8.0 WATER (SURFACE AND GROUNDWATER)

8.1 Introduction

8.1.1 Background & Objectives

Hydro-Environmental Services (HES) was engaged by Tom Philips and Associates on behalf of Kilsaran Concrete to undertake an Environmental Impact Assessment (EIAR) for hydrology and hydrogeology aspects in relation to the proposed further development of an existing hard rock quarry at Bellewstown, Co. Meath. The proposed continuation area is within an area previously permitted by An Bord Pleanála under Ref. No. PL17.QD0013.

The objectives of the assessment include:

- Undertake a detailed review of the receiving water environment (surface and groundwater) in the area of the proposed development;
- Identify any significant and likely potential effects on surface water and groundwater due to the proposed development;
- Identify mitigation measures to avoid, remediate or reduce significant negative effects; and,
- Undertake hydrological cumulative impact assessment for the proposed continuation along with any existing or proposed developments within the local catchments.

8.1.2 Proposed Development Summary

The proposed continuation of the quarry, which extends to the north and west of the site, comprises a total area of approximately 39.4ha with a permitted extraction continuation area of approximately 9.2ha (17.3ha in total including existing extraction area). The deepening of the existing quarry floor and proposed extension area to +98mOD will be carried out using conventional blasting techniques; the processing of the extracted material using mobile crushing and screening plant; product stockpiles; proposed landscaped overburden and topsoil storage/screening berms. It is proposed that surface water runoff and groundwater seepages will be discharged via the existing settlement pond and licenced discharge point (Licence Ref No. 10/02).

No amendment to the existing discharge licence is being sought. Discharge of wastewater will be to ground via a proposed upgraded wastewater treatment system and percolation area.

To increase the number of daily truck loads (currently restricted to no. 32 a day) to the quarry it is proposed a new access road and entrance, with the access road being c.1.7km in length with an average width of 6m will be constructed to the northeast of the quarry. The proposed route of the access road is along private agricultural tillage land. Public road works (as described in Section 3.4.6.1 of the EIAR) such the widening of the carriageway of the L1615 and structural reinforcement work on Beaumont Bridge will also be required.

8.1.3 Site Location & Description

The existing quarry site for which further development is being sought is located approximately 1.2km to the west of Bellewstown, Co. Meath. The existing quarry site, which has a total area of approximately 47.3ha is bordered by agricultural land along its northern and western boundaries while a local public road defines its eastern boundary and a local public road along with a number of private dwelling sites define its southern boundary. The site is situated on an elevated hilltop (pre-existing quarry development elevation ~130 – 160m OD) overlooking the surrounding lower-lying landscape. The adjacent land slopes away from the site along all boundaries of the quarry with the slope being steepest on its northern and southern boundaries.

The existing quarry extraction footprint within the site is approximately 8.1ha which comprises 3 no. benches. The upper bench is at approximately 129m OD (metres above Ordnance Datum) while the lower bench is at approximately 115m OD. A sump for collection and removal of surface water and groundwater seepage is located at the south-eastern corner of the lower bench. The sump is pumped to a settlement pond, hydrocarbon interceptor and reed bed at the southern boundary of the site prior to being discharged (under discharge licence, Licence Ref: 10/02) via a local drainage ditch to a tributary stream of the River Nanny (i.e., to the Lunderstown Stream). The sump pump is switched on and off manually according to the level of water in the sump. Discharge from the quarry is measured continuously by means of a v-notch weir and water level data logger as per the discharge licence requirements.

Within the existing site ancillary quarry infrastructure includes a main office, car park, weighbridge, shipping office, workshops, toilet facilities and water supply well. Wastewater will be discharged (<5m^3/day) to ground via a permitted septic tank located to the north of the main office area. Fuel tanks for central heating and vehicle refuelling will be located within a permitted bunded fuel storage area located west of the workshop Two separate workshop/garage areas are located to the south of the site entrance.

8.1.4 Relevant Guidance

The Hydrology / Hydrogeology section of the EIAR is carried out in accordance with relevant guidance contained in the following documents:

- Environmental Protection Agency (2022): *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*;
- European Commission (2017): *Environmental Impact Assessment of Projects – Guidance on the Preparation of the Environmental Impact Assessment Report*;
- Institute of Geologists Ireland (2013) *Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements*;
- National Roads Authority (2008): *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*;
- Department of the Environment, Heritage and Local Government; *Quarries and Ancillary Activities – Guidance for Authorities* (April 2004);
- Environmental Protection Agency (2006): *Environmental Management in the Extractive Industry (Non-Scheduled Minerals)*;

- *Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment* (DoHPLG, 2018); and,
- Guidance *on the preparation of the EIA Report* (Directive 2011/92/EU as amended by 2014/52/EU), (European Union, 2017).

8.2 Methodology

8.2.1 Desk Study

A desk study of the proposed development site, surrounding area and receiving water environment was completed in advance of undertaking the site visits, monitoring and hydrogeological investigations. This involved collecting all relevant geological, hydrological, hydrogeological and meteorological data for the area, and included review and consultation with the following data sources:

- Environmental Protection Agency databases (www.epa.ie);
- Geological Survey of Ireland – Groundwater, Geological and Heritage Databases (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- EPA/WFD River Catchments Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 13 (Geology of Meath). Geological Survey of Ireland (GSI, 1999);
- Geological Survey of Ireland (2003) – Duleek Groundwater Body Initial Characterization Report;
- OPW Flood Hazard Mapping (www.floodinfo.ie); and,
- Environmental Protection Agency – "Hydrotool" Map Viewer (www.epa.ie); and,
- CFRAM Flood Risk Assessment maps (www.cfram.ie).

8.2.2 Site Specific Sources of Information

Data from the following sources of site monitoring data and investigations were used in the EIAR assessment:

- Quarry discharge daily volumetric monitoring data;
- Quarterly quarry discharge water quality monitoring;
- Site visits and hydrological surveys of the proposed site and surrounding area were undertaken by HES on 4th September and 13th November 2020; and 22nd June and 11th August 2021;
- Data loggers were installed in 3 no. on-site monitoring wells (W2, W3 & W5) from September 2020 to June 2021 for continuous (2hr interval) water level monitoring;

- Falling head tests on the existing boreholes at the quarry were undertaken in 2014 to estimate bedrock permeability values of the rock proposed for continued extraction;
- Receiving water surface water and quarry discharge sampling for additional baseline water quality analysis/characterisation was undertaken on 4th September and 13th November 2020;
- Groundwater sampling (for laboratory analysis) of 2 no. of the on-site monitoring wells (W3 & W5) was completed on 11th August 2021; and,
- Walkover survey of the new proposed access road route.

8.3 Receiving Environment

8.3.1 Introduction

To assist with the presentation of data in this section, the descriptors of the water environment have been split between surface and groundwater environments.

8.3.2 Surface Water

<u>Rainfall & Evapotranspiration</u>

Long term rainfall (1981 – 2010) and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall (AAR) recorded at Bellewstown, 1.2km east of the site and at Duleek, 3.3km northwest of the site, are presented in Table 8.1.

Station		E-Coord		N-Coord		Ht (mOD)		Opened		Closed		
Bellewstown		309,800		267,200		122		1975		N/A		
Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	
66.7	50.1	54.6	56.2	63.4	67.7	60.1	77.6	62.2	86	75.5	74.9	795
Duleek G.S.		304,700		268,200		29		1949		N/A		
Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	
74.7	55.9	59.4	58.8	62.1	66.3	58.6	72.8	65.4	89	76.2	76.6	816
										Average		**806**

Table 8.1: Local Average long term Rainfall Data.

The closest synoptic[1] station where the average potential evapotranspiration (PE) is recorded is at Dublin Airport, approximately 25km southeast of the site. The long-term average PE for this station is 554mm/year. This value is used as a best estimate of the site PE. Actual evapotranspiration (AE) at the site is estimated as 526mm/year (which is 0.95 x PE).

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

Effective rainfall (ER) = AAR – AE
= 806mm/yr – 526mm/yr
ER = 280mm/yr

Regional & Local Hydrology

Regionally the proposed site is located in the River Nanny surface water catchment (Nanny-Delvin. The majority of the quarry site including the proposed site entrance access road and quarry continuation area are located in the Nanny(Meath)_SC_020 sub-catchment while the southern section of the site including the quarry discharge point is located in Nanny(Meath)_SC_020 sub-catchment (Lunderstown Stream sub-catchment). A regional hydrology map is shown as Figure 8.1.

On its route towards the Irish Sea, the River Nanny flows to the west (~3km) and north (~1.8km) of the site. The Lunderstown Stream, which is a tributary of the River Nanny (Nanny(Meath)_SC_020), flows to the south (~1km) of the site prior merging with the River Nanny approximately 3.4km to the southwest of the site (discharge from the quarry is to the Lunderstown Stream via a drainage ditch which runs in a southerly direction to the south of the site). A minor local tributary stream of the River Nanny emerges immediately to the north of the site (Knockisland Stream) and another stream (Gafney Stream) emerges 850m to the east of the quarry site. The existing quarry site entrance and proposed site access road drain to the downstream Gafney Stream. A local hydrology map is shown as Figure 8.2.

The Dry Weather Flow (DWF) and 95%ile of the River Nanny at Duleek (EPA Station No. 08011) is recorded to be 0.01m^3/sec and 0.06m^3/sec respectively. The 95%ile and 50%ile flow of the Lunderstown Stream is estimated to be 0.019m^3/sec and 0.075m^3/sec respectively (EPA Hydrotool).

Site Drainage

There are no natural surface water drainage features within the existing quarry site boundary or proposed continuation area and all surface water runoff drains towards the sump area. A drainage ditch is present along the proposed northern continuation boundary. This drains into the Knockisland Stream which flows in a northerly direction towards the River Nanny.

Rainfall landing within the site wholly contained in the quarry and is therefore can only be potentially lost to evaporation, recharged to the local groundwater table (very limited) or

[1] Meteorological station at which observations are made for synoptic meteorology and at the standard synoptic hours of 00:00, 06:00, 12:00, and 18:00.

during very wet periods collects on the quarry floor and is pumped from the site via the quarry sump to the settlement pond and reed bed for licensed discharge to the Lunderstown Stream via a drainage ditch. Discharges from the quarry are dealt with in Section 'Quarry Discharge' below. During heavy rainfall events storage of surface water can be undertaken within the quarry footprint itself and then pumped from the quarry at a controlled rate in compliance with the discharge licence. Recharge to local groundwater is very minimal as a result of the local geology and the reasons for this are described further below.

As stated above, the route of the proposed access drains to Gafney Stream. The Gafney Stream flows into the River Nanny approximately 1.5km downstream of the site.

Greenfield Runoff Rates

The natural Greenfield runoff rate for the quarry site (Qbar) pre-development was calculated using the Institute of Hydrology (Report 124) calculation. The calculation is completed for the total areas of the site that would have existed (prior to development) within the Delvin Coastal catchment and also for the River Nanny catchment.

$$Q_{Bar} = 0.00108 \times (AREA)^{0.89} \times (SAAR)^{1.17} \times (SOIL)^{2.17}$$

Where,

Q_{Bar} is the mean annual flood flow from a rural catchment in m^3/sec;

AREA is the area of the catchment/site in (km^2);

SAAR is the standard average annual rainfall (mm); and,

SOIL is the soil index.

