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BALLINCLARE QUARRY, KILBRIDE, CO. WICKLOW

GROUNDWATER AND SURFACE WATER
RISK ASSESSMENT

Prepared for:

KILSARAN CONCRETE UNLIMITED COMPANY

Prepared by:

HYDRO-ENVIRONMENTAL SERVICES

DOCUMENT INFORMATION

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TABLE OF CONTENTS

FIGURES (IN TEXT)

TABLES IN TEXT

APPENDICIES

1. INTRODUCTION

1.1 BACKGROUND

Hydro-Environmental Services (HES) were commissioned by Kilsaran Concrete Unlimited Company, to respond to the hydrological and hydrogeological issues raised in An Coimisiún Pleanála's (ACP) Further Information Request (FIR) letter dated 9th October 2025. The FIR was issued in relation to the proposed operation of a construction and demolition (C&D) waste recovery facilities and the backfilling of an existing hard rock quarry by way of inert fill (*i.e.* the 'proposed development') at Ballinclare Quarry, Kilbride Co Wicklow (*i.e.* the 'application site') (ACP Case Number: ACP-321255-24).

This Surface and Groundwater Risk Assessment Report has been prepared in response to FIR Item 1 (c) which is reproduced below:

> *"Item 1: In relation to the mitigation measures proposed by the applicant in relation to the risk to groundwater and surface water contamination, the EPA considers that the effectiveness of the mitigation measures proposed would be best demonstrated at the minimum through:*
>
> *(c) An assessment on the potential impact to groundwater and down-gradient water supply wells from the site, having regard to the Agency "Guidance on the Authorisation of Discharges to Groundwater" and provision of mitigation measures to address identified potential impacts."*

The proposed development provides for backfilling of the quarry to its original ground level using imported inert waste, principally soil and stone, generated by construction projects. Complementary C&D waste recovery facilities will also be established at the application site to produce recycled (secondary) aggregate by crushing and soil washing and will provide for an integrated waste management facility for inert C&D waste at the application site.

In response to FIR Item 1 (c) this Surface and Groundwater Risk Assessment Report:

- Presents the baseline characteristics and sensitivity of the receiving surface and groundwater environment at the application site based on the entire available historic and recent geological and hydrogeological datasets;
- Details the significant site specific geological and hydrogeological dataset which is available for the application site. This data was presented in the submitted Environmental Impact Assessment Report (EIAR);
- Presents a Conceptual Site Model (CSM), as detailed in the submitted EIAR, which has been developed using all available desk study information and site investigation data;
- Summarises the key characteristics of the proposed development and the mitigation measures which will be implemented to ensure the protection of the receiving surface and groundwater environments; and,
- Undertakes a qualitative risk assessment of the proposed development at Ballinclare Quarry, Kilbridge, Co. Wicklow on the surface water and groundwater environments.

1.2 STATEMENT OF AUTHORITY

Hydro-Environmental Services (HES) are a specialist geological, hydrological, hydrogeological and environmental practice that 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.

Our core areas of expertise and experience include geology, hydrology and hydrogeology. We routinely complete impact/risk assessments for hydrology and hydrogeology for a large variety of project types including sand and gravel pits and bedrock quarries.

This surface water and groundwater risk assessment report has been prepared by Michael Gill, Adam Keegan, and Conor McGettigan.

Michael Gill (P. Geo., B.A.I., MSc, Dip. Geol., MIEI) is an Environmental Engineer with over 23' years' environmental consultancy experience in Ireland. Michael has completed numerous geological, hydrological and hydrogeological risk assessments. In addition, he has substantial experience in surface water and groundwater risk assessments and site suitability assessments, contaminated land investigation and assessment, wetland hydrology/hydrogeology, water resource assessments, surface water drainage design, and surface water/groundwater interactions. Michael prepared the Water Chapter of the EIAR for the proposed development.

Adam Keegan PGeo (BSc, MSc) is a hydrogeologist with 7 years of experience in the environmental sector in Ireland. Adam has been involved in numerous hydrological and hydrogeological impact assessments, flood risk assessments and hydrogeological monitoring as part of the team at HES. Adam has worked on quarry infill assessments at Brownswood Quarry (Wexford), Clasheen Pit (Kerry) and Killarney East pit (Kerry). Adam prepared the Water Chapter of the EIAR for the proposed development.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with over 5 years' experience in the environmental sector in Ireland. Conor holds an M.Sc. in Applied Environmental Science (2020) and a B.Sc. in Geology (2016) from University College Dublin. Conor routinely prepares the hydrological and hydrogeological impact/risk assessments for a wide range of development including wind farms and quarries.

2. RISK ASSESSMENT METHODOLOGY & DATA SOURCES

2.1 REFERENCED GUIDELINE

Item 1 (c) of ACP's FIR letter, dated 9th October 2025, references the following document:

- *Environmental Protection Agency (2011): Guidance on the Authorisation of Discharges to Groundwater.*

The surface and groundwater risk assessment presented herein has been prepared in accordance with the above guidance.

In terms of the nature of the proposed development (*i.e.* a licensed, integrated material recovery / recycling facility and inert landfill), it is considered to be a "Tier 3", "higher-risk activity" as per the terminology and guidance outlined in the above referenced guidelines.

However, due to the nature of the local hydrogeological environment, as detailed in the submitted EIAR and reinforced in this surface and groundwater risk assessment report, there will be limited potential for effects on groundwater, with downstream surface waters being the primary sensitive receptor in terms of the water environment.

2.2 DESK STUDY

A desk study of the application site and the surrounding lands was completed in order to gather all relevant geological, hydrological, hydrogeological and meteorological data for the local area. This desk study was completed by HES as part of the baseline characterisation for the EIAR, and has been checked and updated as part of this assessment. The desk study included consultation with the following sources of information:

- Environmental Protection Agency Database (www.epa.ie);
- Geological Survey of Ireland - Groundwater Databases (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie):
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directive "Catchments" Map Viewer (www.catchments.ie);
- Teagasc/GSI soil and subsoil mapping (www.gsi.ie);
- Bedrock Geology 1:100,000 scale map series, Sheet 16 (Geology of Kildare - Wicklow) Geological Survey of Ireland (GSI, 1995);
- Geological Survey of Ireland – Wicklow Groundwater Body: Initial Characterisation Report (GSI, 2004) and,
- OPW Flood Mapping (www.floodinfo.ie).

2.3 SITE-SPECIFIC DATA

In additional to the publicly available online databases listed above in **Section 2.2**, HES reviewed all available geological, hydrological and hydrogeological data for the application site. This data was incorporated into the submitted EIAR, is reiterated herein, and is used to inform this assessment.

The available historic hydrological/hydrogeological data included:

- Site Investigation works completed by White Young Green (WYG) in 2005 comprising the drilling of 4 no. trial wells (TW1-TW4), a survey of local domestic wells, groundwater and surface water sampling and a surface water drainage survey;
- WYG drilled an additional 2 no. wells at the application site in 2007 (TW5 and TW6);
- Groundwater sampling in 2007 (3 no. samples) and 2019 (monthly samples);
- SLR completed site investigations in 2014 comprising of 2 no. rotary cored boreholes (BH1 and BH2) and 3 no. groundwater monitoring wells (GW1-GW3);

- Surface water sampling in 2019 (3 no. samples); and,
- Seasonal groundwater level monitoring.

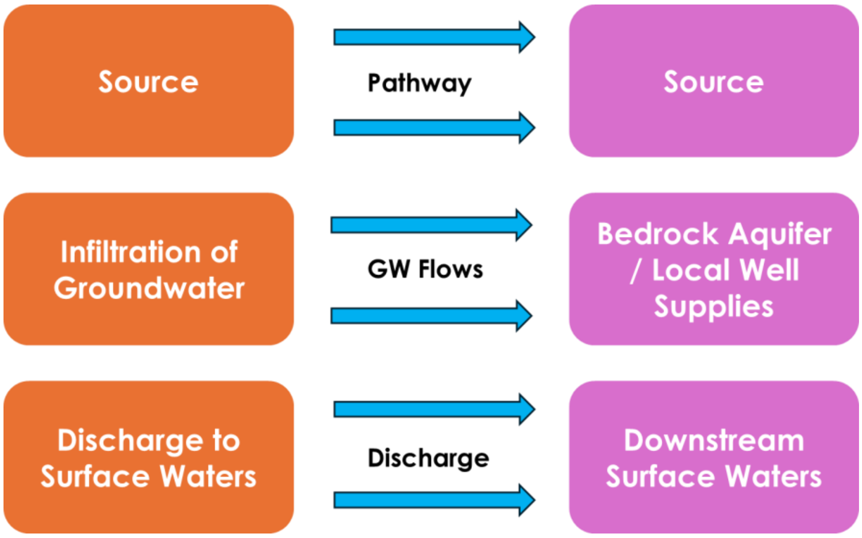
Recent site investigations and monitoring included:

- Detailed inspections of the quarry faces including logging of soil/subsoil and bedrock exposures;
- The completion of surface water sampling in 2024 (2 no. rounds of 5 no. samples);
- The completion of groundwater quality monitoring in 2024 (2 no. rounds of 3 no. samples); and,
- Seasonal and continuous groundwater level monitoring.

In addition to the above, monthly monitoring of discharges from the quarry is being completed in accordance with the existing discharge licence.

2.4 OVERVIEW OF RISK ASSESSMENT PROCESS

The conventional source-pathway-target model (see example below) was applied to assess potential risks on downstream/downgradient environmental receptors (see below, bottom S-P-R is an example) as a result of the proposed development.



3. GEOLOGICAL ENVIRONMENT

3.1 INTRODUCTION

This section describes the land, soils and geology in the local area. The existing geological conditions at the application site have been interpreted from both desk study information, site investigation data and from field walkover survey notes.

3.2 SITE DESCRIPTION AND TOPOGRAPHY

The quarry is located in the townlands of Ballinclare and Carrigmore, Kilbride, Co. Wicklow. The main quarry face is along the northern site boundary cutting into the slope of the land. Ground levels in the vicinity of the application site vary between c. 50mAOD (metres above Ordnance Datum) at the southern site boundary, rising to c. 90mAOD at the highest point on the northern boundary. Typical levels over the northern boundary range from 60mAOD to 80mAOD.

When operational, the quarry was worked dry with very little inflow of groundwater reported within the quarry void. A quarry sump (~70,000m^3 in volume) located on the lowest quarry floor level was used to collect any surface water falling in the area of the quarry void and any minor inflows of groundwater. During previous quarrying operations, periodic pumping of the water from the quarry sump to on-site storage tanks was carried out. This water was recycled and used in concrete production activities and on-site dust suppression.

The quarry faces consist of an upper 20m face followed by three further smaller faces of between 12-15m in height each. The lowest quarry floor level is at the base of the central sump at c.21.5mAOD. The wider quarry floor is at ~37mAOD.

Land-use at the application site comprises of the quarry void and ancillary concrete/ asphalt / block production areas. Surrounding land use is mainly agricultural farmland, with dispersed residential housing along local roads and areas of commercial forestry.

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

3.3 SITE GEOLOGY

The geology of the application site is described based on the following available datasets:

- Desk study data and GSI mapping (Section 3.3.1);
- Historic boreholes (TW1-TW6 as described in Section 3.3.2.1);
- Recent boreholes (GW1, GW2, and GW3 as described in Section 3.3.2.2); and,
- Observation and mapping of the hundreds of meters of exposed bedrock along the various quarry faces within the existing quarry.

3.3.1 Desk Study Data

Available desk study data relating to site geology is summarised in

Table A.

