were taken from the outflow, the four monitoring boreholes and various ponds/sumps/flows within the site and surrounding area. Borehole locations are shown in yellow on Figure 8.15, ponds and flows within and close to the site are shown in green and stream locations with the tributary of the St Johnston stream are shown in blue. The samples were sent to Aqualab for conductivity analysis and the results are summarised below in Figure 8.15. Values are given in µS/cm. Where more than one measurement of conductivity was taken for the same sample point over two or more dates, the average figure is presented. Certificates of analysis are presented in Appendix 8.2.
Groundwater from the boreholes on site is seen to have variable conductivity values averaging at 422 µS/cm. The ponds within the main quarry void show considerable groundwater influence and show an average value of 513 µS/cm.
The main pond on site, Settlement Pond 1, has an average conductivity value of 381 µS/cm. It is likely that Settlement Pond 1 is groundwater fed with an additional supply of surface water runoff from the surrounding area and water pumped from the quarry void which is a mixture of surface and groundwater.

The other two ponds sampled outside the quarry void, Settlement Pond 2 and the pond nearest the western boundary of the site, show relatively low conductivity readings. These ponds may be predominantly surface water fed.
The average outflow conductivity was 319 µS/cm which would appear to be surface water with a groundwater contribution. The pond just outside the quarry entrance has conductivity value of 311 µS/cm which suggests a mixture of groundwater and surface water.
Conductivity in the St Johnston stream tributary was around 260 µS/cm upstream of site discharge and approximately 400 m downstream of the site discharge. Immediately downstream of the discharge point, the stream showed a slightly elevated conductivity readings of an average of 287 µS/cm which is likely to be due to the groundwater influence within the discharge waters.

Figure 8.15: Conductivity values for water sources through site



8.5 Receiving Environment

8.5.1 Designated Areas

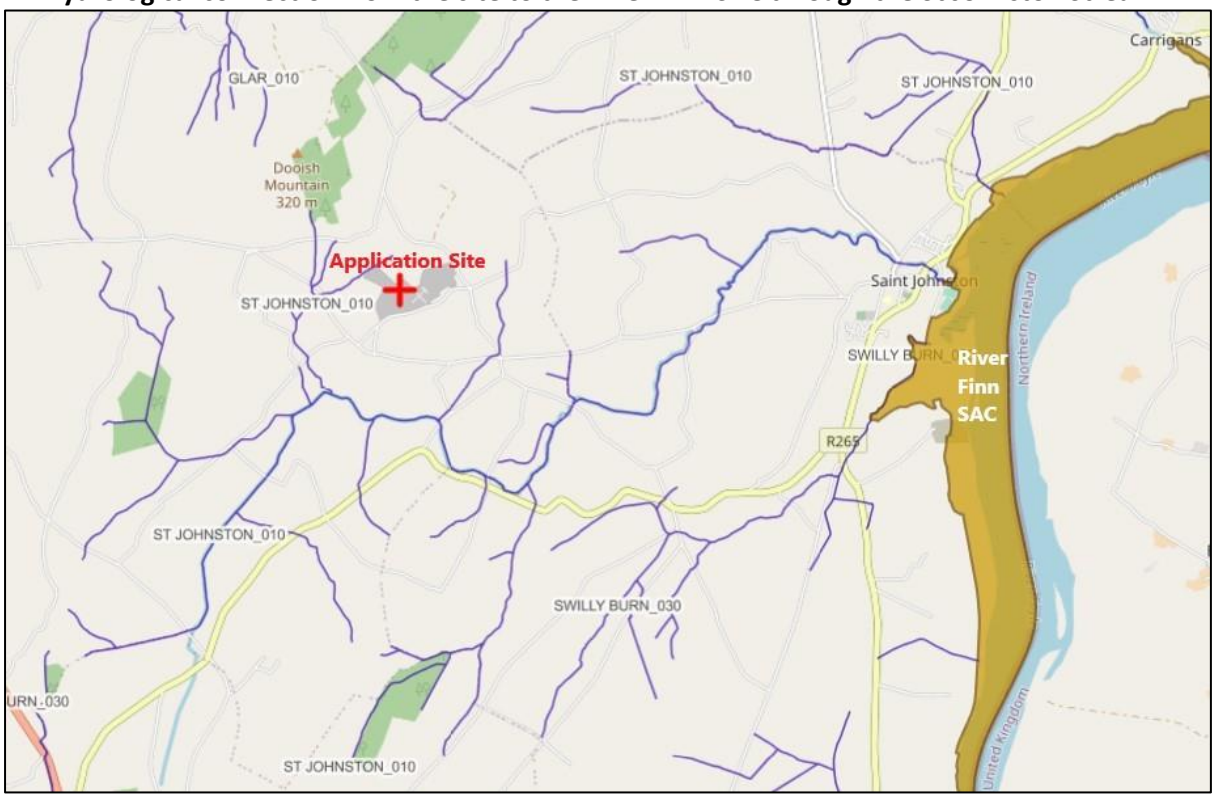
The River Finn SAC is located 4.37 km east of the site (site code 002301). Lough Swilly SPA is located 8.1 km north of the site (site code 004075). Lough Swilly SAC is located 7.62 km north of the site. The River Foyle and Tributaries SAC is located in Northern Ireland and since 1 January 2021, nature conservation areas in the UK (including Northern Ireland) are no longer considered to be a part of the Natura 2000 network[1]. Under best practice, Greentrack have screened in this SAC. The River Foyle and Tributaries Special Area of Conservation (Site Code UK0030320) is located 4.37 km east of the site.

From a hydrological perspective the designated sites that are connected by a surface or groundwater link is the River Finn SAC and River Foyle and Tributaries SAC. Water flowing off the site flows in to a tributary of the St Johnston stream which in turn flows into the Foyle system. The River Finn SAC and

[1]Office of the Planning Regulator - https://www.opr.ie/wp-content/uploads/2021/03/9729-Office-of-the-Planning-Regulator-Appropriate-Assessment-Screening-booklet-15.pdf

River Foyle and Tributaries SAC form part of the Foyle system. The River Finn SAC and River Foyle and Tributaries SAC are 4.37 km east of the site but the hydrological flow path from the site to where the St Johnston Stream empties into the Foyle system is approximately 8.4 km. Figure 8.16 below shows the connection from the site to the River Finn SAC and River Foyle and Tributaries SAC through the St Johnston Stream.

Figure 8.16:
Hydrological connection from the site to the River Finn SAC through the St Johnston Stream.



Produced using EPA Map viewer

The qualifying interest of the River Finn SAC are:

- Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae) [3110]
- Northern Atlantic wet heaths with Erica tetralix [4010]
- Blanket bogs (* if active bog) [7130]
- Transition mires and quaking bogs [7140]
- Salmo salar (Salmon) [1106]
- Lutra lutra (Otter) [1355]

The qualifying interest of the River Foyle and Tributaries SAC are:

- Atlantic Salmon *(Salmo salar)*
- Otter (*Lutra lutra)*
- Water courses of plain to montane levels with the Ranunculus fluitans and Callitricho-Batrachion vegetation
- Sea Lamprey
- River Lamprey
- Brook Lamprey
- Freshwater Peral Mussel

Any historical or potential impact on hydrology due to activities connected (directly or indirectly) with the subject site may have potential impact on these habitats/conservation interests. This issue is dealt with in detail in the remedial NIS which will also accompany the substitute consent application.

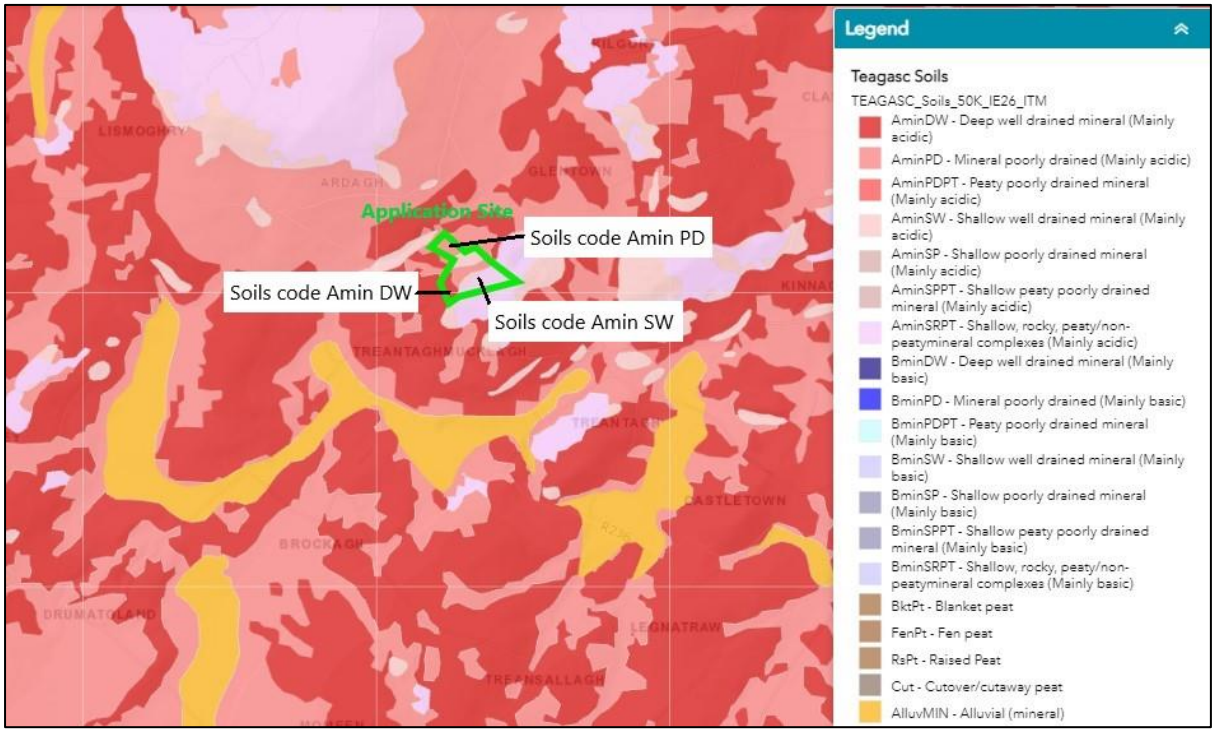
8.5.2 Soil

There are no undisturbed soils left on site. Almost all ground has been stripped of soil for excavation or for the creation of haul roads or other site infrastructure. Pre-development there would have been three classifications of soils on the application site available from the GSI website.

A large portion of the site would have been categorised as Amin SW which is described as a shallow well mineral soil (mainly acidic). A significant proportion of the site would have been classified as Amin PD which is described as a poorly drained mineral soil (mainly acidic). A small portion of the site in the southwest would have been categorised as Amin DW which is described as deep well drained mineral soil (mainly acidic).

Figure 8.17 shows an extract from the GSI webviewer depicting the soils on the application site. The soils of the site are discussed in more detail in *Section 7 Land, Soils and Geology*.

Figure 8.17: Soil on the application site



(from GSI webviewer)

8.5.3 Bedrock Geology

The area is underlain by meta-sedimentary rocks which are assigned to the Lough Foyle Succession of the Dalradian. Most of the rocks in the Lough Foyle Succession belong to the Argyll Group and the Southern Highland Group of Middle to Upper Dalradian age, and the rocks were originally deposited about 600 to 700 million years ago. The most recent geological map of the area is Geology of North Donegal, 1:100,000 scale, published by the Geological Survey of Ireland, in 1997. The quarry itself is in the upper part of the Lough Foyle Succession and the rocks are of Cambrian age. The stratigraphic sequence in the Lough Foyle succession is poorly understood due to intermittent exposure and structural complexity. The main lithologies present are meta-greywackes/psammites and meta-pelites/slates. All the strata exposed in the application site are slates.

A full description of the geology of the site is given in Section 7, Land, Soils and Geology, and in Appendix 7.1, Geological Report.

8.5.4 Aquifer Classification and Potential Recharge

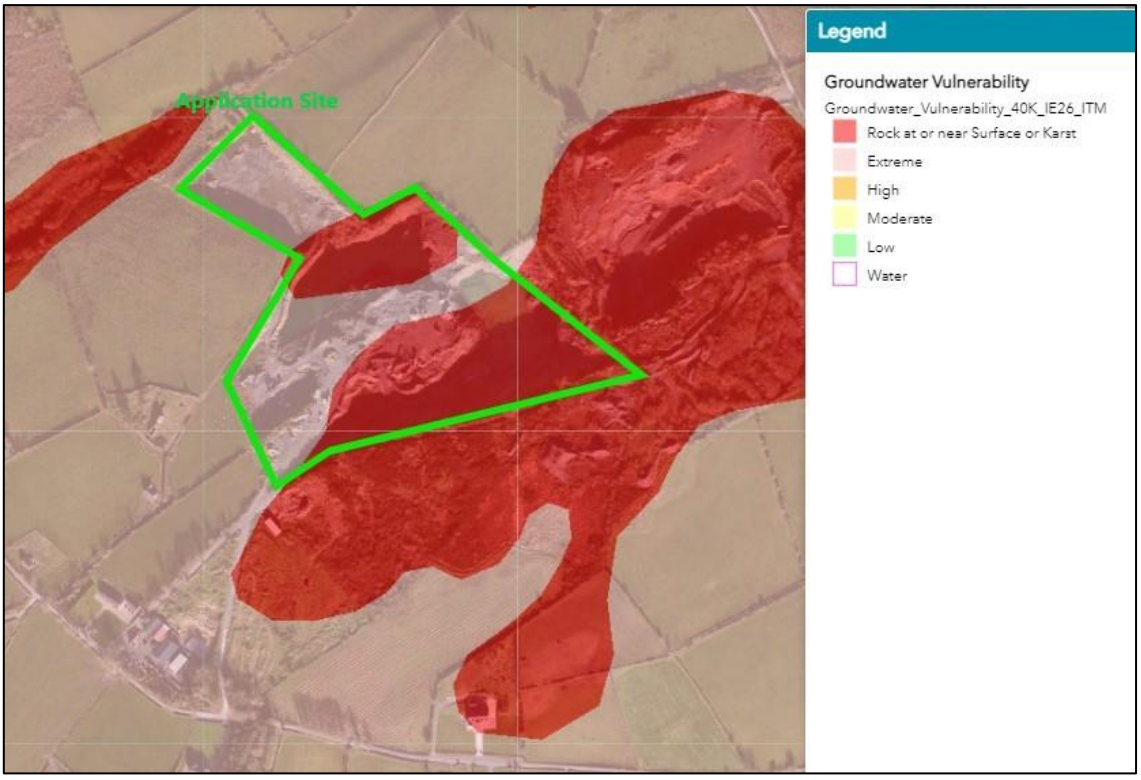
The Lough Foyle Succession is listed as the bedrock underlying the site. These rocks are classified by the Geological Survey of Ireland (GSI) as being a poor aquifer and generally unproductive with only locally productive zones. Aquifer recharge occurs diffusely through the subsoil and outcrops and is limited by the low permeability of the bedrock. Groundwater recharge is limited due to the general impermeability of the underlying bedrock and is capped at 100 mm/year by GSI estimates.

