5

SOILS, LAND AND GEOLOGY

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5.1 INTRODUCTION

This Chapter of the remedial Environmental Impact Assessment Report (rEIAR) considers and assesses any potential impacts resulting from quarrying related activities that have been carried out at Hudson Brothers Ltd Kildare quarry (the 'Site'), on the surrounding land, soils and geology.

It is noted that activity at the Site involved the extraction of both rock (greywacke) and sand and gravel by excavation techniques. The extraction activities continued to take place above the water table, with dry mining of the sands and gravels and rock.

The following assessment was prepared by Kit Pannell (BSc, MSc). Kit is a hydrogeologist with over 11 years experience, with focus on regulatory reporting within the mining industry.

5.1.1 TECHNICAL SCOPE

The technical scope of this assessment is to consider the potential impacts and effects on soils, land and geology that could have resulted because of the quarrying related activities carried out at the Site. This assessment considers the potential sources of change resulting from Development activities detailed in the project description (Chapter 2.0).

The loss of agricultural soils will be considered, as will the potential geotechnical risks, impact on geologically important sites and land quality. Associated secondary potential impacts from changes to land quality on human health are also considered. It should be noted that this assessment does not, however, constitute a contaminated land risk assessment, a geotechnical/geohazard risk assessment, or detailed quantitative human health risk assessment.

The potential effects associated with hydrogeological and hydrological receptors are considered in Chapter 6.0 (Water), with reference to water quality in relation to land quality in this chapter. The effects of the Development on population and human health are addressed in Chapter 3.0 (Population & Human Health). Any secondary effects on ecology or biodiversity due to changes in land quality or habitat removal are considered in Chapter 4.0 (Ecology and Biodiversity).

5.1.2 GEOGRAPHICAL AND TEMPORAL SCOPE

The geographical study area for the assessment covers the EIA boundary (Site) (identified on Figure 5-1) and a buffer zone of 500 m (forming the study area) from the EIA Site boundary, because most potential effects to geological and soil receptors are anticipated to occur within the Development footprint or immediately adjacent to it. In the context of this rEIAR, the Site boundary contains lands which form the existing quarry area and some areas which extend beyond the working areas.

The baseline for this rEIAR has been set to September 2020, and the rEIAR process has assessed environmental impacts from that date to the present. This assessment period equates to approximately three and a half years and is identified as 'short-term' duration (those lasting one to seven years). With reference to available aerial imagery, there is only imagery for March and June in 2020. Although this imagery is outside of the review period, it is key in defining the baseline conditions and is presented in this assessment.