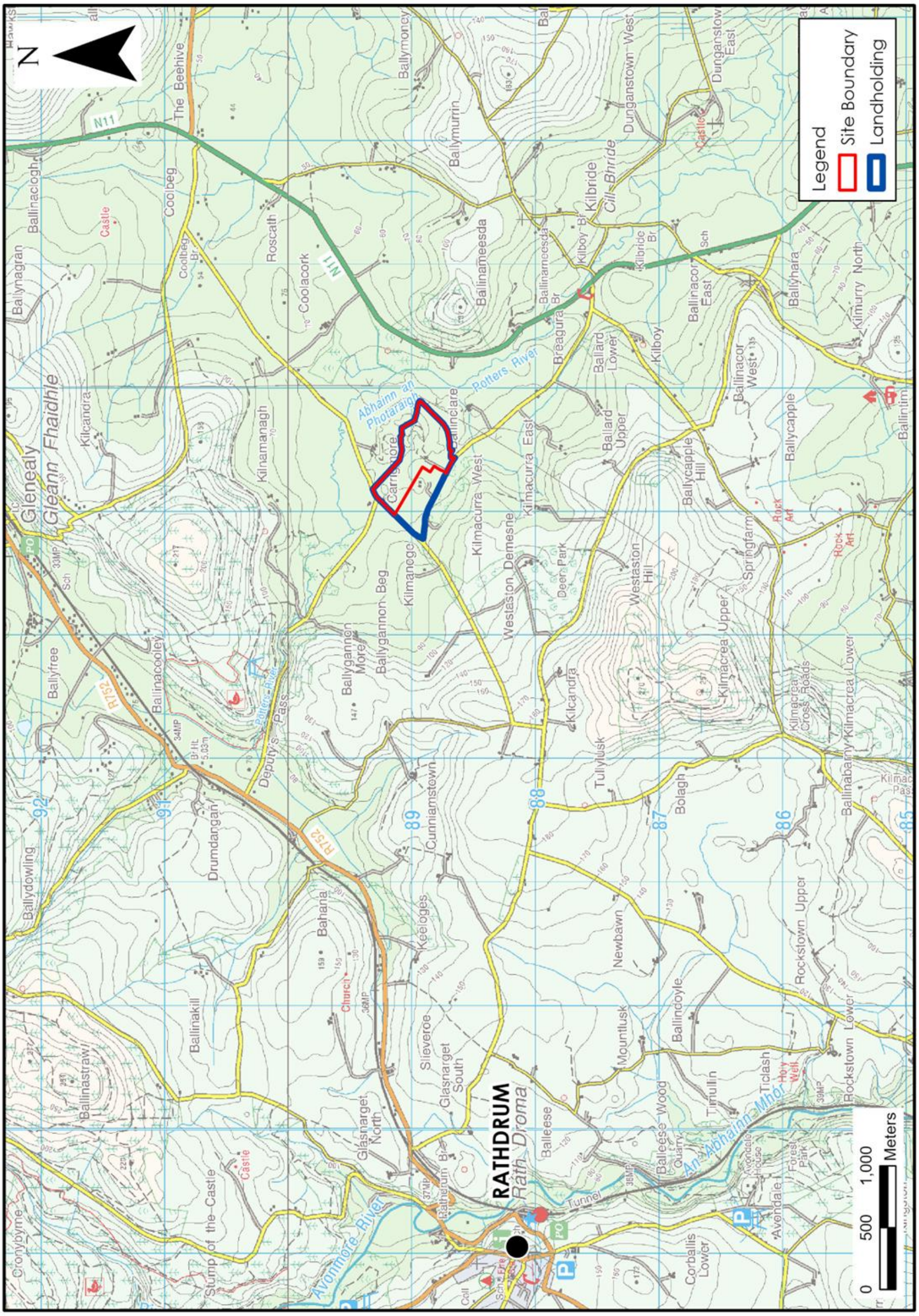


Figure A: Site Location Map

Table A: Geological Desk Study

Soils and Subsoils	The published Teagasc soils map (www.gsi.ie) indicates that the soil cover was thin to absent over the original extraction area at the application site. The soils in the western part of the application site are classified as mainly acidic, shallow, well-drained mineral soils (AminSW). The soils towards the east of the application site are classified as mainly acidic, shallow, poorly-drained mineral soils (AminSP). GSI/EPA maps indicate that there are no subsoils at the application site and that bedrock is at the surface. The western corner of the application site is indicated to be underlain by glacial till subsoils derived from Lower Palaeozoic sandstones and shales.
Bedrock	The GSI map (www.gsi.ie) the bedrock underlying the application site to consist of Diorite comprising of micro diorite to microgranite sills and minor dykes. There are north-south running faults to the east and west of the quarry, but none are mapped within the quarry footprint. The bedrock geology has been confirmed as diorite to 40m beneath the quarry floor (from borehole drilling at BH1 and BH2).
Geological Heritage	The GSI database indicates that Kilmacurra Quarry, a quarry which is no longer active or operational and located approximately 500m south of the application site, on the opposite side of the L1157 Local Road, is a designated County Geological Site (Ref. No. WW038). Kilmacurra Quarry has been recommended as a County Geological Site under IGH Theme No. 11, Igneous Intrusions. The IGH summary notes that diorite is an important minor igneous rock in Wicklow and that the quarry provides good exposure of diorite on quarry faces and in loose blocks. There are no other designated County Geological Sites located in the vicinity of the application site.

3.3.2 Site Investigation Data

3.3.2.1 Historic Site Investigation Data

5 no. investigative boreholes were drilled at the application site in October 2014. Of these 3 no. boreholes were drilled to establish groundwater levels around the quarry and 2 no. boreholes were drilled to provide more detailed information on bedrock geology beneath the quarry floor at the time.

Boreholes logs produced on foot of the October 2024 investigations and groundwater well drilling records demonstrate that diorite at the application site extends to a depth of between -9mAOD and -10mAOD.

A site investigation and monitoring location map is included as **Figure B**.

3.3.2.2 Recent Site Investigation Data

Recent examinations of the exposed quarry faces at Ballinclare confirms that the quarry is entirely developed within massive Silurian Diorite. One thin zone of sheared, weaker rock associated quartz veining was identified within the existing quarry, but this zone is very thin.

A total of 3 no. boreholes (GW1-GW3, refer to **Figure B**) were drilled for groundwater monitoring at the application site under the supervision of HES between 8th and 10th October 2024. The borehole logs are included as **Appendix 7-E** of the submitted EIAR.

A summary of the geology from these borehole logs is as follows:

- Borehole GW1 – WEATHERED BEDROCK encountered between 0-1.8mbgl (metres below ground level), overlying competent DIORITE from 1.8mbgl to 68mbgl. No major or minor fractures are noted in the borehole log;

- Borehole GW2 – MADE GROUND recorded from 0m to 6mmbgl. A cavity is recorded from 6mbgl to 7mbgl in the interface between the Made Ground and the underlying diorite, with a significant water inflow. This is considered a misinterpretation of soft made ground overlying the competent Diorite at 7mbgl. There is no geological reason that a cavity should occur in this type of formation (no karstification is possible). Strong to very strong, dark grey to green, crystalline, medium to coarse grained DIORITE is logged from 7mbgl to 61mbgl with no fractures or water strikes recorded; and,
- Borehole GW3 – Boulder clay is logged from 0 to 6mbgl, overlying strong to very strong, dark grey to green, crystalline, medium to coarse grained DIORITE from 6 to 65mbgl.

Broadly the logs reflect strong to very strong diorite with little permeability or porosity, overlain by 1.8m to 6m of overburden / weathered rock / made ground.

3.4 SUMMARY OF SITE GEOLOGY

The following is a summary of the geology of the application site based on the historic and recent site investigation data:

- Natural soils/subsoils have been removed from the quarry void to facilitate the historic extraction of diorite bedrock;
- The bedrock at the application site comprises of strong to very strong diorite; and,
- The bedrock is overlain by boulder clay or made ground with depths of overburden ranging from 1.8 to 6m.

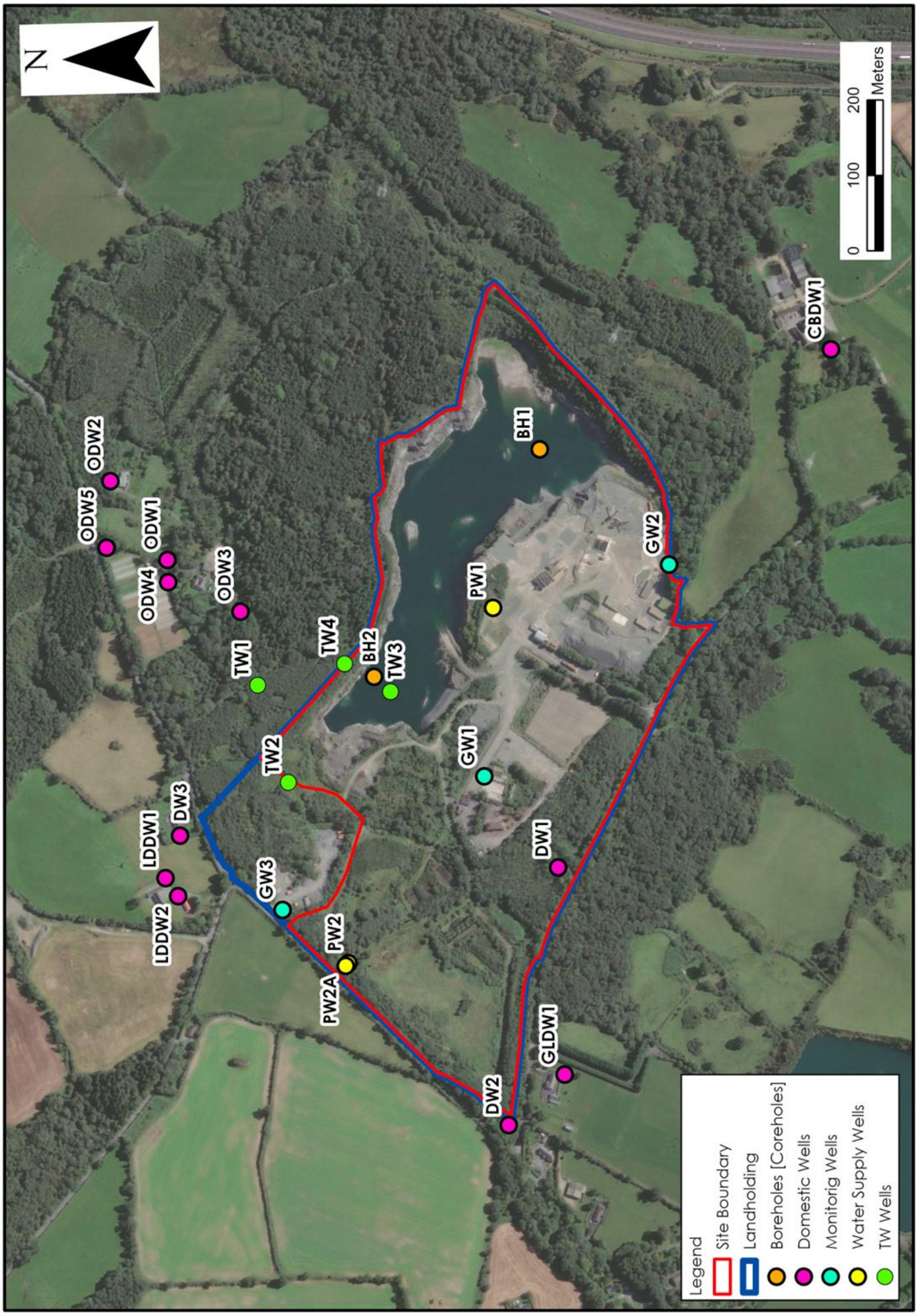


Figure B: Site Investigation & Monitoring Locations

4. WATER ENVIRONMENT

4.1 INTRODUCTION

This section describes the water environment in the local area. The existing hydrology (surface water) and hydrogeological (groundwater) conditions at the application site have been interpreted from both desk study information, site investigation data and from site walkover notes.

4.1.1 Desk Study Data

Available desk study data relating to the water environment is summarised in **Table B**.