8.5.5 Groundwater Vulnerability

A search of the GSI database on aquifer vulnerability revealed that most of the site has exposed rock, or rock near to the surface and the remainder of the site has the aquifer vulnerability classed as extreme.

In reality most of the soils/subsoils have been stripped from the site so the majority of the site has exposed rock at the surface. Figure 8.15 below shows the classification of groundwater vulnerability on site.

Figure 8.18: Aquifer vulnerability classification



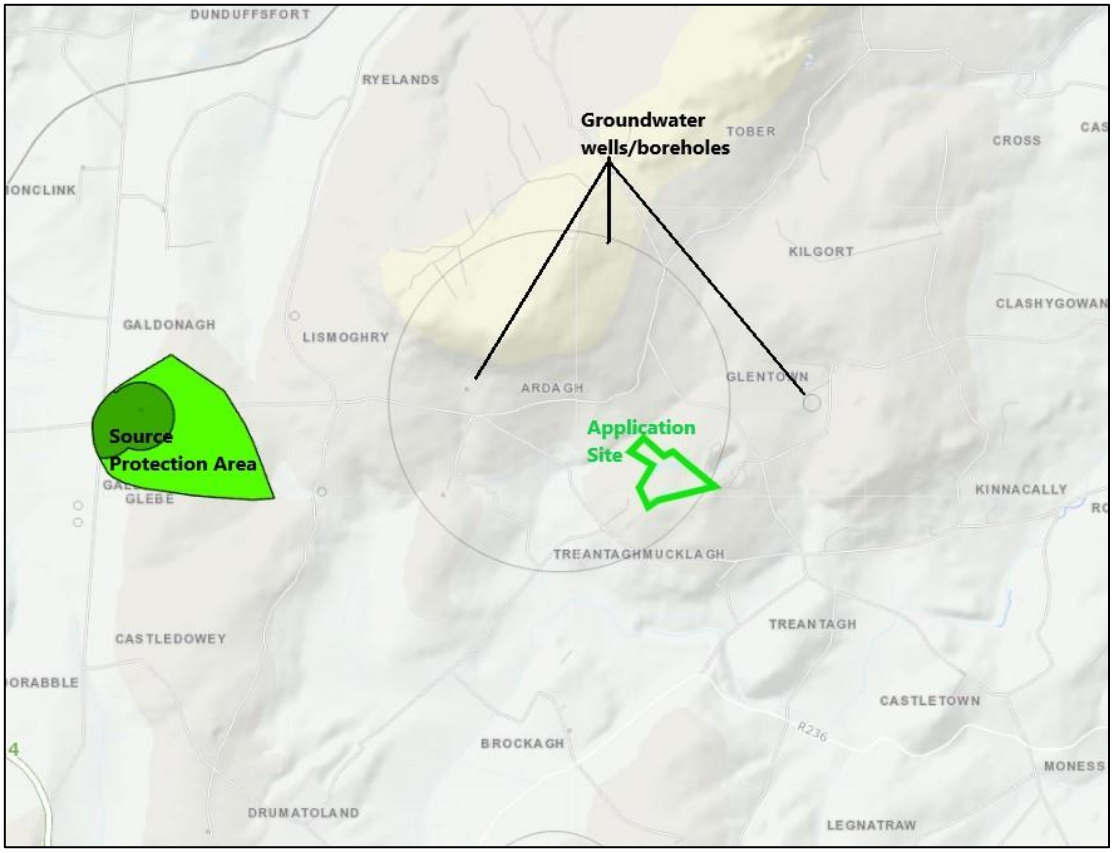
(from GSI mapviewer)

8.5.6 Source Protection Areas and Groundwater Wells

A search for the nearest EPA source protection area to the site found that the nearest Source Protection Area is 2.1 km west in a separate hydrological catchment area in the townlands of Magherabeg/Veagh. There are approximately 8 recorded groundwater wells within 3 km of the application site. There are no wells within the zone of influence of the site. The nearest listed wells to the site are located in the townlands of Ardagh (510 m NW) and Glentown (775 m NE). Figure 8.19 below shows the groundwater wells in the vicinity of the site. On the historic 6'' map series there are no springs or wells listed in the vicinity of the site.

In addition to the listed wells there are several dwellings surrounding the application site which utilise shallow groundwater wells for drinking water supplies. There is also a spring on the side of the L-5414 approximately 250 m northwest of the site that is used by local people for drinking water. None of these local wells and springs are within the zone of influence of the application site.

Figure 8.19: Groundwater Wells



(from GSI mapviewer)

8.5.7 Regional Hydrology

8.5.7.1 Surface Water

The subject site is located within the Northwestern River Basin District, hydrometric area 01 – Foyle (BGNIIENW) and Johnston Stream sub catchment area (JohnstonStream_SC_010), and St Johnston River Sub Basin (St Johnston_010). Figure 8.16 shows the regional network of watercourses flowing east towards the Foyle.

8.5.7.2 Surface Water Quality

There are no EPA monitoring points on the tributary of the St Johnston Stream directly linked to the application site. There are 4 historical EPA monitoring points along the main reach of the St Johnston Stream. The latest Q values for all these monitoring stations indicate a range of Q values from 1 (bad) to 4 (good) ecological status. Only one of the monitoring results was relatively recent and taken in 2019. This was the value of Q4 (good ecological status) and the sampling point was immediately upstream of the village of St Johnston. Other Q values are historical taken in 1990 and 1981 and may have limited relevance for current studies.

Greentrack conducted an ecological assessment of the receiving waters of the tributary of the St Johnston Steam upstream and downstream of the discharge point. The ecological assessments were made using a standard kick sample.

The assessed Q score for the stream downstream of the discharge point was 3-4 indicating 'good' water quality. The assessed Q score for the stream upstream of the discharge point was 3 indicating moderate water quality. These Q scores and the approximate assessment points are shown in 8.20 below. Further details on the ecological assessments are provided in Appendix 8.6.

Figure 8.20: Q values for the St Johnston Stream

(from EPA mapviewer)

In addition to ecological assessment, an assessment of the water chemistry of the receiving waters was made. The results of samples analysed as part of this study and those taken as part of the discharge licence conditions are presented in Table 8.6 below. All samples are taken from the tributary of the St Johnston stream. Sample point 1 relates to upstream of the site discharge, sample 2 from downstream of the site discharge and sample 3 upstream of the Glen Bridge. The sample points are indicated on Figure 8.5.

Table 8.6: Water Chemistry of Receiving Waters

Sampling Date	Sample Point	Parameter						
		pH	SS mg/L	Total Phophorus (as P) mg/L	COD mg/L	Ammonia mg/L	Orthophosphate (as P) mg/L	BOD mg/L
13.05.2022	**1**	8.13	<5					
13.05.2022	**2**	7.98	<5					
23.05.2016	**4**	8.36	<1	0.17	<16	0.05	0.03	1.04

An examination of these results shows that the chemical quality of the waters in the St Johnston stream are high. BOD and Ammonia values are in the category of 'high' ecological status as defined in the Environmental Objectives Surface Water Regulations values (S.I. 272 of 2009). The values for pH are within the accepted range of 6-9, and suspended sediment values are below laboratory detection levels and lower than the 25 mg/L threshold specified in the Freshwater Fish Directive (2006/44/EC).

8.5.8 Regional Hydrogeology

The regional groundwater body is the River Foyle groundwater body, EPA code IEGBNI_NW_G_051. For the purposes of WFD water management, groundwater in Ireland is assigned, assessed, and managed within 514 local groundwater bodies, which range in size from < 1km^2 to 1,887km^2. The

application site lies within the Northwest Donegal Groundwater Basin and the River Foyle Groundwater Body discharging surface water and groundwater directly into the River Foyle as its eastern boundary. The following is an extract from the description for the River Foyle Groundwater Body by the GSI:

'In the absence of inter-granular permeability, groundwater flow is expected to be concentrated in upper fractured and weathered zones and in the vicinity of fault zones. Groundwater level data points are mainly <6 m below ground level. Unconfined groundwater flow paths are short (30-300 m), with groundwater generally following the topography and then discharging rapidly to seeps, small springs and streams. Water strikes are only marginally deeper than the estimated interconnected fissure zone and are associated with low yields. Shallow flow is more likely to be dominant. Overall, groundwater flow is eastwards, towards the R. Foyle.

Groundwater will discharge locally to streams and rivers crossing the aquifer and also to small springs and seeps. Owing to the poor productivity of the aquifers in this body it is unlikely that any major groundwater - surface water interactions occur. Baseflow to rivers and streams is relatively low.'

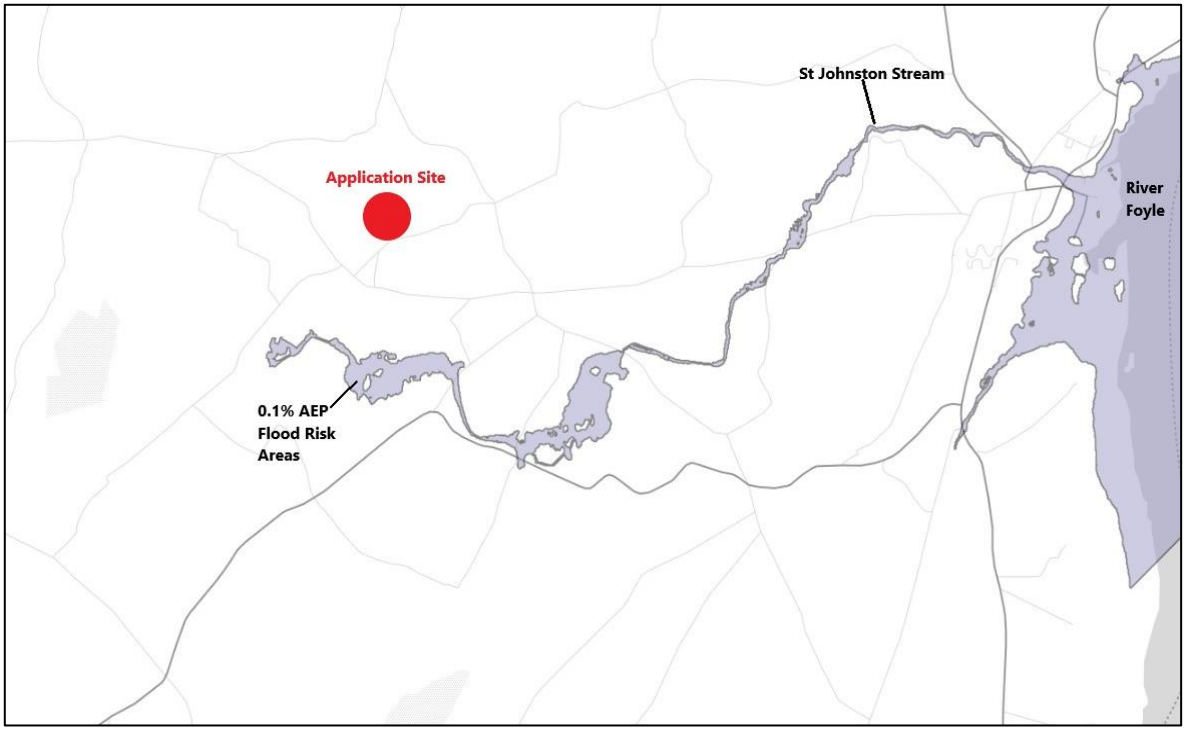
8.5.8.1 Groundwater WFD Status

Article 8 of the Water Framework Directive requires the establishment of programmes of monitoring for groundwater. The groundwater monitoring programmes by the EPA primarily focus on providing information that can be used to assess the environmental status of groundwater bodies. Groundwater in the region for the monitoring period 2013-2018 achieved 'good' quality status. The River Foyle Groundwater Body is considered 'not at risk' by the EPA.

8.5.9 Flood Risk

An appraisal of the available flood maps was made to determine if there was any flood risk at the site or if any of the extraction and processing activities had been likely to increase the risk of flooding either at the site or elsewhere. An examination of the flood maps (floodinfo.ie) for the area show the application site and surrounding area to be at low risk of river flooding events. The flood risk map in relation to the application site is shown below in Figure 8.21. The layers active are the low probability of flooding, 0.1% AEP (1 in a 1000 chance of occurring) and the high-end future scenario is also modelled. This takes in the potential effects of climate change modelling an increase in rainfall of 30% and sea level rise of 1,000mm.