A Q_{bar} calculations are summarised in **Table 8.2** below.

Site Catchment Location	Return Period	Growth Factor	Qbar (m3/sec)
River Nanny	Mean annual	0	0.034
	30 Year	1.55	0.053
	100 Year	1.9	0.065
Delvin Coastal	Mean annual	0	0.025
	30 Year	1.55	0.038
	100 Year	1.9	0.047

Table 8.2: Site Greenfield Runoff Rates.

Surface Water Quality

EPA Q-rating data for the River Nanny downstream of the site (6 no. station locations) all indicate Poor Status (Q-rating of 3). There is no Q-rating data available for Lunderstown Stream, Knockisland Stream or Gafney Stream.

Surface water samples from the Lunderstown Stream (upstream of the drain receiving discharge from the quarry) were taken on 6th September and 12th November 2020. Results are shown in Table 8.3 below (refer to Appendix 8.1 for certificate of analysis).

Parameter	EQS	Sample Date	
		06/09/2020	12/11/2020
Total Suspended Solids (mg/L)	$25^{(+)}$	<5	6
Ammonia (mg/L)	Good Status: ≤0.065 High Status ≤ 0.04(*)	0.02	<0.02
Nitrite NO_2 (mg/L)	-	0.01	0.01
Ortho-Phosphate – P (mg/L)	Good Status ≤ 0.035 to High Status: ≤0.025(*)	0.05	0.03
Nitrate - NO_3 (mg/L)	-	32.78	42.9
Phosphorus (mg/L)	-	0.1	<0.1
Chloride (mg/L)	-	31.2	31
BOD	Good Status: ≤ 1.5 High Status: ≤ 1.3(*)	<1	1

(+) S.I. No. 293 of 1988: Quality of Salmon Water Regulations.
(*) S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009.

Table 8.3: Contemporary Surface Water Sampling Results.

Total suspended solids were reported as <5mg/L and 6mg/L which is below the threshold set out in S.I. 293 of 1988.

Ammonia ranged between <0.02 and 0.02mg/L which is below the "High Status" threshold with respect the Surface Water Regulations (S.I. 272 of 2009).

Orthophosphate exceeded both the "Good Status" and "High Status" threshold in the first sampling round but achieved "Good Status" in the second round. BOD achieved "High Status" on both sampling rounds.

Nitrate is the parameter that was notably elevated in both sampling rounds. The elevated nitrate is likely to agricultural related as tillage farming is intensively practiced in the area.

WFD Surface Water Body Status

Local Surface Water Body (SWB) status information are available (www.catchments.ie).

The Lunderstown Stream and the River Nanny upstream of Duleek (Nanny(Meath)_030) are assigned a Moderate status while the River Nanny downstream of Duleek (Nanny(Meath)_050) only achieved Poor status (this includes the Knockisland Stream and the Gafney Stream).

8.3.3 Hydrogeology

Background on Geology

The generalised mapped bedrock unit in the area of the quarry is the Ordovician Volcanics. The existing quarry site and proposed continuation area are located in two sub unit types which are called the Hilltown Formation and the Carnes Formation respectively. The Hilltown Formation, which underlies the majority of the existing quarry site (the proposed continuation area and access road route), comprises tuff and mudrock. The Carnes Formation, which underlies a narrow section on the south of the existing quarry site, comprises greywacke and mudstone. Intrusions of Diorite are mapped within the Hilltown Formation. A bedrock geology map is shown as Figure 8.3.

A number of phases of exploratory drilling have been undertaken within the existing extraction footprint and proposed continuation area which are described below. The locations of boreholes and monitoring wells undertaken during previous site investigations are shown on Figure 8.4. Refer to Appendix 7.3 of the Geology Chapter (Chapter 7) for all borehole logs.

In May 2008 a geological investigation was carried out by John Barnett and Associates (JBA), which included the rotary coring of 3 boreholes in the proposed continuation area. The boreholes were drilled to a depth of 60m below ground level (mbgl). Drilling Log sheets for these boreholes (which have since been decommissioned) are presented in Appendix 7.3. The geology encountered generally comprises weak, orange-brown, strongly weathered tuff to very strong, brown to green, moderately weathered, fine grained tuff. The weaker tuff was generally located at shallow depths (<5mbgl). The only exception to this is in JBA-BH2 where a strongly weathered and weak horizon was noted at depth between 34 and 34.4mbgl.

As part of a quarry investigation a total of 14 exploratory "blast" boreholes[2] were drilled within the quarry footprint and proposed continuation area by Tobin Consulting Engineers in October 2008. A summary of the drilling is shown in Table 8.4 below.

All boreholes encountered a succession of weak to strong, tuffaceous rhyolites, sedimentary deposits and diorite.

The findings of both the above drilling investigations are consistent with the mapped geology of the area. The Rhyolitic tuff exposed on the existing quarry walls comprises massive, unbedded rock with very few open fractures being visible. Bedrock jointing is very tight across the site. The bedrock on the northern wall of the existing quarry dips in a southerly direction.

[2] Only BH2, BH5, BH12 & BH13 now remain

Borehole ID	Total depth (mbgl)	Summary Lithology	Recorded Water strikes
BH1	40.2	Rhyolitic Tuff	Small water inflows at 5.23m, 9.3m & 26.2m
BH2	35.2	Rhyolitic Tuff	Dry, very minor inflow @15.2m
BH3	40.2	Rhyolitic Tuff/Diorite	Small Water strikes @ 9m, 13.1m & 27m
BH4	40.2	Rhyolitic Tuff	Slight water inflows @ 8.8m & 38.96m
BH5	40.2	Rhyolitic Tuff	Drilled Dry.
BH6	40.2	Rhyolitic Tuff	Drilled Dry.
BH7	40.2	Rhyolitic Tuff	Drilled Dry.
BH8	40.2	Rhyolitic Tuff	Slight water inflows @ 7.6m & 18m
BH9	40.2	Rhyolitic Tuff	Slight water inflows @ 8m, 20.2m & 35m
BH10	40.2	Rhyolitic Tuff	Water inflows in crushed material at surface
BH11	40.2	Rhyolitic Tuff	Water inflows in crushed material at surface
BH12	40.2	Rhyolitic Tuff	Slight water inflows at 7m
BH13	40.2	Rhyolitic Tuff	Slight water inflows at 15m & 38.9m
BH14	40.2	Rhyolitic Tuff	Slight water inflows at 3m

Table 8.4: Summary Exploration Borehole Data (Tobins, 2008).

Local and Site Hydrogeology

The Geological Survey of Ireland (GSI) has classified the Ordovician Volcanic in this area as Poor Bedrock Aquifers - PI (Bedrock which is generally unproductive except for local zones). Bedrock aquifers types are shown on **Figure 8.5**.

The majority of groundwater flow is reported to take place through the upper 3m of the bedrock in a broken and weathered rock zone and major groundwater flows are not expected to be encountered below 10m of the ground surface (GSI, 2004). The majority of groundwater flow will take place in this upper section where the rock is weathered and fractured and bulk aquifer groundwater transmissivities are presumed to be generally low (<10m^2/day). Please note that within the majority of the proposed development area the upper 10m and more of original rock head has already been excavated away as result of the existing quarry development (with the exception of the far west of the proposed continuation area), hence this upper weathered layer where the majority of groundwater flow is noted to occur no longer exists. The bedrock now proposed for extraction is generally deep, unweathered rock and is more competent with a lower permeability compared to the removed upper weathered layers. No groundwater inflows were noted from the quarry walls within the extraction footprint with the exception of some very insignificant minor seepages which is consistent with the above conceptual model.

Based on exploration drilling within the quarry footprint and proposed continuation by Tobin Consulting Engineers (2008) low groundwater yields were reported (1m3/day - 10m3/day) with some boreholes (BH5, BH6 & BH7) were drilled dry (refer to Table 8.4 above and Figure 8.4). The highest number of water strikes were recorded in the top 10m of bedrock (0-10mbgl range) and this is mainly due to the presence of interstitial water (i.e. from precipitation and runoff) stored in the near surface bedrock of the quarry floor which is generally more broken (i.e. has a higher porosity) than deeper bedrock as a consequence of blast hole drilling and rock blasting itself which was previously undertaken to lower the existing quarry floor to its present level. The floor of the quarry also has a layer of hardcore fill which allows for some storage of surface water on top of the more solid underlying bedrock. From Table 8.5 it can be seen that there was a significant overall decreasing trend in the number of water strikes with depth in the rock proposed for extraction. A natural reduction in bedrock weathering and fracture density with depth is generally typical of bedrock aquifers, especially for low permeability bedrock aquifers such as the Ordovician Volcanics.

Depth Range (m)	No. of Groundwater Strikes
0 - 10	8
10 - 20	4
20 - 30	3
30 - 40	3

Table 8.5: Summary of Groundwater Strikes.

A 72-hour pumping test was undertaken by Tobin Consulting Engineers between the 17th and 20th November 2008 to investigate the hydrogeological properties of the bedrock below the floor of the existing quarry that is proposed for vertical extraction. For a discharge rate of 1.5m^3/hour (36m^3/day) and a total drawdown of 52.67m the specific capacity was determined to be ~0.7m^3/day/m which would be assigned a productivity class of V (5) in terms of the GSI well productivity classification. This is the lowest productivity classification as defined by the GSI. The productivity classification for the pumping borehole is consistent with the poorly productive aquifer classification. As outlined above the pumping well (PW1) is located on the middle bench of the existing quarry floor and was drilled to a total depth of 60mbgl. The other exploratory holes drilled on the quarry floor are consistent with PW1 (i.e. Table 8.4 above).

The major inflows during the drilling of PW1 were reported in the top 4 – 5m of rock on the quarry floor. This shallow zone as discussed above is likely to comprise infill material overlying broken in-situ bedrock fractured as a result of the quarrying and blasting activities. This broken and more porous zone acts as a storage area for surface water within the quarry footprint.

It was reported that once the shallow water (stored within the broken rock) was removed by the early pumping the water level in the well drop very steadily down to 51.5m indicating that groundwater inflows from the deeper bedrock intercepted by the well which is proposed for are extraction are minimal.

During the pumping test groundwater levels were monitored at borehole locations within the quarry site (i.e. BH8, BH2, W1, W2, W3, BH3, BH12, BH13, W4 and W5) and a number of local domestic wells (private wells are dealt with Section 'Private Well Supplies' below). All monitoring boreholes, including the boreholes with 25m of the pumping well displayed very little reaction during the test. The maximum drawdown of 0.1m was recorded in BH13 which is located approximately 25m to the northeast of PW1. All of the site investigation data available for the quarry and proposed extension area are in-line with the Poor Aquifer classification of low permeability bedrock.

<u>Bedrock Permeability Values</u>

To determine the permeability characteristics of the bedrock within the application site proposed for continuation, falling head tests were undertaken on the SLR investigation holes wells BH4, BH7, BH8 and BH9 in March 2014 (refer to Table 8.6). These wells were chosen for completion of falling head tests as detailed logs are available for them. Detailed logs were not available for W1 – W5 at the time of reporting.