Table B: Hydrological and Hydrogeological Desk Study

Climate	The SAAR (Standard Average Annual Rainfall) recorded at Ballinclare is c. 1,142mm/yr for the period 1991-2020 (Met Eireann). The Potential Evapotranspiration (PE) at Casement, the closest synoptic station for which PE data is available (c. 50km northwest of the application site), is 491.3mm/yr. The actual evapotranspiration (AE) has a mean value of 764.3mm/yr from January to December 2018.
Regional & Local Hydrology	The application site is located in the Ovoca-Varty surface water catchment, the Redcross sub-catchment and the Potters River WFD river sub-basin. The Potters River (IE_EA_10P010500) is located to the north and east of the application site. It flows in an easterly direction initially and then turns to flow to the south-east. It is located c. 300m from the application site at its closest point. The Kilmacurra Stream [EPA Name: Ballinameesda lower stream (IE_EA_10P010300)] is located c. 200m to the south of the application site and flows in an easterly direction, to its confluence with the Potters River. The Potters River then flows to the southeast for c. 7.5km, before discharging to the Irish Sea at Potters Point.
EPA Biological Q-Rating Monitoring	The closest EPA monitoring station to the application site is located on the Potters River at Kilboy Bridge. Here the Potters River achieved a Q4 rating (Good Q-status) in 2024. Further downstream at Castletimon Bridge the Potters River also achieved a Q4 rating in 2024.
Surface Water Flow Volumes	For the Water Framework Directive, the EPA has developed a catchment-based model for the calculation of flow duration curves for ungauged catchments. For the Potters River at the quarry, the catchment area is estimated at c. 23.8km^2 with an average annual rainfall of c. 1,053mm/yr. (1960-1991). The estimation of flow duration report for the Potters River estimates the 5%tile flow at c. 1.685m^3/s and the 95%tile lower flow is estimated at 0.057m^3/s.
Flood Risk	The OPW website (www.floodmaps.ie) indicates that there are no recorded flood events in the vicinity of the application site along the Potters River. PFRA Map Reference 2019/MAP/188/A covers the area around the application site and indicates no flooding potential associated with the Potters River. However, areas with an indicative pluvial 1%AEP (100-year) event (associated with overland flow and ponding) are noted in the vicinity of the application site along the Potters River. National Indicative Fluvial Mapping (NIFM) River Flood Extents (Present Day) flood mapping are also available for review (www.floodmaps.ie). These show flood zones along the Potters River downstream of the application site.
Hydrogeology	The application site is underlain by diorite bedrock, identified as the Carrigmore Diorite. The bedrock geology underlying the application site is classified as being a Poor Aquifer (Ll) – Bedrock which is Generally Unproductive except in local zones.

Groundwater Vulnerability	Groundwater vulnerability at the application site is mapped by the GSI (www.gsi.ie) as E (Extreme) or X (rock at or near the surface). As the soil and subsoil cover has been removed from the quarry footprint, and therefore there is no protection, the groundwater vulnerability rating will be X or E.
Water Framework Directive	Local Groundwater Body (GWB) and Surface water Body (SWB) status information is available from (www.catchments.ie). The Potters_010 and Potters_020 SWBs in the vicinity and downstream of the application site achieved "Moderate" and "Good" status respectively. The Potters_010 SWB is deemed to be "at risk" of failing to meet its WFD objectives and is listed as being under significant pressure from agricultural activities, forestry, hydromorphology, mines and quarries and other unknown pressures. The risk status of the Potter's_020 SWB is currently "under review". The Wicklow GWB underlying the application site achieved "Good" status in all 3 no. WFD cycles. This GWB has been deemed to be "at risk" of failing to meet its WFD objectives. Agriculture activities are listed as a significant pressure on this GWB.
Designated Sites	There are several designated sites located within 10km of the application site. However, the majority of these sites have no potential to be impacted by the proposed development due to the lack of hydrological and hydrogeological connectivity. The closest designated sites are Glenealy Woods pNHA and Deputy's Pass Nature Reserve SAC are located c. 1km and 1.6km north-west of the application site respectively. However, as both are at a higher ground level, in different aquifers and upstream of the discharge from the site to the Potters River, they cannot therefore be impacted by any site based activities. There is no surface water pathway from the application site to Glenealy Woods pNHA and Deputy's Pass Nature Reserve SAC. Only the Buckroney-Brittas Dunes and Fen SAC/pNHA is located downstream of the surface water discharge from the quarry. It is located at the coast, a distance of c. 7.5km downstream and it is located on lands overlying a different aquifer (GWDTE-Buckroney-Brittas Fen) than that which occurs at the application site.
Water Resources	The application site is not located within any groundwater public or group supply source protection area. The closest is the Redcross Public Water Supply (PWS) located approximately 5km south of the application site. It is understood that there is no mains water supply or group water scheme in the area, and that dwellings in the area each have individual private groundwater wells. The closest domestic dwelling at Knockanereagh to the south of the quarry, is approximately 220m from the quarry void. In terms of surface waters, the Potters_110 SWB is identified as a DWPA (Drinking Water Protected Area). The abstraction from the Potter's River is for the Glenealy Public Supply and the abstraction point is from the Barnbawn stream, located ~4km northwest of the application site. This is located upstream of the application site.

4.1.2 Site Investigation Data

The following historic site investigation data relating to the surface and groundwater environment was consulted as part of this risk assessment:

- WYG completed surface water sampling at 3 no. locations in 2007;
- Surface water sampling was completed at 3 no. locations (SW1, SW3B and SW4) on 5th and 26th March 2019;
- Borehole logs and noted on groundwater strikes from the 3 no. boreholes drilled under the supervision of HES (GW1-GW3);
- Groundwater level monitoring in 3 no. boreholes (GW1-GW3) in 2014; and,

- Monthly groundwater quality data from 3 no. monitoring wells (GW1-GW3) from May to November 2019.

More recent site investigation data includes:

- HES completed 2 no. rounds of 5 no. surface water samples (SW1, SW4, SW5, SW6 and SW7) on 29th May and 19th June 2024;
- Continuous groundwater level monitoring in 4 no. quarry wells (PW2A, GW1, GW2 and GW3) and in 4 no. local domestic wells (ODW1, ODW3, CBDW1, KHDW1) between 26th January and 4th July 2024; and,
- An additional 2 no. rounds of groundwater quality monitoring (GW1-GW3) on 19th June and 4th July 2024.

In addition to the above-mentioned water quality sampling, monitoring has been ongoing as part of the discharge licence conditions at the site since late 2021. The monitoring comprised of sampling from 2 no. locations (MP1 and MP2) and daily analysis of discharge from the quarry.

Please note that site investigation and monitoring locations are illustrated on **Figure B**, and surface water sampling locations are indicated on **Figure C**.

4.2 SURFACE WATER ENVIRONMENT

4.2.1 Site Drainage

Currently, rainfall across the application site mostly drains towards the quarry void, with a smaller quantity slowly infiltrating to ground where it recharges the shallow overburden where permeability occurs, with some further limited recharge to the underlying bedrock also likely occurring. During storm events, surface water runoff across most of the application site will drain to the quarry floor / void (it being the lowest point within the application site), while some runoff from the western end of the site will flow towards the discharge drain at the western boundary.

The existing quarry void is currently being dewatered. Water is being treated and discharged at the north of the site into the Ballinclare Stream (a small tributary of Potters River).

When operational the quarry was effectively worked dry with very little inflow of groundwater reported within the void. A quarry sump located at the lowest level on the quarry floor collected any surface water falling over the void area and any minor inflows of groundwater which occurred. This water was recycled and used in concrete production activities and on-site dust suppression, with periodic pumping of water to on-site storage tanks as required.

The quality of water in the existing void has been established above with the water samples analysed from the quarry sump. Daily discharge volumes during the emptying of the quarry will not exceed the discharge licence limit of a maximum of 72m^3/hr (1,728m^3/day).

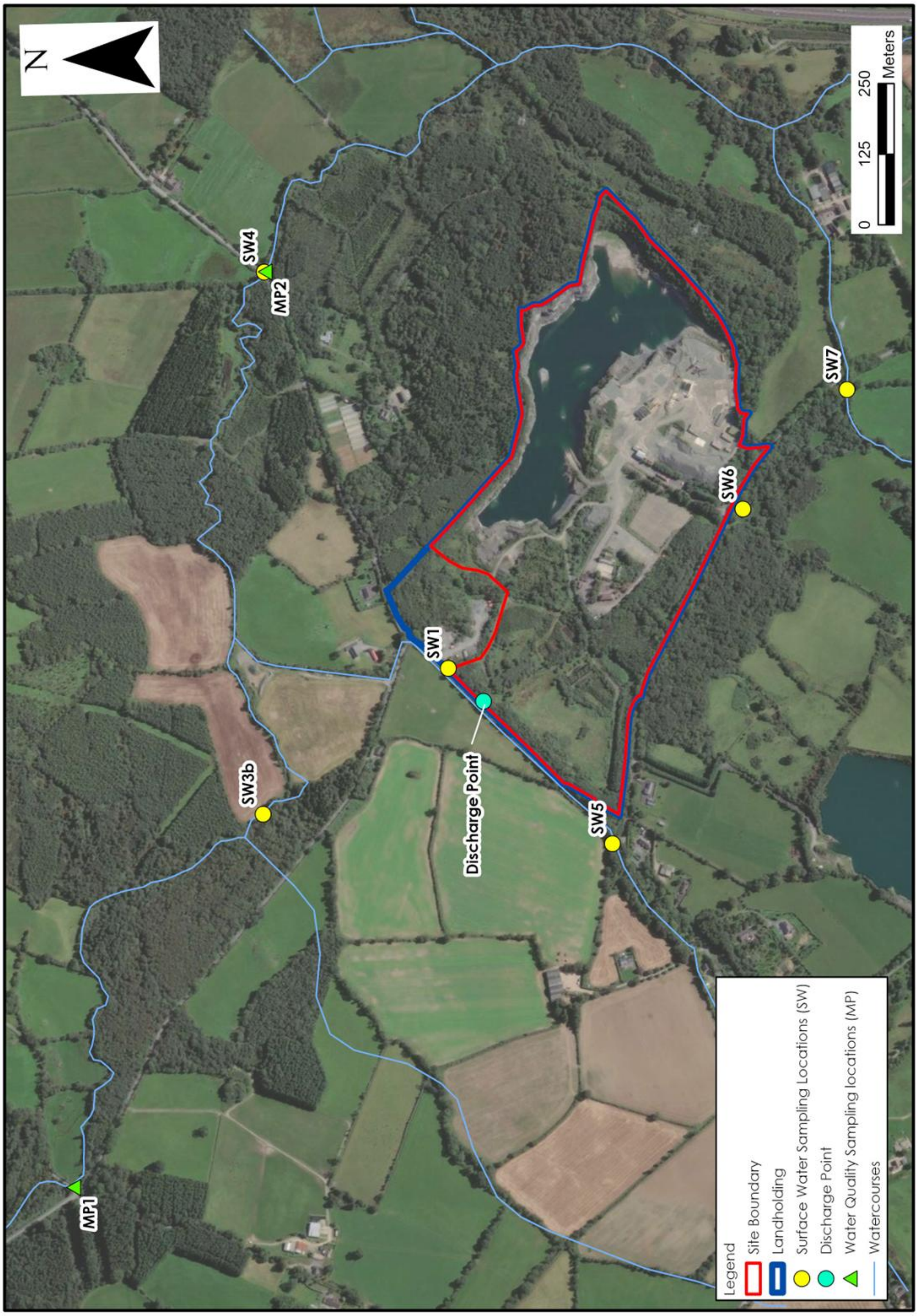


Figure C: Surface Water Sampling Locations

4.2.2 Surface Water Quality

4.2.2.1 Historic Surface Water Quality Data

WYG Water Quality Sampling (2007)
WYG obtained 3 no. surface water samples in May 2007, from a drain upstream of the quarry entrance, at the drain's confluence with Potters Bar downstream of the quarry and from a containment pond at the quarry entrance. These samples were analysed for major anions, cations and suspended solids. All surface water samples were found to comply with the EPA Interim Guideline Values, with the exception of potassium in the containment pond at the quarry entrance. The water sample from the settlement pond showed the highest value for conductivity, alkalinity, sulphate, and calcium of all the samples but these levels are still within the recommended limits and are probably a result of concentration due to evaporation.