Figure 8.21: Flood Risk in the area around the application site



(Image from floodmaps.ie)

There are no recorded flood events within 2.5 km of the application site. The closest recorded flood event is a recurring flood event in the townland of Ryelands approximately 5 km to the northwest. The source of this recurring flood is runoff. There is no hydrological connection between this flood event and the application site.

The site will have had the topsoil stripped and used to create screening berms leaving an exposed rock surface at various depths over the course of extraction. The rock surface may have had potential to create a flashier response to rainfall events than the undeveloped ground. However, any increase in rainfall response times is likely to have been attenuated by the creation of voids and ponds within the quarried area.

There is currently a vast quarry void with a footprint of over 2 hectares and potential to be filled to a minimum of 10 m depth. This is a possible 200,000 m^3 attenuation capacity and more than offsets any slight increase in rainfall response times. Over the course of extraction, the quarry void would not have been as large as its current size, but significant ponds and voids would have evolved with extraction to more than compensate for slight increases in rainfall response times.

8.6 Water Management

Mechanisms and infrastructure have been in place to ensure that effluent leaving the site is treated and will not negatively affect surface or groundwaters. The greatest threat to water quality leaving the site is from untreated or poorly treated effluent. The main source of effluent will be incident rainfall on extraction and working areas of the proposal leading to contaminated runoff.
The existing site drainage is described in section 8.4.9 and shown in Figure 8.4.

Historically over the recent extraction period, water movement through the site has remained broadly similar. Within the quarry void, over time, the point of extraction has changed and with it the point to which surface waters naturally flow within the void. This has meant that different areas of the quarry void have required pumping and waters have always been pumped to the large pond for settlement and discharge has been through the secondary settlement pond and the same outflow point.

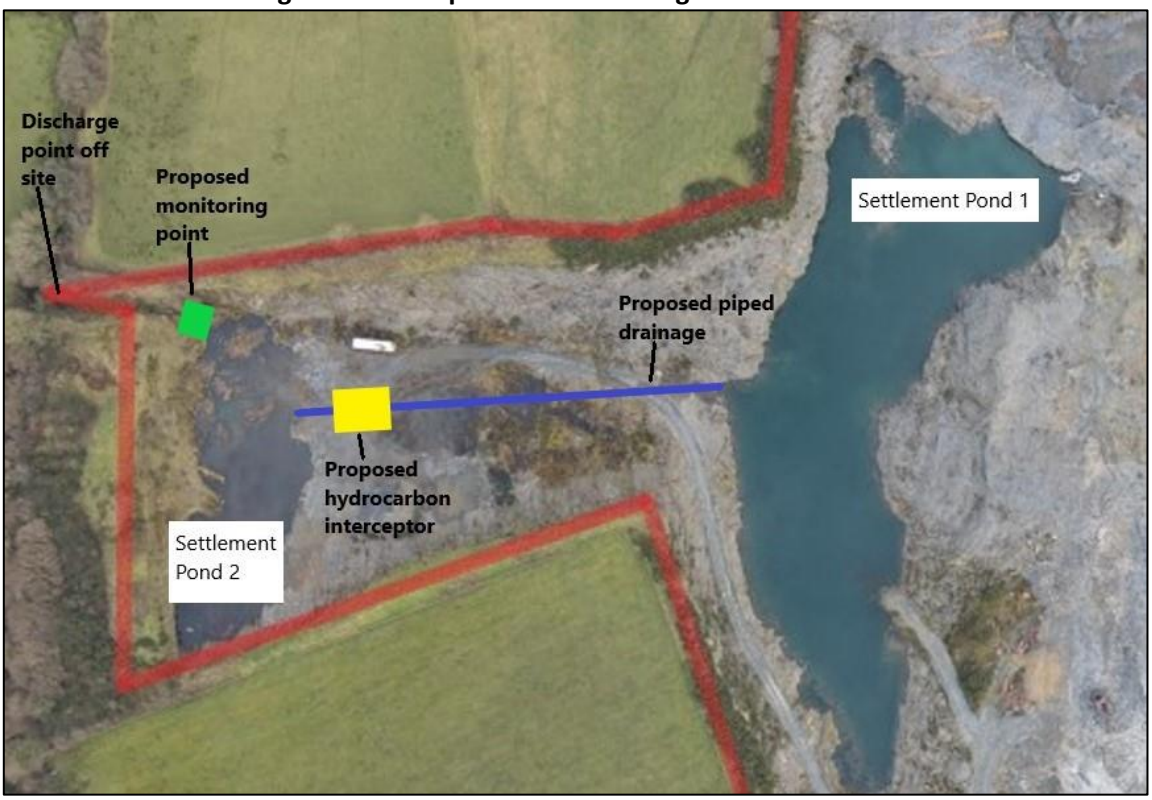
Between Settlement Ponds 1 & 2 flow is by gravity through unregulated surface channels. Part of the flow is direct to Settlement Pond 2 through a meandering channel following the route of a redundant haul road, and part of the flow is diverted through a naturalised wetland area to Settlement Pond 2. Water quality monitoring as part of this study and conditioned by the discharge licence have shown that the quality of effluent leaving the site is high and there does not appear to have been any significant negative impact on the water quality of the receiving waters.

The channel through which site outflow is directed to the receiving waters is heavily vegetated and will provide further attenuation. Photograph 8.1 in Section 8.4.12.1 shows the discharge channel.

8.6.1 Proposed Drainage

It is proposed to regularise the drainage between Settlement Ponds 1 & 2. Currently this is unregulated flow over a redundant haul road. It is proposed to pipe this flow directly between Settlement Pond 1 & 2 and install a hydrocarbon interceptor as best practice. There is no evidence of any historical hydrocarbon contamination associated with the activities on site but is recommended as best practice before discharge of waters off site. Also recommended is a dedicated monitoring point where grab samples for chemical analysis and flow rate measurements can be taken. It is recommended that the sample point be installed at the outflow of Settlement Pond 2 immediately before discharge off site. The position of the proposed drainage between Settlement Ponds 1 & 2, hydrocarbon interceptor and monitoring point are shown in Figure 8.22 below.

Figure 8.22: Proposed water management measures



8.6.2 Effluent Treatment

It is likely that the main contaminant arising from activities on site would have been suspended sediment contained within runoff. Effluent from the extraction and processing areas has been treated by settlement.

Over the course of recent extraction history (1978 – 2022) all areas of the site have been worked out to varying degrees. Historical aerial photographs available on Google Earth Pro ™ show processing machinery in different part of the site from 2010 to present. Information from the applicant states

that runoff from extraction and processing areas was always directed towards the nearest available pond/sump for settlement treatment before any potential discharge from site. There are no records available of sizes/depths of settlement ponds used over the course of extraction history.

The current treatment system is examined for effectiveness.

All relatively recent extraction and processing activities have taken place within the main quarry void. The northern portion of the site around Settlement Ponds 1 & 2 was last worked c. 2010. The northern outshot of the site where Settlement Pond 2 is located is now a redundant area of the quarry and has been let recolonise for biodiversity benefits.

Any surface water runoff within the main quarry void is directed to any one of a number of temporary ponds within the void. The exact location of the temporary ponds changes with the extraction location on the quarry floor. There is also a significant groundwater contribution to these temporary ponds as discussed in Section 8.4.15.1. The ponds are pumped out using a mobile water pump on as-needed basis. Effluent is pumped to Settlement Pond 1. If there are no significant amounts of rainfall to generate runoff, the temporary ponds generally remain dry after pumping due to the extremely low transmissivity of the bedrock.

Settlement Pond 1 has been formed from a previously worked out area and holds a significant volume of water. The base of the pond varies between 116 mOD and 114 mOD and sits at a higher level than the main quarry deck which is at approximately 107 mOD (Photograph 8.5, Section 8.4.15 refers). There are no observed leaks or seeps through the quarry face from the pond due to the extremely low transmissivity of the bedrock on site.

The footprint of Settlement Pond 1 is approximately 8,765 m^2 and at an average depth of 2.5 m has a capacity of 21,913 m^3.

Flow from Settlement Pond 1 is to Settlement Pond 2 via unregulated surface flow. There is a proposal to pipe this connection to regularise the flow path.

Settlement Pond 2 is a previously worked out portion of ground close to the northern boundary of the site adjacent to the site discharge point. The general area around Settlement Pond 2 has recolonised with vegetation and in particular wetland vegetation including reeds and bulrushes. The footprint of Settlement Pond 2 is approximately 2,400 m2 and has an average depth of 0.5 m providing an additional settlement capacity of 1,200 m^2. Settlement, and in particular treatment function, provided by Settlement Pond 2 will be higher than calculated by settlement alone due to the complex bio-geochemical processes occurring within the wetland plant root zone aiding contaminant removal and increasing settlement function.

Settlement Pond 1 & 2 provide total settlement capacity on site of 23,113 m^3.

8.6.2.1 Area generating effluent

With regard to effluent treatment, the calculations below relate to the extraction and working area of the current site. There is also discussion below as to the likely areas generating effluent in a historical context. The total catchment at its maximum is estimated at 73,366 m^2. The area estimation was made with the aid of online mapping tools, topographical maps for the site and on the ground verification of flow directions and catchment areas. The three sub-catchments identified on site are shown in Figure 8.3. The sub-catchment on the western side of the site, shown in yellow on Figure 8.3, appears to discharge to ground and is not included in settlement calculations. This area appears to have been a redundant working area for some time.

The total drainage area requiring effluent treatment is taken as 73,366 m^2.

8.6.2.2 Effluent Volumes

To calculate sufficient settlement capacity the average runoff rates for the site are used with the settlement capacity to estimate residence time in the treatment system. To calculate average runoff rates the annual effective rainfall is assessed against the amount of rainfall that will percolate into the groundwater system. Effective rainfall (ER) is the average amount of incident rainfall minus the amount of Actual Evapotranspiration (AE). AE is usually calculated as 82% of Potential Evapotranspiration (PE). (The 82% figure has been used in recent studies and will calculate a higher ER rate than the customary 95% calculation rate which has been traditionally used). PE figures are available from Met Eireann for Malin Head. Malin Head is the nearest Met Eireann synoptic recording station located approximately 50 km to the north of the application site. Annual mean PE is 527.3mm.

AE = PE * 82 % ***AE = 432.4 mm***

However, the AE figure for the application site will be considerably less due to the lack of vegetation. A conservative figure of 50 mm AE is estimated for the site.

Average annual rainfall (AAR) can be taken from long term data sets produced by Met Eireann (1981-2010). The figure from Malin Head is 1,076mm. A more representative average annual rainfall figure is obtained from the Met Eireann Carrigans metrological station, 10 km east of the application site. The average annual rainfall for the last available 5 years data (2020 – 2016 inclusive) is 1,054 mm.

The effective rainfall represents the water available for runoff and groundwater recharge. The effective rainfall for the site is calculated as follows:

- **Effective rainfall = AAR – AE**
- **ER = 1054 mm – 50 mm**
- **ER = 1004 mm**

A proportion of runoff will percolate into the ground and become groundwater. The calculations for this site are based on most of the site being stripped of topsoil and effectively bare rock. Bare rock runoff coefficients vary between 0.82 and 0.94. The figure of 0.94 is used because of the observations regarding the low transmissivity of the slate bedrock. This means that of the 1,004 mm effective rainfall approximately 944 mm will generate runoff. This figure equates to an annual runoff figure for the site of 69,257 m^3 for the drainage area. This approximates to a daily runoff figure of 190 m^3 from incident rainfall requiring effective treatment before discharge off site.

8.6.2.3 Treatment Capacity and Residence Time

Settlement ponds and tanks are designed so that under ideal conditions all particles having an equivalent spherical diameter of d (typically 0.006mm) or greater are removed. Ideally the settlement tank will have parallel sides and a smooth floor to induce horizontal linear flow within the pond. To prevent re-suspension of sediment in a settlement pond a depth of at least 1m should be maintained. The minimum residence time for settlement of sediment varies from quarry to quarry dependent on a number of variables. In ideal conditions a settlement tank should have a retention time of greater than 11 hours to settle out particles with a diameter greater than 0.006mm. (A retention time of 24 hours is recommended for particles with a diameter greater than 0.004mm (fine silt)). This allows most of the suspended sediment to settle out of solution.

The total available settlement capacity is provided by Settlement Pond 1 (21,913 m^3) and Settlement Pond 2 (1,200 m^3). The total settlement capacity provided is 23,113 m^3. Additional settlement capacity may be provided by temporary sumps/ponds on the quarry deck but these are not taken into consideration for these calculations.

The residence time for the average daily runoff amount of 190 m^3 will be approximately 122 days. This is more than adequate time to settle sediment out of solution.

8.6.2.4 Treatment Capacity for Extreme Weather Events

Calculations shown in Section 8.6.2.3 have shown the settlement capacity to be more than adequate under average conditions. However, in reality, incident rainfall will not be consistent throughout the year. To ensure the settlement capacity on site is robust under all conditions, calculations are made of the expected residence time of effluent on site in response to an extreme weather event. The one in a 100-year 6-hour storm event is widely used as suitably extreme weather event. Rainfall returns from Met Eireann indicate that 55.1 mm of rainfall would be associated with the 1 in 100-year 6-hour storm event at the application site.

The maximum area serviced by the settlement system is approximately 73,366 m^2. Assuming a worst-case scenario whereby all incident rainfall on the site generated runoff (no percolation to ground or evapotranspiration taken into consideration).

In this worst-case scenario, 4,042 m^3 of runoff would be generated requiring treatment before discharge. The available settlement capacity 23,113 m^3.

