7. HYDROLOGY & HYDROGEOLOGY

7.1 Introduction

7.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by McCarthy Keville O'Sullivan Ltd. (MKO) to carry out an environmental impact assessment report (EIAR) of the likely effects of the proposed infilling and restoration of a sand and gravel quarry (i.e. the site) at Portersize, Ballitore, Co. Kildare on the water environment (hydrology and hydrogeology).

The applicant plans to utilise the site, which is an operating quarry, as a soil recovery facility under an EPA waste licence which will grant permission to accept inert soil and stones (EWC 17 05 04) that will be used to infill and restore the site.

The objectives of the assessment area to:

- Produce a baseline study of the existing water environment (surface and groundwater) in the area of the proposed development;
- Identify likely positive and negative impacts of the proposed development on surface and groundwater during construction and operational phases of the development;
- Identify mitigation measures to avoid, remediate or reduce significant negative impacts; and,
- Assess significant residual impacts, effects and cumulative impacts of the proposed development along with other local infrastructural developments.

7.1.2 Statement of Authority

Hydro-Environmental Services (HES) are a specialist hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford.

This chapter of the EIAR was prepared by Michael Gill and David Broderick of HES.

Michael Gill is an Environmental Engineer with over 17 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms in Ireland. He has also managed EIAR assessments for infrastructure projects and private residential and commercial developments. In addition, he has substantial experience in wastewater engineering and site suitability assessments, contaminated land investigation and assessment, wetland hydrology/hydrogeology, water resource assessments, surface water drainage design and sustainable drainage systems (SUDs) design, and surface water/groundwater interactions.

David Broderick is a Hydrogeologist with over 13 years' experience in both the public and private sectors. Having spent two years working in the Geological Survey of Ireland (GSI) working mainly on groundwater and source protection studies, David moved into the private sector. David has a strong background in groundwater resource assessment and hydrogeological/hydrological investigations in relation to developments such as quarries and landfills. David has completed numerous geology and water sections for input into EIARs for a range of commercial developments.

7.1.3 Scoping and Consultation

The scope for this chapter of the EIAR has also been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process is outlined in Section 2.4 of this EIAR. Issues and concerns highlighted with respect the water environment are summarised in Table 7-1 below.

Table 7-1: Summary of Water Environment Related Scoping Responses

Consultee	Description	Addressed in Section
Geological Survey of Ireland (GSI)	• No comment	n/a
Health Service Executive (HSE)	• All drinking water sources should be identified. • Any potential impacts on surface water runoff should be assessed and mitigation measures detailed. Site drainage, increased rainfall and the possibility of flooding should all be considered when identifying possible impacts and mitigation measures. • The drinking water source to the proposed development should be identified. • The wastewater method should be identified and, if it is not to the mains sewage system, the impacts should be assessed.	• Addressed in Section 7.3.12 • Addressed in Section 7.3.5 and 7.4.4.4 • Addressed in Section 7.3.4 and 7.3.12 • Addressed in Section 7.3.4
Inland Fisheries Ireland (IFI)	• Likely impacts of and measures to be adopted to control and dispose of generated suspended solids and contaminated surface water runoff during site preparation and infill. • Potential sources of contaminated surface waters are the fill working area and all areas with machinery and truck movement including access roading. • Potential impacts on groundwaters with measures detailed, to prevent impacts including those from liquid materials including oils, fuels etc. with storage details specifying e.g. impermeable, bunded and secured areas within the site. • Where water for road dampening for dust control or for any other use will be required, please state the source of this water. In general, IFI requires there be no interference with or contamination of surface or ground waters either within or contiguous to these sites.	• Addressed in Sections 7.4.3 and 7.4.4

Consultee	Description	Addressed in Section
Irish Water (IW)	• Any potential impacts on the assimilative capacity of receiving waters in relation to IW discharge outfalls including changes in dispersion /circulation characterises. • Any potential impact on the contributing catchment of water sources either in terms of water abstraction for the development (and resultant potential impact on the capacity of the source) or the potential of the development to influence/ present a risk to the quality of the water abstracted by IW for public supply.	Addressed in Section 7.4.4.4 Addressed in Section 7.3.12

7.1.4 Relevant Legislation

The EIAR is prepared in accordance with the requirements of European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive') as amended by Directive 2014/52/EU.

The requirements of the following legislation are complied with:

- S.I. No. 349 of 1989: European Communities (Environmental Impact Assessment) Regulations, and subsequent Amendments (S.I. No. 84 of 1994, S.I. No. 101 of 1996, S.I. No. 351 of 1998, S.I. No. 93 of 1999, S.I. No. 450 of 2000 and S.I. No. 538 of 2001, S.I. 134 of 2013 and the Mineral Development Act 2017), the Planning and Development Act, and S.I. 600 of 2001 Planning and Development Regulations and subsequent Amendments. These instruments implement EU Directive 85/337/EEC and subsequent amendments, on the assessment of the effects of certain public and private projects on the environment;
- Directives 2011/92/EU and 2014/52/EU on the assessment of the effects of certain public and private projects on the environment, including Circular Letter PL 1/2017: Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive);
- Planning and Development Act, 2000, as amended;
- S.I. No 296 of 2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which transposes the provisions of Directive 2014/52/EU into Irish law;
- S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations, resulting from EU Directive 78/659/EEC on the Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life;
- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy) and S.I. No. 722 of 2003 European Communities (Water Policy) Regulations which implement EU Water Framework Directive (2000/60/EC) establishing a framework for the Community action in the field of water policy and provide for implementation of 'daughter' Groundwater Directive (2006/118/EC) on the protection of groundwater against pollution and deterioration. Since 2000 water management in the EU has been directed by the Water Framework Directive (WFD) (2000/60/EC) (as amended by Decision No. 2455/2011/EC; Directive

2008/32/EC; Directive 2008/105/EC; Directive 2009/31/EC; Directive 2013/39/EU; Council Directive 2013/64/EU; and Commission Directive 2014/101/EU ("**WFD**"). The WFD was given legal effect in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003);

- S.I. No. 684 of 2007: Waste Water Discharge (Authorisation) Regulations 2017, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);S.I. No. 106 of 2007: European Communities (Drinking Water) Regulations 2007and S.I. No. 122 of 2014: European Communities (Drinking Water) Regulations 2014, arising from EU Directive 98/83/EC on the quality of water intended for human consumption (the "Drinking Water Directive") and EU Directive 2000/60/EC;
- S.I. No. 9 of 2010: European Communities Environmental Objectives (Groundwater) Regulations 2010 (as amended by S.I. No. 389/2011; S.I. No. 149/2012; S.I. No. 366/2016; the Radiological Protection (Miscellaneous Provisions) Act 2014; and S.I. No. 366/2016); and,
- S.I. No. 296 of 2009: The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (as amended by S.I. No. 355 of 2018).

7.1.5 Relevant Guidance

The water section of the EIAR is carried out in accordance with guidance contained in the following:

- Institute of Geologists Ireland (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- National Roads Authority (2005): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Inland Fisheries Ireland (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, 2006);
- 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).

7.2 Methodology

7.2.1 Desk Study & Preliminary Hydrological Assessment

A desk study and preliminary hydrological assessment of the Proposed Development site and the surrounding area was completed in advance of the field work. This involved collection of all relevant geological, hydrological, hydrogeological and meteorological data for the area. This included consultation with the following sources:

- Environmental Protection Agency database (www.epa.ie);
- 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);
- EPA/Water Framework Directive Map Viewer (www.catchments.ie);

- Bedrock Geology 1:100,000 Scale Map Series, Sheet 16 (Geology of Kildare - Wicklow). Geological Survey of Ireland (GSI, 1997);
- Geological Survey of Ireland (2004) – Groundwater Body Initial Characterization Reports;
- OPW Flood Hazard Mapping (www.floodinfo.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).

7.2.2 Site Investigations

An initial site walkover and geological baseline mapping was undertaken by HES in January 2020. Site investigations and baseline monitoring was undertaken between April and August 2020.

In summary, investigations to address the Water section of the EIAR included the following:

- Walkover surveys and hydrological mapping of the proposed site and the surrounding area were undertaken whereby water flow directions and drainage patterns were recorded;
- A preliminary assessment of flood risk was completed for the proposed development footprint area and local surface water bodies;
- Drilling of 4 no. monitoring wells to investigate depth to bedrock, overburden lithology, the local groundwater regime and groundwater quality;
- Field hydrochemistry measurements (electrical conductivity, pH and temperature) were taken to determine the origin and nature of surface water and groundwater flows; and,
- Surface water and groundwater (well purging) sampling was undertaken to determine the baseline quality of waters in the area of the site.

7.2.3 Impact Assessment Methodology

The guideline criteria (EPA, August 2017) for the assessment of likely significant effects require that likely effects are described with respect to their extent, magnitude, type (i.e. negative, positive or neutral) probability, duration, frequency, reversibility, and transfrontier nature (if applicable). The descriptors used in this environmental impact assessment are those set out in the EPA (2017) Glossary of effects as shown in Chapter 1 of this EIAR.

In addition to the above methodology, 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 7-2 are then used to assess the potential effect that the Proposed Development may have on them.

Table 7-2: Receptor Sensitivity Criteria (Adapted from www.sepa.org.uk)

Sensitivity of Receptor	
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	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	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 aquifer

7.3 Receiving Environment

7.3.1 Site Description, Land and Topography

The proposed development site is located in the townland of Portersize, approximately 1.5 kilometres (km) southeast of Ballitore, County Kildare. The R448 Regional Road is located approximately 0.5 km to the west of the site and the R747 is located adjacent to the south of the site, where it forms a junction at the site entrance. The proposed site for infill and restoration is an active sand and gravel quarry which operates above the local groundwater table.

The proposed development being applied for under this current planning application includes for the infilling and restoration of an existing and future quarry void with inert soil and stone over an area of approximately 18.95 hectares (ha). The planning application boundary area measures approximately 34.25 ha which is contained within a landholding in the control of Noel Lawler Sand & Gravel Ltd., of approximately 65.20ha.

The floor elevation of the quarry void varies between approximately 110mOD (Ordnance Datum – Malin Head) and 129mOD with the lowest area being on the north of the extraction area and the highest at the south.

The site is bordered by grassland to the east, west and south where the natural ground elevation varies between 130m and 135mOD. The northern site boundary is defined by the Crookstown Stream. The northern extent of the extraction area is set back at least 100m from the Crookstown Stream and much of the site in between is tree covered natural ground. A manmade earthen berm, which is approximately 6-7m high, runs along the bank of the Crookstown Stream, close to the northern boundary.

A reception cabin, a weigh bridge and maintenance/welfare facilities are located on the west of the site which is the access point to the extraction area. An aggregate processing area (wet and dry sorting) is located in the central area of the quarry void along with a number of closed system/recycling washing lagoons and aggregate stockpiles.

Access to the site via a site entrance road is from the R747 which is located to the southwest of the site.

7.3.2 Water Balance

Long term Annual Average Rainfall and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall (1981 - 2010) recorded at Ballitore rainfall station ~1.5km northwest of the site, are presented below in Table 7-3.

The closest synoptic station where the average potential evapotranspiration (PE) is recorded is at Dublin Airport, ~130 km northeast of the site. The long-term average PE for this station is 512mm/yr. This value is used as a best estimate of the site PE. Actual Evaporation (AE) at the site is estimated as 486mm/yr (which is 0.95 × PE).

Table 7-3: Local Average long-term Rainfall Data (mm)

Station		X-Coord		Y-Coord		Ht (mOD)		Opened		Closed		
Ballitore		140,500		72,000		67		1953		N/A		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
148.1	105.7	100.8	76.6	77.8	74.6	69.1	85.2	91.2	141.4	127.7	138.4	1236.6

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

= 1237mm/yr – 486mm/yr

ER = 751mm/yr

7.3.3 Regional and Local Hydrology

Regionally the proposed site is located in the Barrow River surface water catchment within Hydrometric Area 14 of the South Eastern River Basin District (SERBD).

On a more local scale, the proposed site is located in Greese River (Greese_SC_010) surface water catchment. The Greese River flows in a southerly direction approximately 500m to the west of the site. The site itself drains to the Crookstown Stream which flows westerly along the northern boundary of the site prior to merging with the Greese River approximately 600m downstream of the site.

A local hydrology map is shown as Figure 7-1.