Water Quality Sampling (2019)
Surface water samples were taken from 3 no. surface water locations (SW1, SW3B and SW4) and the existing sump at Ballinclare Quarry on 2 no. occasions in March 2019 (5th and 26th March).

SW1 is situated on the small stream which runs past the quarry, into which the licensed discharge flows. Location SW3B is located on the Potters River upstream of the application site and location SW4 is at the bridge downstream of it. Results of water testing on collected samples are presented in Table 7-4 in the submitted EIAR. Elevated arsenic concentrations were recorded in the quarry sump water samples taken at that time.

The water quality results were compared against quality thresholds set out in the Surface Water Regulations (S.I. 272/2009 and S.I. 327/2012). The results from the quarry sump were also compared against the Surface Water Regulations as well as the EPA Interim Guideline Values (EPA IGVs), Groundwater Regulations S.I. 9/2010 (GW Regs) and Drinking Water Regulations (S.I. 99/2023, DW Regs). The following exceedances were noted:

- At SW1, zinc concentrations exceed threshold values in SW S.I. 272/2009 EQS Other Surface Waters (MACs) on 26th March 2019;
- At SW3B, BOD exceeds both the good and high-quality standard (S.I. 272/2009) on 26th March 2019;
- At SW4, BOD exceeds both the good and high-quality standard (S.I. 272/2009) on 26th March 2019;
- The recorded concentrations at the quarry sump:
    - exceeds the environmental quality standards for arsenic on both 5th and 26th March 2019;
    - exceeds EPA IGV criteria for orthophosphate on 5th and 26th March 2019;
    - exceeds EPA IGV criteria for potassium on 5th March (not tested for on 26th March 2019); and,
    - exceeds Drinking Water limits for antimony on 5th March 2019 (not tested for on 26th March 2019).

4.2.2.2 Recent Surface Water Quality Data

Further surface water samples were taken by HES on 29th May 2024 and 19th June 2024 at SW1 and SW4-SW7. Sampling locations are upstream and downstream of Ballinclare Quarry. The results of these analyses demonstrated good quality water across the sampling locations, with no analytes above the relevant environmental quality standard. Suspended solids ranged between <5-7 mg/L, while BOD ranged between <1-1.8 mg/L. The results are presented in Table 7-5 of the submitted EIAR.

The water quality results from sample locations SW1-SW7 were compared against quality thresholds set out in the Surface Water Regulations (S.I. 272/2009 and S.I. 327/2012). The results from the quarry sump were also compared against the Surface Water Regulations as well as the EPA Interim Guideline Values (EPA IGVs), Groundwater Regulations S.I. 9/2010 (GW Regs) and Drinking Water Regulations (S.I. 99/2023, DW Regs). The following exceedances were noted:

- The BOD value recorded at SW7 on 29th May 2024 (1.8 mg/L), exceeds both the Good and High limits for surface waters (S.I. 272/2009) of 1.3 and 1.5 mg/L respectively, however the mean BOD recorded at SW7 is below both the Good and High mean limits (2.2 and 2.8 mg/L respectively);
- The recorded Arsenic value at SW6 (10.6 µg/L) on 19th June 2024 exceeds the Drinking Water Guideline threshold value of 10 µg/L. This concentration does not exceed the Surface Water guideline values (25 µg/L); and,
- There were no further exceedances of water quality limits from the samples taken from SW1 and SW1-SW7 on 29th May and 19th June 2024.

4.2.2.3 Discharge Licence Monitoring

The water quality results from sample locations MP1 and MP2 were compared against environmental quality standards set out in the Surface Water Regulations (S.I. 272/2009 and S.I. 327/2012). The results from the quarry discharge were also compared with these standards, as well as the water quality criteria stipulated in the quarry Discharge Licence (WPL-116).

The results are summarised in Table 7-6 (Quarry Discharge), Table 7-7 (MP1), and Table 7-8 (MP2) of the submitted EIAR.

The following is noted form the data:

- There is a significant quantity of analyses for each parameter. As a result, there is a high confidence level in the interpretation of the data;
- The variation of pH at all monitoring points is comparable. All data meets the EQS thresholds;
- The range of BOD values recorded at the quarry discharge is lower than at MP1 and MP2, although data from all locations indicate Good status water quality is achieved for BOD;
- The range of TSS values recorded at the MP2 are higher than the quarry discharge and higher than those recorded at MP1, and the range recorded at MP1 is higher than the quarry discharge. Background TSS variations recorded in the Potters River are higher than what is being discharged from the quarry;
- The range of Ammonia concentrations recorded at the quarry discharge is lower than at MP1 and MP2. Data from the quarry discharge would meet Good status water quality requirements, but data from MP1 and MP2 would not. Background ammonia variations recorded in the Potters River are higher than what is being discharged from the quarry;
- The range of Ortho-P concentrations recorded at MP2 is lower than both MP1 and the quarry discharge, and would achieve Good/High status at MP2 (downstream) on mean/95%tile analysis. Data from the quarry discharge has a lower range than MP1. Data from the quarry discharge would meet Good status water quality requirements. Background ortho-P variations recorded in the Potters River at MP1 are higher than what is being discharged from the quarry, but downstream concentrations of Ortho-P recorded at MP2 are much lower than at MP1;
- Except for Mercury, all other dissolved metals concentrations are lower than the Surface Water Regulation EQSs (S.I. 272/2009 as amended) at all monitoring points. The Mercury exceedances occur at the detection limit value (0.1µg/L), but with the absence of the "<" sign. These may be a laboratory reporting error and should be <0.1µg/L (i.e. the detection limit of the analysis);
- It is noted that there were 2 (of 614 data points) exceedances of the Arsenic Discharge Licence ELV (2 samples had Arsenic concentrations >7µg/L (but all results were less than the MAC-EQS of 20 µg/L stated in S.I. 272/2009);

- There were 270 (of 291 data points) exceedances of the Nickel Discharge Licence ELV (270 samples had Nickel concentrations of >3.22µg/L (but based on all data for 2022, 2023, and 2024 the annual average (AA) value is less than the AA-EQS of 20 µg/L stated in S.I. 272/2009) (AA of Nickel for 2022: 5.3 µg/L (n = 26); AA for Nickel for 2023: 4.8 µg/L (n = 235); AA for Nickel for 2024: 3.9 µg/L (n = 28)); and,
- Monthly biological Q Value sampling has been carried out at MP1 and MP2 since December 2022 (refer to **Appendix 7-L** of the submitted EIAR). Upstream and downstream Q Values have been recorded as fluctuating between Q 3-4 and Q4. JKW Environmental conclude that "Based on the conducted kick sampling and using a direct comparison of samples taken upstream and downstream from December 2022 to June 2024 it can be concluded that discharges from dewatering at Ballinclare Quarry have not had any notable adverse impact on the aquatic ecosystem of the Potters River."

All available data indicates that the ongoing discharge from the quarry has not had a notable adverse impact on water quality or the aquatic ecosystem of the Potters River.

4.3 HYDROGEOLOGICAL ENVIRONMENT

4.3.1 Site Investigation Data

Borehole logs are available for 3 no. groundwater wells at the Application site (GW1-GW3). A summary of the borehole logs is as follows:

- Borehole GW1 – WEATHERED BEDROCK encountered between 0-1.8mbgl, overlying competent DIORITE from 1.8 to 68mbgl. One minor water strike is noted at 57m, with a very small inflow volume of 20 gals/hr (0.09m^3/hr). No major or minor fractures are noted in the borehole log;
- Borehole GW2 – MADE GROUND recorded from 0-6mbgl. A cavity is recorded from 6 to 7mbgl in the interface between the Made Ground and the underlying diorite, with a significant water inflow of 2000 gals/hr (9 m^3/hr) in this section. This is considered a misinterpretation of soft made ground overlying the competent Diorite at 7m. The water strike in this section (6m-7m) is interpreted as reflecting groundwater in loose unconsolidated material, perched on top of the impermeable diorite bedrock at 7m. There is no geological reason that a cavity should occur in this type of formation (no karstification is possible). Strong to very strong, dark grey to green, crystalline, medium to coarse grained DIORITE is logged from 7 to 61mbgl depth with no fractures or water strikes recorded; and,
- Borehole GW3 – Boulder clay is logged from 0m to 6m, overlying strong to very strong, dark grey to green, crystalline, medium to coarse grained DIORITE from 6m to 65m depth. One minor water strike is logged at 8m, with an inflow volume of 100 gals/hr (0.45m^3/hr).

Broadly the logs reflect strong to very strong diorite with little permeability or porosity, overlain by 1.8m to 6m of overburden / weathered rock / Made Ground. The primary water inflow recorded during the drilling occurred in the interface between Made Ground and Diorite in GW2, likely due to increased permeability in the Made Ground increasing recharge through this material, before it reaches the Diorite bedrock and flows along the top of the hard bedrock, unable to permeate further vertically. The recorded well yields are low, and accord with the well yield class defined for Poor aquifers ("Poor (P) aquifers would generally have 'moderate' or 'low' well yields - less than 100 m^3/d.")

4.3.2 Groundwater Levels

As previously noted, a number of boreholes have been drilled at the application site. Groundwater levels were monitored in these boreholes, and the results are presented in Table 7-11 of the submitted EIAR.

The groundwater levels range between 50.8-58.04mAOD in boreholes GW1-GW3, and at ~37.8mAOD in BH1 during 2014 when it was historically pumped. The groundwater levels show highly localised variations **Figure D**. However, a localised groundwater flow is derived from groundwater levels recorded in monitoring and domestic wells near the site and flows broadly towards the Potters River, to the east and southeast of the site, with regional deeper groundwater flow towards the coast to the east. The primary control on groundwater flow direction is the topography and the variability/thickness of subsoils.

Dataloggers were installed in wells PW2A, GW1, GW2 and GW3 as well as in 4 no local domestic wells (ODW1, ODW3, CBDW1, and KHDW1). These dataloggers recorded water levels over the period between 26th January and 04th July 2024. In total, over 688 cumulative days of data were collected, consisting of 8,260 data points. A plot of recorded water levels is illustrated as **Figure E**.

Groundwater levels in these monitored wells range from ~63.6mAOD at GLDW1, situated southwest of the site, to 44.3mAOD at a monitored domestic well (KHDW1) situated ~2km southeast of the site. A further high groundwater level of 62.47mAOD is recorded in a domestic well (ODW3) on the northern side of the quarry, with groundwater flowing north here towards a further domestic well (ODW1) with a recorded water level of 52.47mAOD.

The groundwater level data indicates that local groundwater wells to the north, south and west of the site are all hydraulically upgradient, while wells to the east are potentially downgradient, however a watercourse exists (Kilmacurra Stream) which likely acts as a hydraulic boundary separating the quarry from these downgradient receptors.

Topographically, the catchment area feeding towards the quarry is small. Rain falling within the catchment runs off rapidly rather than recharging through the almost impermeable bedrock and so reaches the application site in the form of shallow groundwater rather than deep bedrock groundwater. Any groundwater flowing through the upper (fractured) bedrock will eventually discharge into Potters River.