For a 1 in 100-year 6-hour storm event the expected residence time for effluent for treatment is calculated at 5.7 days. This is more than adequate time to settle out fine silt particles from the effluent before discharge off site. The current effluent treatment system is shown to be robust under extreme conditions.

The current settlement pond arrangement is less than ideal in design regards as neither pond has smooth sides and floors. This is more than compensated for with the large capacity provide by each pond and the wetland plants factor in Settlement Pond 2.

8.6.2.5 Historical Treatment Capacity

As a crude means of attempting to assess what levels of effluent treatment were in place during the extraction period of the site was made examining the available aerial photographs. Historical aerial imagery for the site from 2005 show no hydrological connection from the site to the tributary of the St Johnston stream. It is assumed that a discharge point was created shortly before the discharge licence (LWat 67) from Donegal County Council was achieved.

Taking a worst-case scenario approach, the site was assessed when the available settlement treatment appeared to be at its smallest capacity. In 2010, Settlement Pond 2 had not yet been created and Settlement Pond 1 was considerably smaller than it is currently. Information supplied by the applicant states that all discharges of surface water from the main quarry void came through Settlement Pond 1.

The footprint of Settlement Pond 1 at this time was approximately 3,300 m^2. Taking a conservative estimate of an average 1 m depth, this leaves an estimated settlement capacity of 3,300 m^3. Using a similar approach to that taken in section 8.6.2.4 above, whereby a worst-case scenario of a 1 in 100-year 6-hour storm event would generate 4,042 m^3 runoff requiring treatment, historical settlement time is estimated to be 19.6 hours. This is adequate time to settle out most of the fine fraction of sediment out of solution.

8.6.4 Monitoring Point

A water quality and flow rate monitoring point is proposed to be installed immediately before treated effluent is discharged off site, downstream of Settlement Pond 2. Figure 8.22 indicates the position of this point. This will allow access for monitoring of water quality as part of licence conditions and also for general environmental management of the site.

8.7 Groundwater Impact

Rock extraction has the potential to affect the water table by creating a cone of depression within the extraction void and can affect water supplies dependant on the groundwater resource in certain situations.

Within the application site the water table in the bedrock has been shown to be at relatively shallow levels (<5 mbgl) outside the quarry void created by previous activity. No significant ingress of groundwater to the quarry void was observed through any of the exposed quarry faces and some crude testing of the underlying aquifer properties showed it to be of extremely low transmissivity (0.0014 – 0.4 m^2/day) consistent with GSI categorisation.

Previous extraction activity has caused a large cone of depression in the groundwater table on the site. The cone of depression is not symmetrical or evenly distributed throughout the site as it will vary with depth of extraction. While difficult to define the actual extent of the impact of quarry activity within the site, it is not expected to have any significant negative impact outside the extraction areas as groundwater levels are shown to be at expected levels within relatively short distances from the edge of extraction areas. The cone of depression formed by previous extraction is steep sided due to the extremely low transmissivity of the bedrock slate. There is not expected to be any significant change in groundwater levels outside the site boundaries as a result of activities on site. No groundwater supplies will be impacted by the proposed activity.

Figures 8.13 & 8.14 are conceptual site models of groundwater levels on the site showing the estimated cone of depression created by quarry activity.

8.8 Impact Assessment

Soil/overburden removal, rock extraction, rock crushing and screening, and stockpiling of aggregate and concrete product all have the potential to generate suspended sediment within the surface water runoff leaving the site. The use of hydrocarbon fuels and lubricants on site in vehicles and plant carries the potential for contamination of surface waters and groundwaters through leaks and accidental spillage. The quarrying of rock beneath the water table and the removal or alterations of catchments can have potential impacts on the surface and groundwater regimes. The potential impacts to surface waters and groundwaters are assessed, and existing and proposed mitigation measures are outlined.

8.8.1 Surface Water Quality Impacts from Suspended Sediment Load during construction phase involving earth movement and berm construction

The construction of berms and earth movement to facilitate construction activity may have lead to discharge of suspended sediment load in runoff which may be directed to surface watercourses leading to the St Johnston Stream and ultimately to the River Finn SAC and River Foyle and Tributaries SAC.

- **Receptor(s):** St. Johnston Stream, River Finn SAC, River Foyle and Tributaries SAC
- **Pathway(s):** Surface discharge to river system
- **Pre-mitigation Impact:** Moderate short-term negative effect on a sensitive receptor

The mitigation measures that are in place and proposed are listed below;

- Robust settlement pond system to treat effluent before discharge
- Single discharge point from entire site
- Trade discharge licence in place since 2009 when hydrological link from site to tributary of St Johnston Stream was established

Residual Effect: Short-term imperceptible negative effect on surface water quality
Significance of Effects: No significant effects on surface water quality are expected

8.8.2 Surface Water Quality Impacts from Suspended Sediment Load during extraction & processing phase

The development discharges effluent off site directly to a surface watercourse leading to the St Johnston Stream and ultimately to the River Finn SAC and River Foyle and Tributaries SAC.

- **Receptor(s):** St. Johnston Stream, River Finn SAC, River Foyle and Tributaries SAC
- **Pathway(s):** Surface discharge to river system
- **Pre-mitigation Impact:** Moderate short-term negative effect on a sensitive receptor

The mitigation measures that are in place and proposed are listed below;

- Adequate settlement pond capacity to reduce sediment load in the effluent to acceptable levels before discharge offsite (Section 8.6.2).
- Suitable drainage system in place to direct effluent and runoff that may become contaminated with suspended sediment to the settlement pond and system.
- Regular maintenance of settlement ponds (and drainage system) to ensure efficiency and appropriate disposal of material removed.
- Suspension of extraction and material handling activities for the duration of a red level rainfall warning issued by Met Eireann.
- Regular monitoring of the discharge point.
- Single discharge point subject to the conditions of a trade discharge licence from Donegal County Council.
- Dedicated piped channel proposed between Settlement Ponds 1 & 2.

Residual Effect: Short-term imperceptible negative effect on surface water quality
Significance of Effects: No significant effects on surface water quality are expected

8.8.3 Surface Water and Groundwater Quality Impacts from Hydrocarbon Contamination

The development discharges effluent off site directly to a surface watercourse leading to the St Johnston Stream and ultimately to the River Finn SAC and River Foyle and Tributaries SAC.

- **Receptor(s):** St. Johnston Stream, River Finn SAC, River Foyle and Tributaries SAC, Local Groundwater Body
- **Pathway(s):** Surface discharge to river, discharge directly to groundwaters
- **Pre-mitigation Impact:** Moderate short-term negative effect on a sensitive receptor

The mitigation measures that are in place and proposed are listed below:

- Lubricants stored in a bunded area in machinery shed off site.
- A hydrocarbon interceptor is proposed within the drainage system downstream of Settlement Pond 1.
- Refuelling of static plant on site carried out using a fully bunded bowser/mobile fuel truck.
- Drip trays used for all re-fuelling operations. Best practice for re-fuelling incorporated into the Environmental Management System for the site.
- Regular inspections and maintenance scheduling for all plant and vehicle to minimise the potential for malfunction or leak.
- Emergency spill kit with oil boom, absorbers etc. is proposed to be kept on site for use in the event of an accidental spillage/leak.
- Regular visual monitoring of all surface waters onsite for any surface sheen or sign of potential hydrocarbon pollution.

Residual Effect: Short-term imperceptible negative effect on surface water quality

Significance of Effects: No significant effects on surface water quality or groundwater quality are expected

8.8.4 Surface Water and Groundwater Quality Impacts from wastewater discharged from canteen/office area

The development has discharged wastewater effluent by percolation to ground. Some percolation may have reached the groundwater body or surface water system and the St Johnston Stream and ultimately to the River Finn SAC and River Foyle and Tributaries SAC.
There are no longer toilet/canteen facilities on site. This is an historical potential impact.

- **Receptor(s):** St.Johnston Stream, River Finn SAC and River Foyle and Tributaries SAC, River Foyle Groundwater Body
- **Pathway(s):** Percolation to surface water drainage system, percolation to groundwater
- **Pre-mitigation Impact:** Imperceptible short-term negative effect on a sensitive receptor.

The mitigation measures that were in place are listed below

- Wastewater was directed into a purpose-built septic tank with associated percolation area built to EPA specification.

Residual Effect: Short-term imperceptible negative effect on surface water quality and groundwater
Significance of Effects: No significant effects on surface water quality and groundwater quality are expected

8.8.5 Groundwater impacts due to extraction below water table

The development extracts bedrock some of which may be below the water table.

- **Receptor(s):** Local Groundwater Body
- **Pathway(s):** Direct due to removal of bedrock
- **Pre-mitigation Impact:** Imperceptible permanent negative effect on a low sensitivity receptor

There are no mitigation measures proposed as volumes of groundwater contained in the bedrock are low and transmissivity through the rock is shown to be extremely low. Small amounts of water that would have percolated to groundwater will now flow directly to the surface water system.
No negative impact expected outside of the site boundary.

Residual Effect: Imperceptible permanent negative effect on groundwater.
Significance of Effects: No significant effects on groundwater supply are expected

8.8.6 Surface Water ecology losses due to alteration of catchment flow regime

The development has altered the greenfield site conditions which have supplied surface and groundwater to the tributary of the St Johnstone stream which may affect the ecology and base flow of the watercourse.

- **Receptor(s):** Tributary of the St. Johnston Stream, River Finn SAC and River Foyle and Tributaries SAC
- **Pathway(s):** Direct due to alteration of water supply to stream
- **Pre-mitigation Impact:** Imperceptible permanent negative effect on a high sensitivity receptor

There are no mitigation measures proposed as volumes of surface water supplied to the stream pre-development is not expected to have changed from the current situation. Pre-development, some

surface water flow may have reached the stream slightly further downstream than now and some of the groundwater baseflow supply may have been more gradual along the length of the stream channel rather than concentrated through the site discharge point. Overall, the nature of the supply to the stream may have changed slightly but the volumetric contribution from the site area is expected to have remained constant.

Residual Effect: Imperceptible negative effect on tributary to St Johnston stream. No negative effects on St Johnston Stream, River Finn SAC and River Foyle and Tributaries SAC.
Significance of Effects: Neutral effects on St Johnston Stream, River Finn SAC and River Foyle and Tributaries SAC are expected.

8.8.7 Cumulative Impacts

The application site must also be considered in association with other developments located within or close to the application site.

8.8.7.1 Other Developments

A search of the planning portal of the Donegal County Council website revealed no planned development which may result in significant cumulative impact in the vicinity of the application site. The application site is situated in a rural environment where the two main land uses are low intensity livestock farming and private commercial forestry.
There is another stone quarry adjoining the application site to the east which is considered for cumulative impact. Tinney's quarry is located downstream of the adjacent quarry. There does not appear to be a surface water discharge from the adjacent site so no cumulative impact on the receiving waters of the St Johnston Stream system are expected. Application site testing of the chemistry of the groundwaters shows the quality to be good, therefore no cumulative effect is expected from any discharge to groundwaters from the adjacent quarry.

8.8.8 Determination of Environmental Impact Significance Pre-mitigation

Impact	**Receptor**	**Description of Impact (Character/Magnitude/Duration /Probability/Consequences)** Negligible - High	**Existing Environment (Significance/Sensitivity)** Negligible -High	**Significance** Imperceptible - Profound
Surface Water Quality Impacts from Suspended Sediment Load during construction phase involving earth movement and berm construction	St Johnston Stream, River Finn SAC, River Foyle and Tributaries SAC	Medium	Medium	Moderate
Surface Water Quality Impacts from Suspended Sediment Load during extraction & processing	St Johnston Stream, River Finn SAC, River Foyle and Tributaries SAC	Medium	Medium	Moderate
Surface Water and Groundwater Quality Impacts from Hydrocarbon Contamination	St Johnston Stream, River Finn SAC, River Foyle and Tributaries SAC, Local Groundwater Body	Low-Medium	Medium	Slight
Surface Water and Groundwater Quality Impacts from wastewater discharged from toilets/canteen	St Johnston Stream, River Finn SAC, River Foyle and Tributaries SAC, River Foyle Groundwater Body	Low-Negligible	Medium	Not significant
Groundwater Impacts due to extraction below water table	River Foyle Groundwater Body	Low-Negligible	Low	Not significant
Surface Water ecology losses due to alteration in catchment flow regime	St Johnston Stream, River Finn SAC and River Foyle and Tributaries SAC	Negligible	Medium	Not significant

8.8.9 Summary of Mitigation Measures Proposed

Summary of Mitigation Measures Proposed
• Adequate settlement pond capacity to reduce sediment load in the effluent to acceptable levels before discharge off-site (Section 8.6.2).
• Suitable drainage system in place to direct effluent and runoff that may become contaminated with suspended sediment to the settlement pond and system.
• Regular maintenance of settlement ponds (and drainage system) to ensure efficiency and appropriate disposal of material removed.
• Suspension of extraction and material handling activities for the duration of a red level rainfall warning issued by Met Eireann.
• Regular monitoring of the discharge point.
• Single discharge point subject to the conditions of a trade discharge licence from Donegal County Council.
• Dedicated piped channel proposed between Settlement Pond 1 & 2.
• Lubricants stored in a bunded area in machinery shed off site.
• A hydrocarbon interceptor is proposed within the drainage system downstream of Settlement Pond 1.
• Refuelling of static plant on site carried out using a fully bunded bowser/mobile fuel truck.
• Drip trays used for all re-fuelling operations. Best practice for re-fuelling incorporated into the Environmental Management System for the site.
• Regular inspections and maintenance scheduling for all plant and vehicle to minimise the potential for malfunction or leak.
• Emergency spill kit with oil boom, absorbers etc. is proposed to be kept on site for use in the event of an accidental spillage/leak.
• Regular visual monitoring of all surface waters onsite for any surface sheen or sign of potential hydrocarbon pollution.