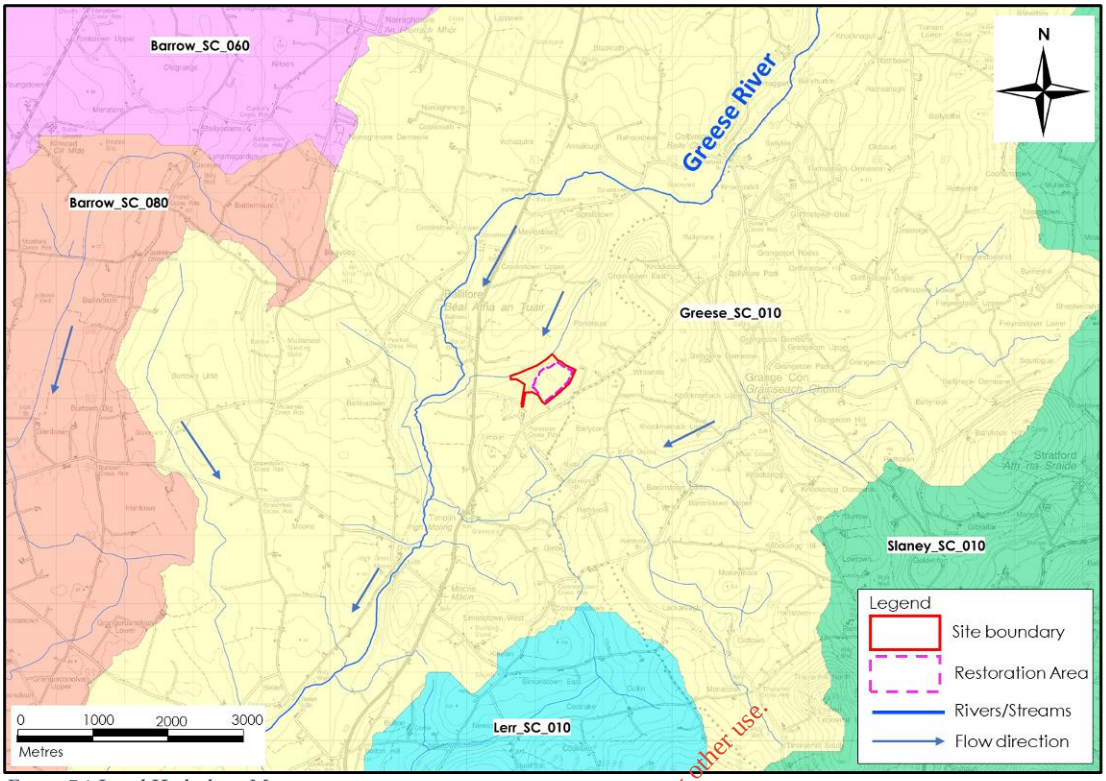

Figure 7-1 Local Hydrology Map

7.3.4 Site Drainage

There are no natural drainage features or manmade drains within the site. The majority of the rainfall landing on the site infiltrates into the underlying sand and gravel deposits. There are 3 no. lagoons (closed network) located in the central area of the on-site and these are used for the recycling of water used in aggregate washing. There is a manmade pond located on the northwest of the site, adjacent to the Crookstown Stream (from which the pond draws water), from which water is occasionally pumped to maintain water levels in the 3 no. washing lagoons. There is a bored well (W1) located next to the manmade pond which is also used to top-up the washing lagoon. There are 4 no. additional ponds located on the northwest of the site, two of which are partially infilled.

There are no surface water discharges from the site.

Drinking water is sourced from the quarry operators private well (PW1) which is located close to the site entrance.

Sanitary wastewater from the existing quarry site is treated in on-site septic tank treatment units and percolation areas. This will also be used during the proposed development.

A site drainage map/water management is shown as Figure 7-2.

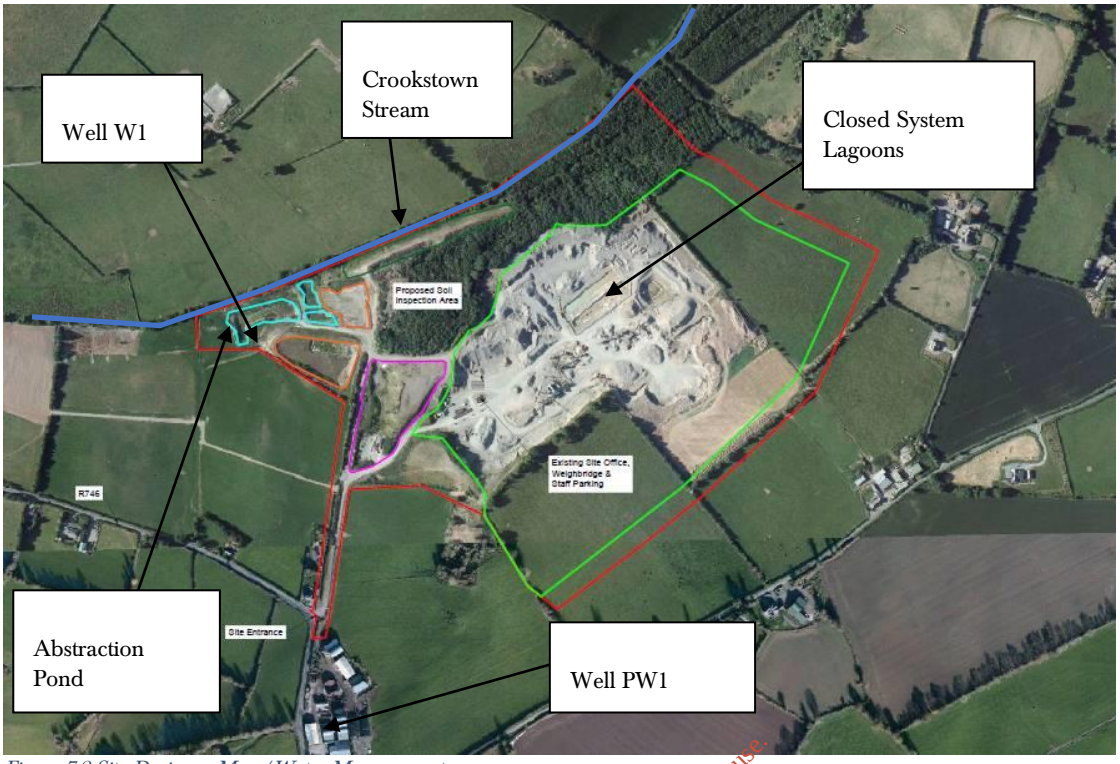

Figure 7-2 Site Drainage Map / Water Management

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7.3.5 Flood Risk Identification

OPW's flood hazard mapping (www.floodmaps.ie), CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie), Department of Environment, Community and Local Government on-line planning mapping (www.myplan.ie) and historical mapping (i.e. 6" & 25" base maps) were consulted to identify those areas as being at risk of flooding.

Where complete the Catchment Flood Risk Assessment and Management (CFRAM)[1] OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the PFRA maps. However, CFRAM mapping is currently not available for the area of the site.

The PFRA mapping (refer to Figure 7-3 below), shows the 100-year and Extreme Event flood zones of the Crookstown Stream which flows westerly along the northern boundary of the site. The mapped 100-year flood encroaches the site on the low-lying north-western corner, however there is no proposed infilling in this area. Isolated areas of pluvial flooding are mapped within the current extraction area, but due to the exposed nature of permeable sand and gravel, ponding is not likely to occur.

OPW's Flood Hazard mapping was consulted to identify those areas as being at risk of flooding (Figure 7-4). There are no reports of flooding incidents in the immediate area of the site footprint. There are reports of recurring flood events along the Greese River at Ballitore town which is upstream of the proposed development.

There is no text on local available historical 6-inch or 25-inch mapping for the proposed site that identify areas that are "prone to flooding" within the site boundary, or immediately downstream of the site.

1 CFRAM is Catchment Flood Risk Assessment and Management. The national CFRAM programme commenced in Ireland in 2011, and is managed by the OPW. The CFRAM Programme is central to the medium to long-term strategy for the reduction and management of flood risk in Ireland.

Based on the above information there is low potential risk of flooding at the development site.

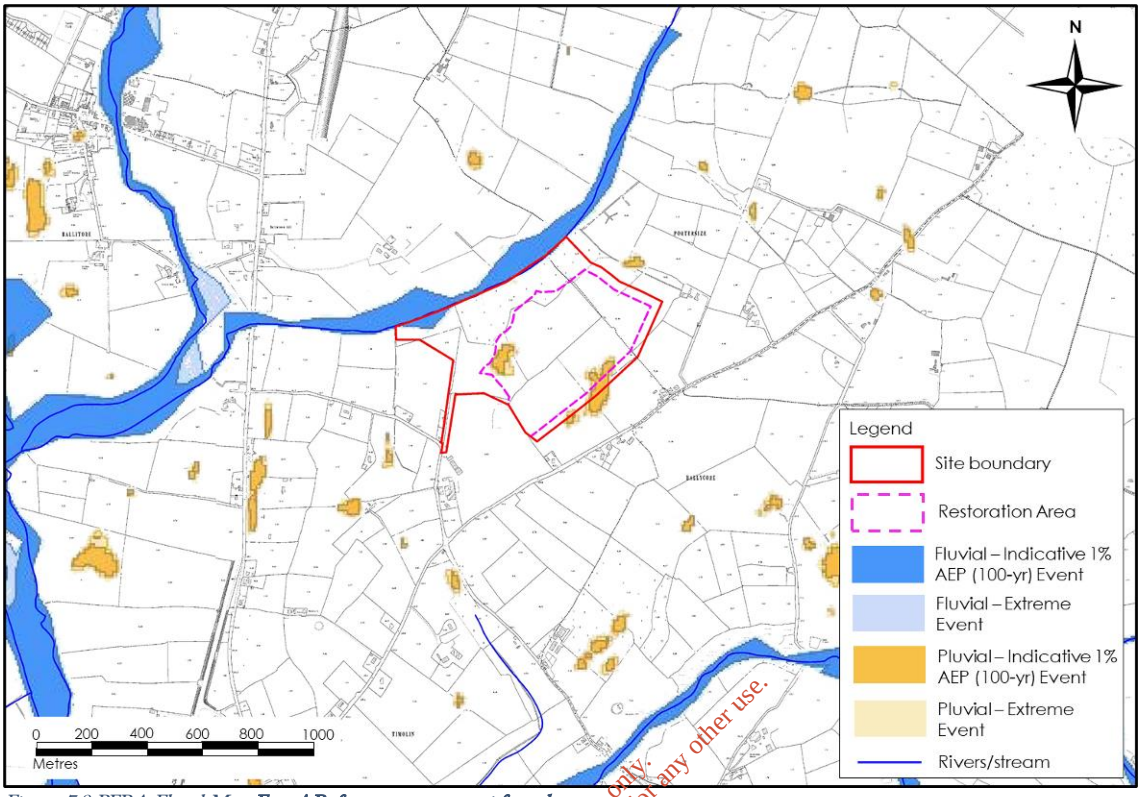


Figure 7-3 PFRA Flood Map ***Error! Reference source not found.***

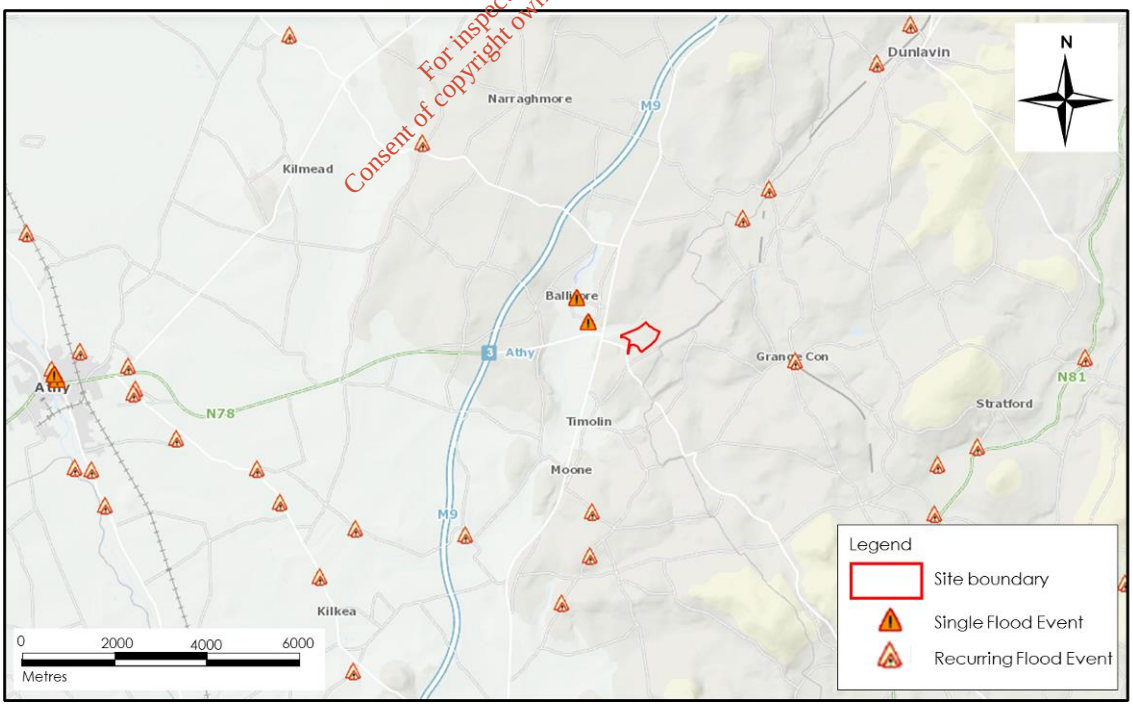


Figure 7-4 OPW Flood Hazard Mapping

7.3.6 Surface Water Hydrochemistry

Q-rating data is available for the Greese River catchment upstream and downstream of the proposed site. Most recent data (2017) show that the upstream EPA monitoring location is given a Q rating of 3 (Poor Status) and the downstream location a Q rating of 3-4 (Moderate).

Surface water sampling of the Crookstown Stream was undertaken upstream (SW1) and downstream of the site (SW2) on 29th June 2020 where it flows to the north of the site.

Results of analysis are show alongside relevant surface water regulations in Table 7-4 below. Certificates of analysis are shown in Appendix 7-1.