Borehole I.D.	Solution	K Value (m/sec)
SLR - BH4	Bouwer-Rice	3.21×10^{-9}
SLR - BH7	Bouwer-Rice	8.3×10^{-9}
SLR - BH8	Bouwer-Rice	4.06×10^{-8}
SLR - BH9	Bouwer-Rice	6.6×10^{-8}
Application Site Average		**2.95×10^{-8}**

Table 8.6: Results of Falling Head Tests.

The results of falling head tests give permeability values in the range of 6.6×10^{-8}m/s to 3.21×10^{-9}m/s which would be considered a very low permeability for bedrock. The permeability values for the boreholes within the application are consistent with the bedrock encountered during drilling which was competent, high quality rock with no significant recordable groundwater strikes or inflows.

Groundwater Levels & Gradients

Monthly groundwater level data from July 2008 to May 2021 are available for on-site groundwater monitoring wells W1 to W5 and for an off-site private domestic well - W6 (refer to Plate 8.1 below for plot).

(Please note, the quarry was temporarily closed due to poor market conditions in June 2012 to January 2014, There were no monthly groundwater level monitoring undertaken during this time).

The on-site monitoring wells are located outside of the main extraction footprint area/continuation area and close to the site boundary. Summary water level data for this period are shown in Table 8.7 below. The off-site domestic well is discussed in Section 'Private Well Supplies' below.

MW Name	Ground Elevation (m OD)	Max WL (m bgl)	Min WL (m bgl)	Max WL (m OD)	Min WL (m OD)	Range (m)
W1	141.84	10.55	19.94	131.29	121.90	9.39
W2	129.39	2.32	12.17	117.22	127.07	9.85
W3	131.76	8.3	19.97	123.46	11.67	11.67
W4	151.66	8.19	17.48	143.47	134.18	9.29
W5	143.98	8.26	17.21	135.72	126.77	8.95
W6*	135.32	1.53	6.97	133.79	126.82	6.97

Table 8.7: Summary of Water Level Data (July 2008 – May 2021).

The seasonal groundwater level fluctuation range across the borehole locations is relatively consistent. The largest groundwater level range in W3 is due to the fact that the well is located closest to the existing extraction area and therefore groundwater levels will be most affected particularly during the summer months when recharge is less. Well W6, which is an off-site private well, is the furthest away well from the extraction area.

The long-term groundwater level trend for the on-site monitoring wells shows only a small reduction in groundwater levels of 2 -3m over the monitoring period (July 2008 – May 2021).

The groundwater levels in private well W6 do not show any significant reduction over the monitoring period.

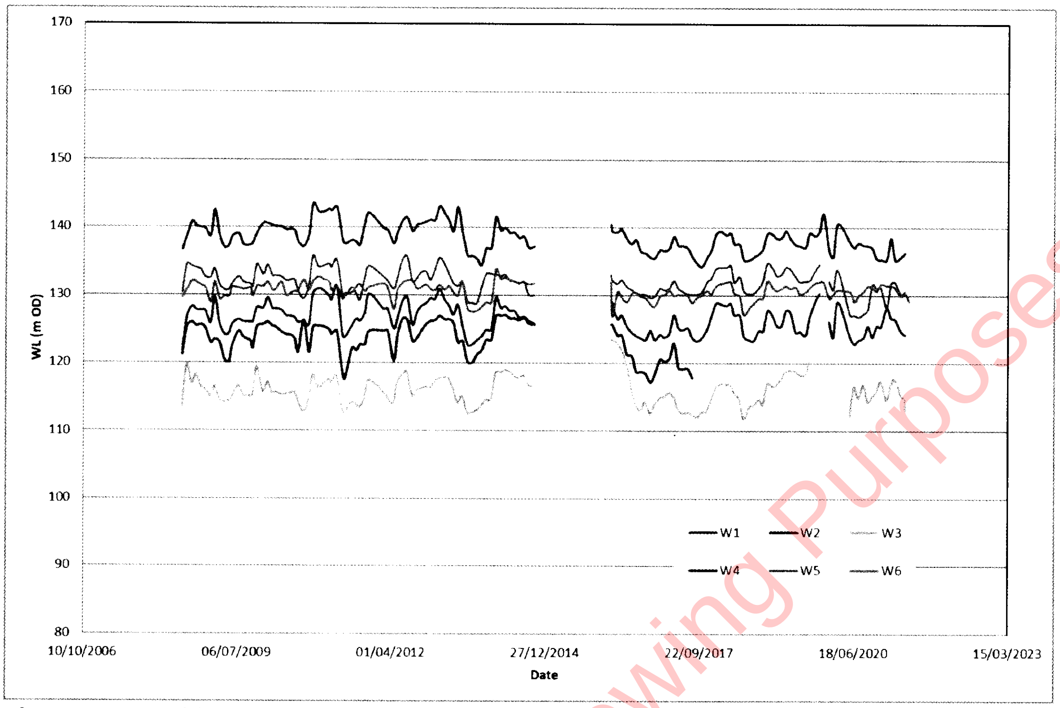

Plate 8.1: Monthly Groundwater Levels (July 2008 – May 2021).

Data loggers were installed in boreholes W2, W3 & W5 from 4th September 2020 to 18th May 2021 for continuous (2 hour intervals) water level recording. A groundwater level plot against daily rainfall depths (rainfall data from Dublin Airport) for this period is shown as Plate 8.2.

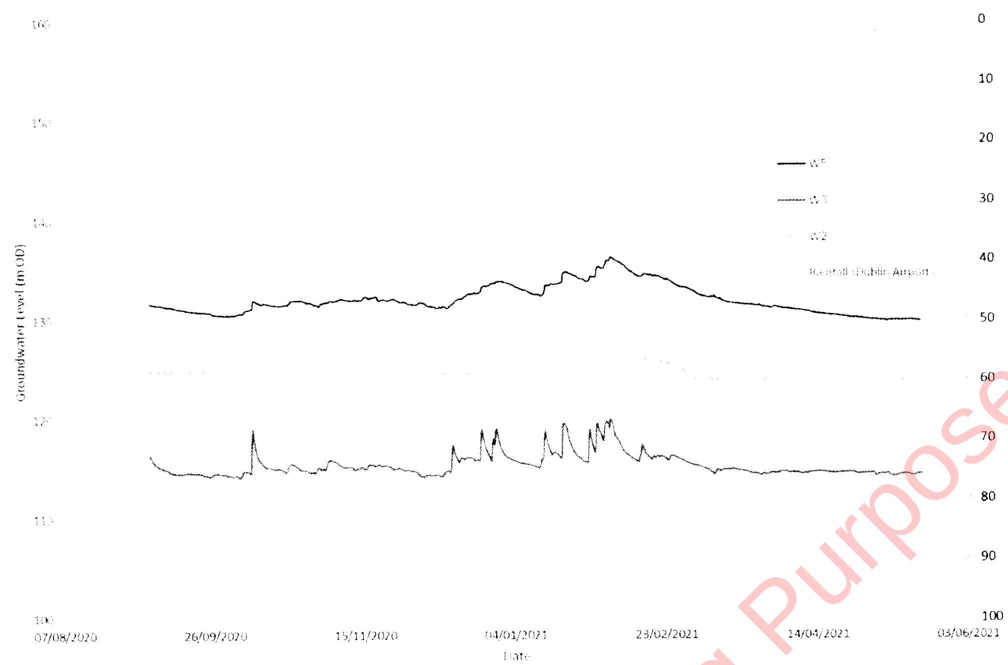

Plate 8.2: Groundwater Level Plots & Rainfall Depths.

An assessment of the groundwater level plots indicates that groundwater levels in the area of the quarry respond to rainfall events rather than quarry pumping.

In terms of rainfall events groundwater level responses were significantly more pronounced in W3 (in particular) and W5 with a subdued reaction in W2.

The upper bedrock intercepted by borehole W3 and W5 is relatively shallow in comparison to the deeper more competent (i.e. unweathered) bedrock intercepted by W2 which is located on the quarry floor. The more pronounced water level reaction to rainfall in the shallower bedrock boreholes is consistent with the hydrogeological conceptual presented in Section 'Hydrogeology' above, where the majority of groundwater recharge and movement is expected to take place in the upper 3 - 10m of bedrock and below this depth movement of groundwater will generally be limited and of small/low volumetric flux. The more pronounced water level reaction to rainfall in boreholes which intercept shallower bedrock outside the quarry void compared to boreholes on the quarry floor can also be attributed to a double tiered groundwater regime (shallow groundwater in weathered bedrock outside of the quarry void and a groundwater level below the floor of the quarry void. This is discussed further below.

Groundwater levels within the quarry site indicate a relatively steep groundwater gradient in the area of the quarry void. The relatively steep groundwater gradients in and around the quarry void can be attributed to a double tiered groundwater level system as a result of low permeability bedrock. The double tiered system, which comprises water levels in the bedrock surrounding the quarry void and water levels on the quarry floor within the void, creates a steep groundwater gradient between the two systems as a result of low permeability bedrock. This steep groundwater gradient means that the groundwater catchment to the quarry void (discussed in more detail below) is kept localised to the near vicinity of the quarry site.

The SLR site investigation monitoring wells are located to the west and northwest of the application area. These are located within the overall Kilsaran landholding. Water levels in these monitoring wells were noted to be relatively shallow (i.e. <2mbgl) and given the significant elevation of the area, would indicate underlying low permeability bedrock where the majority of groundwater flow is constrained to the upper weather layer. This is consistent with the poor aquifer characteristics of the area.

A groundwater contour plot for levels measured on 22nd June 2021 is shown as Figure 8.6. The groundwater level contour plot indicates (as discussed above) very steep groundwater gradients in the area of the quarry void. The quarry's location on a topographic highpoint along with surrounding low permeability bedrock (which creates a local double tiered groundwater regime) means that the groundwater catchment to the quarry void is kept localised to the area of the quarry site. The localised extent of the groundwater catchment to the quarry means that groundwater seepages to the quarry void will be restricted by the recharge capacity of the bedrock immediately surrounding the void which is relatively low (i.e. <100mm/year).

The groundwater level contours indicate a groundwater catchment divide just to the south of the quarry whereby the groundwater flow direction is to the south on its southern aspect and towards the quarry void on its northern aspect. A second groundwater catchment divide (present as a result of the quarry void) appears to exist along the northern section of the quarry whereby flow will be in a northerly direction away from the quarry void north of the divide. The continuation area does not extend north or south of these groundwater catchment divides. The continuation area is not expected to alter the existing hydrogeology of the local area in any significant way due to the low permeability of the bedrock and the localised groundwater flow regime.

Overall, the groundwater contours and monitoring well hydrographs as presented above indicate a quarry void with limited groundwater seepage input (from very localised groundwater recharge) with the majority of pumping being undertaken to remove surface water. Quarry discharge is dealt with in Section 'Quarry Discharge Water Quality Monitoring' below.

Groundwater Quality

Results of groundwater sampling undertaken within the quarry site on 11th August 2021 are attached as Appendix 8.2 attached below along with the EU Groundwater Regulation ((S.I. no. 9 of 2010) and EU Drinking Water Regulation (S.I. 122 of 2014) and threshold values.