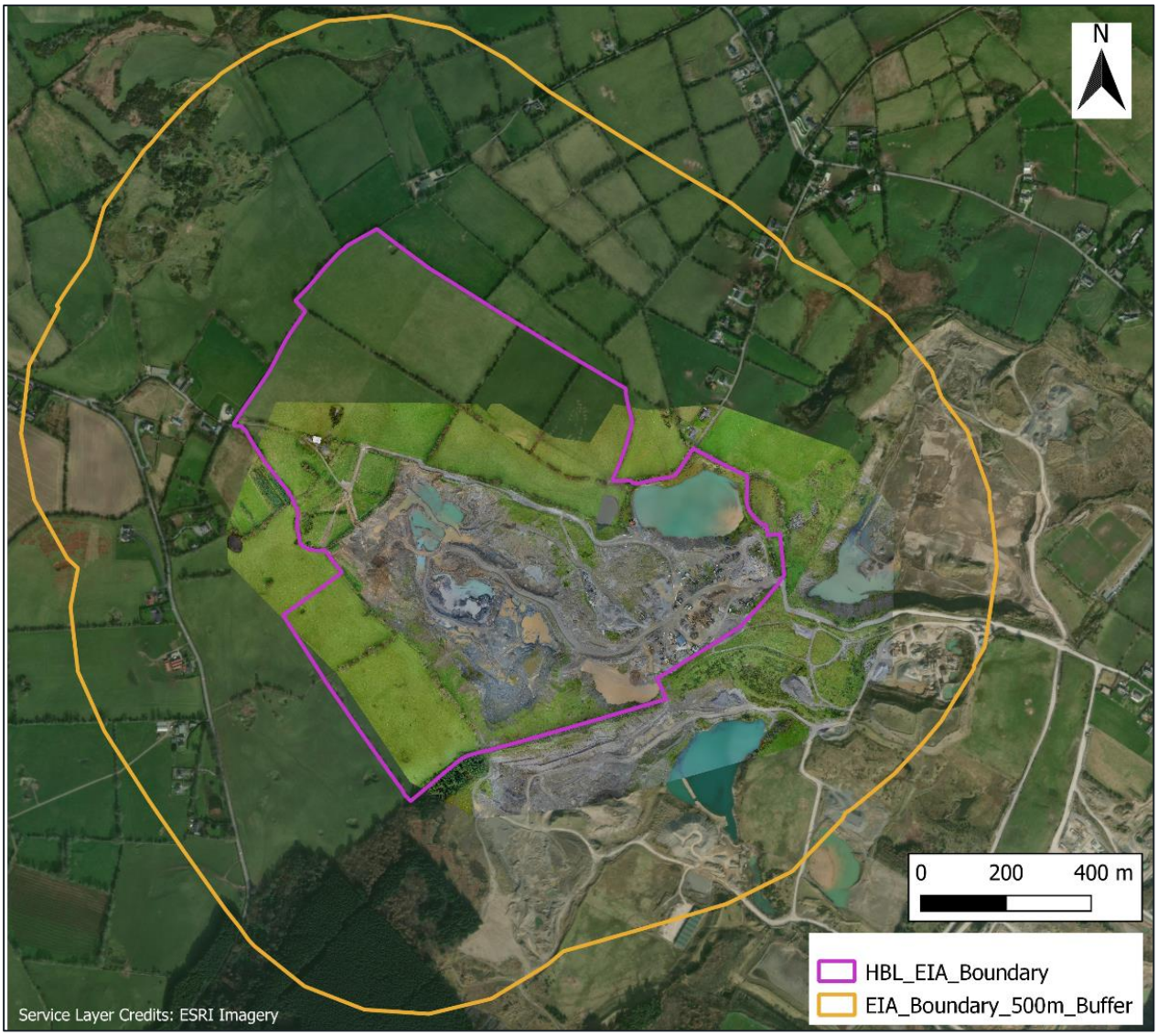

Figure 5-1 - Location of the Site (EIA Boundary) and 500 m Buffer

5.2 LEGISLATIVE AND POLICY CONTEXT

This section addresses the legislation and guidance that has been considered when preparing this chapter, and key policy context relevant to soils, land and geology that has guided the focus of the assessment.

5.2.1 LEGISLATION

This assessment has been made with cognisance to relevant legislation, including but not limited to:

- European Union Directive 2011/92/EU as amended by Directive 2014/52/EU – these Directives required that certain private and public projects which are likely to have significant resultant environmental impacts are subject to a formalised Environmental Impact Assessment prior to their consent.
- European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (SI No. 296 of 2018) which amended the Planning and Development Act, 2000, and the

Planning and Development Regulations, 2001. The 2014/52/EU Directive was transposed into Irish law through this Directive.

- The European Communities (Environmental Liability) Regulations 2008 (as amended) - These Regulations (SI 547/2008) transpose EU Directive 2004/35/CE on environmental liability with regard to the prevention and remedying of environmental damage. The purpose of these Regulations is to establish a framework of environmental liability based on the 'polluter-pays' principle, to prevent and remedy environmental damage. The Environmental Protection Agency (EPA) is designated as the competent authority for all aspects of these Regulations.
- The Environmental Protection Agency Act 1992 and the Protection of the Environment Act 2003 – which detail the requirements associated with general pollution control and activities that come under integrated pollution prevention and control.

5.2.2 RELEVANT POLICIES AND PLANS

The National Planning Framework (Project Ireland 2040) includes National Policy Objective 60 to "Conserve and enhance the rich qualities of natural and cultural heritage of Ireland in a manner appropriate to their significance".