Table 7-4: Surface Water Sampling Results

Parameter	EQS	Sample ID	
		SW1	SW2
Total Suspended Solids (mg/L)	25(+)	<5	17
Ammonia (mg/L)	Good Status: ≤0.065 High Status ≤ 0.04(*)	<0.02	0.03
Nitrite NO_2 (mg/L)	-	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	Good Status ≤ 0.035 to High Status: ≤0.025(*)	<0.02	<0.02
Nitrate - NO_3 (mg/L)	-	31.3	32.2
Nitrogen (mg/L)	-	7.2	7.8
Phosphorus (mg/L)	-	<0.1	<0.1
Chloride (mg/L)	-	17.9	19.1
BOD	Good Status: ≤ 1.5 High Status: ≤ 1.3(*)	<1	<1

(+) S.I. No. 293 of 1988: Quality of Salmon Water Regulations, resulting from EU Directive 78/659/EEC on the Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life.
(*) S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009.

Total suspended solids are reported as <5 and 17mg/L respectively for SW1 and SW2. Albeit SW2 is elevated, both results are below the standard set out in S.I. 293 of 1988. The stretch of stream at SW2 was very slow flowing with some algae accumulation which likely resulted in the high suspended solid result.

With respect the Surface Water Regulations (S.I. 272 of 2009), all results for ammonia N, ortho-phosphate and BOD are below the "High Status" threshold.

7.3.7 Hydrogeology

According to the GSI aquifer mapping (www.gsi.ie) the site is underline by a Poor Bedrock Aquifer (Bedrock which is generally unproductive) made up by the Silurian Metasediments and Volcanics strata. Based on monitoring well drilling undertaken at the site in June 2020, the local bedrock formation comprises of SHALE.

The sand and gravels which overlie the SHALE in the area of the site have not being classified by the GSI as an aquifer as the deposits appear to be relatively thinner and isolated (by till deposits) from the more extensive Narraghmore Locally Important Gravel Aquifer which is located ~0.6km to the west of the site. A local aquifer map is shown as Figure 7-5.

Based on monitoring well drilling undertaken at the site (refer to Figure 7-5 for well locations), the natural depth of sand and gravels in the area of the proposed development (outside the extraction footprint) range between approximately 4m and 13m and comprise poorly sorted SAND and GRAVEL with occasional horizons of SAND or SILT dominated layers.

Based on the trial pits undertaken by John Barnett and Associates (JBA) in 2005, bedrock is close (0 - 1m) to the lower quarry floor on the north of the extraction area and within 3-4m on the upper floor level on the south of the extraction area.

The groundwater level monitoring carried out to date (26th June to 4th September 2020) show that the sand and gravels are unsaturated at least during the summer and autumn months. During this monitoring period the groundwater levels across the site typically varied between approximately 95m OD (@ MW1) and 127m OD (@ MW3). Groundwater plots for each of the monitoring wells is attached as Appendix 7-2.

Based on the measured groundwater levels, the local groundwater gradient (flow direction) is westerly/north-westerly towards the Crookstown Stream as shown in Figure 7-6 below.

The Silurian Metasediments and Volcanics (i.e. SHALES), which underlie the sands and gravels in this area, have no inter-granular permeability; groundwater flow occurs in fractures and faults; in-filling of fractures is to be expected. The permeability of individual fractures and the degree of interconnection will be generally low, with fracturing confined to local zones. Permeability is highest in the upper few metres but generally decreases rapidly with depth. The drilling undertaken at the proposed site indicates that the top 1-2m of bedrock is very weak and weathered with strength increasing with depth. All groundwater strikes encountered during the drilling were very small (i.e. <0.5L/s).

In general, groundwater flow is concentrated in the upper 15m of the aquifer (GSI, 2004), although deeper inflows from along fault zones or connected fractures can be encountered. Significant yields can be obtained where boreholes are drilled into known fault zones. In these rocks groundwater flow paths are expected to be relatively short, typically from 30-300m, with groundwater discharging to small springs, or to the streams that traverse the aquifer. Flow directions are expected to approximately follow the local surface water catchments (GSI, 2004). As mentioned above, the groundwater gradient in the area of the site is westerly / north-westerly towards the Crookstown Stream.

Baseflow contribution to streams tends to be low, particularly in summer as the groundwater regime cannot sustain summer baseflows due to low storativity within the aquifer. In winter, low permeabilities will lead to a high groundwater table. Local groundwater flow directions will mimic topography whereby flow paths will be from topographic high points to lower elevated discharge areas at local streams.

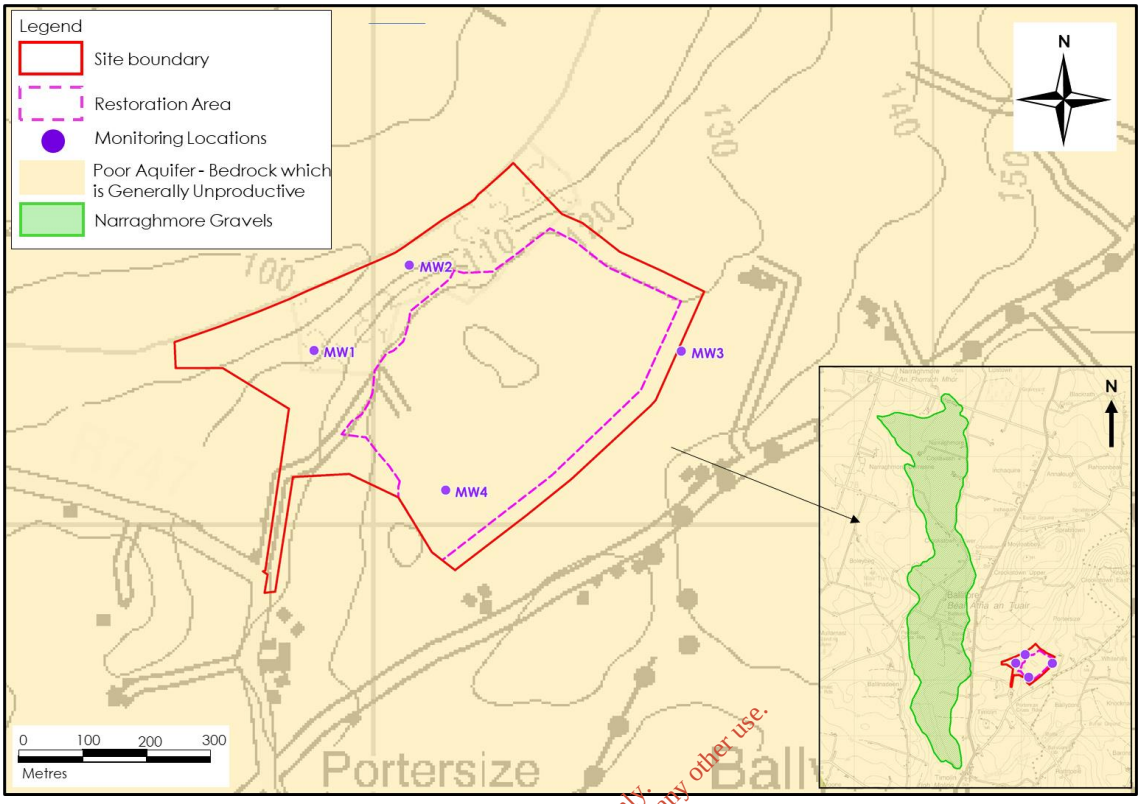


Figure 7-5 GSI Aquifer Mapping

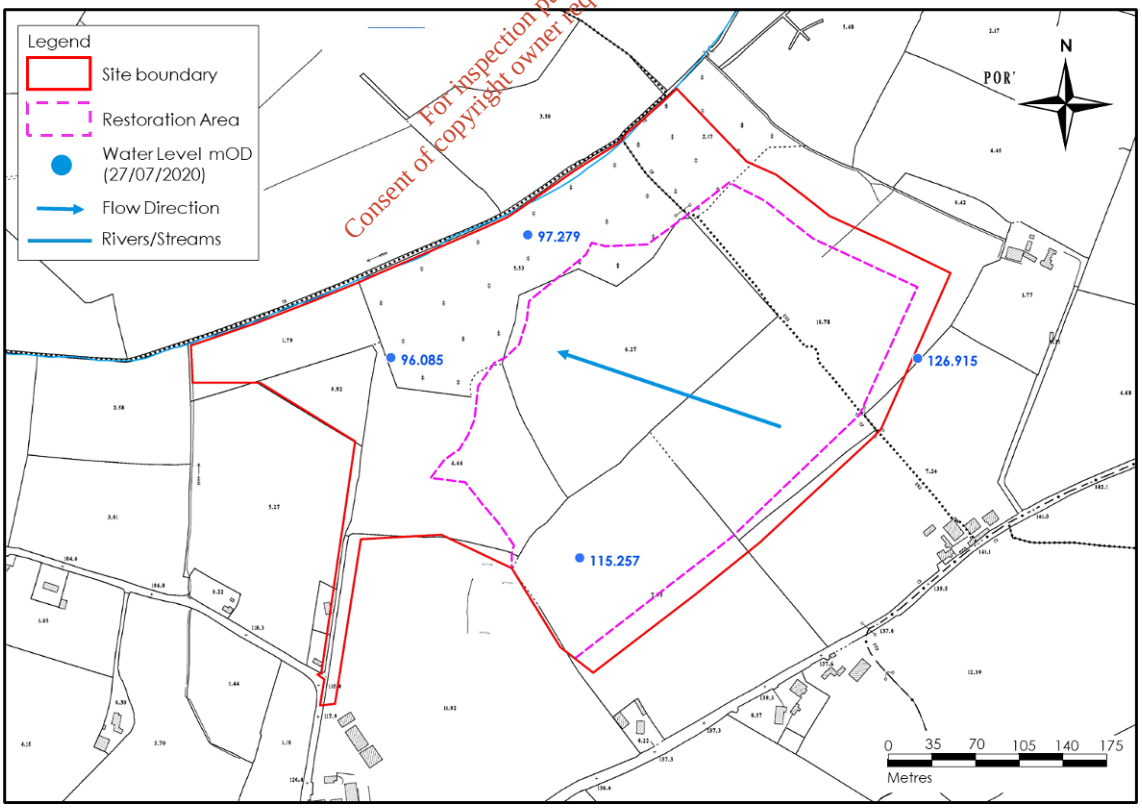


Figure 7-6 Groundwater Levels and Flow Direction

7.3.8 Groundwater Vulnerability

Based on the GSI mapping, the groundwater in the area of the site has mainly a 'High' groundwater vulnerability rating. This does not account for the extraction at the site which has reduced the thickness of sand and gravel within the extraction footprint.

Based on the drilling undertaken at the site, a High rating is applicable to the south of the extraction area and an Extreme vulnerability rating is applicable to the north of the extraction area (refer to the hydrogeological conditions in Table 7-5 below with respect the site geology and groundwater levels.

Backfilling the site with inert material could be viewed as a good approach to lowering the vulnerability rating, i.e. provide better aquifer protection in the long term.

Table 7-5: GSI Groundwater Vulnerability Rating

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

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

7.3.9 Groundwater Hydrochemistry

Groundwater quality monitoring was completed at on-site monitoring wells (MW01 to MW04). As described in Section 7.3.7 above the groundwater flow direction at the site is to the west / northwest and therefore MW03 and MW04 are the up-gradient wells and MW01 and MW02 are the down-gradient wells (refer to Figure 7-5).

Purging (pumping), field hydrochemistry monitoring and baseline sampling of the on-site monitoring wells was completed on 28th June 2020.

The laboratory results[2] are presented in Table 1 in Appendix 7-3 and compared with the relevant groundwater regulation values (S.I. No. 9 of 2010) and drinking water regulation values (S.I. No. 122 of 2014). The original laboratory reports are also attached in Appendix 7-3.

The groundwater hydrochemistry is not typical of Silurian Metasediments (i.e. non-calcareous) because the groundwater make-up is likely influenced to some extent by the overlying sand and gravels which are derived from limestone (i.e. calcareous).

Overall, the groundwater quality is typical for an area where agriculture is the dominant land use. The only exceedances with regard to groundwater/drinking water regulation values were nitrate and ortho-phosphate. Nitrate was elevated in MW01 and MW03. Given that nitrate is elevated in both an up-gradient well and down-gradient well suggests the source is not on-site and is likely to be agriculture

[2] *Groundwater analysis conducted by accredited laboratory: ELS Cork, www.elsltd.com/*

related. Orthophosphate is elevated above the groundwater regulation value in MW02 which is also likely to be agricultural related.

There was no exceedance with regard to heavy metals or hydrocarbons. Hydrocarbons would be the primary potential pollutant from an active quarry site, as a result of long-term machinery operation.

7.3.10 Water Framework Directive Status and Risk Result

Local surface water body status and risk result are available from (www.catchments.ie).

The EPA/WFD river water body quality status for the Greese River upstream and downstream of the site is "Poor" and "Moderate" respectively. The Crookstown Stream has been given a "Moderate" status.

The Newross Groundwater Body (GWB: IE_SW_G_152) underlies the quarry site. It is assigned 'Good Status'[3], (www.wfdireland.ie), this applies to both quantitative status and chemical status.

7.3.11 Designated Sites & Habitats

Designated sites include National Heritage Areas (NHAs), Proposed National Heritage Areas (pNHAs) Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs). The Proposed Development site is not located within any designated conservation-site.

The closest designated site to the proposed development site is Ballycore Rath pNHA which is located approximately 0.5km to the south of the site. There is no groundwater or surface water connectivity between this designated site and the proposed development.

The only downstream designated site that is hydrologically connected to the proposed development is the River Barrow and River Nore SAC [002162], which is located approximately 16km downstream of the site. Hydrological connectivity to this SAC is via the Crookstown Stream adjacent to the northern site boundary, which is a tributary of the Greese River located approximately 650m to the west of the site boundary. The Greese River is a tributary to the River Barrow and River Nore SAC.