An exceedance over S.I. 122 of 2014 for ammonium and manganese was reported for well W3.

The elevated concentration of manganese in W3 in comparison to W5 is likely to be as a result of variations in geology across the site.

Potential sources of ammonium include animal/farmyard waste and wastewater.

An on-site septic tank is located approximately 50m to the north of the existing site entrance. However, the septic tank is located down-gradient of W3 and therefore it is an unlikely source. A cluster of third-party dwelling houses is located up-gradient to the southeast of W3 and septic tanks are potential sources.

Groundwater Vulnerability

The vulnerability rating (www.gsi.ie) of the aquifer underlying the site, proposed continuation area and new access road is rated as "Extreme" in this area. This is consistent with the subsoil mapping where subsoils were mapped to be absent in the area of the site. This would have been the case prior to the existence of the quarry as subsoil cover away from disturbed areas is relatively thin or even absent.

Groundwater Body Status

The Groundwater Body (GWB) in which the quarry site and proposed extension are located is the Duleek GWB and it is assigned an over "Good Status". The overall quantitative and chemical status is Good.

Private Well Supplies

Based on EPA and GSI mapping sources there are no public or groundwater supplies within 7km of the quarry site. The Bog of Ring Source Protection Area in North County Dublin is the closest mapped public groundwater source to the site.

Private wells are the main source of water in the Bellewstown area. Generally, every house in the vicinity of the quarry has its own well supply. The distribution of water wells is normally one to every house but in some cases two or three house are supplied by one single well. Houses within 150m of the site boundary where wells are known to exist are shown on Figure 8.7 and summarised in Table 8.8 below. Given the topography of the area, the localised groundwater catchment to the quarry and the predominant surface water pumping regime it was not deemed necessary to include wells at a greater distance than this within this assessment. There is also sufficient data (that will be outline below) to indicate that there is no discernible impact on these private wells as a result of the current quarry operation.

Well ID	Type	Total depth (m)	Datum Elevation (m OD)	Distance from Quarry Footprint (m)	Comment
DW1(a)	BH	10	-	155	Old well
DW1 (b)		25	-	163	Drilled adjacent to DW1 (a)
W6	BH	-	135.32	196	Supplies 2 no. houses
DW2	BH	-	-	190	Details unknown
DW3	BH	30	140	192	
DW4	BH	35	137	230	
DW5	BH	27	-	240	
DW6	BH	-	-	265	Details unknown
DW7	BH	-	-	283	Details unknown
DW8	BH	-	-	310	Details unknown
DW9	BH	-	-	480	
DW10	Dug	3	-	200	Located within Kilsaran landholding area.

Table 8.8: Summary of Known Private Wells within 150m of Site Boundary.

Historically, the groundwater levels in the wells surveyed were generally less than 6m below ground level with the average total well depth being 33m.

The groundwater level contour and catchment map (refer to Figure 8.6) indicate that the houses to the south of the quarry site (i.e. along the east/west oriented public road where most of the local private dwellings in the area exist) are outside of the groundwater catchment to the quarry and proposed extension area. The groundwater contour map indicates that a groundwater catchment divide separates that quarry and these wells to the south of the site, in particular the wells to the southwest of quarry. This also means that groundwater flow from below the quarry site or proposed continuation will not flow towards these wells and therefore there is a very low groundwater contamination risk to these wells from the quarry in the unlikely event of potential spillage or leakage.

The wells to the southeast of the quarry development are significantly closer to the extraction footprint than the wells to the southwest but are up-gradient to the quarry. It should be noted that the proposed extraction area does not extend laterally towards these wells. The proposed continuation area extends in a westerly and northerly direction and therefore the separation distance between the local private wells and quarry extraction area will not change.

Long term water level monitoring data is available for private well W6 between July 2008 and May 2021 (refer to Plate 8.1 above).

Well W6 is located ~196m to the southeast of the quarry footprint. Based on the groundwater contours this is well is located up-gradient of the quarry site.

The water levels in W6 ranged between 1.53 – 6.97mbdl (metres below datum level/well head) or 133.79m to 126.82 OD respectively over the monitoring period (July 2008 – May 2021).

Apart from seasonal fluctuations the well shows no significant long-term rising or falling water level trends over this monitoring period. Please note that monitoring of this well commenced after the development of the existing lower bench and therefore any lowering of the water table by extraction of the existing lower bench would not be picked up in the monitoring data. Regardless, the current quarry operation does not appear to be negatively impacting on this well in terms of its function as a water supply source.

8.3.4 Site Monitoring Data

Quarry Discharge Volumes

Water from the quarry sump is pumped intermittently (i.e. is switched on and off manually in accordance with surface water levels in the sump) to a settlement pond, hydrocarbon interceptor and reed bed filter prior to being discharged from the site via a holding chamber with a v-notch weir and water level data logger for measurement of flow. The location of the settlement pond, hydrocarbon interceptor, reed bed, holding chamber along with the discharge point are shown on Figure 8.4. The discharge point is to a land drain which flows into the Lunderstown Stream approximately 1km downstream of the site. The existing discharge licence for the site (Licence Ref No. 10/02) limits discharge volumes to 19.25m^3/hour (5.35L/s) or 462m^3/day. No amendment to the existing discharge licence is being sought for the proposed extension as no significant increases in pumping are expected.

Daily discharge volumes for the period July 2020 to July 2021 are shown on Plate 8.3 below. During this period total daily discharges varied from 0 to 570m^3/day with a daily average of 107m^3/day.

There were only 10 no. occasions when the daily discharge limit was exceeded during that year period. The primary reason for this is that pumping from the quarry sump in the past has been sporadic, whereby water was allowed to build up on the quarry floor and then pumped continuously out over a subsequent two to three day period. Pumping was switched on and off manually.

Going forward, it is proposed that pumping from the quarry and continuation area will be undertaken in a more controlled manner whereby a high water level and low water level in the sump will control daily discharge volumes. This means that the average daily discharge can be maintained below 462m^3/day, thereby preventing exceedances. The overall average discharge rate of 107m^3/day over the monitoring period is well below the discharge limit and indicates that this is achievable during the proposed continuation.

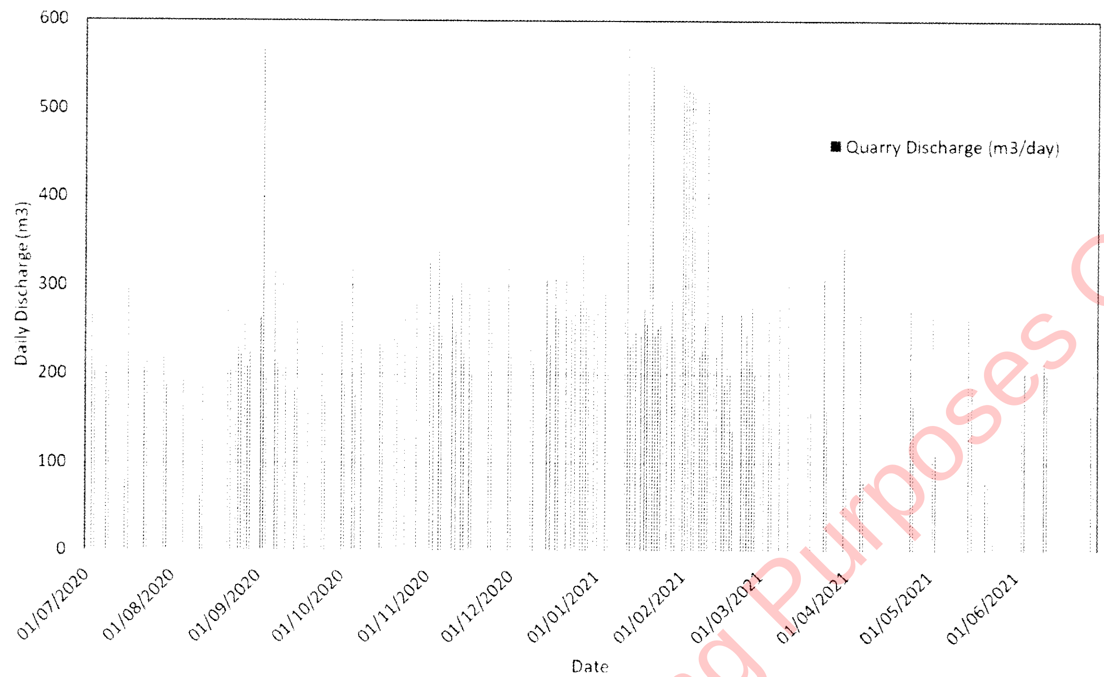

Plate 8.3: Bellewstown Daily Quarry Daily Discharge Volumes (July 2020 – July 2021).

Quarry Discharge Water Quality Monitoring

A condition of the existing Discharge Licence (Licence Ref: 10/02) did require monthly measurement of quarry discharge. However, this monitoring commenced in 2012 with a reduction to quarterly in 2013. As discussed in the above sections the discharge from the site (i.e. pumped discharge) comprises predominantly surface water runoff with a minor groundwater component. The samples are taken at the discharge point downstream of the settlement pond, reed bed filter and hydrocarbon interceptor (Type 1 full retention separator NSF20).

A summary of the contemporary discharge water quality data for the years 2020 and 2021 are shown in Table 8.9 below along with the Maximum Limit Values (MLVs as defined in the discharge licence) permitted by the discharge licence.

Parameter	Units	MLV	Max	Min	Average	No. of Exceedences	No. of Samples
pH	pH	**≥ 6 ≤ 9**	7.9	7.6	7.8	0	6
BOD	mg/L	**5**	<2	<2	<2	0	6
COD	mg/L	**50**	<5	<5	<5	0	6
Suspended Solids	mg/L	**15**	4	<2	<2	0	6
Nitrate as N	mg/L	**11**	11.14	6.45	8.9	1	6
Ammonia N	mg/L	**0.2**	0.08	0.01	0.03	0	6
Ortho-Phosphate	mg/L	**0.05**	0.03	0.01	0.03	0	6
TPH (C6-C40)	µg/L	**50**	<1	<1	<1	0	6
BTEX (S/L)	µg/L	**10**	<1	<1	<1	0	6

MLV – Discharge licence Maximum Limit Value

Table 8.9: Summary of Discharge Water Quality Data (2020 – 2021 to date).

There was only one exceedances over the MLV and this was nitrate on 18th November 2020. All other monitoring results for were below the MLV.

8.3.5 Flood Risk Assessment

OPW's CFRAM National Indictive Fluvial Mapping and Past Flood Event Mapping (www.floodinfo.ie) was consulted to identify those areas as being at risk of flooding.

No medium probability (100-year) or low probability (1000-year) flood zone areas within the site boundary, proposed continuation area or new access road route were identified from the CFRAM mapping.

The site's location on a topographic high point means the risk of flooding in the area as a result of fluvial flood events is low. No flood events are mapped along the Lunderstown Stream to the south of the south of the site, however flood events are noted on the River Nanny in the Duleek area downstream of the site.