The Kildare County Development Plan 2023-2029 (KCDP) is the key strategy document which structures the proper planning and sustainable development of land-use across County Kildare over the six-year statutory period of the plan.

The KCDP acknowledges the potential environmental effects of the aggregate industry and importance of protecting surrounding residential and natural amenities. The KCDP also identifies that gravel resources are important to the general economy and provide a valuable source of employment in some areas of the county. There is an increasing demand for aggregates and that areas for extraction of aggregates and minerals are needed in the county. To address this the KCDP identifies that planning policies should be carefully constructed to avoid adverse effects on aggregate resources and related extractive industries. The KCDP notes that it is necessary to ensure that aggregates can be sourced without significantly damaging the landscape, environment, groundwater and aquifer sources, road network, heritage and / or residential amenities of the area. KCC has adopted policies and objectives within the development plan in relation to the protection of environs from adverse environmental impact from extractive industry.

Specific policies and objectives relating to the protection of the geological environment and land include the following:

RD P8 – (It is the policy of KCC to) Support and manage the appropriate future development of Kildare's natural aggregate resources in appropriate locations to ensure adequate supplies are available to meet the future needs of the county and the region in line with the principles of sustainable development and environmental management and to require operators to appropriately manage extraction sites when extraction has ceased.

RD O42 – (It is the objective of KCC to) Ensure that development for aggregate extraction, processing and associated concrete production does not significantly impact the following:

- *Special Areas of Conservation (SACs)*
- *Special Protection Areas (SPAs)*
- *Natural Heritage Areas (NHAs)*

- *Other areas of importance for the conservation of flora and fauna.*
- *Zones of Archaeological Potential.*
- *The vicinity of a recorded monument.*
- *Sensitive landscape areas as identified in Chapter 13 of this Plan.*
- *Scenic views and prospects.*
- *Protected Structures.*
- *Established rights of way and walking routes.*
- *Potential World Heritage Sites in Kildare on the UNESCO Tentative List, Ireland.*

RD O43 – (It is the objective of KCC to) Consult with the Geological Survey of Ireland (GSI), with regard to any developments likely to have an impact on sites of Geological Importance.

RD O44 – (It is the objective of KCC to) Require applications for mineral or other extraction to include (but not limited to):

- *An Appropriate Assessment Screening where there is any potential for effects on a Natura 2000 site.*
- *An Environmental Impact Assessment Report (EIAR).*
- *An Ecological Impact Assessment may also be required for subthreshold developments to evaluate the existence of any protected species / habitats on site.*

RD O49 – (It is the objective of KCC to) Have regard to the following guidance documents (as may be amended, replaced, or supplemented) in the assessment of planning applications for quarries, ancillary services, restoration and after-use:

- *Quarries and Ancillary Activities: Guidelines for Planning Authorities, DEHLG (2004). - Environmental Management Guidelines*
- *Environmental Management in the Extractive Industry (Non-Scheduled Minerals), EPA (2006). - Archaeological Code of Practice between the DEHLG an ICF (2009).*
- *Geological Heritage Guidelines for the Extractive Industry (2008).*
- *Wildlife, Habitats, and the Extractive Industry – Guidelines for the protection of biodiversity within the extractive industry, NPWS (2009).*

5.2.3 RELEVANT GUIDANCE

This assessment has been made with cognisance to relevant guidance and advice, including but not limited to:

- Relevant European Commission guidance – Guidance on the Preparation of the Environmental Impact Assessment Report (2017).
- The EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (May 2022) – which presents key topics of interest, high-level information on the interactions that should be considered in relation to EIA legislation, and overviews on the recommended approach to describing the baseline environment, completing impact assessments, describing effects, and addressing mitigation and monitoring.

- Department of Housing, Planning and Local Government. Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (August 2018).
- The National Roads Authority Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2008) in relation to aspects to be considered and assessment approach (including relative receptor importance and cross discipline interactions).
- Institute of Geologists of Ireland. Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (April 2013).
- The National Roads Authority Guidelines for the Creation, Implementation and Maintenance of an Environmental Monitoring Plan (undated) in relation to impact mitigation.
- CIRIA C741: Environmental Good Practice on Site (2015, Fourth Edition) in relation to source of impact and mitigation.
- The EPA guidelines on Environmental Management in the Extractive Industry (Non-Scheduled Minerals) (2006), for a more environmentally sustainable quarry & pit industrial sector, greater protection for the environment and human health.
- The CIRIA guidance Publication C532 Control of water pollution from construction sites: guidance for consultants and contractors (2001), which provides advice on environmental good practice for the control of water pollution arising from construction activities.