7.3.12 Water Resources

There are no mapped Public Water Supplies or Group Scheme wells in the area of the site (NFGWS registered group schemes).

There are 12 no. GSI mapped wells within 2km of the proposed development site Refer to (Figure 7-7). The closest mapped GSI wells to the site are to the east/southeast which is up-gradient to the site in terms of groundwater flow direction. The other mapped GSI wells, which are located at least 1km to the northwest, are not hydrologically connected to the site either as they are within a separate groundwater catchment to that of the proposed site.

A well survey undertaken for houses within 250m of the proposed site identified 5 no. private wells (PW1 – PW5). These private wells are located along the public road to the south/southeast of the proposed site and are therefore up-gradient of the site with regard groundwater flow (refer to Figure 7-7). As stated in Section 7.3.4. PW1 is the drinking water supply well to the quarry and proposed development.

'Status' means the condition of the water in the waterbody. It is defined by its chemical status and its ecological status, whichever is worse. Waters are ranked in one of 5 classes: High, Good, Moderate, Poor and Bad (WFD, 2010).

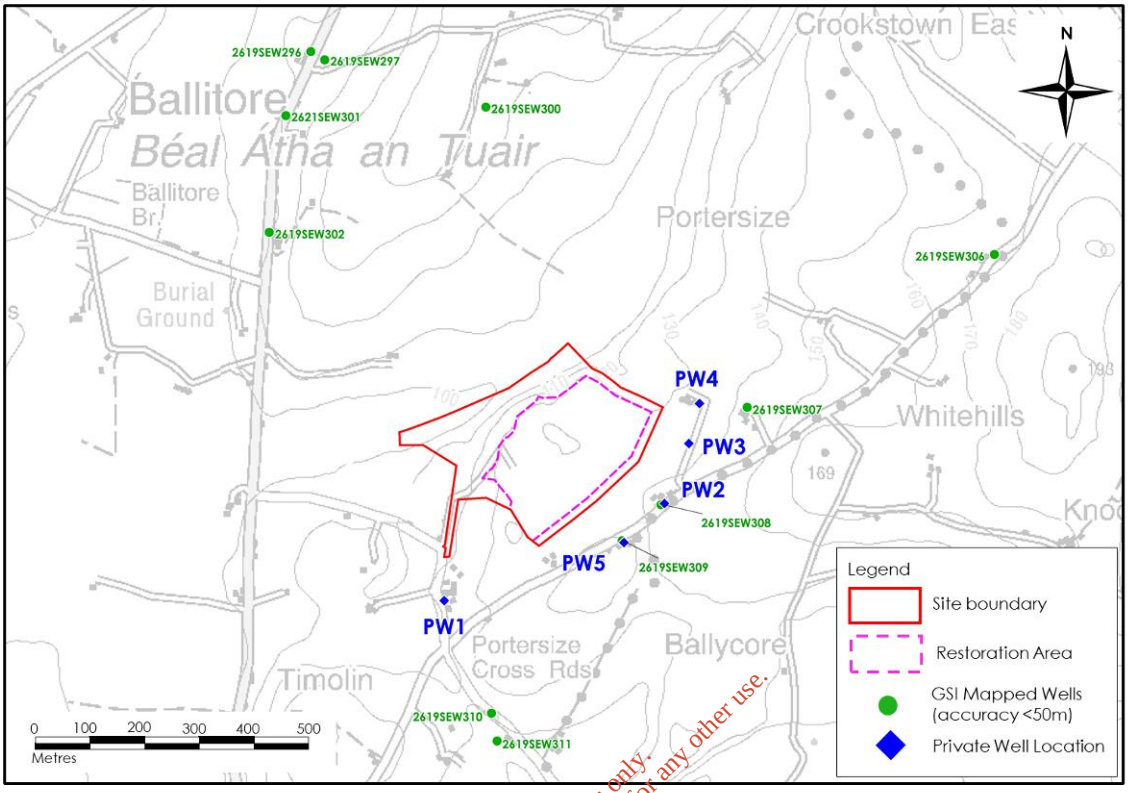


Figure 7-7 Private Well Supplies

7.3.13 Receptor Sensitivity

The primary sensitive receptor to the proposed development site is the Crookstown Stream and Greese River which drain into the downstream River Barrow. The River Barrow is a designated SAC.

Surface water drainage and groundwater flow towards this receptor are the main pathways in need of assessment.

The primary risk to groundwater quality at the site would be from the infill material and hydrocarbon spillage and leakages. These are common potential impacts on all infill/ land-use restoration sites. All infill materials will be inert and potential contamination sources are to be carefully managed at the site during the construction and operational phases of the development and mitigation measures are proposed below to deal with these potential impacts.

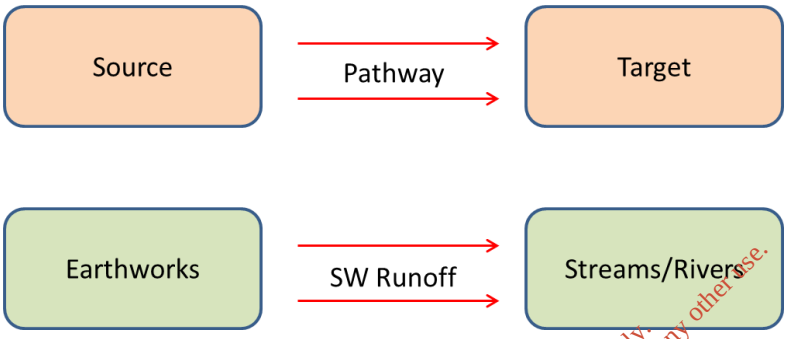
Comprehensive surface water mitigation and controls are outlined below to ensure protection of all downstream receiving waters. Mitigation measures will ensure that surface runoff will be of a high quality and will therefore not impact on the quality of downstream surface water bodies. Any introduced drainage works at the site will mimic the existing hydrological regime thereby avoiding changes to flow volumes leaving the site.

7.4 Likely and Significant Effects and Mitigation Measures

The potential impacts of the Proposed Development and mitigation measures that will be put in place to eliminate or reduce them are set out below.

7.4.1 Overview of Impact Assessment Process

The conventional source-pathway-target model (see below, top) was applied to assess potential impacts on downstream environmental receptors (see below, bottom as an example) as a result of the proposed development.



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

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

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

In order to provide an understanding of the stepwise impact assessment process applied below (Section 7.4.3 and 7.4.4), we have firstly presented below a summary guide that defines the steps (1 to 7) taken in each element of the impact assessment process (refer to Table 7-6). The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

Using this defined approach, this impact assessment process is then applied to all construction and operational activities which have the potential to generate a source of significant adverse impact on the geological and hydrological/ hydrogeological (including water quality) environments.

Table 7-6: Impact Assessment Steps

Step 1	Identification and Description of Potential Impact Source: This section presents and describes the activity that brings about the potential impact or the potential source of pollution. The significance of effects is briefly described.	
Step 2	Pathway / Mechanism:	The route by which a potential source of impact can transfer or migrate to an identified receptor. In terms of this type of development, surface water and groundwater flows are the primary pathways, or for example, excavation or soil erosion are physical mechanisms by which a potential impact is generated.
Step 3	Receptor:	A receptor is a part of the natural environment which could potentially be impacted upon, e.g. human health, plant / animal species, aquatic habitats, soils/geology, water resources, water sources. The potential impact can only arise as a result of a source and pathway being present.
Step 4	Pre-mitigation Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.
Step 5	Proposed Mitigation Measures:	Control measures that will be put in place to prevent or reduce all identified significant adverse impacts. In relation to this type of development, these measures are generally provided in two types: (1) mitigation by avoidance, and (2) mitigation by engineering design.
Step 6	Post Mitigation Residual Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impacts after mitigation is put in place.
Step 7	Significance of Effects:	Describes the likely significant post mitigation effects of the identified potential impact source on the receiving environment.

7.4.2 Do Nothing Scenario

Under the Do-Nothing Scenario the proposed development site will remain unchanged. The quarry will continue to extract aggregate under the current planning permission.

7.4.3 Construction Phase - Likely Significant Effects and Mitigation Measures

7.4.3.1 Earthworks (Removal of Vegetation Cover) Resulting in Suspended Solids Entrainment in Surface Waters

Construction phase activities (as described in Section 3.9 of the EIAR) that will require earthworks resulting in removal of vegetation cover and mineral subsoil (where present) are detailed in the Development Description Chapter (Chapter 3). Potential sources of sediment laden water include:

- Drainage and seepage water resulting from any required vegetation clearing works; and,
- Construction of access roads resulting in entrainment of sediment from the excavations during construction.

These activities have the potential to cause 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. However, this work is minor and will likely be completed in a short amount of time.

There is no direct hydraulic connection between the site and the Crookstown Stream (nearest surface water body), and due to the bowl shaped nature of the existing pit site, overland flow will be in the direction of the lowest ground within the pit, not in the direction of the Crookstown Stream.

Pathway: Drainage routes and overland flow.

Receptors: Down-gradient rivers (Crookstown Stream, Greese River and River Barrow) and dependant ecosystems.

Pre-Mitigation Potential Impact: Negative, indirect, imperceptible, long term, unlikely, impact on surface waters.

Proposed Mitigation Measures:

No specific mitigation required. The proposed infill areas are self-contained due to prevailing topography, and as such will not release surface water to the surrounding environment. Underlying residual sand and gravel will filter any recharge water before it joins the underlying groundwater table.

Residual Effects: As a result of prevailing site geological and topographical conditions, there will be no discharge to surface water during the site preparation phase, and as such there can be no potential pathways to local surface water bodies, other than via groundwater flow. As such we consider residual effects to be - Negative, indirect, imperceptible, long term, unlikely, impact on surface water quality.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality or groundwater will occur.

7.4.3.2 Potential Release of Hydrocarbons during Construction Stage

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

Pathway: Groundwater flow paths and site drainage network (where constructed).

Receptor: Groundwater and surface water.

Pre-Mitigation Potential Impact: Indirect, negative, slight, short term, unlikely impact to local groundwater quality. Indirect, negative, significant, short term, unlikely impact to surface water quality.

Proposed Mitigation Measures:

Mitigation measures proposed to avoid release of hydrocarbons at the site are as follows:

- Minimal refuelling or maintenance of construction vehicles or plant will take place on site. Off-site refuelling will occur at a dedicated refuelling area where possible;
- On-site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off-site, and will be towed around the site by a 4x4 vehicle to where machinery is located. The 4x4 vehicle will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;
- On-site refuelling will be carried out by trained personnel only;
- Fuels stored on site will be minimised. Fuel storage areas if required will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor; and,
- The plant used during construction will be regularly inspected for leaks and fitness for purpose.

Residual Effects: The potential for the release of hydrocarbons to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases of hydrocarbons have been proposed above for the construction phase and these will break the pathway between the potential source and each receptor. The residual effect is - Negative, indirect, imperceptible, short term, unlikely impact to local groundwater quality. Negative, indirect, imperceptible, short term, unlikely impact to surface water quality.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality or groundwater will occur.

7.4.4 Operational Phase - Likely Significant Effects and Mitigation Measures

7.4.4.1 Potential Impacts on Groundwater Quality due to Imported Fill Material

The proposed development comprises importing approximately 2,339,624 tonnes (1,299,791m^3) of inert soil and stone by-product material. Infilling of the site with inert material will pose a low risk to groundwater quality regardless of the vulnerability rating as no harmful contaminants will be present. In addition, inert soil and stone by-product will not contain either organic matter or liquids that will form a source of organic contaminants of microbial pathogens, nor provide a substrate to feed microbial pathogens.

Pathway: Groundwater recharge and flow paths

Receptor: Groundwater

Pre-Mitigation Potential Impact: Negative, imperceptible, indirect, long term, likely, impact on groundwater quality.

Proposed Mitigation Measures:

Infilling of the site with inert soil and by-product material will pose a low risk as no harmful contaminants will be present. Mitigation measures relating to hydrocarbon/chemical spills and leaks are dealt with further below. Prior to the backfilling commencing, it is also proposed to place a layer of low permeability clay across the floor of the quarry pits.

- The following procedures will be put in place to ensure only suitable material is imported to the site: Sourcing material that is proven to be inert prior to transport to the site;
- Pre-agreed source sites for inert material ensuring; no pollutants, unauthorised material, invasive species;
- The site will operate under a dedicated Environmental Management System;
- All required pollution prevention measures will be implemented at the site;
- The operator will prepare and implement an Emergency Response procedure;
- The operator will complete environmental monitoring, including local groundwater monitoring;
- A phased restoration of the site will be implemented, and it will end with the closure of site;
- The operator will have a documented waste recording procedure for all material entering the site; and,
- No unauthorised dumping of waste will be allowed at the site.

Residual Effects: The importation of soil and subsoil is an integral part of the proposed development. Proven and effective control measures to mitigate the risk of contaminated soils being imported to the site are outlined above. Application of these controls will break the pathway between the potential source and the receptor. The residual effect is considered to be - Neutral, indirect, long term, impact on groundwater quality.

Significance of Effects: For the reasons outlined above, no significant effects on groundwater quality will occur.

7.4.4.2 Potential Impacts on Groundwater Levels and Local Well Supplies

Potential impacts on wells include reduced yield/water levels if quarry/pit pumping is required and groundwater quality due to importing of fill material.

As assessed in Section 7.3.12 above, there are no wells located downgradient of the proposed site. The closet wells to the site are up-gradient to the east/ southeast.