The National Indictive Fluvial Mapping shows the extents of the indicative 100-year and 1000-year flood zone which relates to fluvial (i.e. river) flood events. Very localised flooding in the vicinity of the watercourse channel is noted along the Lunderstown Stream with more extensive flooding being mapped along the route of the River Nanny.

To assess the flood risk posed by the proposed quarry development in terms of its discharge a walkover survey of the discharge drain downstream of the discharge point was undertaken as part of the assessment. Discharge from the quarry (at a flow rate of $0.01m^3/sec$) to the drain was occurring at the time of the walkover survey on 22nd June 2021. The drain along most of its length was at least (i.e. pinch point) 1.5m in width and 1m in depth with a water depth of only 0.1m.

Based on the minimum drain channel dimensions as outlined above and a slope of 0.05 (taken from the 1:50,000 scale map) the maximum capacity of the drain is calculated to be

6.35m³/sec (refer to Table 8.10). The maximum discharge rate for the quarry will be limited to 462m³/day (0.0053m³/sec) which is well below the total drain capacity. Also, the surface water catchment to the drain outside of the quarry site is very localised and baseline flows in this drain are expected to be minimal.

Therefore, the risk of the drain flooding during wet periods as a result of quarry discharge input is very low. The capacity of the Lunderstown Stream which exits downstream of the drain is significantly greater than the drain and therefore the risk of flooding within the stream as a result of quarry discharge is negligible to none.

Location	Channel Dimensions			Area (m²)	Wetted Perimeter (m)	Hydraulic Radious, R (m)	Slope (S)	n	Q (m³/s)
	Bottom width (m)	Top width (m)	Depth (m)				(1 in 50)		
Drain	1.50	1.50	1.00	1.50	3.50	0.43	0.0500	0.030	6.355

Table 8.10: Channel Capacity Assessment

8.3.6 Designated Sites

Designated sites include National Heritage Areas (NHAs), Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).

River Nanny Estuary and Shore SPA – identified by the *Natura Impacts Statement* (enclosed at Appendix 6.1 of this EIAR) as potentially being adversely affected by the development site as there is a hydrological link via a stream that receives surface water discharge from the development site. The NIS concludes "*Significant effects cannot be discounted without the implementation of best practice design measures, particularly in relation to the control of run-off of pollutants to watercourses hydrologically connected to the River Nanny Estuary & Shore SPA. With the implementation of the mitigation measures specified in Section 4.2, no indirect habitat loss or deterioration of the Natura 2000 sites in relation to silt-laden or contaminated surface-water run-off arising from the application are deemed likely in this case.*"

8.4 Likely and Significant Effects of the Proposed Development

8.4.1 Construction Phase

EFFECTS & MITIGATION MEASURES
1. Downstream Surface Water Quality Effects in the Lunderstown Stream and River Nanny from Suspended Sediments during Overburden Stripping /Removal There will be a small requirement to strip and store overburden from the north-western section of the continuation area as the quarry face extends into the lands to the north / northwest. Overburden removal will be an intermittent operation but will be completed in the early stages of the continuation, which will progress in advance of the rock extraction during periods of suitable weather. Overburden will be retained and used during

restoration activities such as vegetating the upper benches of the quarry.
Pathways - Runoff, quarry discharge and local drainage routes. **Receptors** – Downstream surface waters (Lunderstown Stream and River Nanny) **Pre-mitigation effects** – Negative, reversible, slight, indirect, likely, temporary effect on surface water quality within the Lunderstown Stream and the River Nanny.
Mitigation Measures: • All surface water arising during the soil stripping works in the continuation area will be captured and directed to the quarry sump for treatment; • Prior to the commencement of overburden stripping works silt fencing will be placed down-slope of the excavation area; These will be embedded into the local soils to ensure all site water is captured and filtered; • Surface water will be collected at low points across the soil stripping works area; • Discharge into the existing quarry sump will occur following settlement treatment in local temporary settlement ponds if required, and any water discharge from these ponds to the quarry floor will be routed through silt bags which will filter any remaining sediment from the pumped water. The entire soil stripping and landscaping works area will be enclosed by a perimeter of double silt fencing; • Daily monitoring of the overburden stripping/landscaping earthworks will be completed by a suitably qualified person. All necessary preventative measures will be implemented to ensure no entrained sediment, or deleterious matter will enter the downstream receiving waters; • Overburden stripping and landscaping works will be scheduled for periods of low rainfall (summer months) to reduce run-off and potential siltation; • Landscaped areas and perimeter berming will be planted with trees and grasses as soon as possible after formation to reduce the potential of surface water erosion; and, • Good construction practices such wheel washers and dust suppression on site roads, and regular plant maintenance will ensure minimal risk. The Construction Industry Research and Information Association (CIRIA) provide guidance on the control and management of water pollution from construction sites ('Control of Water Pollution from Construction Sites, guidance for consultants and contractors', CIRIA, 2001), which provides information on these issues. This will ensure that surface water arising during the course of overburden stripping and landscaping activities will contain minimum sediment.
Residual Effect - All construction drainage/runoff water will be contained and treated to a high standard as per the ongoing quarry inflow water, therefore the residual effects are considered to be -imperceptible, indirect, reversible, unlikely, temporary effect on surface water quality within the Lunderstown Stream and the River Nanny.
Earthworks (Cut and fill and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Waters During the New Access Road Construction - Road construction activities will include cutting and filling which will require earthworks resulting in removal of vegetation cover and excavation of soil and mineral subsoil.

These activities can result in the release of suspended solids to surface watercourses and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality and fish stocks of downstream water bodies. Potential effects are significant if not mitigated against.
Pathways - Runoff, quarry discharge and local drainage routes. **Receptors** - Downstream surface waters (Gafney Stream and River Nanny) **Pre-mitigation effects** - Indirect, negative, slight, long term, Likely effect on down gradient rivers, water quality, and dependant ecosystems in the Gafney Stream and the River Nanny.
Mitigation Measures: • Construction of the proposed access road will only be done over a dry period to avoid water logged soils, heavy rainfall and runoff; • Firstly, the route corridor area will be clearly marked out with fencing or flagging tape to avoid unnecessary disturbance of vegetation; • Double silt fencing will be placed down-gradient of the route corridor prior to excavation / filling work commencing. Silt fences are effective at removing larger particle sized solids. This will act to prevent entry to water courses of sand and gravel sized sediment released from excavation; • Silt fencing will be embedded into the local soils to ensure all site water is captured and filtered; • Additional silt fencing, sand bag or straw bales (pinned down firmly with stakes) will be placed across any natural surface depressions / channels that slope towards a local watercourse; • As the excavation / infilling work progresses, an up-gradient interceptor drain (clean runoff) and down-gradient collector drain (works area runoff with possible entrained sediment) will be placed along the route corridor in advance of the excavation works area; • Check dams / silts traps will be placed every 20 – 30m in the down-gradient collector drain to slow down runoff and remove any suspended sediments; • Temporary check dams / silt fencing arrangements will also be placed in any natural drainage features intercepted by the route that do not having flowing water (i.e. dry gullies and other preferential flowpaths); • If high levels of silt or other contaminants are noted in any local watercourse, all construction works will be stopped. No works will recommence until the issue is resolved and the cause of the elevated source is remedied; • Excavation work will not be undertaken during periods of high rainfall. This will minimise the risk of entrainment of suspended sediment in surface water runoff and transport via this pathway to surface watercourses; • All disturbed ground will be re-seeded at the soonest, practicable opportunity to prevent erosion; and, • All temporary surface water control / protection measures such as silt fencing will be kept in place until disturbed ground has vegetated and stabilised. Regular daily checks will be undertaken. Pre-emptive Site Drainage Management:

The works programme for the initial construction stage of the development will also take account of weather forecasts, and predicted rainfall in particular.

Large excavations and movements of soil/subsoil or vegetation stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

Works should be suspended if forecasting suggests any of the following is likely to occur:

- >10 mm/hr (i.e. high intensity local rainfall events);
- >25 mm in a 24 hour period (heavy frontal rainfall lasting most of the day); or,
- >half monthly average rainfall in any 7 days.

Prior to works being suspended the following control measures should be completed:

- Secure all open excavations;
- Provide temporary or emergency drainage to prevent back-up of surface runoff; and,
- Avoid working during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded.

Monitoring:
An inspection and maintenance plan for the on-site drainage system will be prepared in advance of commencement of any works. Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended.

Residual Effect:
The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect is considered to be - Negative, imperceptible, indirect, short term, unlikely impact on down gradient rivers, water quality, and dependant ecosystems in the Gafney Stream and the River Nanny.

8.4.2 Extractive / Operational Phase

The likely and significant effects of the proposed development and mitigation measures that will be put in place during the extractive/operational phase are shown below.

EFFECTS & MITIGATION MEASURES

1. Increased Groundwater Vulnerability & Potential for Contamination

The continuation will require increasing the extraction area from approximately 8.1ha to approximately 17.3ha which is an increase of 9.2ha.

This will require removal of topsoil and overburden at the proposed extension area thereby increasing the vulnerability of the bedrock aquifer below to contaminants.
Pathways - Recharge to groundwater and groundwater flow within and from the bedrock aquifer. **Receptors** – Groundwater (Duleek GWB). **Pre-mitigation effects** – Indirect, negative, moderate, long term, likely effect on the underlying aquifer within the Duleek GWB.
Mitigation Measures: The main mitigation with respect increased groundwater vulnerability during the extraction phase will be employment of best practice measures with respect to oil usage and refuelling (refer to Section 3 below). Post extraction phase a landscape and restoration plan will be implemented. This will involve previously stripped overburden being placed on the upper quarry benches to establish grassland which will provide a level of protection to groundwater. The lower quarry will be allowed to flood with emphasis on habitat creation and biodiversity.
Residual effect - The application of quarry restoration means effect on groundwater vulnerability will have a neutral effect on groundwater vulnerability on the underlying aquifer within the Duleek GWB.
2. Surface water Quality Effects to the Lunderstown Stream and the River Nanny Resulting from Quarry Discharge and Surface Water Runoff. The surface water run-off component generated from the extraction areas, hardstanding areas and site roads have the potential to contain high levels of suspended solids and hydrocarbons. The groundwater component of the discharge may introduce nutrients into the overall discharge. Runoff from the northern section of the proposed extension (where overburden storage is proposed) potentially could enter the River Nanny via drainage ditches and stream to the north of the site
Pathways - Surface water discharge routes and overland flow. **Receptors** - Down-gradient streams and rivers (Lunderstown Stream and River Nanny) **Pre-mitigation effect** - Indirect, negative, slight, long term, likely water quality effect on down-gradient streams and rivers (i.e. the Lunderstown Stream and the River Nanny). Discharge water quality data are available for the existing quarry as presented in the above baseline assessment. Suspended solids, which is the main parameter of concern in relation to quarry discharge, was less than 2mg/L on average over that period with no exceedances above the licence MAC. There was also no detection of hydrocarbons. A sporadic exceedence were noted in nitrate, however no persistent contamination issue was evident. The potential source is likely to be local land spreading which will occur