5.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

This section presents the method used to assess the impacts and effects of the Development on soils, land and geology, and to secondary associated human health receptors. It establishes the stages of the assessment, and the qualitative criteria used to assess impact magnitude and determine the level of effect significance.

5.3.1 QUALITATIVE ASSESSMENT METHOD

The assessment of potential effects has been undertaken using the qualitative assessment method outlined below, and is supported by the baseline condition information, desk-based information on land, soils and geology available from the Geological Survey of Ireland (GSI), the EPA and previous ground investigations carried out onsite. Due to the short review period, there is unlikely to be any changes in classification by GSI or the EPA. The assessment follows a staged approach, which is summarised below:

1) Confirm baseline conditions – determine baseline and develop conceptual site model by consideration of available records and data sets, site reports and published information.
2) Confirm the key receptors and their value/importance, this may vary over time as new receptors are added (e.g. addition of residential housing).
3) Qualitatively characterise the magnitude of impacts on the receptors – describe what potential changes could have occurred to each receptor because of the Development, identify source-pathway receptor linkages, and assign the magnitudes of impact. This stage considers embedded design mitigation, historical and existing site practices including good practice in construction environment management and pollution prevention.

4) Determine the effect significance of each potential impact on each sensitive receptor.
5) Consider the need for remedial measures if it is considered necessary to reduce the magnitude of any impact and associated effect. If remedial measures are considered necessary, a timeline will be presented in which the measures would be implemented.
6) Assess the residual impact magnitude and residual effect significance after all mitigation is carried out.
7) Identify any monitoring that may be required to measure the success of the remedial measures.

Stages 1 and 2 have been completed using published literature, guidance and available information specific to the Development, which is presented in Chapter 2.0 of this rEIAR. For the identification of receptor value/importance that completes Stage 2, and for the description of impact magnitude (Stage 3), a common framework of assessment criteria and terminology has been used based on the EPA's Guidelines on the Information to be Contained in EIARs (EPA, 2022), with some modifications made to increase clarity. The descriptions for sensitivity of receptors are provided in Table 5-1 and the descriptions for magnitude of impact are provided in Table 5-2.

The potential for an impact to have occurred at a receptor has been determined using the understanding of the baseline environment and its properties and consideration of whether there is a feasible linkage between a source of impact and each receptor (i.e. a conceptual site model).

Table 5-1 – Environmental value (sensitivity) and descriptions

Value (sensitivity) of receptor / resource	Typical Description
High	High importance and rarity, national scale, and limited potential for substitution. For example: – Global/European/National designation – Large volumes of nationally or locally important peat – Well drained and highly fertile soils – Proven economically extractable mineral resource – Human health.
Medium	Medium or high importance and rarity, regional scale, limited potential for substitution. For example: – Regionally important sites – Moderately drained and/or moderate fertility soils.
Low	Low or medium importance and rarity, local scale. For example: – Locally designated sites – Poorly drained and/or low fertility soils.
Negligible	Very low importance and rarity, local scale.

Table 5-2 – Magnitude of impact and descriptions

Magnitude of impact (change)		Typical description
High	Adverse	– Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements. – Significant harm to human health - death, disease, serious injury, genetic mutation, birth defects or the impairment of reproductive functions. – Significant harm to buildings/infrastructure/plant - Structural failure, – substantial damage or substantial interference with any right of occupation.
	Beneficial	– Large scale or major improvement of resource quality; extensive restoration; major improvement of attribute quality.
Medium	Adverse	– Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements.
	Beneficial	– Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality.
Low	Adverse	– Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements.
	Beneficial	– Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring.
Negligible	Adverse	– Very minor loss or alteration to one or more characteristics, features or elements.
	Beneficial	– Very minor benefit to or positive addition of one or more characteristics, features or elements.