Due to the measured groundwater levels and historical observations, no pumping will be necessary as groundwater levels are below the floor of both pits.

Pathway: Groundwater flow paths, groundwater levels and groundwater quality

Receptor: Groundwater levels and groundwater quality

Pre-Mitigation Potential Impact: No impact on groundwater levels. Negative, indirect, imperceptible, long term, unlikely, impact on the local groundwater quality.

Proposed Mitigation Measures:

The measures outlined in Section 7.4.4.1 will ensure no impacts occur to local groundwater quality. No pumping or dewatering will be required during void backfilling operations, so there can be no impact on groundwater levels.

Residual Effects: No impact on groundwater levels. Negative, indirect, imperceptible, long term, unlikely, impact on the local groundwater quality.

Significance of Effects: For the reasons outlined above, no significant effects on groundwater levels and local well supplies will occur.

7.4.4.3 Impacts on Groundwater Vulnerability

As discussed above it is proposed to import soil and stone by-product and fill the quarry void over an area of approximately 18.95ha, at an average depth of >20 m. The total infill volume is in the order of 2,339,624 tonnes (1,299,791m^3). The groundwater vulnerability rating after the fill will be improved/lowered as the additional fill will provide additional aquifer protection at the site. The groundwater vulnerability rating is currently High to Extreme.

Pathway: Groundwater recharge.

Receptor: Groundwater

Pre-Mitigation Potential Impact: Positive, slight, direct, permanent, likely impact on the local groundwater vulnerability rating and aquifer protection.

Proposed Mitigation Measures:

In terms of impacting on the groundwater vulnerability of the site, the importing of the inert fill will have a positive effect on the site in that the groundwater vulnerability rating will be lower. No direct mitigation measures in relation to groundwater vulnerability are required.

Residual Effects: Direct, positive, slight, permanent, likely impact on groundwater vulnerability rating and improvement in aquifer protection.

Significance of Effects: For the reasons outlined above, there will be a reduced groundwater vulnerability rating through enhanced aquifer protection.

7.4.4.4 Impacts on Receiving Surface Water Quality

During the backfilling phase, as the ground level is raised and the permeability of the soil/subsoil altered by the imported fill material, surface water pathways may be created towards the Crookstown Stream.

The quarry infilling will require significant earthworks and site levelling, and there is a potential risk of poor-quality surface water runoff (i.e. suspended sediments) reaching the Crookstown Stream, especially as infill levels approach natural surrounding ground levels. Mitigation measures will be put in place to attenuate and treat any surface water runoff.

Pathway: Surface water flow paths

Receptor: Surface Water Bodies

Pre-Mitigation Potential Impact: Negative, significant, indirect, short term, likely impact on local surface water quality.

Proposed Mitigation Measures:

Management of surface water runoff/groundwater ingress will be undertaken as follows:

- A natural buffer exists of approximately 100m exists between the Crookstown Stream and the proposed infill area. The permeability within this region will remain high, with a recharge coefficient of approximately 80%. This provides a soakage area for surface waters which may arise.
- Runoff from the infilled pits will be directed into newly constructed drains and swales situated along the perimeter of the infill areas;

- Settlement ponds will be constructed down gradient of the drainage routes. These ponds will not be lined, the low permeability subsoil currently at the site will allow any surface water to recharge to groundwater;
- Any sediment which settles at the base of the ponds will be removed at regular intervals to maintain the permeability of the ponds; and,
- There will be no net change in runoff/recharge rates from the site.

Management of surface water from the entrance road, inspection area, the wheelwash area, the car park and ancillary buildings will be directed through silts traps, an oil interceptor and constructed wetland soakaway, which will provide a buffer zone for suspended sediment. Runoff from the refuelling area will also be drained via a full hydrocarbon interceptor and then routed to the soakaway via the wetland area.

Residual Effects: 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, long term, unlikely impact on local surface waters.

Significance of Effects: For the reasons outlined above, no significant residual impacts on the surface water environment will occur.

7.4.4.5 Potential Release of Hydrocarbons

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

Pathway: Groundwater and surface water flow paths.

Receptor: Groundwater and surface water.

Pre-Mitigation Potential Impact: Negative, indirect, slight, short term, likely impact to local groundwater quality. Negative, indirect, significant, short term, unlikely impact to surface water quality.

Proposed Mitigation Measures:

Mitigation measures proposed to avoid release of hydrocarbons at the site are as follows:

- On site re-fuelling of machinery will be carried out in a dedicated refuelling area, or using a mobile fuel bowser.
- Drainage from the refuelling areas will be routed through a full hydrocarbon interceptor, a wetland, and then a soakaway for final discharge to ground. There will be an inspection chamber between the wetland and the soakaway to all for inspection/sampling.
- When not in use, the mobile fuel bowser will be parked on a level area within a bunded area at the existing operational quarry.
- Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;
- Onsite refuelling will be carried out by trained personnel only;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose;

- Where possible, maintenance of construction/operation vehicles or plant will take place outside of the proposed infill areas, or in the maintenance shed of the operational quarry, or off-site;
- An emergency plan for the operational phase to deal with accidental spillages will be implemented as follows:
    - Procedures and contingency plans will be set up to deal with emergency accidents or spills. The following steps provide the procedure to be followed in the event of oil/fuel spill or leak:
    - Stop the source of the spill and raise the alarm to alert people working in the vicinity of any potential dangers;
    - If applicable, eliminate any sources of ignition in the immediate vicinity of the incident;
    - Contain the spill using the spill control materials, track mats or other material as required. Do not spread or flush away the spill;
    - If possible, clean up as much as possible using the spill control materials;
    - Contain any used spill control material and dispose of used materials appropriately using a fully licensed waste contractor with the appropriate permits so that further contamination is limited;
    - Notify the Site Manager immediately giving information on the location, type and extent of the spill so that they can take appropriate action; and,
    - The Site Manager will inspect the site and ensure the necessary measures are in place to contain and clean up the spill and prevent further spillage from occurring.

Residual Effects: The potential for the release of hydrocarbons to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases of hydrocarbons have been proposed above and will break the pathway between the potential source and each receptor. The residual effect is considered to be - Negative, indirect, imperceptible, short term, unlikely impact to local groundwater quality. Negative, indirect, imperceptible, short term, unlikely impact to surface water quality.

Significance of Effects: For the reasons outlined above, no significant effects on surface water or groundwater quality will occur.

7.4.4.6 Potential Hydrological Impacts on Designated Sites

The only designated site that is hydrologically connected to the proposed development is the River Barrow and River Nore SAC which is located approximately 16km downstream of the site.

Pathway: Surface water/ Groundwater flow paths.

Receptor: Down-gradient water quality and designated sites.

Pre-Mitigation Potential Impact: Negative, imperceptible, indirect, short term, likely impact on surface water quality and designated sites.

Impact Assessment & Proposed Mitigation Measures:

Mitigation measures are outlined in Sections 7.4.3.1 (Sediment), 7.4.4.1 (Water levels), 7.4.4.1 (Groundwater), 7.4.4.4 (Surface water), and 7.4.4.5 (Hydrocarbons) above which, when implemented, will provide the necessary protection to these hydrologically sensitive areas.

The proposed mitigation measures which will include drainage control measures, sediment control measures and mitigation measures related to spills/chemical releases will ensure that there will be no net

change in surface water runoff from the site and no impact on groundwater quality. Therefore, significant direct, or indirect impacts on the SAC will not occur.

Residual Effects: No significant impacts will occur.

Significance of Effects: For the reasons outlined above, no significant impacts on designated sites will occur.

7.4.5 Final Restoration and Aftercare - Likely Significant Effects and Mitigation Measures

The principal activity undertaken at the application site is for the restoration of lands at a sand and gravel quarry void. The void will be backfilled to original land contours and restored for agricultural use.

No significant impacts on the water environment are envisaged during the final restoration and aftercare stage of the proposed development.

7.4.6 Post Consent Monitoring

Groundwater quality monitoring will be completed for 1 year following closure of the infill site. Monitoring should be completed on a quarterly basis.

7.4.7 Cumulative Impacts

Due to the nature of the groundwater regime and high permeability of the subsoil, there is will be no runoff during the construction phase of the project. During the operational phase of the quarry infilling, mitigation measure will be put in place to attenuate surface water runoff from the site. There will be no discharges from the site. Therefore, there will be no cumulative impacts on the surface water environment. Similarly, the groundwater regime will remain unchanged and there will be no cumulative impacts on the groundwater regime.

APPENDIX 7-1

LABORATORY ANALYSIS REPORT – SURFACE WATER

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

Report No: HYDR-410290620
Document No: EF0011

CERTIFICATE OF ANALYSIS

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

Date Received 29/06/2020
Date Reported 08/07/2020
Order Number N/A

For the Attention of: Hydro Environmental Services

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

Comments N/A

Report Authorised by: Rosemary Thomas

Rosemary Thomas
Environmental Chemistry Manager

Conditions:
1. Results in this report relate only to the items tested
2. Reports may not be reproduced except in full without the approval of ALS Life Sciences Ltd
3. All queries regarding this report should be addressed to the Technical Manager at the above address
*4. A * next to a method reference signifies that ALS Life Sciences Ltd is NOT INAB accredited for this method*
5. Results reported as CFU/cm² are calculated based on information supplied by customer regarding area swabbed
6. SUBCON indicates analysis subcontracted to approved subcontractors who do not hold accreditation for this test*
7. SUBCON^ indicates analysis subcontracted to approved subcontractors who hold accreditation for this test
8. Where sampling is undertaken by ALS personnel, sampling activities are outside the scope of INAB accreditation
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Report No: HYDR-410290620

Document No: EF0011

CERTIFICATE OF ANALYSIS

Date Received 29/06/2020
Date Reported 08/07/2020
Order Number N/A

Sample Type Water
Client ID Lawlers SW1 29/6
Date Tested 29/06/2020
ALS ID 4050795

Test	Result	Unit	Method
Suspended Solids	<5	mg / l	P202
Phosphorus	<0.10	mg/l P	P207
Turbidity	1.53	NTU	P239
BOD 5 day Total	<1	mg/l O2	P280
Ammonia	<0.02	mg/l NH3-N	P281
Chloride	17.9	mg/l CL	P281
Nitrate	31.3	mg/l NO3	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	<0.02	mg/l P	P281
Nitrogen (Total)	7.2	mg/L N	P285

Sample Type Water
Client ID Lawlers SW2 29/6
Date Tested 29/06/2020
ALS ID 4050796

Test	Result	Unit	Method
Suspended Solids	17	mg / l	P202
Phosphorus	<0.10	mg/l P	P207
Turbidity	5.42	NTU	P239
BOD 5 day Total	<1	mg/l O2	P280
Ammonia	0.03	mg/l NH3-N	P281
Chloride	19.1	mg/l CL	P281
Nitrate	32.2	mg/l NO3	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	<0.02	mg/l P	P281
Nitrogen (Total)	7.8	mg/L N	P285

Report Authorised by: Rosemary Thomas

Rosemary Thomas
Environmental Chemistry Manager

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Client **Hydro Environmental Services**
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For the Attention of: Hydro Environmental Services

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

Comments N/A

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7. SUBCON^ indicates analysis subcontracted to approved subcontractors who hold accreditation for this test
8. Where sampling is undertaken by ALS personnel, sampling activities are outside the scope of INAB accreditation
9. Dil next to a method reference indicates that a dilution of the water sample was undertaken during testing

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

Report No: HYDR-410290620

Document No: EF0011

CERTIFICATE OF ANALYSIS

Date Received 29/06/2020
Date Reported 08/07/2020
Order Number N/A

Sample Type Water
Client ID Lawlers SW1 29/6
Date Tested 29/06/2020
ALS ID 4050795

Test	Result	Unit	Method
Suspended Solids	<5	mg / l	P202
Phosphorus	<0.10	mg/l P	P207
Turbidity	1.53	NTU	P239
BOD 5 day Total	<1	mg/l O2	P280
Ammonia	<0.02	mg/l NH3-N	P281
Chloride	17.9	mg/l CL	P281
Nitrate	31.3	mg/l NO3	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	<0.02	mg/l P	P281
Nitrogen (Total)	7.2	mg/L N	P285

Sample Type Water
Client ID Lawlers SW2 29/6
Date Tested 29/06/2020
ALS ID 4050796

Test	Result	Unit	Method
Suspended Solids	17	mg / l	P202
Phosphorus	<0.10	mg/l P	P207
Turbidity	5.42	NTU	P239
BOD 5 day Total	<1	mg/l O2	P280
Ammonia	0.03	mg/l NH3-N	P281
Chloride	19.1	mg/l CL	P281
Nitrate	32.2	mg/l NO3	P281
Nitrite	<0.05	mg/l NO2	P281
Orthophosphate	<0.02	mg/l P	P281
Nitrogen (Total)	7.8	mg/L N	P285