anyway regardless of whether the development proceeds or not.
Mitigation Measures: No additional mitigation is proposed. The total discharge from the quarry site and proposed continuation area will be maintained below the existing discharge limit of 462m3/day. Discharge from the quarry will continue to be passed through an adequately sized settlement pond, reed bed filter and hydrocarbon interceptor. The reed bed filter is relatively new and therefore has not reached its treatment capacity in terms of nutrient removal. Increased nutrient reduction is expected to occur as the reed beds develop. The discharge quality is monitored on a quarterly basis and this is to continue at the quarry. Discharge volumes will be continuously monitored at the discharge point location. A silt fence will be installed between the placed overburden material and the drainage ditch at the northern boundary of the proposed development site during the emplacement of the storage area and while vegetation is establishing on the placed overburden material to prevent erosion. The silt fence will prevent any suspended solids entering the drainage ditch and potentially reaching the River Nanny. With regard the proposed access road and site entrance, there will be a requirement for quarry traffic to use a wheel wash prior to exiting the site via the proposed new road and site entrance. This will prevent sediment build-up on the road surface. The road will also be swept regularly to maintain a clean surface. Runoff from the road surface will be allowed disperse into the adjacent grassland which will provide a natural vegetation filter for road runoff. Also, a soakaway will be located at the junction of the private haul road and public road no L1615. The soakaway is designed to cater for surface water runoff from the junction/entrance area. The soakaway BRE365 Infiltration Test Report is attached as Appendix 8.3.
Residual Effects – Due to the good quality of the quarry discharge, relatively low discharge volumes and drainage mitigation, residual effects will be Indirect, negative, imperceptible, long term, likely effect on down-gradient streams and rivers (i.e. the Lunderstown Stream and the River Nanny).
3. Leakages and Spillages from Oil & Chemical Storage Areas Oil and chemical storage tanks that are not within bunded areas create the potential for spillages or leaks to migrate down into soil or groundwater beneath the site or be released into the receiving surface water with the quarry discharge.
Pathways – Groundwater Recharge, Groundwater Flowpaths and quarry pumping. **Receptors** – Groundwater (Duleek GWB) & downstream surface water (Lunderstown Stream and River Nanny) **Pre-mitigation Effects** – Indirect, negative, slight, long term, likely effect on groundwater

(Duleek GWB) and surface water in the Lunderstown Stream and the River Nanny).
Mitigation Measures: Sources of hydrocarbons (such as oil based substances or other hazardous chemicals) have and will be located within safely bunded areas that safely contain all spillages and prevent the migration of contaminants into the underlying bedrock aquifer. Refuelling of quarry plant has and will only take place in designated bunded refuelling areas or by mobile bowser with availability of suitable spill kits. All discharge (surface water and groundwater) from the quarry extraction area will be passed through a hydrocarbon interceptor prior to be being released into the receiving water. Runoff from the areas of the site sloping away from the extraction footprint (i.e. overburden storage area to north of the site) will not have much machinery traffic once the overburden is emplaced and therefore oil/chemical leaks and spillages is not expected to be an issue. The proposed access road will be inspected and swept clean on a regular basis which will remove sediment and residues from the road surface.
Residual Effect – The use and storage of hydrocarbons and small volumes of chemicals is a standard risk associated with all quarry sites. Proven and effective measures to mitigate the risk of spills and leaks have been proposed above and will break the pathway between the potential source and the receptor. The residual effects will be – Negative, indirect, imperceptible, medium term, likely impact on groundwater (Duleek GWB) and surface water quality in the Lunderstown Stream and the River Nanny.

4. Discharge of Treated Effluent to Groundwater In unsuitable site conditions discharge of effluent to groundwater has the potential to impact on groundwater and surface water quality.
Pathway – Groundwater flow paths and Surface water drainage routes. **Receptor** – Groundwater (Duleek GWB) & downstream surface water (Lunderstown Stream and River Nanny) **Pre-mitigation effect** – Indirect, negative, slight, long term, likely on groundwater (Duleek GWB) and surface water in the Lunderstown Stream and the River Nanny.
Mitigation Measures It is proposed that wastewater from the site will be discharged through a permitted upgraded on-site wastewater treatment system and percolation unit.
Residual Impact – Proven and effective measures to treat wastewater will break the pathway between the potential source and the receptor. The residual effects will be – Negative, indirect, imperceptible, medium term, likely effect on groundwater (Duleek GWB) and surface water quality in the Lunderstown Stream and the River Nanny.
5. Water Quality Impacts on the River Nanny Estuary & Shore (SPA) River Nanny Estuary & Shore (SPA) exists approximately 16km downstream of the quarry development.
Pathway – Surface water flowpaths **Receptor** – River Nanny Estuary & Shore (SPA) **Pre-mitigation Effect** – Indirect, negative, imperceptible, long term, likely effect on designated sites (River Nanny Estuary & Shore (SPA)). Discharge water quality data are available for the existing quarry as presented in the above baseline assessment. Suspended solids, which is the main parameter of concern in relation to quarry discharge, was less than 2mg/L on average over that period. There was also no detection of hydrocarbons. An exceedance was noted in relation to nitrate, however no persistent contamination issue was evident.
Mitigation Measures: No additional mitigation proposed. Discharge from the quarry is and will continue to be passed through an adequately sized settlement pond, reed bed filter and hydrocarbon interceptor. The reed bed filter is relatively new and therefore has not reached its treatment capacity in terms of nutrient removal. Increased nutrient reduction is expected to occur as the reed beds develop.

The discharge quality is monitored on a quarterly basis, and this is to continue at the quarry. Discharge volumes are continuously monitored at the discharge point location. In terms of the northern overburden storage area, runoff will essentially be Greenfield runoff once the overburden storage area has been vegetated. Silt fencing will be put in place until vegetation growth occurs. The proposed access road will be inspected and swept clean on a regular basis which will remove sediment and residues from the road surface.
Residual Effect – No effect on downstream designated site (River Nanny Estuary & Shore (SPA))
6. Effect on Local Groundwater Levels The creation of a deeper quarry void down to 98m OD that intercepts the water table has the potential to impact on local groundwater levels in the vicinity of the quarry. The proposed additional vertical extraction depth of 18m (proposed depth from the existing lower bench level) is relatively small and no significant impacts are anticipated.
Pathway – Groundwater flowpaths & gradients **Receptor** – Local groundwater regime **Pre-mitigation Effect** – Direct, negative, slight, long term, likely effect on groundwater levels within the Duleek GWB. The groundwater level contour plot for the existing quarry site (Figure 8.8) indicates that the groundwater catchment to the quarry is localised to the site and this is not expected to change significantly as a result of the continuation. Overall groundwater volumes pumped from the existing quarry make up a very small proportion of the overall quarry discharge. No significant groundwater inflows are anticipated as a result of the proposed extension.
Mitigation Measures: No mitigation measures are proposed. Due to the low permeability of the proposed bedrock for extraction and localised groundwater catchment to the quarry, further significant effects as a result of the proposed extension will not occur.
Residual Effect - Direct, negative, slight, long term, Likely effect on groundwater levels within the Duleek GWB.
7. Effects on Local Well Supplies (Quality and Quantity) The creation of a wider and deeper quarry void and quarry operations have the potential to effect on local well supplies in terms of quantity (i.e. impacts on groundwater levels) and quality (i.e. hydrochemistry).
Pathway – Groundwater flow paths & gradients. **Receptor** – Local well supplies. **Pre-mitigation effect** – Indirect, negative, imperceptible, long term, likely effect on local well supplies in terms of quantity (i.e. impacts on groundwater levels) and quality (i.e.

hydrochemistry).
Mitigation Measures: Due to the low permeability of the proposed rock for continued extraction and localised groundwater catchment to the quarry, further significant effects on groundwater levels or quality are not anticipated and therefore significant impacts on local well supplies is not anticipated. This distance between the local wells and proposed quarry continuation area will remain the same as the proposed lateral extension is not in the direction of the local wells. Also, as stated above, sources of hydrocarbons (such as oil based substances or other hazardous chemicals) have and will be located within safely bunded areas that safely contain all spillages and prevent the migration of contaminants into the underlying bedrock aquifer. Refueling of quarry plant has and will only take place in designated bunded refueling areas or by mobile bowser with availability of suitable spill kits. Monitoring of on-site groundwater levels and off-site groundwater levels (i.e. W6) will continue to ensure no significant effects are occurring.
Residual Effect - Indirect, negative, imperceptible, long term, likely effect on local well supplies in terms of quantity (i.e. impacts on groundwater levels) and quality (i.e. hydrochemistry).

8.4.3 Post Closure

On completion of the restoration works, the quarry sump pump will be removed from the site and the water level in the void will be allowed to return to its natural level which is estimated to be approximately 125m OD based on the available groundwater level data for the site. There will be no drainage/discharge from the site post closure.

No significant effects are expected during the post closure phase of the development.

8.4.4 Significant Effects on the Water Environment

No significant effects on the surface water or groundwater environment as a result of the proposed development will occur. Monitoring of quarry discharge (volumes & quality), on-site groundwater levels and off-site groundwater levels (i.e. W6) will continue to ensure no significant effects are occurring.

8.4.5 Human Health Effects

Potential health effects arise mainly through the potential for groundwater contamination and impacts on local wells. Hydrocarbons, in the form of fuels and oils, will be used on-site during aggregate extraction.

There will be best practice controls in place to ensure any potential sources of contamination on the site will be managed appropriately and the volumes present will be small in the context of the scale of the project. The potential imperceptible residual effects associated with groundwater contamination and subsequent health effects are negligible.

8.4.6 Cumulative Impacts

There is no proposal to amend the existing discharge licence limits in terms of volume or discharge quality (MLV) and therefore no additional potential negative effects are anticipated on downstream waters in terms of surface water quality or flows. Therefore, the proposed extension is not anticipated to contribute to hydrological cumulative effects in the River Nanny.

With regard groundwater, due to the low permeability of the proposed bedrock for extraction and localised groundwater catchment to the quarry, significant cumulative effects as a result of the proposed extension will not occur. There is also a lack of off-site factors/developments to contribute to cumulative groundwater effects.

Other development works are required to facilitate the proposed development, as well as improving road infrastructure generally for the area. These works include proposals to improve the carriageway of the L1615 including the application of a new surface overlay on the L1615 from its junction with the R150 to the entry / exit point of the proposed link road. Strengthening works of Beaumont Bridge on the River Nanny will also be required. However, due to the fact that there is no proposed alteration of the quarry discharge regime, in-combination effects with public road improvement works will not occur.

APPENDIX 8.1: CERTIFICATE OF ANALYSIS FOR SURFACE WATER.

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ISO 17025 INAB ACCREDITED TESTING
DETAILED IN SCOPE REG NO.166T

Report No: HYDR-374070920
Document No: EF0011

CERTIFICATE OF ANALYSIS

Client **Hydro Environmental Services**
22 Lower Main Street
Dungarvan
Co. Waterford

Date Received 07/09/2020
Date Reported 19/09/2020
Order Number 1527

For the Attention of: Hydro Environmental Services

Sample Reception 2 sample(s) received in good condition.