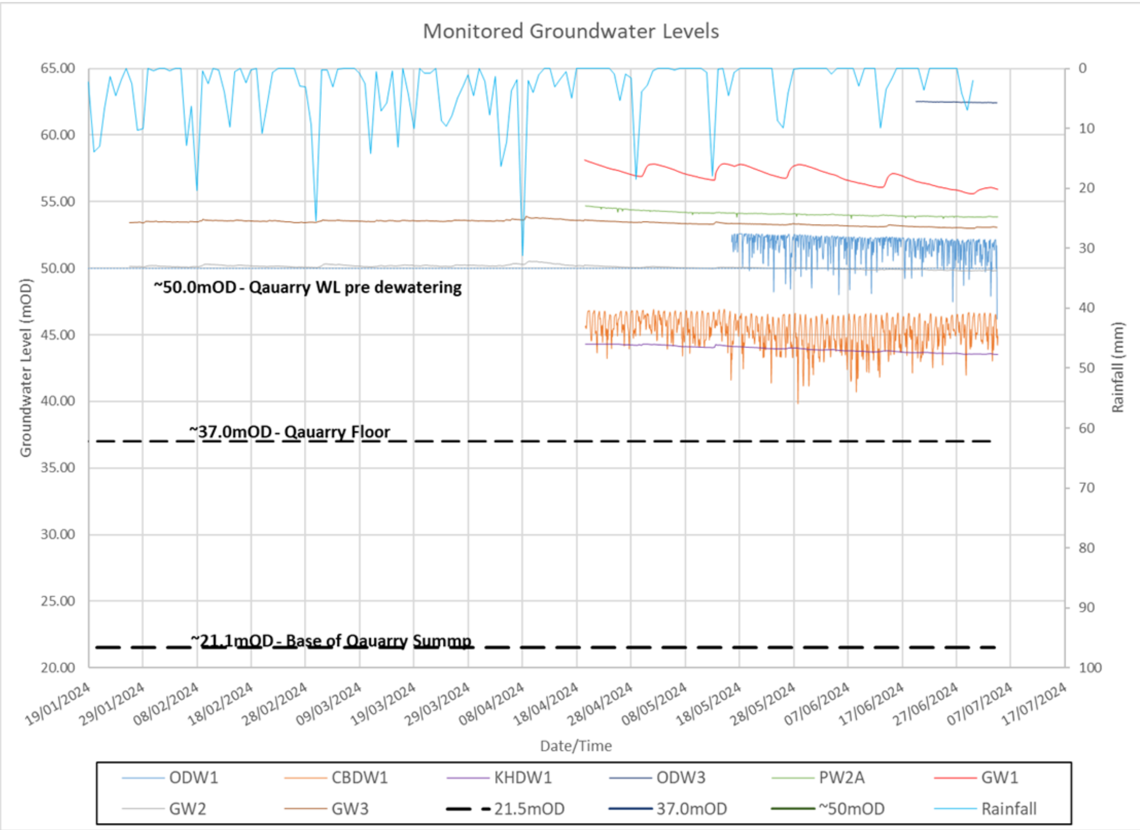


Figure D: Monitored Groundwater Levels (January to July 2024)

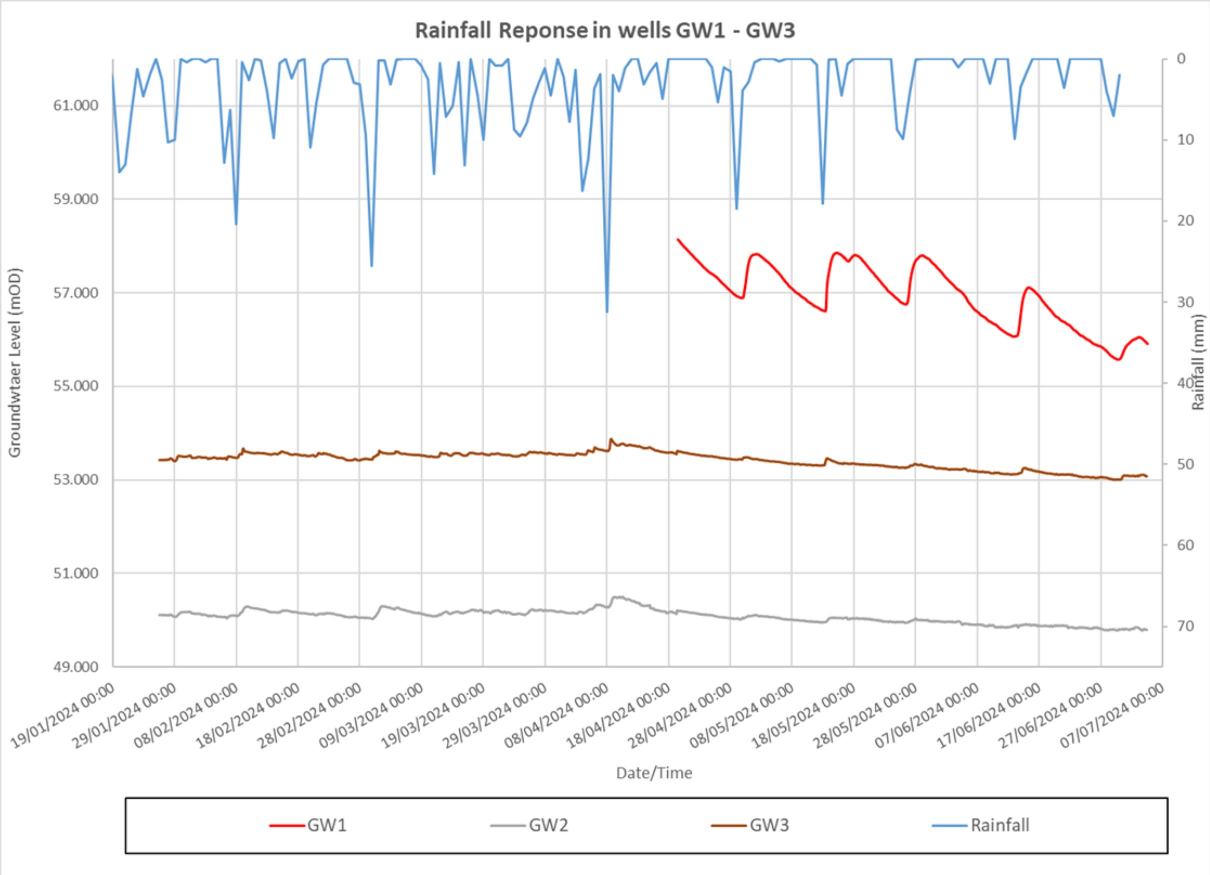


Figure E: Groundwater Level Response in wells GW1-GW3 (January to May 2024)

4.3.3 Groundwater Quality

4.3.3.1 Historic Groundwater Quality Data

Groundwater samples were taken from the 3 no. existing monitoring wells (GW1-GW3) once a month from May to November 2019 (7 no. sampling rounds).

The results of groundwater quality testing are presented in **Appendix 7-F** of the submitted EIAR. Average, minimum, and maximum results are presented in Tables 7-12 of the EIAR.

The 2019 groundwater quality testing identified the following exceedances:

- Ammonia is elevated above assessment criteria in GW1 in November 2019 only. This is likely to be as a result of agricultural practices in the area;
- Orthophosphate is elevated above the assessment criteria in all three boreholes during every sampling round, again this is likely to be as a result of agricultural practices in the area;
- Total coliforms is elevated above assessment criteria in all three boreholes during every sampling round;
- Potassium was only sampled in May 2019 when concentrations were elevated in GW1 and GW3;
- Arsenic is elevated in all three boreholes during the majority of sampling rounds. Arsenic is not used on site and again is expected to be naturally occurring, with soil concentrations of 31.47mg/kg recorded by the EPA. The Soil Geochemical Atlas of Ireland shows the wider area to have arsenic in the area at >15mg/kg;
- Iron is elevated in all three boreholes during the majority of sampling rounds;
- Mercury is elevated at all three boreholes during the sampling round in August 2019, but not in another other sampling round in 2019. This is likely associated with trace

metals from the borehole steel casing, as well as sampling error in not filtering the sample in the field for trace metals (standard practise);

- Manganese was only sampled in May 2019 when the concentration was elevated in borehole GW3 only. This is likely to be naturally occurring and the EPA Soils Database records 2147 mg/kg for a soil sample to the south of the site (ID 138). The Soil Geochemical Atlas of Ireland shows the wider area to have manganese in the area at >1400mg/kg;
- Nickel is elevated in GW1 in September and GW2 in October 2019; and,
- Lead was elevated in GW2 and GW3 in June and July 2019. From August to November 2019, the limit of detection was above the assessment criteria.

2024 Groundwater Sampling

Groundwater sampling was carried out on 29th June 2024 in wells GW2, ODW1 and ODW2 and 04th July 2024 in wells GW2, ODW1, ODW2 and LDDW1. The groundwater quality testing identified the following parameter ranges:

- The pH values in GW2, ODW1 and ODW2 ranged between 6.8–7.2, while the conductivity ranged between 243-401µS/cm;
- There was 1 no. exceedance of the EPA IGV and Drinking water Guidelines threshold values (0.14 and 0.5 mg/L) for Ammonia in GW2 on 19th June at a reported value of 0.531mg/L;
- There were 2 no. exceedances of the EPA IGV limit for Orthophosphate (0.03mg/L) in GW2 on both 19th June and 04th July 2024 at reported values of 0.07 and 0.066 mg/L respectively;
- There were exceedances of the Drinking Water Regulations guideline values for Total coliforms in wells GW2, ODW1 and ODW2 during both sampling rounds;
- There were detections of E.Coli in GW2 on 19th June and 04th July (both 6 MPN/100ml), as well as in ODW1 on 04th July at 1 MPN/100ml. Neither of these wells are used for potable well supplies;
- There were exceedances of the Drinking Water Regulations limit for Arsenic (0.01mg/L) in each of the 7 no. samples taken during 2024; and,
- There were minor exceedances of the IGV threshold limits for Sodium, Barium, Boron and Copper in GW2 on 04th July 2024.

Hydrocarbons were below detection limit in all 3 no. boreholes during every sampling round of 2019. There was 1 no. detection of hydrocarbons in GW2 on 04th July 2024 at 0.6 mg/L. Hydrocarbons had been detected during previous sampling from GW2. As stated in the EIAR remedial works at GW2 are proposed to resolve this issue and it is proposed to drill a new monitoring well (GW2A) to facilitate future monitoring as GW2 will be decommissioned.

It is noted that the water pumped from the production borehole (PW1) is not used for potable supply and that bottled drinking water is brought onto the site for consumption as required.

5. HYDROGEOLOGICAL CONCEPTUAL SITE MODEL

A hydrogeological conceptual site model (CSM) has been derived, based on the information included within borehole geological logs, desk study data and in-situ monitoring of groundwater levels in observation wells. A graphic of the CSM is included as **Appendix I** of this report. The conceptual site model is described as follows:

- The bedrock geology of the site is dominated by hard, competent, very low permeability Diorite. The Diorite bedrock is classified as a Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones. Recorded local well yields are all low;
- The diorite is overlain by a thin layer (1-6m) of overburden, which is predominantly described as Clay, but includes gravelly / weathered section across the top of the bedrock. This subsoil-bedrock interface layer is much more porous and more permeable than the underlying Diorite bedrock;
- The topography of the site and surrounding area broadly slopes northeast from an elevation of 270mAOD at Westaston Hill, ~2km southwest of the site, to the Potters River at ~50mAOD, situated ~0.35km northeast of the site;
- Rain falls on the surrounding ground and at the site, with greater rainfall on higher elevations (i.e. southwest of the site) and the rain infiltrates through the relatively thin subsoils;
- The rainfall infiltrates through the subsoil and reaches the low permeability bedrock (Diorite). From this point it cannot infiltrate further vertically except in local areas but not everywhere. As a result, the predominant groundwater flow occurs along the top of the bedrock, and this predominant flow follows the gradient of the local topography. Some recharge enters the bedrock through local weathered zones and fissures. The deeper bedrock flows are localised and relatively short. They do not form regional groundwater flows, and they are not significant in terms of volume;
- Groundwater levels in the area range between 44.3 – 63.6mAOD, with higher elevations recorded towards the west, north and south / southwest of the site. Shallow groundwater flow follows topography and runs along the subsoil-bedrock interface, where that exists;
- The groundwater levels at the site range between 50.8-58.04mAOD, which coincide with the elevation of the subsoil layer, apart from GW1, which displays a higher water level. GW1 showed a consistent higher water level above the level of the flooded quarry, and therefore is potentially disconnected from any local fracture system (although a small inflow is recorded at 57 mbgl). Analysis of the GW1 hydrograph indicates an isolated sump well that fills rapidly after rainfall and slowly drains down until the next rainfall event occurs. The lowest groundwater levels exist towards the east / southeast of the site, the direction in which local groundwater broadly flows;
- The groundwater response to rainfall is relatively quick in most wells (apart from the water level recessions noted in GW1) and similar to that which would be observed in a surface water or shallow groundwater system;
- There is a section of ground to the southwest of the site which slopes to the southwest, at this point groundwater in the subsoils will flow to a drain situated southwest of the site;
- On the northern side of the quarry, a large cliff face exists with high ground situated north of the quarry. A high groundwater level of 62.47 mAOD is recorded north of the quarry at ODW3, thus this area is hydraulically upgradient of the quarry;
- The higher groundwater levels recorded in areas surrounding the site (particularly north and south of the site) are most likely due to increased recharge in these areas as thicker subsoils will exist on undisturbed ground. Further north of ODW1 and ODW3, the ground continues sloping northeast and the shallow groundwater will flow northwest towards the Potters River;
- The available data indicates there are two groundwater flows systems locally:
    - The shallow flow which occurs across the top of the bedrock, and which is driven by recent rainfall recharge;