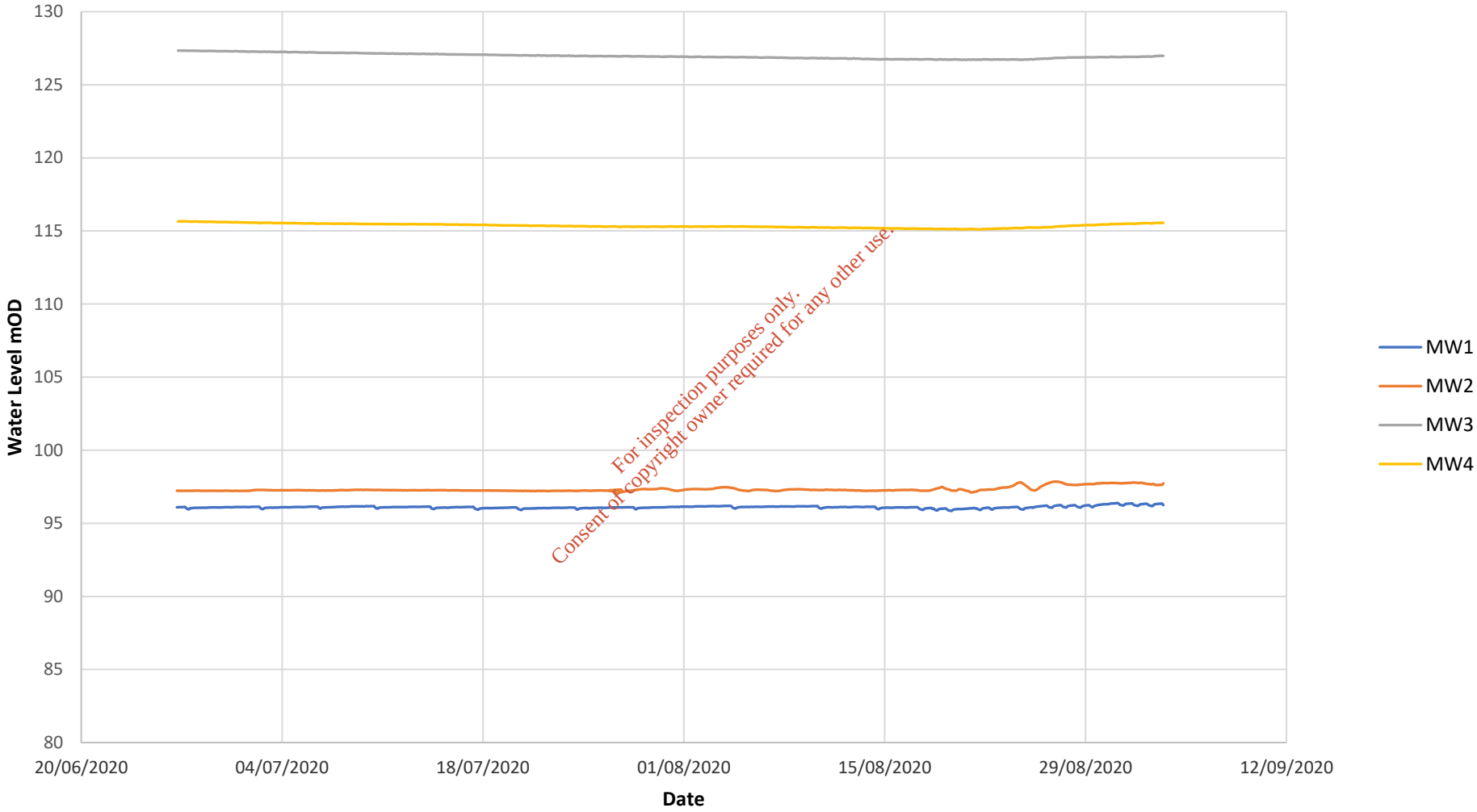
Report Authorised by: Rosemary Thomas

Rosemary Thomas
Environmental Chemistry Manager

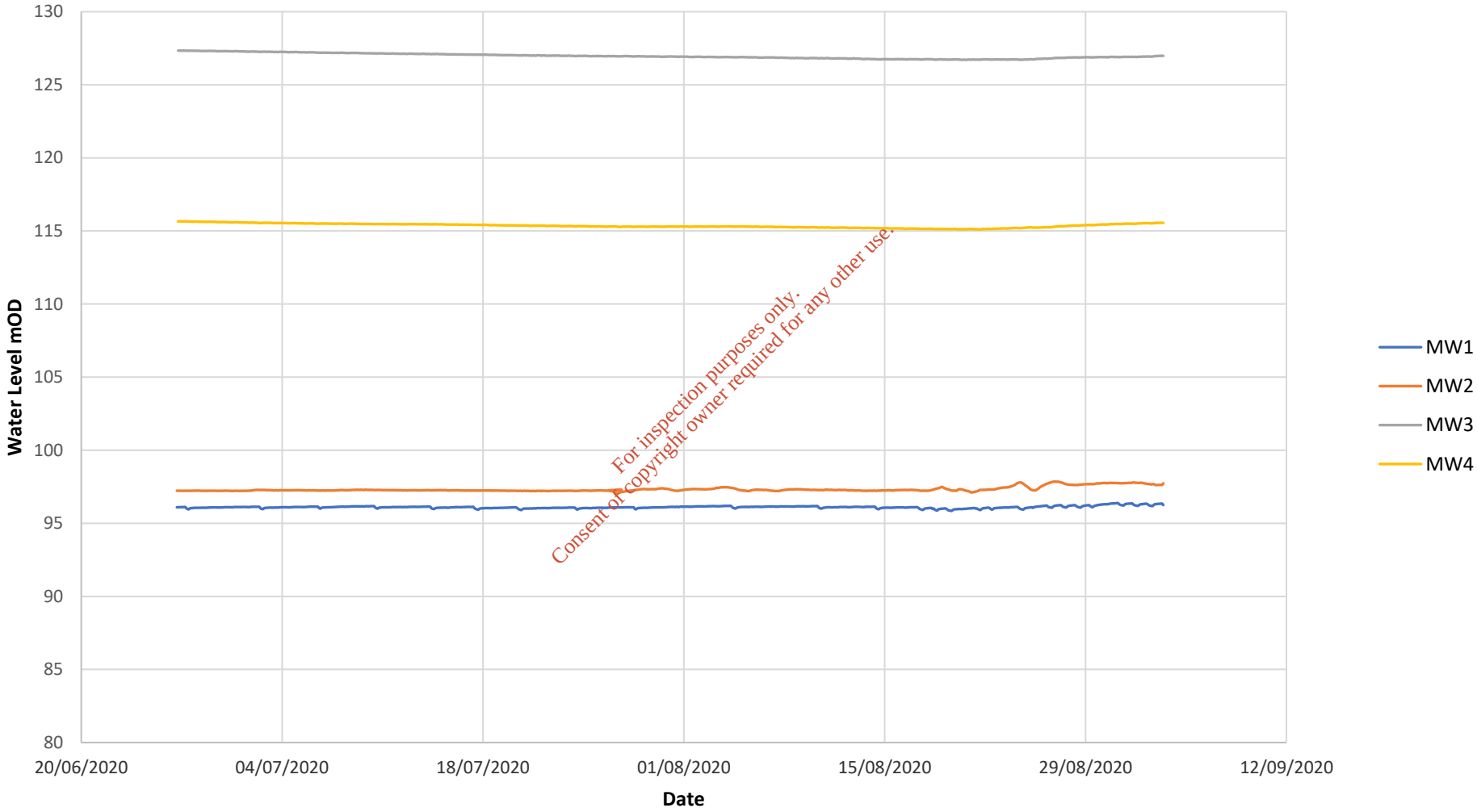
APPENDIX 7-2

GROUNDWATER LEVELS CHART

Lawler Quarry Groundwater Levels



Lawler Quarry Groundwater Levels



APPENDIX 7-3

LABORATORY ANALYSIS REPORT - GROUNDWATER

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

Contact Name	David Broderick	**Report Number**	**183065 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	183065/001
		Date of Receipt	29/06/2020
		Date Started	29/06/2020
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1469	**Date of Report**	23/07/2020
Project No.	QN009167	**Sample Type**	Ground Waters
Customer Ref	Lawlers MW1	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
BOD									
	BOD		EW001	1.0		<1.0	mg/L	INAB	
COD-Chemical Oxygen Demand									
	COD		EW184	8		20	mg/L	INAB	
Gallery Plus-Suite A									
	Ammonia as N		EW175	0.005		<0.005	mg/l N	INAB	
	Ammonia as NH3 (Calc)		EW175	0.006		0.006	mg/l NH3	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		11	mg/l N	INAB	
	Nitrate as N		EW175	0.15		11	mg/l N	INAB	
	Nitrate as NO3 (Calc)		EW175	0.66		50	mg/l NO3	INAB	
	Nitrite as N		EW175	0.005		<0.005	mg/l N	INAB	
	Nitrite as NO2 (Calc)		EW175	0.016		<0.016	mg/l NO2	INAB	
	Phosphate (Ortho/MRP) as P		EW175	0.005		0.025	mg/l P	INAB	
	Chloride mg/L		EW175	1.0		34	mg/L	INAB	
	Sulphate mg/L		EW175	1.0		21	mg/L	INAB	
Metals-Dissolved									
	Iron-Dissolved		EW188	20		<20	ug/L	INAB	
	Manganese-Dissolved		EW188	1.0		2.0	ug/L	INAB	
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Chromium-Dissolved		EW188	1.0		<1.0	ug/L	INAB	
	Copper-Dissolved		EW188	0.003		0.005	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		19.1	mg/L	INAB	
	Nickel-Dissolved		EW188	0.5		0.6	ug/L	INAB	
	Zinc-Dissolved		EW188	1.0		1.8	ug/L	INAB	
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L	INAB	
	Potassium-Dissolved		EW188	0.2		3.0	mg/L	INAB	
	Sodium-Dissolved		EW188	0.5		14.9	mg/L	INAB	
Suspended Solids									
	Suspended Solids		EW013	5		5	mg/L	INAB	
Total Dissolved Solids (TDS)									
	Total Dissolved Solids (TDS)		EW046	15		657	mg/L	INAB	
Total Kjeldahl Nitrogen-TKN (CalcGallery)									
	Total Kjeldahl Nitrogen-TKN (CalcGallery)		EW010	1.0		<1.0	mg/l N	INAB	

Signed : 23/07/2020

Emma Davis-Technical Manager

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6."*" Indicates sub-contract test
7.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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ISO 17025 INAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 111T

Contact Name	David Broderick	**Report Number**	**183065 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	183065/001
		Date of Receipt	29/06/2020
		Date Started	29/06/2020
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1469	**Date of Report**	23/07/2020
Project No.	QN009167	**Sample Type**	Ground Waters
Customer Ref	Lawlers MW1	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Total Nitrogen									
	Total Nitrogen		EW140	1.0		11.3	mg/L	INAB	
TPH (TPH3B1_W) (Sub)									
	Total TPH >C6-C40 (sub)	*	Default	10		<10	ug/L	YES	
	TPH >C21-C40	*	Default	0.1		<0.1	ug/L		
	TPH >C10-C21	*	Default	0.1		<0.1	ug/L		
	TPH>C6-C10	*	Default	0.1		<0.1	ug/L		

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Contact Name	David Broderick	**Report Number**	**183065 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	183065/002
		Date of Receipt	29/06/2020
		Date Started	29/06/2020
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1469	**Date of Report**	23/07/2020
Project No.	QN009167	**Sample Type**	Ground Waters
Customer Ref	Lawlers MW2	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
BOD									
	BOD		EW001	1.0		<1.0	mg/L	INAB	
COD-Chemical Oxygen Demand									
	COD		EW184	8		16	mg/L	INAB	
Gallery Plus-Suite A									
	Ammonia as N		EW175	0.005		<0.005	mg/l N	INAB	
	Ammonia as NH3 (Calc)		EW175	0.006		<0.006	mg/l NH3	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		4.3	mg/l N	INAB	
	Nitrate as N		EW175	0.15		4.4	mg/l N	INAB	
	Nitrate as NO3 (Calc)		EW175	0.66		19	mg/l NO3	INAB	
	Nitrite as N		EW175	0.005		<0.005	mg/l N	INAB	
	Nitrite as NO2 (Calc)		EW175	0.016		<0.016	mg/l NO2	INAB	
	Phosphate (Ortho/MRP) as P		EW175	0.005		0.042	mg/l P	INAB	
	Chloride mg/L		EW175	1.0		17	mg/L	INAB	
	Sulphate mg/L		EW175	1.0		9.7	mg/L	INAB	
Metals-Dissolved									
	Iron-Dissolved		EW188	20		<20	ug/L	INAB	
	Manganese-Dissolved		EW188	1.0		<1.0	ug/L	INAB	
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Chromium-Dissolved		EW188	1.0		1.0	ug/L	INAB	
	Copper-Dissolved		EW188	0.003		<0.003	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		11.0	mg/L	INAB	
	Nickel-Dissolved		EW188	0.5		0.6	ug/L	INAB	
	Zinc-Dissolved		EW188	1.0		1.5	ug/L	INAB	
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L	INAB	
	Potassium-Dissolved		EW188	0.2		0.8	mg/L	INAB	
	Sodium-Dissolved		EW188	0.5		7.9	mg/L	INAB	
Suspended Solids									
	Suspended Solids		EW013	5		295	mg/L	INAB	
Total Dissolved Solids (TDS)									
	Total Dissolved Solids (TDS)		EW046	15		321	mg/L	INAB	
Total Kjeldahl Nitrogen-TKN (CalcGallery)									
	Total Kjeldahl Nitrogen-TKN (CalcGallery)		EW010	1.0		<1.0	mg/l N	INAB	
Total Nitrogen									