Comments Surface Water

Report Authorised by: Lyndsey Hughes

Lyndsey Hughes
Deputy Environmental Chemistry Manager

Conditions:

1. *Results in this report relate only to the items tested*
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ISO 17025 INAB ACCREDITED TESTING

Report No: HYDR-374070920

Document No: EF0011

CERTIFICATE OF ANALYSIS

Date Received 07/09/2020
Date Reported 19/09/2020
Order Number 1527

Sample Type Surface Water
Client ID Bellewatown
Date Tested 07/09/2020
ALS ID 4139593

Test	Result	Unit	Method
Suspended Solids	<5	mg / l	P202
Phosphorus	0.10	mg/l P	P207
COD Total	10	mg/l O2	P210
Sulphate	62.93	mg/l SO4	P243
BOD 5 day Total	<1	mg/l O2	P280
Orthophosphate	0.05	mg/l P	P281
Ammonia	0.02	mg/l NH3-N	P281
Chloride	31.2	mg/l CL	P281
Nitrate	7.4	mg/l NO3N	P281
Nitrite	0.01	mg/l NO2N	P281
Nitrogen (Total)	7.5	mg/L N	P285
Total Petroleum Hydrocarbons	0.012	mg / l	SUBCON^

Sample Type Surface Water
Client ID Bellewatown
Date Tested 07/09/2020
ID 4139594

Test	Result	Unit	Method
Suspended Solids	<5	mg / l	P202
Phosphorus	<0.10	mg/l P	P207
COD Total	<5	mg/l O2	P210
Sulphate	185.60	mg/l SO4	P243
BOD 5 day Total	2	mg/l O2	P280
Orthophosphate	<0.02	mg/l P	P281
Ammonia	<0.02	mg/l NH3-N	P281
Chloride	11.4	mg/l CL	P281
Nitrate	5.4	mg/l NO3N	P281
Nitrite	<0.01	mg/l NO2N	P281
Nitrogen (Total)	5.7	mg/L N	P285
Total Petroleum Hydrocarbons	<0.010	mg / l	SUBCON^

Report Authorised by: Lyndsey Hughes

Lyndsey Hughes
Deputy Environmental Chemistry Manager

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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 166T

Report No: HYDR-381131120
Document No: EF0011

CERTIFICATE OF ANALYSIS

Client	**Hydro Environmental Services** 22 Lower Main Street Dungarvan Co. Waterford	**Date Received**	13/11/2020
		Date Reported	08/12/2020
		Order Number	P1527

For the Attention of: Hydro Environmental Services

Sample Reception 2 sample(s) received in good condition.

Comments N/A

Report Authorised by:

Rosemary Thomas
Environmental Chemistry Manager

Conditions:

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7. SUBCON^ indicates analysis subcontracted to approved subcontractors who hold accreditation for this test
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ISO 17025 INAB ACCREDITED TESTING

Report No: HYDR-381131120

Document No: EF0011

CERTIFICATE OF ANALYSIS

Date Received 13/11/2020
Date Reported 08/12/2020
Order Number P1527

Sample Type Water
Client ID Bellewstown 12.11.2020
Date Tested 13/11/2020
ALS ID 4235397

Test	Result	Unit	Method
Suspended Solids	<5	mg / l	P202
Phosphorus	<0.10	mg/l P	P207
COD Total	<5	mg/l O2	P210
Sulphate	138.98	mg/l SO4	P243
BOD 5 day Total	<1	mg/l O2	P280
Orthophosphate	<0.02	mg/l P	P281
Ammonia	<0.02	mg/l NH3-N	P281
Chloride	12.2	mg/l CL	P281
Nitrate	10.0	mg/l NO3N	P281
Nitrite	<0.01	mg/l NO2N	P281
Nitrogen (Total)	7.2	mg/L N	P285
Total Petroleum Hydrocarbons	<0.01	mg / l	SUBCON^

Sample Type Water
Client ID Bellewstown 12.11.2020
Date Tested 13/11/2020
ALS ID 4235398

Test	Result	Unit	Method
Suspended Solids	6	mg / l	P202
Phosphorus	<0.10	mg/l P	P207
COD Total	6	mg/l O2	P210
Sulphate	58.44	mg/l SO4	P243
BOD 5 day Total	1	mg/l O2	P280
Orthophosphate	0.03	mg/l P	P281
Ammonia	<0.02	mg/l NH3-N	P281
Chloride	31.0	mg/l CL	P281
Nitrate	9.7	mg/l NO3N	P281
Nitrite	0.01	mg/l NO2N	P281
Nitrogen (Total)	8.1	mg/L N	P285
Total Petroleum Hydrocarbons	<0.02	mg / l	SUBCON^

Report Authorised by:

Rosemary Thomas
Environmental Chemistry Manager

APPENDIX 8.2: CERTIFICATE OF ANALYSIS FOR GROUND WATER.

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

Contact Name	David Broderick	**Report Number**	**202280 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	202280/001
		Date of Receipt	12/08/2021
		Date Started	12/08/2021
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1416-4	**Date of Report**	27/08/2021
Project No.	QN009187	**Sample Type**	Ground Waters
Customer Ref	Bellewstown MW3	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.
Coliforms							
Total Coliforms	*	Default-N	0		91	MPN/100ml	
E. Coli	*	Default-N	0		5	MPN/100ml	
Enterococci (IH)							
Enterococci	*	Default	0		9	MPN/100ml	
Gallery Plus-Suite A							
Ammonia as N		EW175	0.005		0.391	mg/l N	INAB
Ammonium as NH4 (calc)		EW175	0.006		0.504	mg/l NH4	INAB
Nitrate as N		EW175	0.15		<0.15	mg/l N	INAB
Nitrite as N		EW175	0.005		<0.005	mg/l N	INAB
Phosphate (Ortho MRP) as P		EW175	0.005		0.029	mg/l P	INAB
Chloride mg/L		EW175	1.0		13	mg/L	INAB
Sulphate mg/L		EW175	1.0		140	mg/L	INAB
Metals-Dissolved							
Hardness-Dissolved		EW188	3.0		310	mg/L CaCO3	YES
Iron-Dissolved		EW188	20		54	ug/L	YES
Subcontracted							
Manganese-Dissolved		EW188	1.0		890	ug/L	
Arsenic-Dissolved		EW188	0.2		7.8	ug/L	YES
Calcium-Dissolved		EW188	1.0		88	mg/L	YES
Copper-Dissolved		EW188	0.003		<0.003	mg/L	YES
Magnesium-Dissolved		EW188	0.3		21.0	mg/L	
Nickel-Dissolved		EW188	0.5		1.0	ug/L	YES
Potassium-Dissolved		EW188	0.2		3.8	mg/L	YES
Sodium-Dissolved		EW188	0.5		15.7	mg/L	YES
Suspended Solids							
Suspended Solids		EW013	5		49	mg/L	INAB
Titralab							
pH		EW153	0.0		7.8	pH Units	INAB
Conductivity @20 DegC		EW153	25		572	uscm-1@20	INAB
Alkalinity Total (R2 pH4.5)		EW153	10		185	mg/L CaCO3	INAB
Subcontracted							
Total Dissolved Solids (TDS)							
Total Dissolved Solids (TDS)		EW046	15		354	mg/L	INAB

Signed : Máire Bradley 27/08/2021

Máire Bradley-Deputy Technical Manager

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5."*" Indicates sub-contract test

Where the date of sampling has not been provided,sample stability times cannot be assessed. It is therefore possible that the results provided may be compromised

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Contact Name	David Broderick	**Report Number**	**202280 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	202280/001
		Date of Receipt	12/08/2021
		Date Started	12/08/2021
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1416-4	**Date of Report**	27/08/2021
Project No.	QN009187	**Sample Type**	Ground Waters
Customer Ref	Bellewstown MW3	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.
Total Dissolved Solids (TDS)								
Total Phosphorus & Orthophosphate-TP/OP								
	Total Phosphorus-TP *Subcontracted*		EW146	0.01		0.11	mg/l P	INAB
Turbidity								
	Turbidity		EW136	0.1		19.3	NTU	INAB

Signed : Máire Bradley 27/08/2021

Máire Bradley-Deputy Technical Manager

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Contact Name	David Broderick	**Report Number**	**202280 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	202280/002
		Date of Receipt	12/08/2021
		Date Started	12/08/2021
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1416-4	**Date of Report**	27/08/2021
Project No.	QN009187	**Sample Type**	Ground Waters
Customer Ref	Bellewstown MW5	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.
Coliforms								
	Total Coliforms	*	Default-N	0		490700	MPN/100ml	
	E. Coli	*	Default-N	0		3	MPN/100ml	
Enterococci (IH)								
	Enterococci	*	Default	0		3	MPN/100ml	
Gallery Plus-Suite A								
	Ammonia as N		EW175	0.005		0.029	mg/l N	INAB
	Ammonium as NH4 (calc)		EW175	0.006		0.037	mg/l NH4	INAB
	Nitrate as N		EW175	0.15		4.8	mg/l N	INAB
	Nitrite as N		EW175	0.005		0.009	mg/l N	INAB
	Phosphate (Ortho/MRP) as P		EW175	0.005		0.102	mg/l P	INAB
	Chloride mg/L		EW175	1.0		24	mg/L	INAB
	Sulphate mg/L		EW175	1.0		8.8	mg/L	INAB
Metals-Dissolved								
	Hardness-Dissolved		EW188	3.0		85	mg/L CaCO3	YES
	Iron-Dissolved		EW188	20		6.22	ug/L	YES
	Subcontracted							
	Manganese-Dissolved		EW188	1.0		7.3	ug/L	YES
	Arsenic-Dissolved		EW188	0.2		6.1	ug/L	YES
	Calcium-Dissolved		EW188	1.0		29	mg/L	YES
	Copper-Dissolved		EW188	0.003		0.0008	mg/L	YES
	Magnesium-Dissolved		EW188	0.3		3.3	mg/L	YES
	Nickel-Dissolved		EW188	0.5		2.2	ug/L	YES
	Potassium-Dissolved		EW188	0.2		<1	mg/L	YES
	Sodium-Dissolved		EW188	0.5		15.8	mg/L	YES
Suspended Solids								
	Suspended Solids		EW013	5		38	mg/L	INAB
Titralab								
	pH		EW153	0.0		6.7	pH Units	INAB
	Conductivity @20 DegC		EW153	25		234	uscm-1@20	INAB
	Alkalinity Total (R2 pH4.5)		EW153	10		65	mg/L CaCO3	INAB
	Subcontracted							
Total Dissolved Solids (TDS)								
	Total Dissolved Solids (TDS)		EW046	15		175	mg/L	INAB

Signed : Máire Bradley 27/08/2021

Máire Bradley-Deputy Technical Manager

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Contact Name	David Broderick	**Report Number**	**202280 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	202280/002
		Date of Receipt	12/08/2021
		Date Started	12/08/2021
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1416-4	**Date of Report**	27/08/2021
Project No.	QN009187	**Sample Type**	Ground Waters
Customer Ref	Bellewstown MW5	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.
Total Phosphorus & Orthophosphate-TP/OP								
	Total Phosphorus-TP		EW146	0.01		0.18	mg/l P	INAB
	Subcontracted							
Turbidity								
	Turbidity		EW136	0.1		10.9	NTU	INAB

Signed : Máire Bradley 27/08/2021

Máire Bradley-Deputy Technical Manager

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APPENDIX 8.3: SOAKAWAY BRE365 INFILTRATION TEST REPORT

HYDROCARE ENVIRONMENTAL LTD

Environmental Consultants
Cooperhill Rd.,
Beamore, Drogheda,
Co. Meath

Job Ref: 21-728

Date: 19 November 2021

FAO: Fergus Gallagher

RE: Soakaway Design per BRE 365

Client: Kilsaran Concrete

Location: Bellewstown, Hilltown Little, Co. Meath

Dear Fergus ,

We have designed the soakaway per BRE 365 & C697 based on the total impermeable area outlined below, as provided by yourself, and Met Eireann's Extreme Rainfall Return Periods.