- Deeper, less connected, local flow within fissures and fractures in the Diorite;
- The shallow flow is the dominant groundwater flow in the area, and this dominant system is also likely the main source of inflow to many of the local groundwater wells;
- The shallow flow system follows topography, with flow from the west, and to the south, and away from the quarry on higher ground to the north;
- More broadly, the deeper groundwater flow likely follows the river drainage pathways and flows to the east-southeast; and,
- All recorded groundwater levels exist ~15-25m above the level of the base of the quarry, and pumping from this quarry has not affected local water levels from the observed data, demonstrating an isolation between the small amounts of groundwater flowing into the quarry through the diorite bedrock and the wider shallow groundwater system. For the purposes of clarity, the majority of water being pumped from the quarry is from rainfall falling directly on the quarry, not groundwater inflows.

6. CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

6.1 SUMMARY OF PROPOSED DEVELOPMENT

The proposed development provides for backfilling of the quarry to its original ground level using imported inert waste, principally soil and stone, generated by construction projects.

Complementary C&D waste recovery facilities will also be established at the application site to produce recycled (secondary) aggregate by crushing and soil washing and will provide for an integrated waste management facility for inert C&D waste at the application site.

The inert wastes to be imported and backfilled at the landfill facility will principally comprise naturally occurring soil, stone and broken rock excavated in the course of construction and development projects in Counties Wicklow, Dublin and Wexford, with some occasional construction and demolition (C&D) waste being imported and used in the construction of internal haul roads. All imported waste accepted for disposal at the landfill facility will comply with the waste acceptance criteria (WAC) for inert landfills set by Council Decision 2003/33/EC.

As part of the development, suitable uncontaminated natural, undisturbed soil waste and/or soil by-product (i.e. non-waste) which conforms to an engineering specification will be imported for re-use in the construction of the basal and side clay liners required for the inert landfill.

On completion, the inert landfill will be restored to a long-term native woodland habitat, similar to that which existed prior to quarry development, and will include provision for establishment of native oak plantations in defined areas around the site.

Full details of the proposed development are provided in Chapter 2 of the EIAR.

6.2 PROPOSED WATER MANAGEMENT AND TREATMENT SYSTEMS

Dewatering of the Quarry Void

To enable the quarry to be re-engineered as an inert landfill, and as previously noted, the quarry void is currently being dewatered, with ponded waters being pumped to an on-site water treatment system and discharged to the Potters River, in line with an existing Local Authority discharge licence (Ref. WPL 116).

Due to elevated natural levels of arsenic in the water collecting in the quarry void, the discharge is treated via a bespoke approved Siltbuster treatment system which assists in the removal of suspended solids from the discharge water. Following treatment to remove the arsenic in the water, the treated water passes through the existing settlement lagoons for final polishing before being discharged off-site.

In terms of the potential for an increase in the risk of flooding in the Potters River, the quarry discharge is currently limited to 20L/s (72m^3/hr, or 1728m^3/day). This discharge flow is a very small proportion of likely larger flood flows in the Potters River. For example, the estimated 5%tile flow in the Potters River is 1.685m^3/s (1685L/s), and the addition of the 20L/s from the quarry only accounts for ~1.2% of that river flow. Discharge from the quarry does not have to be continuous, and therefore can be temporarily stopped during extreme flood events. The quarry discharge will not significantly affect downstream flood flows in the Potters River.

On completion of dewatering, the Siltbuster treatment system will remain in place to continue treating off-site discharges of water from the application site over the life of the proposed development.

Landfill / C&D Water – Runoff Treatment

There will be on-going generation of runoff from rainfall on the landfill over the operational life of the inert landfill facility at the application site and as a result runoff from the infill area will need to be collected and treated prior to being discharged off-site.

The proposed development includes provision for phased infilling of the quarry void. During Phase 1A, surface water runoff from the infill area will be captured and recirculated (or supplied to soil wash plant). Any excess runoff will be tankered off site for licenced disposal. Surface water runoff from the C&D recovery yard will be captured and supplied to the soil wash plant, while runoff from the soil processing area will be directed towards a sump behind the wash plant for re-use in the washing process. Any excess water in the sump on the quarry floor will be treated prior to discharge.

Following the capping and restoring of the Phase 1A area, surface water runoff will be captured by a perimeter toe drain and discharged offsite.

During the follow-on Phase 1 development, the discharge / runoff from the inert landfilling areas will be collected and treated in an Integrated Constructed Wetland. Runoff from the C&D waste recovery and soil processing area will be supplied to the soil wash plant. Any excess water collecting in the sump on the quarry floor will be treated by the Siltbuster system and settlement ponds prior to discharge.

During Phase 2 of the development, whereby the land surface will be raised to 80mAOD, the runoff from active inert landfill areas will be collected and treated within the Integrated Constructed Wetland. Runoff from capped landfill areas and the C&D waste recovery facilities will be collected and directed to temporary balancing ponds. Excess water in these balancing ponds will be treated by the Siltbuster system and settlement ponds prior to licensed discharge.

During Phase 3 of the Proposed Development, the water management system will mimic the Phase 2 operation outlined above.

Schematic details of the surface water management system to be implemented across the inert landfill area at each phase of development are shown in Figure 2-11 to Figure 2-16 of the submitted EIAR.

When installed in parallel, wetland areas can be independently placed out of service to allow for remediation and replenishment of infiltration / substrate media whilst still allowing on-going treatment of any lightly impacted / lightly contaminated run-off ('leachate') through the active bed. Wetland treatment systems have a low visual and amenity impact and require little on-going intervention once installed. The main drawback which can arise with wetlands is that they often require a large footprint area to treat the anticipated input volumes.

An initial assessment indicates that there is sufficient spare land available at Ballinclare Quarry for a wetland treatment system in the western part of the site, adjacent to the planned inert landfill footprint. It is anticipated that the volumes requiring treatment at the facility will be limited by the progressive restoration of the completed landform with a low permeability capping over its operational life, thus minimising the amount of leachate generated and requiring treatment.

The effectiveness of the passive wetland treatment systems can be enhanced by the temporary addition of various, more active treatment systems, such as chemical dosing, aeration or other such processes if required. This can allow a wetland system to handle higher contaminant loads or flows for periods of time (should it be necessary) before reverting back to more standard passive mode of operation, therefore providing flexibility should leachate generation rates and chemical constituents change over time.

Based on the initial assessment and design, the proposed passive wetland treatment system at Ballinclare Quarry will comprise:

(i) A wetland treatment system: comprising the following elements in series:
   a. Anaerobic (biochemical reactor) wetland;
   b. Iron Sequestering Unit (ISU);
   c. Aerobic wetland.

(ii) A leachate reception tank: up to 50m3, self-bunded storage tank with level controls.

(iii) A pump house: housed in a standard shipping container (6.0m x 2.4m x 2.6m) containing feed, discharge and chemical dosing pumps;

(iv) Off-site discharge via existing ditch / drainage channels to the Ballinclare Stream and the Potters River further downstream.

Based on the assumption that the leachate flow rate is generated from a progressively capped inert landfill, the area of on-site wetland required at Ballinclare is assessed to be of the order of 1.06 hectares.

Landfill Groundwater Control System

The previous experience of operating the quarry at the site is that the surrounding volcanic rock is relatively tight, with few faults or fractures and therefore relatively limited volumes of groundwater would flow through it to the quarry void. Once the quarry void is dewatered, the volume of groundwater likely to collect in the sump is expected to be low, with the bulk of any water removed comprising infiltrating rainfall and/or surface water run-off over (or possibly through) the landfilled inert soil and stone.

Notwithstanding this, a groundwater control system will be installed below the clay layer to ensure it is not damaged by hydrostatic uplift pressures. It is envisaged that the drainage system at the base of the quarry / inert landfill cells will comprise a herringbone system of granular drainage channels and that these would feed groundwater inflows to a collection point at the deeper excavation in the middle of the existing quarry floor which effectively acts as a sump over the initial landfilling stages (Phases 1A to 1C). During Phase 1C of landfilling, riser pipes will be installed at the sump area to facilitate the continued operation of the groundwater collection system which controls uplift pressures beneath the basal liner. Submersible pumps will be placed in these risers and will continually lift and remove any dewatered groundwater collecting in them. Pumping will continue until such time as the overlying inert waste has reached a depth / height where the weight of waste exceeds the maximum uplift pressure from surrounding groundwater. At that point in time, pumping of groundwater is likely to cease and the riser pipe will be decommissioned by backfilling it with bentonite.

During Phase 2 of the landfill development, the land surface will be raised above the level of the local groundwater table. As such, there will be no further requirement to manage or pump groundwater.

Soil Washing Plant / C&D Facility

There will be no surface water / groundwater emissions or off-site discharges arising from the proposed soil washing and aggregate recovery activities at the former concrete / asphalt production yard in the south eastern corner of the application site or the C&D recovery area to the west of the site access road (other than direct rainfall runoff captured from the roof of the C&D shed). All process water associated with the winning of recycled aggregate from more granular waste soils or from clay bound C&D, as well as rainfall runoff from these areas will be re-circulated in a closed loop system at the soil wash plant. As such, there is therefore no requirement to make provision for treatment for any process water associated with the activity. Top-up water will be periodically required for the plant and will be provided from the on-site water management system.

The filter cake produced by the plate filter press at the end of the aggregate recovery process contains 85% dry solids. This material will be picked up by a front end loader and transferred via haulage truck for disposal at the adjoining lined landfill facility.

Wastewater Management

Wastewater from the site offices and staff welfare facilities is piped to an existing on-site effluent treatment system. This system, which comprises an aeration treatment unit and two modular Puraflo system over a 300mm deep gravel bed and was previously approved by way of the recent (2016) quarry planning permission and will continue in service for the duration for the life of the proposed waste management facility. A copy of the site characterisation form and details of the on-site wastewater treatment system are provided in **Appendix 7-K** of the submitted EIAR. The existing wastewater system does not have the full capacity for the proposed loading arising when the envisaged maximum numbers of personnel are based on site during the operation of the Proposed Development. Provision is therefore made for excess effluent to be stored in a holding tank, and tankered off site (by a licenced haulier) on a monthly basis. The excess effluent will be transferred to a licenced wastewater treatment plant for off-site treatment and disposal. Details of the sub-surface storage tank are also provided in Appendix 7-K of the submitted EIAR.

Wheelwash

There is an existing wheelwash facility at the application site which will continue to be used over the life of the proposed waste management facility. A further wheelwash will be constructed at the proposed aggregate production yard in the south-eastern corner of the application site. Water supplied to these wheel washes will be recycled in a closed system and topped up with water from the supply well or from the quarry sump / balancing ponds as required. There is no water discharge from the wheelwash systems.