8.8.10 Determination of Environmental Impact Significance Following Mitigation

Impact	**Receptor**	**Description of Impact (Character/Magnitude/Duration /Probability/Consequences)** Negligible - High	**Existing Environment (Significance/Sensitivity)** Negligible -High	**Significance of Impact** Imperceptible - Profound
Surface Water Quality Impacts from Suspended Sediment Load during construction phase involving earth movement and berm construction	St Johnston Stream, River Finn SAC, River Foyle and Tributaries SAC	Medium	Medium	Imperceptible
Surface Water Quality Impacts from Suspended Sediment Load during extraction & processing	St Johnston Stream, River Finn SAC, River Foyle and Tributaries SAC	Medium	Medium	Imperceptible
Surface Water and Groundwater Quality Impacts from Hydrocarbon Contamination	St Johnston Stream, River Finn SAC, River Foyle and Tributaries SAC, Local Groundwater Body	Low-Medium	Medium	Imperceptible
Surface Water and Groundwater Quality Impacts from wastewater discharged from toilets/canteen	St Johnston Stream, River Finn SAC, River Foyle and Tributaries SAC, River Foyle Groundwater Body	Low-Negligible	Medium	Imperceptible
Groundwater Impacts due to extraction below water table	River Foyle Groundwater Body	Low-Negligible	Low	Not significant
Surface Water ecology losses due to alteration in catchment flow regime	St Johnston Stream, River Finn SAC and River Foyle and Tributaries SAC	Negligible	Medium	Not significant

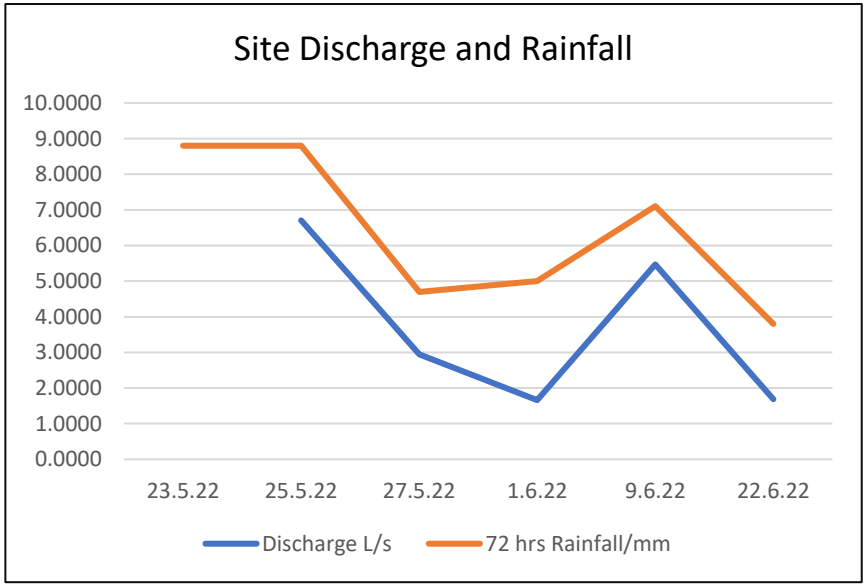
8.8.11 Conclusion

With the implementation of the mitigation measures listed, the implementation of the project as outlined will not have caused a significant negative effect on the surface water or groundwater environments.

Appendix 8.1: Flow Rate Summary

SUMMARY OF CALCULATED FLOW RATES

Location	Flow rate average	L/s		Date	U/S Glen	U/S Discharge	Discharge L/s	Discharge m3/s	72 hrs Rainfall/mm
Glen Bridge	0.01240705	12.41		23.05.2022	0.0144				8.8
Stream above discharge point	0.010255515	10.26		25.05.2022	0.0129	0.0122	6.7052	0.0067	8.8
Site discharge	0.003693734	3.69		27.05.2022	0.0108	0.0099	2.9489	0.0029	4.7
				01.06.2022	0.0093	0.0098	1.6598	0.0017	5.0
				09.06.2022	0.0159	0.0128	5.4655	0.0055	7.1
				22.06.2022	0.0111	0.0067	1.6893	0.0017	3.8



Appendix 8.2: Analytical Results

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CERTIFICATE OF ANALYSIS

Customer: **Greentrack**
4 Roe House,
Dry Arch Business Park ,
Dromore ,
Letterkenny ,

Report no.: **22-00432**
No. of samples: 1
Acceptance date: 20/01/2022
Analysis date: 20/01/2022
Date of issue: 24/01/2022
Contact: Denis Faulkner

Comments
1 x sample ex Tinneys Quarry

Sample ID	Sample type	Client reference	Test method	Test description	Result / Units
22-00432-(01)	Effluent	site discharge	E-105	pH	7.84 @ 18.2°C
			E-103	Suspended Solids	<5 mg/l

The results in this electronically produced test report have been checked and approved. The test report meets the requirements of IS EN ISO/IEC 17025:2017 and is also valid without signature.

Report authorised by: J Cassidy
Julie Cassidy
Senior Technician

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CERTIFICATE OF ANALYSIS

Customer: **Greentrack**
4 Roe House,
Dry Arch Business Park ,
Dromore ,
Letterkenny ,

Report no.:	**22-01838**
No. of samples:	4
Acceptance date:	22/03/2022
Analysis date:	22/03/2022
Date of issue:	23/03/2022
Contact:	Denis Faulkner

Comments
4 x samples ex Tinneys Quarry

Sample ID	Sample type	Client reference	Test method	Test description	Result / Units
22-01838-(01)	Water	DM1(SE)	E-128	Bergerhoff Dust	52.21 mg/m²/day
22-01838-(02)	Water	DM2(SW)	E-128	Bergerhoff Dust	16.55 mg/m²/day
22-01838-(03)	Water	DM3(NW)	E-128	Bergerhoff Dust	9.34 mg/m²/day
22-01838-(04)	Water	DM4(NE)	E-128	Bergerhoff Dust	19.95 mg/m²/day

The results in this electronically produced test report have been checked and approved. The test report meets the requirements of IS EN ISO/IEC 17025:2017 and is also valid without signature.

Report authorised by: J Cassidy

Julie Cassidy
Senior Technician

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CERTIFICATE OF ANALYSIS

Customer: **Greentrack**
4 Roe House,
Dry Arch Business Park ,
Dromore ,
Letterkenny ,

Report no.:	**22-01839**
No. of samples:	1
Acceptance date:	22/03/2022
Analysis date:	22/03/2022
Date of issue:	23/03/2022
Contact:	Denis Faulkner

Comments
1 x sample ex Tinneys Quarry

Sample ID	Sample type	Client reference	Test method	Test description	Result / Units
22-01839-(01)	Effluent	site discharge	E-105	pH	7.80 @ 19.4°C
			E-103	Suspended Solids	<5 mg/l

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Report authorised by: J Cassidy

Julie Cassidy
Senior Technician

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CERTIFICATE OF ANALYSIS

Customer: **Greentrack**
4 Roe House,
Dry Arch Business Park ,
Dromore ,
Letterkenny ,

Report no.:	**22-02622**
No. of samples:	5
Acceptance date:	25/04/2022
Analysis date:	25/04/2022
Date of issue:	03/05/2022
Contact:	Denis Faulkner

Comments
5 x samples ex Tinney's Quarry

Sample ID	Sample type	Client reference	Test method	Test description	Result / Units
22-02622-(01)	Effluent	SW1	E-105	pH	7.92 @ 19.2°C
			E-103	Suspended Solids	<5 mg/l
			E-101	BOD	1.84 mg/l
			E-124	Ammonia (as NH3-N)	<0.01 mg/l
			E-138	Dissolved Inorganic Nitrogen	<0.1 mg/l
			E-138	Dissolved TON	<0.1 mg/l
			E-138	Dissolved Ammonia	0.02 mg/l
			E-110A	#Total Phosphorus (as P)	<0.05 mg/l
			E-109	Orthophosphate (as P)	<0.01 mg/l
			E-113	#Conductivity	329 µS/cm @ 20°C
22-02622-(02)	Water	SW3	E-113	#Conductivity	259 µS/cm @ 20°C
22-02622-(03)	Effluent	SW2	E-113	#Conductivity	441 µS/cm @ 20°C
22-02622-(04)	Effluent	SW4	E-113	#Conductivity	638 µS/cm @ 20°C
22-02622-(05)	Effluent	SW5	E-113	#Conductivity	430 µS/cm @ 20°C

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Report authorised by: J Cassidy

Julie Cassidy
Senior Technician

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CERTIFICATE OF ANALYSIS

Customer: **Greentrack**
4 Roe House,
Dry Arch Business Park ,
Dromore ,
Letterkenny ,

Report no.:	**22-02621**
No. of samples:	4
Acceptance date:	25/04/2022
Analysis date:	25/04/2022
Date of issue:	29/04/2022
Contact:	Denis Faulkner

Comments
4 x samples ex Tinney's Quarry

Sample ID	Sample type	Client reference	Test method	Test description	Result / Units
22-02621-(01)	Ground water	GW1	E-105	pH	7.11 @ 19.1°C
			E-103	Suspended Solids	6 mg/l
			E-124	Ammonia (as NH3-N)	0.06 mg/l
			E-129	#Total Nitrogen	2.05 mg/l
			E-109	Orthophosphate (as P)	<0.01 mg/l
22-02621-(02)	Ground water	GW2	E-105	pH	6.36 @ 18.7°C
			E-103	Suspended Solids	<5 mg/l
			E-124	Ammonia (as NH3-N)	<0.01 mg/l
			E-129	#Total Nitrogen	2.69 mg/l
			E-109	Orthophosphate (as P)	<0.01 mg/l
22-02621-(03)	Ground water	GW3	E-105	pH	7.41 @ 18.7°C
			E-103	Suspended Solids	<5 mg/l
			E-124	Ammonia (as NH3-N)	0.03 mg/l
			E-129	#Total Nitrogen	1.96 mg/l
			E-109	Orthophosphate (as P)	<0.01 mg/l
22-02621-(04)	Ground water	GW4	E-105	pH	7.87 @ 19.0°C
			E-103	Suspended Solids	22 mg/l
			E-124	Ammonia (as NH3-N)	<0.01 mg/l
			E-129	#Total Nitrogen	2.13 mg/l

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CERTIFICATE OF ANALYSIS

Customer: **Greentrack**
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Dry Arch Business Park ,
Dromore ,
Letterkenny ,

Report no.:	**22-02621**
No. of samples:	4
Acceptance date:	25/04/2022
Analysis date:	25/04/2022
Date of issue:	29/04/2022
Contact:	Denis Faulkner

Comments
4 x samples ex Tinney's Quarry

Sample ID	Sample type	Client reference	Test method	Test description	Result / Units
22-02621-(04)	Ground water	GW4	E-109	Orthophosphate (as P)	0.02 mg/l

The results in this electronically produced test report have been checked and approved. The test report meets the requirements of IS EN ISO/IEC 17025:2017 and is also valid without signature.

Report authorised by: J Cassidy
Julie Cassidy
Senior Technician

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Customer: **Greentrack**
4 Roe House,
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Dromore ,
Letterkenny ,

Report no.:	**22-03150**
No. of samples:	2
Acceptance date:	17/05/2022
Analysis date:	17/05/2022
Date of issue:	18/05/2022
Contact:	Denis Faulkner

Comments
2 x samples ex Tinneys Quarry

Sample ID	Sample type	Client reference	Test method	Test description	Result / Units
22-03150-(01)	Water	SW1	E-113	#Conductivity	263 µS/cm @ 20°C
			E-103	Suspended Solids	<5 mg/l
			E-105	pH	8.13 @ 19.8°C
22-03150-(02)	Water	SW2	E-113	#Conductivity	265 µS/cm @ 20°C
			E-103	Suspended Solids	<5 mg/l
			E-105	pH	7.98 @ 19.6°C

The results in this electronically produced test report have been checked and approved. The test report meets the requirements of IS EN ISO/IEC 17025:2017 and is also valid without signature.

Report authorised by: J Cassidy

Julie Cassidy
Senior Technician

In Test Method - 'Subcontracted A' tests are accredited; 'Subcontracted U' tests are unaccredited.
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CERTIFICATE OF ANALYSIS

Customer: **Greentrack**
4 Roe House,
Dry Arch Business Park ,
Dromore ,
Letterkenny ,

Report no.:	**22-03151**
No. of samples:	3
Acceptance date:	17/05/2022
Analysis date:	17/05/2022
Date of issue:	18/05/2022
Contact:	Denis Faulkner

Comments
3 x samples ex Tinneys Quarry

Sample ID	Sample type	Client reference	Test method	Test description	Result / Units
22-03151-(01)	Effluent	SW5	E-113	Conductivity	207µS/cm@20°C
22-03151-(02)	Effluent	SW6	E-113	Conductivity	470 µS/cm@20°C
22-03151-(03)	Effluent	SW7	E-113	Conductivity	274 µS/cm@20°C

The results in this electronically produced test report have been checked and approved. The test report meets the requirements of IS EN ISO/IEC 17025:2017 and is also valid without signature.