Site information supplied by:

Fergus Gallagher Piercetown, Dunboyne Co.Meath

Total Impermeable Area: 600.00 m^2

Rainfall Information as per Met Eireann:

Data for Duleek, Meath
30 year return period
Duration = 60 mins
Rainfall Depth = 25.30 mm
Plus 10% climate change = 27.83 mm

The void ratio for the trench fill was set at 30% (0.3) to accommodate the use of granular fill material, i.e. Rounded gravel. The safety factor was taken as 1.

Soil Infiltration Rate:			
Tests carried out on:	12/11/2021	Base of test:	2.2m BGL
		WTL:	1.8m BGL
Calculated as per BRE 365:	2.37E-06 m sec	(see calculation sheet for details)	

The total impermeble area is ca. 600 square metres and the runoff coefficient is to be set at 1.0 as per BRE 365.

Inflow from:			
	Proposed impermeable areas:	**Area (m^2)**	**Runoff Volume (m3)**
1	Hard Standing Area	600	16.698
2	-	0	0
3	-	0	0
4	-	0	0
	Total inflow from:	600.00	16.698

The depth of the soakaway pit is set at 1.3m below the invert level of the drain. According to BRE 365 method, the pit was calculated as.

42 m L x 1 m W x 1.3 m D

Storage required in soakaway (Inflow - Outflow):	16.22 m^3
Capacity of pit required to accommodate fill material 30% void:	54.07 m^3
Actual capacity of calculated soakaway:	54.60 m^3

The soakaway shall be constructed in trenches as outlined below:

1 no. trenches:

Trench No. 1 **42 m L x 1 m W x 1.3 m D** **Volume: 54.6 m^3**

Total Volume of 54.6 m^3

NB

During the design process, a Silt Trap **must** be incorporated into any drains discharging into the soakaway system. All inflow from permeable paved areas must pass through a suitable geotextile to ensure filtration of fines.

NB

Any paved surface runoff or runoff from a Car parking area **must** pass through an oil interceptor \ hydrocarbon retention geotextile before discharge to the soakaway.

NB

Please note that for the purpose of this design, the fill material used must have no less free volume than 30%.

NB

This design will comply with BRE 365's 24-hour maximum limit for Half-Empty time, with a half empty time of 17 hrs 0 mins

NB

The base of the soakaway has **not** been included in the design calculations.

NB

All elements of the soakaway **must** be well maintained by suitable professionals, *i.e. Silt Traps must be regularly cleaned.*

NB

Please note that all relevant aspects of BRE365 **must** be taken into account in the design and installation of this Soakaway system, eg. Min. 5m separation distance from building foundations.

Hoping this is to your Satisfaction

Yours sincerely,

Daniel Nolan, BA BAI, Msc Environmental Engineering, FETAC Site Assesor

Hydrocare Environmental Ltd. - BRE365 Design Calculations

CLIENT: **Kilsaran Concrete**

LOCATION: **Bellewstown, Hilltown Little, Co. Meath**

Infiltration Rate

Test Hole Dimensions:	
Length [m]	2.70
Width [m]	1.10
Depth [m]	2.20
Drop Time [min]	2024

V_{p75-25} = 2.7 x 1.1 x (1.65 - 0.55) = 3.267 m^3

A_{p50} = (2.7 x 1.1 x 2) + (1.1 x 1.1 x 2) + (2.7 x 1.1) = 11.33 m^2

$f = \frac{3.267}{11.33 \times 2024 \times 60}$ =

Inflow and Outflow

Impermeable Area [m^2]	600.00
Rainfall Depth [mm]	27.83

Soakaway Length [m]	42.00
Soakaway Width [m]	1.00
Soakaway Depth [m]	1.30
Storm Duration [min]	60

Inflow = 600 x 0.02783 =

A_{s50} = (42 x 0.65 x 2) + (1 x 0.65 x 2) = 55.9 m^2

Outflow= 55.9 x 0.0000024 x 3600 =

Volume Required

Void Ratio [%]	30%

Storage = 16.698 - 0.477828 =

Volume = $\frac{16.2202}{0.3}$ =

Half Empty Time

$T_{s50} = \frac{S \times 0.5}{A_{s50} \times f} = \frac{16.2202 \times 0.5}{55.9 \times 0.00000237 \times 3600}$ =

=

BRE 365 TEST HOLE

Dims:	2.7 m L x 1.1 m W x 2.2 m D
Date:	12/11/2021
Client:	Kilsaran Concrete
Location:	Bellewstown, Hilltown Little, Co. Meath

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 304681, Northing: 268483,

	Interval		Years													
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	2.6,	3.6,	4.1,	4.9,	5.5,	5.9,	7.3,	8.8,	9.8,	11.3,	12.5,	13.5,	15.0,	16.2,	17.2,	N/A ,
10 mins	3.6,	5.0,	5.7,	6.9,	7.6,	8.2,	10.1,	12.3,	13.7,	15.7,	17.5,	18.8,	21.0,	22.6,	23.9,	N/A ,
15 mins	4.2,	5.8,	6.7,	8.1,	9.0,	9.7,	11.9,	14.5,	16.1,	18.5,	20.6,	22.2,	24.7,	26.6,	28.2,	N/A ,
30 mins	5.5,	7.6,	8.7,	10.4,	11.5,	12.3,	15.1,	18.2,	20.2,	23.0,	25.5,	27.4,	30.4,	32.6,	34.5,	N/A ,
1 hours	7.3,	10.0,	11.3,	13.4,	14.7,	15.8,	19.1,	22.9,	25.3,	28.7,	31.6,	33.9,	37.4,	40.0,	42.2,	N/A ,
2 hours	9.7,	13.0,	14.7,	17.2,	18.9,	20.2,	24.3,	28.8,	31.7,	35.7,	39.2,	41.9,	46.0,	49.1,	51.7,	N/A ,
3 hours	11.4,	15.2,	17.1,	20.0,	21.8,	23.3,	27.9,	32.9,	36.1,	40.6,	44.5,	47.4,	51.9,	55.4,	58.2,	N/A ,
4 hours	12.8,	16.9,	19.1,	22.2,	24.2,	25.8,	30.7,	36.2,	39.7,	44.5,	48.6,	51.8,	56.6,	60.3,	63.3,	N/A ,
6 hours	15.1,	19.8,	22.2,	25.7,	28.0,	29.7,	35.3,	41.4,	45.2,	50.5,	55.2,	58.7,	64.0,	68.0,	71.3,	N/A ,
9 hours	17.7,	23.1,	25.8,	29.8,	32.4,	34.3,	40.6,	47.3,	51.6,	57.5,	62.5,	66.4,	72.2,	76.7,	80.3,	N/A ,
12 hours	19.9,	25.8,	28.8,	33.1,	35.9,	38.0,	44.8,	52.0,	56.6,	62.9,	68.4,	72.5,	78.7,	83.5,	87.3,	N/A ,
18 hours	23.4,	30.1,	33.5,	38.3,	41.5,	43.9,	51.4,	59.5,	64.6,	71.6,	77.6,	82.1,	88.9,	94.1,	98.3,	N/A ,
24 hours	26.3,	33.6,	37.3,	42.6,	46.0,	48.6,	56.7,	65.4,	70.9,	78.4,	84.8,	89.7,	96.9,	102.4,	106.9,	122.1,
2 days	32.8,	41.3,	45.6,	51.7,	55.6,	58.5,	67.7,	77.5,	83.6,	91.9,	99.0,	104.3,	112.3,	118.3,	123.2,	139.6,
3 days	38.1,	47.7,	52.4,	59.2,	63.5,	66.7,	76.8,	87.5,	94.2,	103.2,	110.8,	116.6,	125.2,	131.6,	136.9,	154.5,
4 days	42.9,	53.3,	58.5,	65.8,	70.5,	74.0,	84.9,	96.3,	103.5,	113.1,	121.3,	127.4,	136.6,	143.4,	149.0,	167.6,
6 days	51.3,	63.3,	69.2,	77.5,	82.8,	86.8,	99.0,	111.9,	119.9,	130.6,	139.7,	146.5,	156.6,	164.2,	170.3,	190.7,
8 days	58.9,	72.2,	78.8,	87.9,	93.8,	98.1,	111.6,	125.7,	134.4,	146.1,	156.0,	163.3,	174.3,	182.5,	189.1,	211.1,
10 days	65.9,	80.5,	87.6,	97.5,	103.8,	108.6,	123.2,	138.3,	147.7,	160.2,	170.8,	178.7,	190.5,	199.2,	206.3,	229.8,
12 days	72.5,	88.2,	95.8,	106.5,	113.3,	118.4,	134.0,	150.2,	160.2,	173.5,	184.7,	193.1,	205.6,	214.8,	222.3,	247.2,
16 days	84.8,	102.6,	111.3,	123.3,	130.9,	136.6,	154.0,	172.1,	183.2,	198.0,	210.4,	219.7,	233.4,	243.6,	251.9,	279.2,
20 days	96.4,	116.1,	125.6,	138.9,	147.3,	153.5,	172.7,	192.4,	204.5,	220.6,	234.2,	244.2,	259.1,	270.2,	279.1,	308.6,
25 days	110.1,	132.0,	142.6,	157.3,	166.5,	173.4,	194.5,	216.1,	229.4,	247.0,	261.8,	272.8,	289.0,	301.1,	310.8,	342.8,

NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf

FOR PLANNING PURPOSES ONLY
NOT CONSTRUCTION ISSUE

SOAKAWAY No.1 LONG SECTION

INSPECTION CHAMBER WITH CONCRETE COVER

Ø 100mm PERFORATED DRAINAGE PIPE @ 1:100 FALL

SILT TRAP

0.3m

1.6m

1.3m

INCOMING SURFACE WATER SEWER

PERMEABLE GEO-TEXTILE

EXISTING SUBSOIL

OPEN GRADED DRAINAGE AGGREGATE Ø 60-100mm WITH MIN VOID RATIO 30%

42m

100mm COMPACTED GRIT SAND

SOAKAWAY No.1 CROSS SECTION

INCOMING SURFACE WATER SEWER

SILT TRAP

1.3

1m

HYDROCARE ENVIRONMENTAL LTD
Tel: 0419842378 / 0877905155
E-mail: info@hydrocare.ie

SOAKAWAY SECTION

FERGUS GALLAGHER
BELLEWSTOWN, HILLTOWN LITTLE,
CO. MEATH

SCALE nts DATE: 17/11/2021