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Contact Name	David Broderick	**Report Number**	**183065 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	183065/002
		Date of Receipt	29/06/2020
		Date Started	29/06/2020
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1469	**Date of Report**	23/07/2020
Project No.	QN009167	**Sample Type**	Ground Waters
Customer Ref	Lawlers MW2	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Total Nitrogen									
	Total Nitrogen		EW140	1.0		4.4	mg/L	INAB	
TPH (TPH3B1_W) (Sub)									
	Total TPH >C6-C40 (sub)	*	Default	10		<10	ug/L	YES	
	TPH >C21-C40	*	Default	0.1		<0.1	ug/L		
	TPH >C10-C21	*	Default	0.1		<0.1	ug/L		
	TPH>C6-C10	*	Default	0.1		<0.1	ug/L		

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Contact Name	David Broderick	**Report Number**	**183065 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	183065/003
		Date of Receipt	29/06/2020
		Date Started	29/06/2020
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1469	**Date of Report**	23/07/2020
Project No.	QN009167	**Sample Type**	Ground Waters
Customer Ref	Lawlers MW3	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
BOD									
	BOD		EW001	1.0		<1.0	mg/L	INAB	
COD-Chemical Oxygen Demand									
	COD		EW184	8		44	mg/L	INAB	
Gallery Plus-Suite A									
	Ammonia as N		EW175	0.005		0.008	mg/l N	INAB	
	Ammonia as NH3 (Calc)		EW175	0.006		0.010	mg/l NH3	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		11	mg/l N	INAB	
	Nitrate as N		EW175	0.15		11	mg/l N	INAB	
	Nitrate as NO3 (Calc)		EW175	0.66		51	mg/l NO3	INAB	
	Nitrite as N		EW175	0.005		0.005	mg/l N	INAB	
	Nitrite as NO2 (Calc)		EW175	0.016		0.018	mg/l NO2	INAB	
	Phosphate (Ortho/MRP) as P		EW175	0.005		<0.005	mg/l P	INAB	
	Chloride mg/L		EW175	1.0		30	mg/L	INAB	
	Sulphate mg/L		EW175	1.0		20	mg/L	INAB	
Metals-Dissolved									
	Iron-Dissolved		EW188	20		<20	ug/L	INAB	
	Manganese-Dissolved		EW188	1.0		2.1	ug/L	INAB	
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Chromium-Dissolved		EW188	1.0		<1.0	ug/L	INAB	
	Copper-Dissolved		EW188	0.003		<0.003	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		8.3	mg/L	INAB	
	Nickel-Dissolved		EW188	0.5		0.5	ug/L	INAB	
	Zinc-Dissolved		EW188	1.0		1.9	ug/L	INAB	
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L	INAB	
	Potassium-Dissolved		EW188	0.2		0.5	mg/L	INAB	
	Sodium-Dissolved		EW188	0.5		11.6	mg/L	INAB	
Suspended Solids									
	Suspended Solids		EW013	5		128	mg/L	INAB	
Total Dissolved Solids (TDS)									
	Total Dissolved Solids (TDS)		EW046	15		514	mg/L	INAB	
Total Kjeldahl Nitrogen-TKN (CalcGallery)									
	Total Kjeldahl Nitrogen-TKN (CalcGallery)		EW010	1.0		<1.0	mg/l N	INAB	
Total Nitrogen									

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Contact Name	David Broderick	**Report Number**	**183065 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	183065/003
		Date of Receipt	29/06/2020
		Date Started	29/06/2020
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1469	**Date of Report**	23/07/2020
Project No.	QN009167	**Sample Type**	Ground Waters
Customer Ref	Lawlers MW3	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Total Nitrogen									
	Total Nitrogen		EW140	1.0		12.1	mg/L	INAB	
	Analyst Sub Comment: Due to equipment breakdown Total N analysis was sub-contract to another accredited lab								
TPH (TPH3B1_W) (Sub)									
	Total TPH >C6-C40 (sub)	*	Default	10		<10	ug/L	YES	
	TPH >C21-C40	*	Default	0.1		<0.1	ug/L		
	TPH >C10-C21	*	Default	0.1		<0.1	ug/L		
	TPH>C6-C10	*	Default	0.1		<0.1	ug/L		

Signed : _____ 23/07/2020

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4.LOQ=Limit of Quantification or lowest value that can be reported
5.ACCRED=Indicates matrix accreditation for the test,a blank field indicates not accredited
6."*" Indicates sub-contract test
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Contact Name	David Broderick	**Report Number**	**183065 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	183065/004
		Date of Receipt	29/06/2020
		Date Started	29/06/2020
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1469	**Date of Report**	23/07/2020
Project No.	QN009167	**Sample Type**	Ground Waters
Customer Ref	Lawlers MW4	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
BOD									
	BOD		EW001	1.0		<1.0	mg/L	INAB	
COD-Chemical Oxygen Demand									
	COD		EW184	8		16	mg/L	INAB	
Gallery Plus-Suite A									
	Ammonia as N		EW175	0.005		0.009	mg/l N	INAB	
	Ammonia as NH3 (Calc)		EW175	0.006		0.011	mg/l NH3	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		5.4	mg/l N	INAB	
	Nitrate as N		EW175	0.15		5.4	mg/l N	INAB	
	Nitrate as NO3 (Calc)		EW175	0.66		24	mg/l NO3	INAB	
	Nitrite as N		EW175	0.005		<0.005	mg/l N	INAB	
	Nitrite as NO2 (Calc)		EW175	0.016		<0.016	mg/l NO2	INAB	
	Phosphate (Ortho/MRP) as P		EW175	0.005		0.025	mg/l P	INAB	
	Chloride mg/L		EW175	1.0		11	mg/L	INAB	
	Sulphate mg/L		EW175	1.0		9.6	mg/L	INAB	
Metals-Dissolved									
	Iron-Dissolved		EW188	20		31	ug/L	INAB	
	Manganese-Dissolved		EW188	1.0		4.2	ug/L	INAB	
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Chromium-Dissolved		EW188	1.0		1.2	ug/L	INAB	
	Copper-Dissolved		EW188	0.003		<0.003	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		18.0	mg/L	INAB	
	Nickel-Dissolved		EW188	0.5		1.5	ug/L	INAB	
	Zinc-Dissolved		EW188	1.0		2.1	ug/L	INAB	
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L	INAB	
	Potassium-Dissolved		EW188	0.2		1.4	mg/L	INAB	
	Sodium-Dissolved		EW188	0.5		11.0	mg/L	INAB	
Suspended Solids									
	Suspended Solids		EW013	5		103	mg/L	INAB	
Total Dissolved Solids (TDS)									
	Total Dissolved Solids (TDS)		EW046	15		418	mg/L	INAB	
Total Kjeldahl Nitrogen-TKN (CalcGallery)									
	Total Kjeldahl Nitrogen-TKN (CalcGallery)		EW010	1.0		<1.0	mg/l N	INAB	
Total Nitrogen									

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

Contact Name	David Broderick	**Report Number**	**183065 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	183065/004
		Date of Receipt	29/06/2020
		Date Started	29/06/2020
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1469	**Date of Report**	23/07/2020
Project No.	QN009167	**Sample Type**	Ground Waters
Customer Ref	Lawlers MW4	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Total Nitrogen									
	Total Nitrogen		EW140	1.0		5.2	mg/L	INAB	
	Analyst Sub Comment: Due to equipment breakdown Total N analysis was sub-contract to another accredited lab								
TPH (TPH3B1_W) (Sub)									
	Total TPH >C6-C40 (sub)	*	Default	10		<10	ug/L	YES	
	TPH >C21-C40	*	Default	0.1		<0.1	ug/L		
	TPH >C10-C21	*	Default	0.1		<0.1	ug/L		
	TPH>C6-C10	*	Default	0.1		<0.1	ug/L		

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Table 1
Monitoring Well Groundwater Sampling Results
Lawlers Quarry, Co. Kildare

Parameter	Units	MW1 28/06/2020	MW2 28/06/2020	MW3 28/06/2020	MW4 28/06/2020	Drinking Water Regs (S.I. 122 of 2014)	Groundwater Regs (S.I. 9 of 2010)
BOD	mg/l	<1	<1	<1	<1	-	-
COD	mg/l	20	16	44	16	-	-
Ammonia N	mg/l N	<0.005	<0.005	<0.008	0.009	0.3	0.175
Chloride	mg/L	34	17	30	11	250	187.5
Conductivity (Field)	µs/cm	580	562	600	584	2500	1875
Iron (Dissolved)	mg/L	<0.02	<0.02	<0.02	0.031	0.2	-
Magnesium (Dissolved)	mg/L	19.1	11	8.3	18	-	-
Manganese (Dissolved)	mg/L	0.002	<0.001	0.0021	0.0042	0.05	-
Cadmium (Dissolved)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.005	0.00375
Chromium (Dissolved)	mg/L	<0.001	0.001	<0.001	0.0012	0.05	0.05
Copper (Dissolved)	mg/L	0.005	<0.003	<0.003	<0.003	2	1.5
Lead (Dissolved)	mg/L	<0.0003	<0.0003	<0.0003	<0.0003	0.01	0.01875
Nickle (Dissolved)	mg/L	0.0006	0.0006	0.0005	0.0015	0.02	0.015
Zinc (Dissolved)	mg/L	0.0018	0.0015	0.0019	0.0021	-	-
Mercury (Dissolved)	mg/L	<0.00002	<0.00002	<0.00002	<0.00002	0.001	0.00075
Total Nitrogen	mg/l N	11.3	4.4	12.1	5.2	-	-
Nitrate	mg/L as NO3	**50***	19	**51**	24	50	37.5
Nitrite	mg/L as NO2	<0.016	<0.016	0.018	<0.016	0.5	0.375
pH (Field)	pH Units	7.1	7.2	6.9	7.2	6.5 - 9.5	-
Phosphate (Ortho)	mg/L as P	0.025	**0.042***	<0.005	0.025		0.035
Potassium (Dissolved)	mg/L	3	0.8	0.5	1.4		-
Sodium	mg/L	14.9	7.9	11.6	11	200	150
Sulphate	mg/L as SO4	21	9.7	20	9.6	250	187.5
Total Suspended Solids	mg/L	5	295	128	103	-	-
Total Dissolved Soilds	mg/L	657	321	514	418	-	-
TPH	mg/l	<0.01	<0.01	<0.01	<0.01	-	-

* Towards Setting Guideline Values for the Protection of Groundwater in Ireland - Interim Report (EPA, 2003)
NAC - No abnormal change
Bold with Asterix - exceeds GW Regs (SI 9 of 2010) TV value
Bold Underlined - exceeds Drinking Water Reg (SI 122 of 2014) paramter value

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

Contact Name	David Broderick	**Report Number**	**183065 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	183065/001
		Date of Receipt	29/06/2020
		Date Started	29/06/2020
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1469	**Date of Report**	23/07/2020
Project No.	QN009167	**Sample Type**	Ground Waters
Customer Ref	Lawlers MW1	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
BOD									
	BOD		EW001	1.0		<1.0	mg/L	INAB	
COD-Chemical Oxygen Demand									
	COD		EW184	8		20	mg/L	INAB	
Gallery Plus-Suite A									
	Ammonia as N		EW175	0.005		<0.005	mg/l N	INAB	
	Ammonia as NH3 (Calc)		EW175	0.006		0.006	mg/l NH3	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		11	mg/l N	INAB	
	Nitrate as N		EW175	0.15		11	mg/l N	INAB	
	Nitrate as NO3 (Calc)		EW175	0.66		50	mg/l NO3	INAB	
	Nitrite as N		EW175	0.005		<0.005	mg/l N	INAB	
	Nitrite as NO2 (Calc)		EW175	0.016		<0.016	mg/l NO2	INAB	
	Phosphate (Ortho/MRP) as P		EW175	0.005		0.025	mg/l P	INAB	
	Chloride mg/L		EW175	1.0		34	mg/L	INAB	
	Sulphate mg/L		EW175	1.0		21	mg/L	INAB	
Metals-Dissolved									
	Iron-Dissolved		EW188	20		<20	ug/L	INAB	
	Manganese-Dissolved		EW188	1.0		2.0	ug/L	INAB	
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Chromium-Dissolved		EW188	1.0		<1.0	ug/L	INAB	
	Copper-Dissolved		EW188	0.003		0.005	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		19.1	mg/L	INAB	
	Nickel-Dissolved		EW188	0.5		0.6	ug/L	INAB	
	Zinc-Dissolved		EW188	1.0		1.8	ug/L	INAB	
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L	INAB	
	Potassium-Dissolved		EW188	0.2		3.0	mg/L	INAB	
	Sodium-Dissolved		EW188	0.5		14.9	mg/L	INAB	
Suspended Solids									
	Suspended Solids		EW013	5		5	mg/L	INAB	
Total Dissolved Solids (TDS)									
	Total Dissolved Solids (TDS)		EW046	15		657	mg/L	INAB	
Total Kjeldahl Nitrogen-TKN (CalcGallery)									
	Total Kjeldahl Nitrogen-TKN (CalcGallery)		EW010	1.0		<1.0	mg/l N	INAB	

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

Contact Name	David Broderick	**Report Number**	**183065 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	183065/001
		Date of Receipt	29/06/2020
		Date Started	29/06/2020
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1469	**Date of Report**	23/07/2020
Project No.	QN009167	**Sample Type**	Ground Waters
Customer Ref	Lawlers MW1	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Total Nitrogen									
	Total Nitrogen		EW140	1.0		11.3	mg/L	INAB	
TPH (TPH3B1_W) (Sub)									
	Total TPH >C6-C40 (sub)	*	Default	10		<10	ug/L	YES	
	TPH >C21-C40	*	Default	0.1		<0.1	ug/L		
	TPH >C10-C21	*	Default	0.1		<0.1	ug/L		
	TPH>C6-C10	*	Default	0.1		<0.1	ug/L		