Report authorised by: J Cassidy

Julie Cassidy
Senior Technician

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CERTIFICATE OF ANALYSIS

Customer: **Greentrack**
4 Roe House,
Dry Arch Business Park ,
Dromore ,
Letterkenny ,

Report no.:	**22-03152**
No. of samples:	4
Acceptance date:	17/05/2022
Analysis date:	17/05/2022
Date of issue:	18/05/2022
Contact:	Denis Faulkner

Comments
4 x samples ex Tinneys Quarry

Sample ID	Sample type	Client reference	Test method	Test description	Result / Units
22-03152-(01)	Ground water	BH01	E-113	Conductivity	511 µS/cm @ 20°C
22-03152-(02)	Ground water	BH02	E-113	Conductivity	325 µS/cm @ 20°C
22-03152-(03)	Ground water	BH03	E-113	Conductivity	211 µS/cm @ 20°C
22-03152-(04)	Ground water	BH04	E-113	Conductivity	319 µS/cm @ 20°C

The results in this electronically produced test report have been checked and approved. The test report meets the requirements of IS EN ISO/IEC 17025:2017 and is also valid without signature.

Report authorised by: J Cassidy

Julie Cassidy
Senior Technician

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CERTIFICATE OF ANALYSIS

Customer: **Greentrack**
4 Roe House,
Dry Arch Business Park ,
Dromore ,
Letterkenny ,

Report no.:	**22-03270**
No. of samples:	2
Acceptance date:	20/05/2022
Analysis date:	20/05/2022
Date of issue:	23/05/2022
Contact:	Denis Faulkner

Comments
2 x samples ex Tinneys Quarry

Sample ID	Sample type	Client reference	Test method	Test description	Result / Units
22-03270-(01)	Water	SW3 bottom pond	E-113	Conductivity	263 µS/cm @20°C
22-03270-(02)	Water	SW4 big pond	E-113	Conductivity	320 µS/cm @20°C

The results in this electronically produced test report have been checked and approved. The test report meets the requirements of IS EN ISO/IEC 17025:2017 and is also valid without signature.

Report authorised by: J Cassidy

Julie Cassidy
Senior Technician

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CERTIFICATE OF ANALYSIS

Customer: **Greentrack**
4 Roe House,
Dry Arch Business Park ,
Dromore ,
Letterkenny ,

Report no.:	**22-03512**
No. of samples:	4
Acceptance date:	31/05/2022
Analysis date:	31/05/2022
Date of issue:	31/05/2022
Contact:	Denis Faulkner

Comments
4 x samples ex Tinneys Quarry

Sample ID	Sample type	Client reference	Test method	Test description	Result / Units
22-03512-(01)	Water	BH01	E-113	Conductivity	1017 µS/cm @ 20°C
22-03512-(02)	Water	BH02	E-113	Conductivity	437 µS/cm @ 20°C
22-03512-(03)	Water	BH03	E-113	Conductivity	316 µS/cm @ 20°C
22-03512-(04)	Water	BH04	E-113	Conductivity	356 µS/cm @ 20°C

The results in this electronically produced test report have been checked and approved. The test report meets the requirements of IS EN ISO/IEC 17025:2017 and is also valid without signature.

Report authorised by: J Cassidy
Julie Cassidy
Senior Technician

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CERTIFICATE OF ANALYSIS

Customer: **Greentrack**
4 Roe House,
Dry Arch Business Park ,
Dromore ,
Letterkenny ,

Report no.:	**22-04025**
No. of samples:	4
Acceptance date:	23/06/2022
Analysis date:	23/06/2022
Date of issue:	24/06/2022
Contact:	Denis Faulkner

Comments
4 x samples ex Tinneys Quarry

Sample ID	Sample type	Client reference	Test method	Test description	Result / Units
22-04025-(01)	Water	BH01	E-113	Conductivity	701µS/cm@20°C
22-04025-(02)	Water	BH02	E-113	Conductivity	373 µS/cm @20°C
22-04025-(03)	Water	BH03	E-113	Conductivity	168 µS/cm@20°C
22-04025-(04)	Water	BH04	E-113	Conductivity	330 µS/cm@20°C

The results in this electronically produced test report have been checked and approved. The test report meets the requirements of IS EN ISO/IEC 17025:2017 and is also valid without signature.

J Cassidy

Report authorised by:
Julie Cassidy
Senior Technician

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CERTIFICATE OF ANALYSIS

Customer: **Greentrack**
4 Roe House,
Dry Arch Business Park ,
Dromore ,
Letterkenny ,

Report no.: **22-04026**
No. of samples: 4
Acceptance date: 23/06/2022
Analysis date: 23/06/2022
Date of issue: 24/06/2022
Contact: Denis Faulkner

Comments
4 x samples ex Tinneys Quarry

Sample ID	Sample type	Client reference	Test method	Test description	Result / Units
22-04026-(01)	Effluent	SW1	E-105	pH	8.03 @20.5°C
			E-103	Suspended Solids	<5 mg/l
			E-113	#Conductivity	355 µS/cm @ 20°C
22-04026-(02)	Water	SW3	E-113	#Conductivity	258 µS/cm @ 20°C
22-04026-(03)	Water	SW4	E-113	#Conductivity	308 µS/cm @ 20°C
22-04026-(04)	Water	SW5	E-113	#Conductivity	311 µS/cm @ 20°C

The results in this electronically produced test report have been checked and approved. The test report meets the requirements of IS EN ISO/IEC 17025:2017 and is also valid without signature.

Report authorised by: J Cassidy

Julie Cassidy
Senior Technician

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CERTIFICATE OF ANALYSIS

Customer: **Greentrack**
4 Roe House,
Dry Arch Business Park ,
Dromore ,
Letterkenny ,

Report no.:	**22-04027**
No. of samples:	4
Acceptance date:	23/06/2022
Analysis date:	23/06/2022
Date of issue:	24/06/2022
Contact:	Denis Faulkner

Comments
4 x samples ex Tinneys Quarry

Sample ID	Sample type	Client reference	Test method	Test description	Result / Units
22-04027-(01)	Water	DM1-(SE)	E-128	Bergerhoff Dust	18.25 mg/m²/day
22-04027-(02)	Water	DM2-(SW)	E-128	Bergerhoff Dust	45.42 mg/m²/day
22-04027-(03)	Water	DM3-(NW)	E-128	Bergerhoff Dust	6.79 mg/m²/day
22-04027-(04)	Water	DM4-(NE)	E-128	Bergerhoff Dust	12.73 mg/m²/day

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Julie Cassidy
Senior Technician

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CERTIFICATE OF ANALYSIS

Customer: **Greentrack**
4 Roe House,
Dry Arch Business Park ,
Dromore ,
Letterkenny ,

Report no.: **22-01227**
No. of samples: 4
Acceptance date: 22/02/2022
Analysis date: 22/02/2022
Date of issue: 23/02/2022
Contact: Denis Faulkner

Comments
4 x sample water

Sample ID	Sample type	Client reference	Test method	Test description	Result / Units
22-01227-(01)	Water	DM1 (SE)	E-128	Bergerhoff Dust	66.64 mg/m²/day
22-01227-(02)	Water	DM2 (SW)	E-128	Bergerhoff Dust	4.24 mg/m²/day
22-01227-(03)	Water	DM3 (NW)	E-128	Bergerhoff Dust	6.37 mg/m²/day
22-01227-(04)	Water	DM4 (NE)	E-128	Bergerhoff Dust	8.49 mg/m²/day

The results in this electronically produced test report have been checked and approved. The test report meets the requirements of IS EN ISO/IEC 17025:2017 and is also valid without signature.

Report authorised by: F. Moloney
Fiona Moloney
Technician

In Test Method - 'Subcontracted A' tests are accredited; 'Subcontracted U' tests are unaccredited.
Tests are unaccredited if prefixed by # or if INAB logo is not visible on the report.
Unless otherwise stated in the comments section, samples were accepted for testing in a satisfactory condition.
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AQUALAB is a registered business name of Pelagia Feed (Ireland) Ltd - registered in Ireland, No. 8639 Revision: 13

AQUALAB

Donegal Road
Killybegs
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(E) aqualab.killybegs@pelagia.com

CERTIFICATE OF ANALYSIS

Customer: **Greentrack**
4 Roe House,
Dry Arch Business Park ,
Dromore ,
Letterkenny ,

Report no.:	**22-02623**
No. of samples:	4
Acceptance date:	25/04/2022
Analysis date:	25/04/2022
Date of issue:	27/04/2022
Contact:	Denis Faulkner

Comments
4 x samples ex Tinney's Quarry

Sample ID	Sample type	Client reference	Test method	Test description	Result / Units
22-02623-(01)	Water	DM1(SE)	E-128	Bergerhoff Dust	84.9 mg/m²/day
22-02623-(02)	Water	DM2(SW)	E-128	Bergerhoff Dust	63.2 mg/m²/day
22-02623-(03)	Water	DM3(NW)	E-128	Bergerhoff Dust	1.70 mg/m²/day
22-02623-(04)	Water	DM4(NE)	E-128	Bergerhoff Dust	20.8 mg/m²/day

The results in this electronically produced test report have been checked and approved. The test report meets the requirements of IS EN ISO/IEC 17025:2017 and is also valid without signature.

Report authorised by: J Cassidy

Julie Cassidy
Senior Technician

In Test Method - 'Subcontracted A' tests are accredited; 'Subcontracted U' tests are unaccredited.
Tests are unaccredited if prefixed by # or if INAB logo is not visible on the report.
Unless otherwise stated in the comments section, samples were accepted for testing in a satisfactory condition.

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CERTIFICATE OF ANALYSIS

Customer: **Greentrack**
4 Roe House,
Dry Arch Business Park ,
Dromore ,
Letterkenny ,

Report no.:	**22-03271**
No. of samples:	4
Acceptance date:	20/05/2022
Analysis date:	20/05/2022
Date of issue:	23/05/2022
Contact:	Denis Faulkner

Comments
4 x samples ex Tinneys Quarry

Sample ID	Sample type	Client reference	Test method	Test description	Result / Units
22-03271-(01)	Water	DM1-(SE)	E-128	Bergerhoff Dust	25.9 mg/m²/day
22-03271-(02)	Water	DM2-(SW)	E-128	Bergerhoff Dust	107 mg/m²/day
22-03271-(03)	Water	DM3-(NW)	E-128	Bergerhoff Dust	5.52 mg/m²/day
22-03271-(04)	Water	DM$-(NE)	E-128	Bergerhoff Dust	9.34 mg/m²/day

The results in this electronically produced test report have been checked and approved. The test report meets the requirements of IS EN ISO/IEC 17025:2017 and is also valid without signature.

Report authorised by: J Cassidy

Julie Cassidy
Senior Technician

In Test Method - 'Subcontracted A' tests are accredited; 'Subcontracted U' tests are unaccredited.
Tests are unaccredited if prefixed by # or if INAB logo is not visible on the report.
Unless otherwise stated in the comments section, samples were accepted for testing in a satisfactory condition.
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Appendix 8.3: Borehole Dip Readings

BOREHOLE DIP READINGS

	gw level mbgl	gw level mOD	gw level mbgl	gw level mOD	gw level mbgl	gw level mOD	gw level mbgl	gw level mOD
Date	BH01		BH02		BH03		BH04	
17/02/2022	1.90	132.53	3.15	122.23	1.16	116.19	1.42	107.99
04/03/2022	1.85	132.58	2.76	122.62	0.84	116.51	1.28	108.13
21/03/2022	1.70	132.73	2.65	122.73	1.63	115.72	1.51	107.9
01/04/2022	2.03	132.4	4.53	120.85	2.05	115.30	1.66	107.75
08/04/2022	1.55	132.88	4.06	121.32	0.40	116.95	0.66	108.75
15/04/2022	1.43	133.00	3.87	121.51	0.76	116.59	1.26	108.15
29/04/2022	1.71	132.72	4.06	121.32	1.96	115.39	2.03	107.38
06/05/2022	3.23	131.20	4.23	121.15	0.77	116.58	1.21	108.20
13/05/2022	1.77	132.66	4.10	121.28	0.78	116.57	1.22	108.19
19/05/2022	1.71	132.72	4.22	121.16	0.76	116.59	1.45	107.96
27/05/2022	2.95	131.48	4.24	121.14	0.83	116.52	1.34	108.07
01/06/2022	3.15	131.28	4.40	120.98	0.95	116.40	3.66	105.75
03/06/2022	2.98	131.45	4.37	121.01	0.79	116.56	1.24	108.17
09/06/2022	3.12	131.31	4.26	121.12	0.79	116.56	1.32	108.09

Appendix 8.4: Aquifer Slug Test

Hydraulic Conductivity

A 2L slug of water was removed from each borehole with a manual bailer and then the recovery of groundwater levels was measured at various time intervals with an electronic dip meter. Using the Bouwer-Rice method with the data from the drawdown and recovery of each borehole, an estimation of the hydraulic conductivity was made.

Caution is advised due to the number of assumptions that had to be made.