Long-Term (Post Closure) Surface Water Management

Following completion of landfilling and restoration works, the wetland area at the western end of the application site will remain in-situ and allowed to naturally evolve and re-wild, with no provision being made for any active long-term maintenance. The wetland system will be retained as a wildlife feature as part of the restoration, refer to Chapter 2 of this EIAR and Figure 2.4.

Post closure, the surface water management system at the landfill provides for a shallow interceptor drains (scrape or swale) to intercept surface water run-off from the restored landform and to direct it to the wetland area on the western side of the application site.

The wetland area will effectively serve as a long-term soakaway, settlement lagoon and/or attenuation pond for surface water run-off (from both the restored landfill and the restored C&D waste recovery area) prior to its discharge off-site via the established drainage network to the Potters River.

Due to the topography of the proposed landform, it will not be possible to direct all the run-off from the restored landfill to the wetland / proposed settlement lagoon by gravity and as such, the residual, southern flank will be drained to a swale / attenuation pond along the southeastern boundary (refer to Figure 2-19) that will discharge to an existing stream which flows to the Kilmacurra Stream.

Site Entrance Drainage Collection and Water Management System

Runoff from the site entrance area and the weighbridge area will be collected and treated in a hydrocarbon interceptor, and it will then pass to the existing storage pond [30m x 15m x 3m = 1,350m^3 volume). Excess water from the storage pond will be pumped (duty and standby pumps will be installed to ensure redundancy) to the main quarry drainage system, where it will either be used for water supply to the soil washing plant or treated and discharged.

Site Water Supply

Water supply to the site office and welfare facilities will continue to come from well PW2.

7. SURFACE WATER & GROUNDWATER RISK ASSESSMENT

A Qualitative Surface Water and Groundwater Risk Assessment is presented in a table format below. In respect of all sources identified the pathway and risk assessment relates to the listed receptors (Please refer to the CSM in **Appendix I**). The assessment of the proposed development on the water environment is divided into 2 no. aspects, (1) Surface water; and (2) Groundwater for all phases of the proposed development.

7.1.1 Surface Water (Construction Phase)

Note 1: Risk to listed Receptors

	Source	Pathway	Receptor	Risk(1) before mitigation measures	Mitigation/ Design Measures	Risk(1) after mitigation measures
SW1	Accidental spills/leaks of hydrocarbons.	Discharge to surface waters.	Surface water quality in downstream watercourses (*i.e.* Kilmacurra Stream and Potters River).	Moderate	• Water in the quarry void will be pumped to the treatment plant (Siltbuster) and will then be routed to the settlement / attenuation ponds for further treatment (settlement) prior to discharge at the Potters River. Should the capacity of the settlement ponds be exceeded then additional ponds will be constructed; • All surface water discharges to the Potters River will comply with the emission limits set by the discharge licence [WPL116] (or those which may supersede them in any waste licence issued by the EPA); and, • Best practice mitigation measures will be implemented with respect to hydrocarbons as follows: o No refuelling of plant / machinery, maintenance or repairs will take place in the quarry void to prevent accidental spillages reaching the ground or being washed off in surface water; o A refuelling pad with connection to hydrocarbon separator is provided at the application site, beside the workshop. All mobile plant and machinery refuelling will take place on the refuelling pad; o Drip trays will be used for all other refuelling activities; o All refuelling will be completed by competent / trained operatives; o All plant / machinery maintenance and repairs will take place under cover in the existing	Imperceptible.

					workshop at the site or on the hardstand refuelling pad; o All plant will be regularly maintained and inspected daily for leaks of fuels, lubricating oil or other contaminating liquids; o Fuel storage will continue at the existing bunded storage facility at the site; o All petroleum-based products (lubricating oils, waste oils, etc.) will be stored on drip trays under cover in the workshop to prevent pollution due to accidental leakages; o Waste oil and grease containers will be stored under cover in the workshop. Waste containers will be collected and disposed of by a suitably licenced contractor; o An emergency spill response kit (with containment booms, absorbent materials and drip tray) will be provided on-site to contain/ stop the migration of any accidental spillages, should they occur; o Plant operators will be briefed during 'toolbox' talks and site induction on where the spill kit is kept and how and when it is deployed; o Regular visual inspection and testing will be undertaken of the integrity of tanks, drums, bunded pallets and double skinned containers; o Traffic management systems at the site will reduce potential conflicts between vehicles, and the potential risk of collisions and associated fuel spills or oil leaks; and, o Site speed limits will be implemented across the site to further reduce the likelihood and significance of collisions and the possibility of a fuel leak from such a collision.	
SW2	Uncontrolled discharge	Discharge to surface waters.	Surface water quantity in downstream watercourses (i.e. Kilmacurra Stream and Potters River) and flood risk.	Slight	• There will be no uncontrolled discharge to surface waters; • Water in the quarry void will be pumped to the treatment plant (Siltbuster) and will then be routed to the settlement / attenuation ponds for further treatment (settlement) prior to discharge at the Potters River. Should the capacity of the settlement ponds be exceeded then additional ponds will be constructed; • All surface water discharges to the Potters River will comply with the emission limits set by the discharge licence [WPL116] (or those which may supersede them in any waste licence issued by the EPA); and,	Imperceptible

					• The volume of water discharged from the application site compared to flood flows in the Potters River is negligible and therefore the discharge water will not result in increased flood risk in the river.	
SW3	Poor quality discharge	Discharge to surface waters	Buckroney-Britta Dunes and Fen SAC/pNHA	Slight	• Effect is unlikely due to the separation distance, the small volumes of water to be discharged in comparison to the flows in the Potters River, and the lack of any hydrological dependency of the qualifying interests of the SAC/pNHA. • The mitigation detailed for SW1 and SW2 will ensure the protection of downstream surface water quality, thereby protecting the SAC/pNHA.	Imperceptible
7.1.2 Surface Water (Operational Phase)						
SW4	Accidental leaks of fuels/oils.	Discharge to surface waters.	Surface water quality in downstream watercourses (i.e. Kilmacurra Stream and Potters River).	Moderate to Significant	• The same mitigation measures as those detailed for SW1 will be implemented for the protection of surface water quality during the operational phase in relation to hydrocarbons. • In addition, a surface water management plan will be implemented (refer to Section 6.2 above).	Imperceptible
SW5	Elevated concentrations of suspended solids	Discharge to surface waters.	Surface water quality in downstream watercourses (i.e. Kilmacurra Stream and Potters River).	Moderate	• The same mitigation measures as those detailed for the construction phase (i.e. Siltbuster, settlement / attenuation ponds) will ensure the protection of surface water quality during the operational phase. • There will be no discharge of untreated or unattenuated waters. • In addition, a surface water management plan will be implemented (refer to Section 6.2 above).	Imperceptible.
SW6	Contaminants in imported soil, C&D material	Discharge to surface waters	Surface water quality in downstream watercourses (i.e. Kilmacurra Stream and Potters River).	Moderate	• Only soil and stone waste and C&D material carried by authorised waste collectors will be accepted at the proposed waste facility at Ballinclare Quarry. All waste intake and acceptance will be subject to regulation and control by way of any EPA Waste Licence issued in respect of the proposed facility; • Waste shall be accepted from customers only after initial waste profiling and waste characterisation off-site. Characterisation testing will be undertaken in advance by customers, clients or sub-contractors forwarding soil and stone backfill materials to the application site; • Operating procedures at the proposed facility will require all wastes forwarded for landfilling and/or recovery purposes to be pre-sorted at source, inert and free of any non-hazardous / hazardous domestic, commercial or industrial wastes. Any waste consignment	

					arriving at the facility with such wastes intermixed with it will be deemed unacceptable for acceptance at the facility on the basis of a CCTV / visual inspection at the weighbridge and will be immediately rejected and re-directed off-site to an alternative authorised waste facility; • All inert soil and stone imported to the facility will be unloaded (end-tipped) from trucks at the active landfill area. In addition to visual / CCTV inspection at the weighbridge(s), it will be inspected again by site based personnel to ensure that there is no non-hazardous or hazardous waste intermixed with it. Should any intermixed, non-inert waste be identified at this point, the entire consignment will be rejected and reloaded back onto the HGV / tipper truck and the haulier directed to remove it off-site to another authorised (i.e. permitted or licensed) waste facility; and, • Similarly, should any non-inert or non-C&D waste be identified amongst incoming waste consignments at the C&D waste recovery areas, the entire waste consignment will also be rejected and reloaded onto the HGV / tipper truck and the haulier directed to remove it off-site to another authorised waste facility.	
SW6	Poor quality discharge	Discharge to surface waters	Buckroney-Britta Dunes and Fen SAC/pNHA	Slight	• Limited potential for effects. • The mitigation measures detailed for SW3 and SW4 will ensure the protection of downstream surface water quality, thereby protecting the SAC/pNHA.	Imperceptible.
7.1.3 Surface Water (Post-Operational Phase)						
SW7	Elevated concentrations of suspended solids	Surface water runoff.	Surface water quality in downstream watercourses (i.e. Kilmacurra Stream and Potters River).	Moderate	• Appropriate seasonal timing of site restoration works, soil subsoiling and grass seeding will reduce any adverse impacts of soil erosion across the site. • Once the site is backfilled, it will become vegetated and runoff and drainage will either percolate to ground or runoff and drain passively from the site via the wetland area. A small area of the southeastern corner of the site will drain locally to a suitably sized swale /attenuation pond and will discharge following treatment to the Kilmacurra Stream. • The long-term surface water management regime for the backfilled landform is described in Chapter 2 of the EIAR and will be established incrementally over time, as landfill and restoration work proceeds. On completion of the quarry backfilling and restoration works, any	Imperceptible.

					outstanding long-term site drainage works will be completed.	

7.1.4 Groundwater (Construction Phase)

Note 1: Risk to listed Receptors

	Source	Pathway	Receptor	Risk(1) before mitigation measures	Assessment/ Mitigation/ Design Measures	Risk(1) after mitigation measures
GW1	Accidental spills/leaks of fuels	Recharge and groundwater flowpaths	Underlying groundwater quality and local groundwater well supplies	Moderate	• The same mitigation measures listed for SW1 above will ensure the protection of groundwater quality during the construction phase.	Imperceptible.
GW2	Dewatering	Pumping of the quarry void.	Groundwater levels and groundwater quantity in local well supplies.	Moderate	• The proposed development will have no effects on groundwater levels in local domestic wells; o The poorly productive nature of the bedrock aquifer; o Local groundwater wells are sourced from the overburden aquifer, which lies above and is separate from the groundwater in the diorite bedrock; o Local domestic wells are either upgradient of the site, or where downgradient are separated from the site by a hydraulic barrier (*i.e.* surface water stream); o Local domestic wells show no significant response to the existing pumping/dewatering regime; and, o No response has been recorded in local domestic wells despite a water level drop of ~13m at Ballinclare Quarry.	Imperceptible.

7.1.5 Groundwater (Operational Phase)

GW3	Accidental leaks/spills of fuels/oils	Groundwater recharge and groundwater flows.	Local groundwater quality and groundwater quality in local well supplies.	Moderate	• The same mitigation measures listed for SW1 above will ensure the protection of groundwater quality during the operational phase. • Furthermore, an inert landfill liner will be constructed as the base and sides of the landfill which will protect the underlying bedrock aquifer.	Imperceptible.

GW4	Contaminants in imported material and/or C&D material	Groundwater recharge and groundwater flows.	Local groundwater quality and groundwater quality in local well supplies.	Slight to Moderate	• The mitigation measures detailed for SW6 will ensure the protection of local groundwater quality. • Importantly a clay liner will be imported and used to construct a 1m basal thick and side liner for the inter landfill areas. This clay liner will be low permeability (≤$1x10^{-7}$m/s) and will isolate the landfill from the surrounding hydrogeological environment.	Imperceptible.
GW5	Dewatering	Groundwater pumping	Local groundwater quantity and groundwater levels in local well supplies.	Slight to Moderate	• There will be no effects for the same reasons as those detailed in GW2 above.	Imperceptible.