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Contact Name	David Broderick	**Report Number**	**183065 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	183065/002
		Date of Receipt	29/06/2020
		Date Started	29/06/2020
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1469	**Date of Report**	23/07/2020
Project No.	QN009167	**Sample Type**	Ground Waters
Customer Ref	Lawlers MW2	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
BOD									
	BOD		EW001	1.0		<1.0	mg/L	INAB	
COD-Chemical Oxygen Demand									
	COD		EW184	8		16	mg/L	INAB	
Gallery Plus-Suite A									
	Ammonia as N		EW175	0.005		<0.005	mg/l N	INAB	
	Ammonia as NH3 (Calc)		EW175	0.006		<0.006	mg/l NH3	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		4.3	mg/l N	INAB	
	Nitrate as N		EW175	0.15		4.4	mg/l N	INAB	
	Nitrate as NO3 (Calc)		EW175	0.66		19	mg/l NO3	INAB	
	Nitrite as N		EW175	0.005		<0.005	mg/l N	INAB	
	Nitrite as NO2 (Calc)		EW175	0.016		<0.016	mg/l NO2	INAB	
	Phosphate (Ortho/MRP) as P		EW175	0.005		0.042	mg/l P	INAB	
	Chloride mg/L		EW175	1.0		17	mg/L	INAB	
	Sulphate mg/L		EW175	1.0		9.7	mg/L	INAB	
Metals-Dissolved									
	Iron-Dissolved		EW188	20		<20	ug/L	INAB	
	Manganese-Dissolved		EW188	1.0		<1.0	ug/L	INAB	
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Chromium-Dissolved		EW188	1.0		1.0	ug/L	INAB	
	Copper-Dissolved		EW188	0.003		<0.003	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		11.0	mg/L	INAB	
	Nickel-Dissolved		EW188	0.5		0.6	ug/L	INAB	
	Zinc-Dissolved		EW188	1.0		1.5	ug/L	INAB	
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L	INAB	
	Potassium-Dissolved		EW188	0.2		0.8	mg/L	INAB	
	Sodium-Dissolved		EW188	0.5		7.9	mg/L	INAB	
Suspended Solids									
	Suspended Solids		EW013	5		295	mg/L	INAB	
Total Dissolved Solids (TDS)									
	Total Dissolved Solids (TDS)		EW046	15		321	mg/L	INAB	
Total Kjeldahl Nitrogen-TKN (CalcGallery)									
	Total Kjeldahl Nitrogen-TKN (CalcGallery)		EW010	1.0		<1.0	mg/l N	INAB	
Total Nitrogen									

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

Contact Name	David Broderick	**Report Number**	**183065 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	183065/002
		Date of Receipt	29/06/2020
		Date Started	29/06/2020
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1469	**Date of Report**	23/07/2020
Project No.	QN009167	**Sample Type**	Ground Waters
Customer Ref	Lawlers MW2	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Total Nitrogen									
	Total Nitrogen		EW140	1.0		4.4	mg/L	INAB	
TPH (TPH3B1_W) (Sub)									
	Total TPH >C6-C40 (sub)	*	Default	10		<10	ug/L	YES	
	TPH >C21-C40	*	Default	0.1		<0.1	ug/L		
	TPH >C10-C21	*	Default	0.1		<0.1	ug/L		
	TPH>C6-C10	*	Default	0.1		<0.1	ug/L		

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Contact Name	David Broderick	**Report Number**	**183065 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	183065/003
		Date of Receipt	29/06/2020
		Date Started	29/06/2020
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1469	**Date of Report**	23/07/2020
Project No.	QN009167	**Sample Type**	Ground Waters
Customer Ref	Lawlers MW3	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
BOD									
	BOD		EW001	1.0		<1.0	mg/L	INAB	
COD-Chemical Oxygen Demand									
	COD		EW184	8		44	mg/L	INAB	
Gallery Plus-Suite A									
	Ammonia as N		EW175	0.005		0.008	mg/l N	INAB	
	Ammonia as NH3 (Calc)		EW175	0.006		0.010	mg/l NH3	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		11	mg/l N	INAB	
	Nitrate as N		EW175	0.15		11	mg/l N	INAB	
	Nitrate as NO3 (Calc)		EW175	0.66		51	mg/l NO3	INAB	
	Nitrite as N		EW175	0.005		0.005	mg/l N	INAB	
	Nitrite as NO2 (Calc)		EW175	0.016		0.018	mg/l NO2	INAB	
	Phosphate (Ortho/MRP) as P		EW175	0.005		<0.005	mg/l P	INAB	
	Chloride mg/L		EW175	1.0		30	mg/L	INAB	
	Sulphate mg/L		EW175	1.0		20	mg/L	INAB	
Metals-Dissolved									
	Iron-Dissolved		EW188	20		<20	ug/L	INAB	
	Manganese-Dissolved		EW188	1.0		2.1	ug/L	INAB	
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Chromium-Dissolved		EW188	1.0		<1.0	ug/L	INAB	
	Copper-Dissolved		EW188	0.003		<0.003	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		8.3	mg/L	INAB	
	Nickel-Dissolved		EW188	0.5		0.5	ug/L	INAB	
	Zinc-Dissolved		EW188	1.0		1.9	ug/L	INAB	
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L	INAB	
	Potassium-Dissolved		EW188	0.2		0.5	mg/L	INAB	
	Sodium-Dissolved		EW188	0.5		11.6	mg/L	INAB	
Suspended Solids									
	Suspended Solids		EW013	5		128	mg/L	INAB	
Total Dissolved Solids (TDS)									
	Total Dissolved Solids (TDS)		EW046	15		514	mg/L	INAB	
Total Kjeldahl Nitrogen-TKN (CalcGallery)									
	Total Kjeldahl Nitrogen-TKN (CalcGallery)		EW010	1.0		<1.0	mg/l N	INAB	
Total Nitrogen									

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

Contact Name	David Broderick	**Report Number**	**183065 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	183065/003
		Date of Receipt	29/06/2020
		Date Started	29/06/2020
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1469	**Date of Report**	23/07/2020
Project No.	QN009167	**Sample Type**	Ground Waters
Customer Ref	Lawlers MW3	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Total Nitrogen									
	Total Nitrogen		EW140	1.0		12.1	mg/L	INAB	
	Analyst Sub Comment: Due to equipment breakdown Total N analysis was sub-contract to another accredited lab								
TPH (TPH3B1_W) (Sub)									
	Total TPH >C6-C40 (sub)	*	Default	10		<10	ug/L	YES	
	TPH >C21-C40	*	Default	0.1		<0.1	ug/L		
	TPH >C10-C21	*	Default	0.1		<0.1	ug/L		
	TPH>C6-C10	*	Default	0.1		<0.1	ug/L		

Signed : _____ 23/07/2020

Emma Davis-Technical Manager

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6."*" Indicates sub-contract test
7.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

ENVIRONMENTAL LABORATORY SERVICES
EXCELLENCE THROUGH ACCREDITATION

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

Contact Name	David Broderick	**Report Number**	**183065 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	183065/004
		Date of Receipt	29/06/2020
		Date Started	29/06/2020
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1469	**Date of Report**	23/07/2020
Project No.	QN009167	**Sample Type**	Ground Waters
Customer Ref	Lawlers MW4	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
BOD									
	BOD		EW001	1.0		<1.0	mg/L	INAB	
COD-Chemical Oxygen Demand									
	COD		EW184	8		16	mg/L	INAB	
Gallery Plus-Suite A									
	Ammonia as N		EW175	0.005		0.009	mg/l N	INAB	
	Ammonia as NH3 (Calc)		EW175	0.006		0.011	mg/l NH3	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		5.4	mg/l N	INAB	
	Nitrate as N		EW175	0.15		5.4	mg/l N	INAB	
	Nitrate as NO3 (Calc)		EW175	0.66		24	mg/l NO3	INAB	
	Nitrite as N		EW175	0.005		<0.005	mg/l N	INAB	
	Nitrite as NO2 (Calc)		EW175	0.016		<0.016	mg/l NO2	INAB	
	Phosphate (Ortho/MRP) as P		EW175	0.005		0.025	mg/l P	INAB	
	Chloride mg/L		EW175	1.0		11	mg/L	INAB	
	Sulphate mg/L		EW175	1.0		9.6	mg/L	INAB	
Metals-Dissolved									
	Iron-Dissolved		EW188	20		31	ug/L	INAB	
	Manganese-Dissolved		EW188	1.0		4.2	ug/L	INAB	
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Chromium-Dissolved		EW188	1.0		1.2	ug/L	INAB	
	Copper-Dissolved		EW188	0.003		<0.003	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		18.0	mg/L	INAB	
	Nickel-Dissolved		EW188	0.5		1.5	ug/L	INAB	
	Zinc-Dissolved		EW188	1.0		2.1	ug/L	INAB	
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L	INAB	
	Potassium-Dissolved		EW188	0.2		1.4	mg/L	INAB	
	Sodium-Dissolved		EW188	0.5		11.0	mg/L	INAB	
Suspended Solids									
	Suspended Solids		EW013	5		103	mg/L	INAB	
Total Dissolved Solids (TDS)									
	Total Dissolved Solids (TDS)		EW046	15		418	mg/L	INAB	
Total Kjeldahl Nitrogen-TKN (CalcGallery)									
	Total Kjeldahl Nitrogen-TKN (CalcGallery)		EW010	1.0		<1.0	mg/l N	INAB	
Total Nitrogen									

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

Contact Name	David Broderick	**Report Number**	**183065 - 1**
Address	Hydro-Environmental Services 22, Lower Main Street, Dungarvan,	**Sample Number**	183065/004
		Date of Receipt	29/06/2020
		Date Started	29/06/2020
Tel No	058 44122	**Received or Collected**	Hand
Customer PO	P1469	**Date of Report**	23/07/2020
Project No.	QN009167	**Sample Type**	Ground Waters
Customer Ref	Lawlers MW4	**Condition on receipt**	Satisfactory

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Total Nitrogen									
	Total Nitrogen		EW140	1.0		5.2	mg/L	INAB	
	Analyst Sub Comment: Due to equipment breakdown Total N analysis was sub-contract to another accredited lab								
TPH (TPH3B1_W) (Sub)									
	Total TPH >C6-C40 (sub)	*	Default	10		<10	ug/L	YES	
	TPH >C21-C40	*	Default	0.1		<0.1	ug/L		
	TPH >C10-C21	*	Default	0.1		<0.1	ug/L		
	TPH>C6-C10	*	Default	0.1		<0.1	ug/L		

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Table 1
Monitoring Well Groundwater Sampling Results
Lawlers Quarry, Co. Kildare

Parameter	Units	MW1 28/06/2020	MW2 28/06/2020	MW3 28/06/2020	MW4 28/06/2020	Drinking Water Regs (S.I. 122 of 2014)	Groundwater Regs (S.I. 9 of 2010)
BOD	mg/l	<1	<1	<1	<1	-	-
COD	mg/l	20	16	44	16	-	-
Ammonia N	mg/l N	<0.005	<0.005	<0.008	0.009	0.3	0.175
Chloride	mg/L	34	17	30	11	250	187.5
Conductivity (Field)	µs/cm	580	562	600	584	2500	1875
Iron (Dissolved)	mg/L	<0.02	<0.02	<0.02	0.031	0.2	-
Magnesium (Dissolved)	mg/L	19.1	11	8.3	18	-	-
Manganese (Dissolved)	mg/L	0.002	<0.001	0.0021	0.0042	0.05	-
Cadmium (Dissolved)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.005	0.00375
Chromium (Dissolved)	mg/L	<0.001	0.001	<0.001	0.0012	0.05	0.05
Copper (Dissolved)	mg/L	0.005	<0.003	<0.003	<0.003	2	1.5
Lead (Dissolved)	mg/L	<0.0003	<0.0003	<0.0003	<0.0003	0.01	0.01875
Nickle (Dissolved)	mg/L	0.0006	0.0006	0.0005	0.0015	0.02	0.015
Zinc (Dissolved)	mg/L	0.0018	0.0015	0.0019	0.0021	-	-
Mercury (Dissolved)	mg/L	<0.00002	<0.00002	<0.00002	<0.00002	0.001	0.00075
Total Nitrogen	mg/l N	11.3	4.4	12.1	5.2	-	-
Nitrate	mg/L as NO3	**50***	19	**51**	24	50	37.5
Nitrite	mg/L as NO2	<0.016	<0.016	0.018	<0.016	0.5	0.375
pH (Field)	pH Units	7.1	7.2	6.9	7.2	6.5 - 9.5	-
Phosphate (Ortho)	mg/L as P	0.025	**0.042***	<0.005	0.025		0.035
Potassium (Dissolved)	mg/L	3	0.8	0.5	1.4		-
Sodium	mg/L	14.9	7.9	11.6	11	200	150
Sulphate	mg/L as SO4	21	9.7	20	9.6	250	187.5
Total Suspended Solids	mg/L	5	295	128	103	-	-
Total Dissolved Soilds	mg/L	657	321	514	418	-	-
TPH	mg/l	<0.01	<0.01	<0.01	<0.01	-	-

* Towards Setting Guideline Values for the Protection of Groundwater in Ireland - Interim Report (EPA, 2003)
NAC - No abnormal change
Bold with Asterix - exceeds GW Regs (SI 9 of 2010) TV value
Bold Underlined - exceeds Drinking Water Reg (SI 122 of 2014) paramter value