Calculations were conducted with the limited data to enable a figure for hydraulic conductivity to be estimated for each of the boreholes:

Hydraulic Conductivity

- **BH01: $K = 4.93 \times 10^{-5}$ m/s**
- **BH02: $K = 6.36 \times 10^{-5}$ m/s**
- **BH03: $K = 5.92 \times 10^{-5}$ m/s**
- **BH04: $K = 1.52 \times 10^{-7}$ m/s**

Calculations are based on the Bouwer-Rice method which is based around Thiem's equation:

$$K = [r_c^2 \ln (R_e/r_w)]/2d \times 1/t \times \ln(h_o/h_t)$$

where:

r_c = radius of the unscreened part of the well where the head is rising
r_w = horizontal distance between the well centre to undisturbed aquifer
R_e = radial distance over which the difference in head, h_o, is dissipated in the flow system of the aquifer
d = length of well screen or open section of well
h_o = head in the well at time t_o=0
h_t = head in the well at time $t > t_o$
K = hydraulic conductivity of aquifer in m/s

and: $\ln (R_e/r_w) = \{1.1/\ln(b/r_w) + \{A + B \ln[(D-b)/r_w]\}/(d/r_w)\}^{-1}$

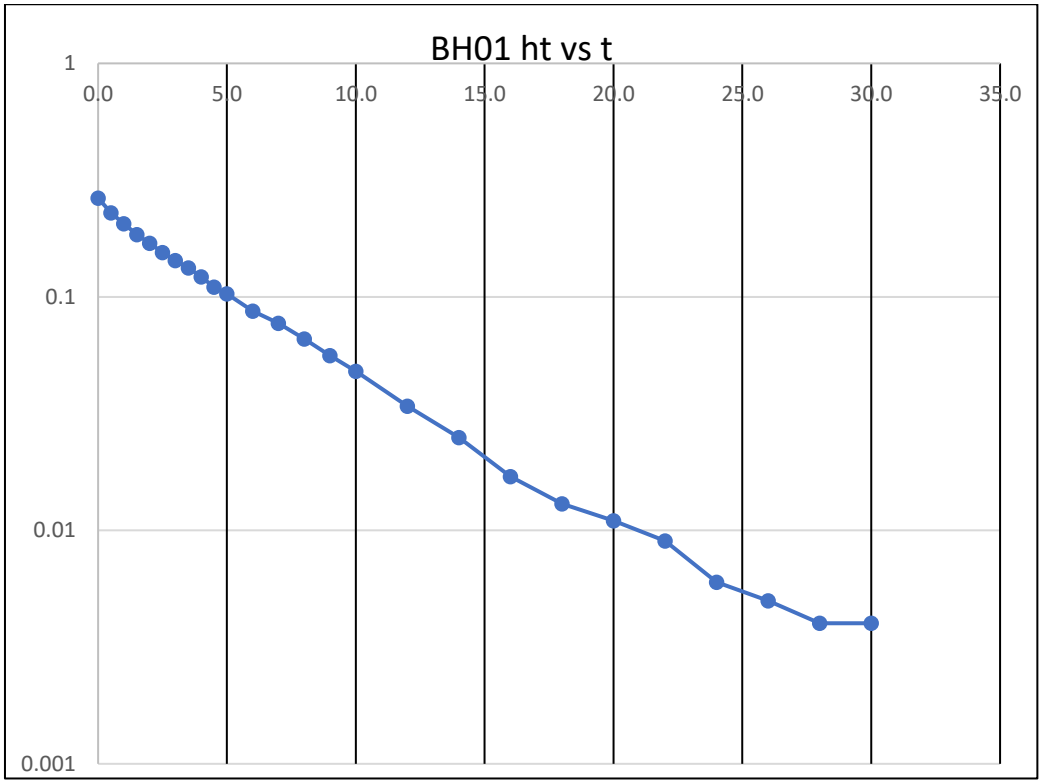
where:

A = dimensionless parameter derived from Bouwer Rice curves
B = dimensionless parameter derived from Bouwer Rice curves
b = depth of water in well
D = depth of water in aquifer
The value of $\ln[(D-b)/r_w]$ is assumed to be 6

The aquifers are assumed to be unconfined and the slope of the plot of h_t against t, on semi-log paper for was used to estimate K.

BHO1

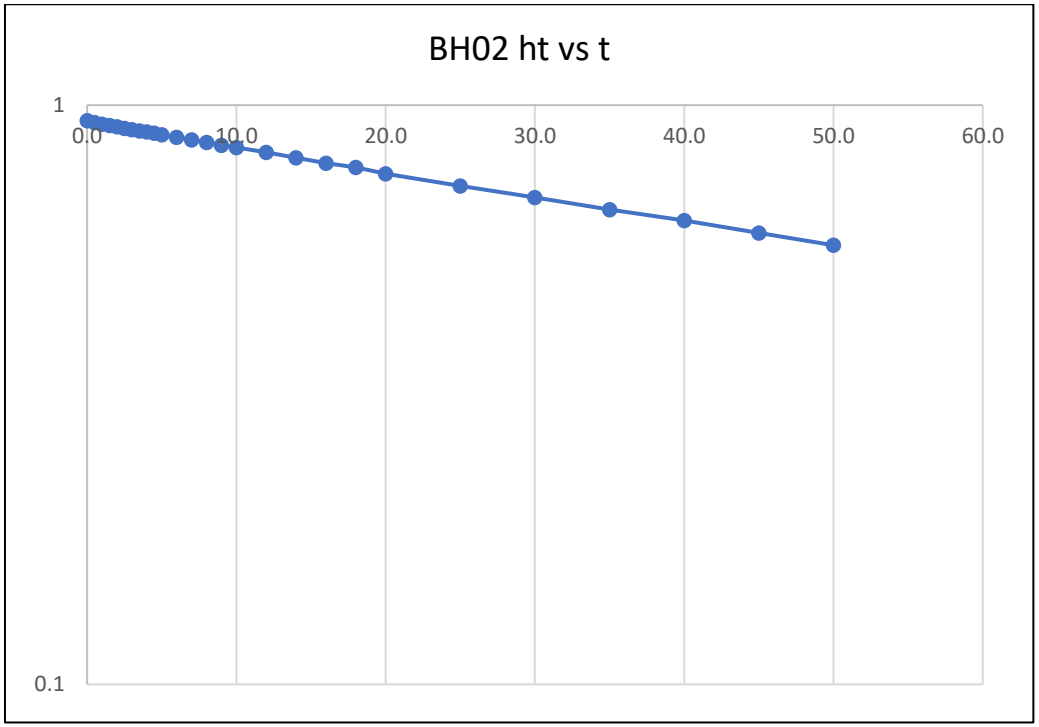
BH01 Initial dip (top of casing)			0.9
Time/mins	**Dip/m**	**ht**	2.605
0.0	2.87	0.265	
0.5	2.834	0.229	
1.0	2.811	0.206	
1.5	2.79	0.185	
2.0	2.775	0.17	
2.5	2.76	0.155	
3.0	2.748	0.143	
3.5	2.738	0.133	
4.0	2.727	0.122	
4.5	2.715	0.11	
5.0	2.708	0.103	
6.0	2.692	0.087	
7.0	2.682	0.077	
8.0	2.671	0.066	
9.0	2.661	0.056	
10.0	2.653	0.048	
12.0	2.639	0.034	
14.0	2.63	0.025	
16.0	2.622	0.017	
18.0	2.618	0.013	
20.0	2.616	0.011	
22.0	2.614	0.009	
24.0	2.611	0.006	
26.0	2.61	0.005	
28.0	2.609	0.004	
30.0	2.609	0.004	



- **BH01: K = 4.93 x 10^{-5} m/s**

BH02

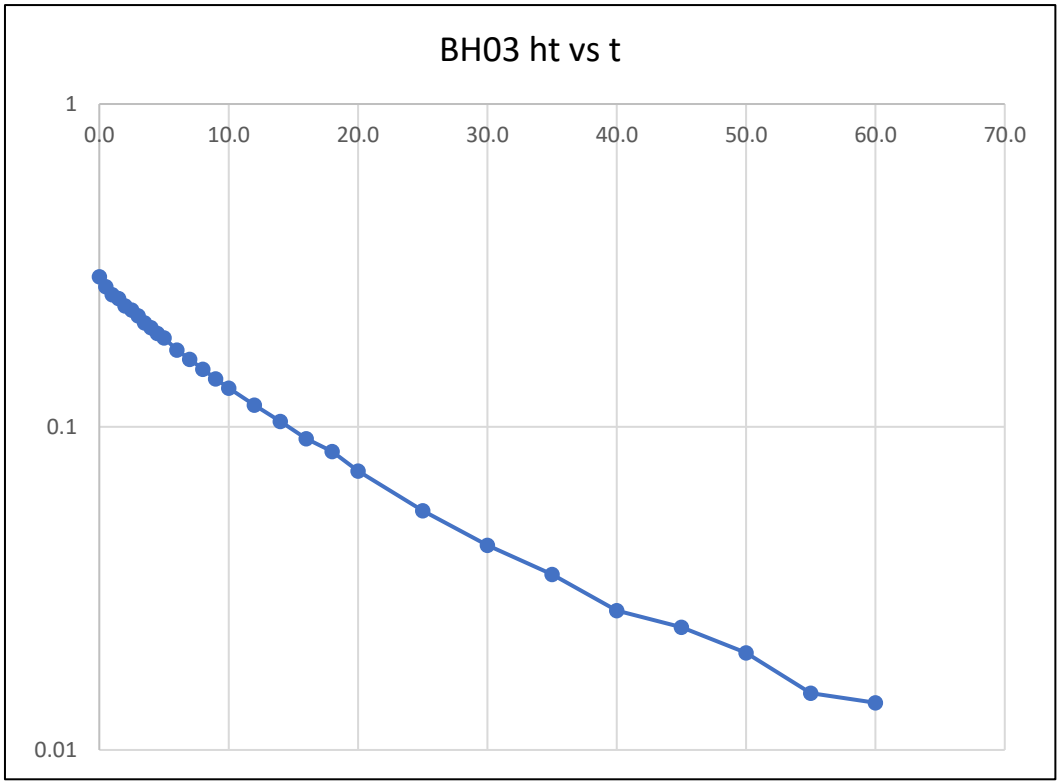
BH02 Initial dip (top of casing)			1.1
Time/mins	**Dip/m**	**ht**	5.155
0.0	6.095	0.94	
0.5	6.088	0.933	
1.0	6.082	0.927	
1.5	6.078	0.923	
2.0	6.073	0.918	
2.5	6.067	0.912	
3.0	6.063	0.908	
3.5	6.058	0.903	
4.0	6.055	0.9	
4.5	6.05	0.895	
5.0	6.044	0.889	
6.0	6.035	0.88	
7.0	6.026	0.871	
8.0	6.017	0.862	
9.0	6.008	0.853	
10.0	6	0.845	
12.0	5.984	0.829	
14.0	5.966	0.811	
16.0	5.949	0.794	
18.0	5.936	0.781	
20.0	5.916	0.761	
25.0	5.88	0.725	
30.0	5.848	0.693	
35.0	5.815	0.66	
40.0	5.787	0.632	
45.0	5.757	0.602	
50.0	5.728	0.573	



- **BH02: K = 6.36 x 10^{-5} m/s**

BH03

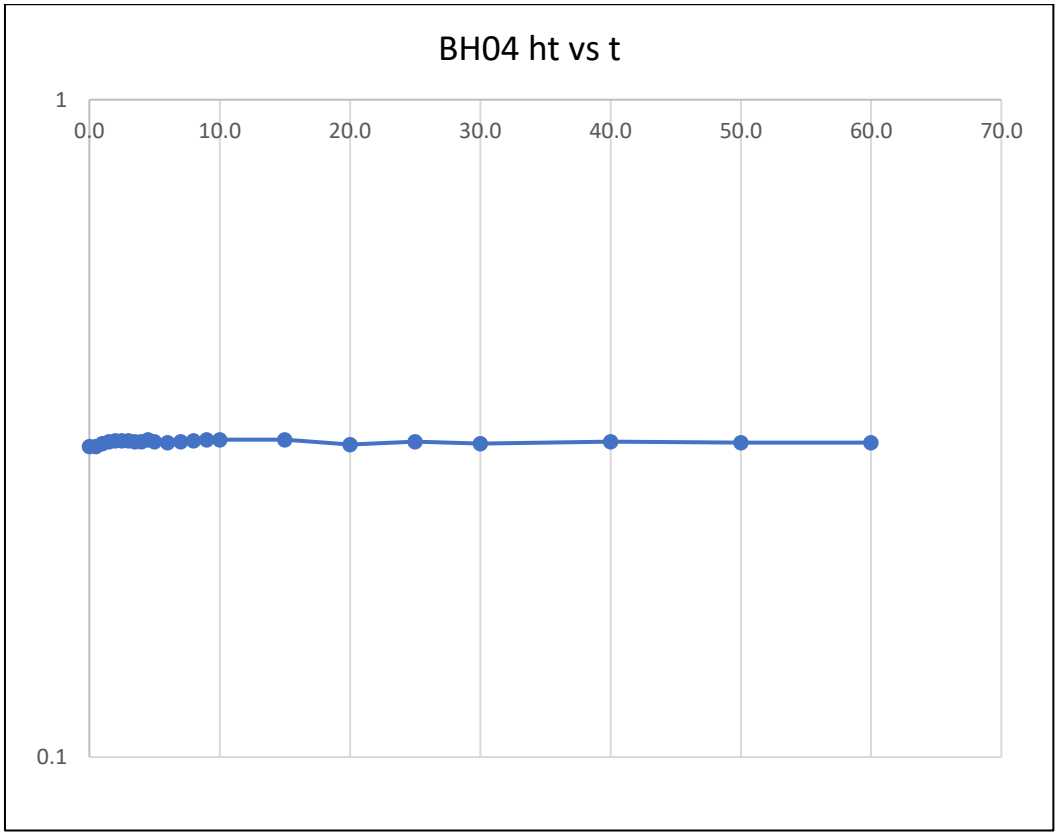
BH03 Initial dip (top of casing)			0.9
Time/mins	**Dip/m**	**ht**	2.863
0.0	3.155	0.292	
0.5	3.135	0.272	
1.0	3.12	0.257	
1.5	3.113	0.25	
2.0	3.1	0.237	
2.5	3.093	0.23	
3.0	3.084	0.221	
3.5	3.073	0.21	
4.0	3.066	0.203	
4.5	3.058	0.195	
5.0	3.052	0.189	
6.0	3.036	0.173	
7.0	3.025	0.162	
8.0	3.014	0.151	
9.0	3.004	0.141	
10.0	2.995	0.132	
12.0	2.98	0.117	
14.0	2.967	0.104	
16.0	2.955	0.092	
18.0	2.947	0.084	
20.0	2.936	0.073	
25.0	2.918	0.055	
30.0	2.906	0.043	
35.0	2.898	0.035	
40.0	2.89	0.027	
45.0	2.887	0.024	
50.0	2.883	0.02	
55.0	2.878	0.015	
60.0	2.877	0.014	



- **BH03: K = 5.92 x 10^{-5} m/s**

BH04

BH04 Initial dip (top of casing)			1.2
Time/mins	**Dip/m**	**ht**	3.233
0.0	3.53	0.297	
0.5	3.53	0.297	
1.0	3.533	0.3	
1.5	3.535	0.302	
2.0	3.536	0.303	
2.5	3.536	0.303	
3.0	3.536	0.303	
3.5	3.535	0.302	
4.0	3.535	0.302	
4.5	3.537	0.304	
5.0	3.535	0.302	
6.0	3.534	0.301	
7.0	3.535	0.302	
8.0	3.536	0.303	
9.0	3.537	0.304	
10.0	3.537	0.304	
15.0	3.537	0.304	
20.0	3.532	0.299	
25.0	3.535	0.302	
30.0	3.533	0.3	
40.0	3.535	0.302	
50.0	3.534	0.301	
60.0	3.534	0.301	



- **BH04: K = 1.52 x 10^{-7} m/s**

Appendix 8.5: Aquifer Recovery Test

Transmissivity

The recovery recharge of the aquifers following the mini-pump tests were used to calculate transmissivity. Caution is advised due to the short duration of the mini-pump tests and the number of assumptions that had to be made.