8. PROPOSED MONITORING PLAN

In order to demonstrate that the proposed development is not having an effect on the surface water and groundwater environments the following monitoring is proposed.

Surface water monitoring will be undertaken in line with the conditions set out in the existing Discharge Licence for the site or any variation thereto required by revision of the licence or by an EPA waste licence.

With regards to groundwater monitoring, a new replacement monitoring well (GW2A) will be installed to replace the existing GW2. GW2 itself will undergo remedial works to remove residual hydrocarbons prior to being decommissioned.

Groundwater quality monitoring will be completed on 3 no. wells (GW1, GW2A and GW3, refer to **Figure B**) on a quarterly basis. Laboratory analysis will include the following analytes:

- pH
- BOD / COD
- Ammonia (as N)
- Nitrate / Nitrite
- Total Nitrogen
- Total Dissolved Solids
- Chloride
- Asbestos
- Electrical Conductivity
- Potassium
- Sodium
- Sulphate
- Total Phosphorous
- Orthophosphate (as P)
- Dissolved metals – As, B, Cd, Cu, Pb, Mg, Mn, Ni, Zn & Hg
- Oils, Fats & Grease
- Total Petroleum Hydrocarbons
- Diesel Range Organics / Petrol Range Organics
- Total Coliforms
- Faecal Coliforms

Test results will be maintained on site and will be furnished to the EPA as required by conditions attaching to any future waste licence.

In addition, baseline groundwater quality monitoring is proposed at local wells CBDW1, GLDW1, DW2, LDDW1, DW3, ODW1, and ODW2 (refer to **Figure B)**. The selected wells will have groundwater quality sampling undertaken twice prior to works commencing and biannually (every two years) thereafter during the construction and operational phases. If on site monitoring indicates any change in groundwater quality during the operational phase, then the frequency of off-site groundwater quality monitoring can be reviewed and increased.

The groundwater monitoring regime will remain in place for the life of the proposed landfilling and recovery operations and for a period of 5 years thereafter during the aftercare period (with proposed monitoring in year 1, year 3, and year 5 in the post closure period).

With regard to groundwater level monitoring, groundwater dataloggers will be installed (or will be left in-situ) in monitoring wells GW1, GW2A and GW3, and these will record continuous water level data. Data from these wells will be downloaded and processed / reviewed on a quarterly basis.

9. REPORT SUMMARY

A geological, hydrological and hydrogeological data review and a surface and groundwater risk assessment has been completed for the proposed development at Ballinclare Quarry, Kilbride, Co. Wicklow. The proposed development involves the restoration of a bedrock quarry using inert soil and stone material.

The risk assessment is informed by detailed site investigations which form a comprehensive baseline dataset. These site investigations occurred across several phases and included borehole drilling, geological logging and inspections, local groundwater well surveys, seasonal and continuous groundwater level monitoring in onsite and offsite groundwater wells, groundwater sampling and surface water quality monitoring. These site investigations were detailed in Chapter 7 of the submitted EIAR.

A detailed hydrological and hydrogeological Conceptual Site Model (CSM) has been produced for the application site using the comprehensive site-specific geological/hydrogeological dataset. The CSM identifies that the local area is dominated by shallow groundwater flow in permeable subsoils and at the interface between the subsoils and the underlying diorite bedrock. The bedrock itself is of low permeability and is classified as a Poor Aquifer. The quarry is currently being dewatered (only small volumes of groundwater, with rainfall forming the vast majority of water requiring treatment) and discharges to the Potters River following treatment and attenuation.

Detailed, tried and tested, best practice mitigation measures have been prescribed which will ensure the protection of the local surface water environment. A detailed water management plan has been designed for each phase of the development. Water management and water treatment proposals are designed and scaled for each phase and each activity. Strict material testing and inspection protocols will be implemented to ensure the material received by the facility is inert. The infilled areas will be progressively landscaped and as a result the area of contact with infill material will be reduced over time. A monitoring programme will be implemented to demonstrate compliance with Licence requirements.

Detailed, tried and tested, best practice mitigation measures have also been prescribed which will ensure the protection of the local hydrogeological (groundwater) environment. To ensure protection of groundwater quality an engineered clay liner will be installed underlying the waste material being infilled in the quarry. This clay liner will have sufficient low permeability (at least $1x10^{-7}$m/s) so as to hydraulically isolate it from the underlying bedrock aquifer. Mitigation and drainage controls are proposed in respect of hydrocarbons, and wastewater from welfare facilities at the application site. It is also noted that groundwater monitoring has revealed that the ongoing quarry dewatering is not having any effect on local groundwater well supplies. Nevertheless, a groundwater monitoring programme will be implemented at the application site to confirm that there is no adverse effect on groundwater levels or groundwater quality.

This risk assessment concludes that with the implementation of the prescribed mitigation measures, that there will be no significant effects with respect to groundwater and/or surface water associated with the proposed development.

* *

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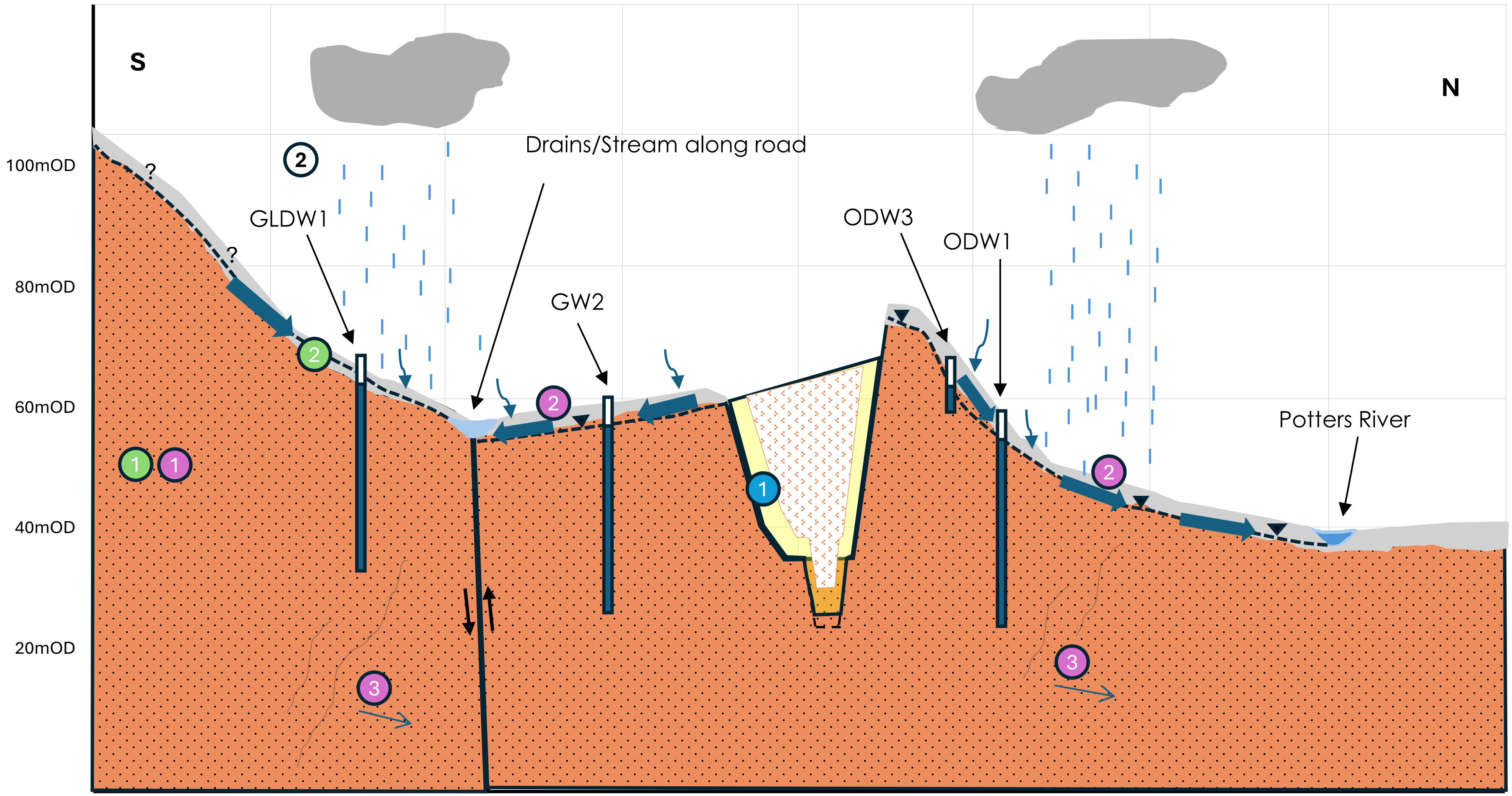
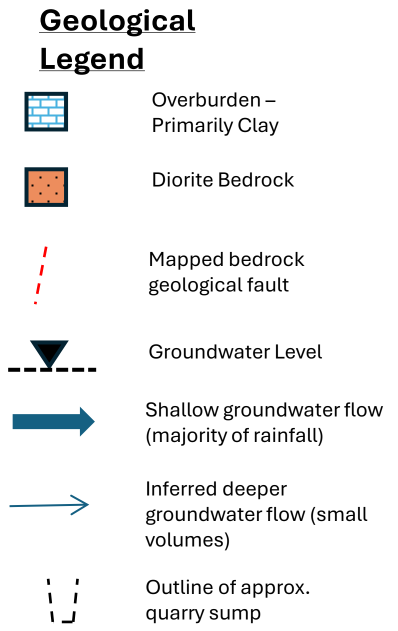
APPENDIX I: CONCEPTUAL SITE MODEL





Drawing notes:

1. A Conceptual Site Model (CSM) is a graphical representation of the known elements of site geology and hydrogeology, and it can include groundwater flowpaths and sensitive receptors.
2. The drawing depicted here is a simplification of the hydrogeological system.
3. The CSM is based on all available data.

CSM Geological Notes:

*This cross-section is a simplification of the local geology.

1. The local geology comprises Hard, competent, low permeability Diorite bedrock, overlain by thin clay/gravel subsoil. The thickness of the subsoil is variable, but can be up to 6m. The Diorite (Di) Formation consisting of micro diorite to microgranite sills and minor dykes. There are north-south running faults to the east and west of the quarry, but none are mapped within the quarry footprint. The bedrock geology beneath the current quarry floor level has been confirmed as diorite to 40m beneath the quarry floor (from borehole drilling at BH1 and BH2). The diorite has been affected by regional deformation and veining and fault gouge associated with the deformation is observed in the quarry faces.
2. Bedrock subcrop/outcrop occurs over much of the northern and eastern area and that the southwestern area of the site is underlain by till derived from lower Palaeozoic sandstone and shale.

CSM Hydrogeological Notes:

*This cross-section is a simplification of a very complex hydrogeological area. Not all local wells are shown.

1. The Diorite bedrock is classified as a Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones. Recorded local well yields are all low.
2. The subsoil-bedrock interface layer is much more porous and more permeable than the underlying Diorite bedrock. Rainfall infiltrates through the subsoil, reaches the subsoil/bedrock interface and moves as shallow groundwater flow, laterally along the top of bedrock. The shallow flow is the dominant groundwater flow in the area and is controlled by topography. This dominant system is also likely the main source of inflow to many of the local groundwater wells.
3. Deeper, less connected, local flow within fissures and fractures in the Diorite bedrock. Fault gouges may inhibit groundwater flow.

CSM Notes Regarding Local Groundwater Wells

1. The proposed fill material will be inert, and the quarry will be lined with low permeability clay.

   The dominant shallow groundwater flow system will not be effected by the proposed infill.

   Any deeper groundwater flow is local, and is likely associated with fissures and fractures, with the main water source coming from local recharge from the shallow subsoil-bedrock rinterface, rather than regional groundwater flow systems.

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