Calculations are based on Theis's recovery method: $s' = [(2.30 \times Q)/(4\pi \times KD)] \times \log(t/t')$ where:

s' = residual drawdown/m
t = time in days since start of pumping
t' = time in days since cessation of pumping
Q = average rate of discharge m^3/d
KD = transmissivity of aquifer in m^2/d

The aquifers are assumed to be unconfined and the slope of the plot of t/t' on semi-log paper was used to estimate KD.

BHO1

Borehole	Date	SWL before test					
BH01	27.05.2022	2.945					
	Pump time start	8.49am	Litres				
Recovery t' /min	Time started	9.02am	36.5				
Time elapsed	Dip reading (top of casing)	True SWL mbgl	s'/m	t/min	t/days	t'/days	t/t'
0				13	0.009028	0.000000	
0.5				13.5	0.009375	0.000347	27
1				14	0.009722	0.000694	14
1.5	9.020	8.120	5.175	14.5	0.010069	0.001042	9.666667
2	9.005	8.105	5.160	15	0.010417	0.001389	7.5
2.5	9.000	8.100	5.155	15.5	0.010764	0.001736	6.2
3	8.992	8.092	5.147	16	0.011111	0.002083	5.333333
3.5	8.984	8.084	5.139	16.5	0.011458	0.002431	4.714286
4	8.975	8.075	5.130	17	0.011806	0.002778	4.25
4.5	8.964	8.064	5.119	17.5	0.012153	0.003125	3.888889
5	8.959	8.059	5.114	18	0.012500	0.003472	3.6
6	8.953	8.053	5.108	19	0.013194	0.004167	3.166667
7	8.934	8.034	5.089	20	0.013889	0.004861	2.857143
8	8.925	8.025	5.080	21	0.014583	0.005556	2.625
9	8.913	8.013	5.068	22	0.015278	0.006250	2.444444
10	8.904	8.004	5.059	23	0.015972	0.006944	2.3
12	8.885	7.985	5.040	25	0.017361	0.008333	2.083333
14	8.869	7.969	5.024	27	0.018750	0.009722	1.928571
16	8.847	7.947	5.002	29	0.020139	0.011111	1.8125
18	8.828	7.928	4.983	31	0.021528	0.012500	1.722222
20	8.811	7.911	4.966	33	0.022917	0.013889	1.65
25	8.777	7.877	4.932	38	0.026389	0.017361	1.52
30	8.700	7.800	4.855	43	0.029861	0.020833	1.433333
35	8.722	7.822	4.877	48	0.033333	0.024306	1.371429
40	8.700	7.800	4.855	53	0.036806	0.027778	1.325
45	8.680	7.780	4.835	58	0.040278	0.031250	1.288889
50	8.662	7.762	4.817	63	0.043750	0.034722	1.26
55	8.628	7.728	4.783	68	0.047222	0.038194	1.236364
60	8.603	7.703	4.758	73	0.050694	0.041667	1.216667
120	8.355	7.455	4.510	133	0.092361	0.083333	1.108333
240	7.942	7.042	4.097	253	0.175694	0.166667	1.054167
348	7.575	6.675	3.730	361	0.250694	0.241667	1.037356
436	7.185	6.285	3.340	449	0.311806	0.302778	1.029817
7350	4.250	3.350	0.405	7363	5.113194	5.104167	1.001769

For BH01 KD is estimated at 0.4 m^2/d

BH02

Borehole	Date	SWL before test					
BH02	27.05.2022	4.235					
	Pump time start	10.18am	Litres				
Recovery t'/mins	Time started	10.30.5am	31				
Time elapsed	Dip reading (top of casing)	True SWL mbgl	s'/m	t/min	t/days	t'/days	t/t'
0							
0.5							
1	8.300	7.200	2.965	13.5	0.009375	0.000694	13.5
1.5	8.195	7.095	2.860	14	0.009722	0.001042	9.333333
2	8.124	7.024	2.789	14.5	0.010069	0.001389	7.25
2.5	8.053	6.953	2.718	15	0.010417	0.001736	6
3	7.997	6.897	2.662	15.5	0.010764	0.002083	5.166667
3.5	7.945	6.845	2.610	16	0.011111	0.002431	4.571429
4	7.898	6.798	2.563	16.5	0.011458	0.002778	4.125
4.5	7.852	6.752	2.517	17	0.011806	0.003125	3.777778
5	7.821	6.721	2.486	17.5	0.012153	0.003472	3.5
6	7.753	6.653	2.418	18.5	0.012847	0.004167	3.083333
7	7.700	6.600	2.365	19.5	0.013542	0.004861	2.785714
8	7.650	6.550	2.315	20.5	0.014236	0.005556	2.5625
9	7.602	6.502	2.267	21.5	0.014931	0.00625	2.388889
10	7.560	6.460	2.225	22.5	0.015625	0.006944	2.25
12	7.475	6.375	2.140	24.5	0.017014	0.008333	2.041667
14	7.389	6.289	2.054	26.5	0.018403	0.009722	1.892857
16	7.318	6.218	1.983	28.5	0.019792	0.011111	1.78125
18	7.245	6.145	1.910	30.5	0.021181	0.0125	1.694444
20	7.172	6.072	1.837	32.5	0.022569	0.013889	1.625
25	6.946	5.846	1.611	37.5	0.026042	0.017361	1.5
30	6.760	5.660	1.425	42.5	0.029514	0.020833	1.416667
35	6.500	5.400	1.165	47.5	0.032986	0.024306	1.357143
40	6.438	5.338	1.103	52.5	0.036458	0.027778	1.3125
45	6.303	5.203	0.968	57.5	0.039931	0.03125	1.277778
50	6.179	5.079	0.844	62.5	0.043403	0.034722	1.25
55	6.068	4.968	0.733	67.5	0.046875	0.038194	1.227273
60	5.970	4.870	0.635	72.5	0.050347	0.041667	1.208333
138	5.330	4.230	-0.005	150.5	0.104514	0.095833	1.09058

For BH02 KD is estimated at 0.08 m^2/d

BH03

Borehole	Date	SWL before test					
BH03	27.05.2022	0.825					
	Pump time start	11.46am	Litres				
Recovery t'/mins	Time started	11.57am	35.4				
Time elapsed	Dip reading (top of casing)	True SWL mbgl	s'/m	t/min	t/days	t'/days	t/t'
0							
0.5							
1	2.785	1.885	1.060	12	0.008333	0.000694	12
1.5	2.620	1.720	0.895	12.5	0.008681	0.001042	8.333333
2	2.512	1.612	0.787	13	0.009028	0.001389	6.5
2.5	2.411	1.511	0.686	13.5	0.009375	0.001736	5.4
3	2.335	1.435	0.610	14	0.009722	0.002083	4.666667
3.5	2.267	1.367	0.542	14.5	0.010069	0.002431	4.142857
4	2.209	1.309	0.484	15	0.010417	0.002778	3.75
4.5	2.155	1.255	0.430	15.5	0.010764	0.003125	3.444444
5	2.122	1.222	0.397	16	0.011111	0.003472	3.2
6	2.039	1.139	0.314	17	0.011806	0.004167	2.833333
7	1.987	1.087	0.262	18	0.0125	0.004861	2.571429
8	1.942	1.042	0.217	19	0.013194	0.005556	2.375
9	1.905	1.005	0.180	20	0.013889	0.00625	2.222222
10	1.875	0.975	0.150	21	0.014583	0.006944	2.1
12	1.834	0.934	0.109	23	0.015972	0.008333	1.916667
14	1.805	0.905	0.080	25	0.017361	0.009722	1.785714
16	1.792	0.892	0.067	27	0.01875	0.011111	1.6875
18	1.778	0.878	0.053	29	0.020139	0.0125	1.611111
20	1.770	0.870	0.045	31	0.021528	0.013889	1.55
25	1.762	0.862	0.037	36	0.025	0.017361	1.44
30	1.754	0.854	0.029	41	0.028472	0.020833	1.366667
35	1.748	0.848	0.023	46	0.031944	0.024306	1.314286
40	1.747	0.847	0.022	51	0.035417	0.027778	1.275
45	1.743	0.843	0.018	56	0.038889	0.03125	1.244444

For BH03 KD is estimated at 0.08 m^2/d

BH04

Borehole	Date	SWL before test					
BH04	27.05.2022	1.335					
	Pump time start	1.23pm	Litres				
Recovery t'/mins	Time started	1.35pm	34.5				
			s'/m				
Time elapsed	Dip reading (top of casing)	True SWL mbgl		t/min	t/days	t'/days	t/t'
0							
0.5							
1							
1.5							
2	7.050	5.850	4.515	14	0.009722	0.001389	7
2.5	7.049	5.849	4.514	14.5	0.010069	0.001736	5.8
3	7.050	5.850	4.515	15	0.010417	0.002083	5
3.5	7.050	5.850	4.515	15.5	0.010764	0.002431	4.428571
4	7.053	5.853	4.518	16	0.011111	0.002778	4
4.5	7.050	5.850	4.515	16.5	0.011458	0.003125	3.666667
5	7.051	5.851	4.516	17	0.011806	0.003472	3.4
6	7.050	5.850	4.515	18	0.0125	0.004167	3
7	7.049	5.849	4.514	19	0.013194	0.004861	2.714286
8	7.049	5.849	4.514	20	0.013889	0.005556	2.5
9	7.048	5.848	4.513	21	0.014583	0.00625	2.333333
10	7.048	5.848	4.513	22	0.015278	0.006944	2.2
12	7.047	5.847	4.512	24	0.016667	0.008333	2
14	7.046	5.846	4.511	26	0.018056	0.009722	1.857143
16	7.045	5.845	4.510	28	0.019444	0.011111	1.75
18	7.044	5.844	4.509	30	0.020833	0.0125	1.666667
20	7.044	5.844	4.509	32	0.022222	0.013889	1.6
25	7.041	5.841	4.506	37	0.025694	0.017361	1.48
30	7.038	5.838	4.503	42	0.029167	0.020833	1.4
35	7.036	5.836	4.501	47	0.032639	0.024306	1.342857
40	7.035	5.835	4.500	52	0.036111	0.027778	1.3
45	7.031	5.831	4.496	57	0.039583	0.03125	1.266667
50	7.028	5.828	4.493	62	0.043056	0.034722	1.24
55	7.026	5.826	4.491	67	0.046528	0.038194	1.218182
60	7.024	5.824	4.489	72	0.05	0.041667	1.2
172	6.970	5.770	4.435	184	0.127778	0.119444	1.069767
7020	4.860	3.66	2.325	7032	4.883333	4.875	1.001709

For BH04 KD is estimated at 0.0014 m^2/d

Appendix 8.6: Ecological Assessment

Ecological Assessment was carried out at two points on the tributary of the St Johnston Stream receiving discharge from the application site. Point 1 was located approximately 10 m downstream of the confluence of the site discharge and Point 2 was located immediately upstream of the discharge point. A 3-minute kick sampling and 1- minute hand search of macroinvertebrates was carried out at each point using a standard hand net (250mm width, mesh size 500 micron) whilst adhering to ISO 10870:2012 standard procedures.

Overall, the list of species was well represented by the more sensitive groups, including *Ephemeroptera* and *Trichoptera.* The two sites surveyed had an abundance of Group B & C taxa present with occasional Group A taxa present in Sample 2. Class A species located at point 2 include the Mayfly species *Heptagenia sulphurea* and *Rhithrogena semicolorata* and stonefly species *Amphinemura sulcicollis.* No Class A species were noted in sample 1.

Both sites had a good range of clean water (Class B) caddisflies present including *Halesus radiatus* and *Seracosoma personatum.* Both sites had frequent numbers of the mayfly species *Baetis rhodani*, which are characteristic of slightly polluted waters along with the freshwater shrimp species *gammaridae* which are also more pollution tolerant (both Class C). Class D (pollution tolerant) crustacean *Asellus aquaticus* were noted at both sites and class E (very tolerant) *Tubificid* sp. worms and *Chironomus riparius* was only noted at site 1.

The diversity and abundance of stoneflies and mayflies across within sample 2 indicates good quality water giving a Q value of 3-4, indicating "Good" water quality. The presence of class D&E taxa with the absence of Class A taxa in sample 1 gives this site a Q value of 3, indicating "Moderate" water quality.