The assessment of magnitude of impact considers whether the change that causes the impact is positive or negative, and whether the impact is direct or indirect, short, medium or long-term, temporary or permanent, and if it is reversible.

For the purposes of this assessment, a direct impact is one that occurred as a direct result of the Development and was likely to have occurred at or near the Development itself. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on one receptor has another knock-on impact on one or more other related receptor(s) (e.g. the Development results in a change in land quality, which then has an indirect impact on human health). Indirect impacts can occur within the study area or away from the Development.

For the purposes of this assessment, the following definitions of duration have been used:

- Temporary – effect likely to last less than 1 year without intervention (i.e. less than the construction phase);
- Short term – effect likely to last 1 to 7 years without intervention;

- Medium term – effect likely to last 7 to 15 years without intervention;
- Long term – effect likely to last 15 to 60 years without intervention; and
- Permanent – effect likely to last over 60 years without intervention.

An irreversible impact is defined as a change to the baseline that would not reverse itself naturally. Such impacts will usually be long-term and irreversible, such as the removal of best and most versatile agricultural soils. A reversible impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

5.3.2 SIGNIFICANCE CRITERIA

The approach followed to derive effects significance from receptor value and magnitude of impacts (Stage 4) is shown in Table 5-3. Where Table 5-3 includes two significance categories, reasoning is provided in the topic chapter if a single significance category is reported. A description of the significance categories used is provided in Table 5-4.

Table 5-3 – Significance Matrix

	Magnitude of Impact (Degree of Change)				
Environmental Value (Sensitivity)		**Negligible**	**Low**	**Medium**	**High**
	High	Slight	Slight or moderate	Moderate or large	Profound
	Medium	Imperceptible or slight	Slight or moderate	Moderate	Large or profound
	Low	Imperceptible	Slight	Slight	Slight or moderate
	Negligible	Imperceptible	Imperceptible or slight	Imperceptible or slight	Slight

Table 5-4 – Significance categories and typical descriptions

Significance Category	Typical Description
Profound	An effect which obliterates sensitive characteristics.
Large	An effect which, by its character, magnitude, duration or intensity alters a significant proportion of a sensitive aspect of the environment.
Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Imperceptible	An effect capable of measurement but without significant consequences.

Residual adverse effects of 'large' or 'profound' significance are considered to be 'significant' for the purposes of this assessment.

If required following the assessment of the current level of effect significance, additional mitigation measures (remedial measures) may be presented that will be used to avoid, prevent, or reduce the magnitude of the impact (Stage 5). The significance of the effect considering the additional mitigation is then assessed (Stage 6) to give the residual effect significance. Any monitoring that will be required to measure the success of the mitigation is included (Stage 7) (see section 5.11).

5.4 BASELINE AND SUBSEQUENT CONDITIONS (2020 TO PRESENT)

This section presents baseline information on soils, land use, land quality and geology. Information about the water environment (including hydrogeology) is presented in Chapter 6.0, Water.

5.4.1 LAND USE

The Site comprises lands which are currently used for quarrying activities. The current extent of the quarry (including extraction, plant and ancillary areas) is ca. 38.8 ha (0.388 km^2) in area. This is land that has been disturbed with quarrying activities, with either topsoil stripped, or sub-soil and rock removed.

The quarry is comprised of five main areas: a northeastern area with buildings, parking and storage areas; an eastern plant area with the processing plant used for the screening and washing of excavated material and a water treatment plant; a southern area where sediment laden water from processing is pumped to settle in a silt pond; a central area where material is subject to extraction; and a northern area where surface run off and rainwater is captured and recycled for processing.

The assessment period covers the years from September 2020 to present. A review of available aerial photography has been undertaken to assess the change in land use since March 2020.

There are several historical maps available for the area, which are related to the operational years that are the subject of this rEIAR, including:

- March 2020 aerial imagery (Google Earth)
- June 2020 aerial imagery (Google Earth)
- March 2022 aerial imagery (ESRI World Imagery)
- 26th January 2023 drone survey of the quarry area (Landmark Survey)
- 25th October 2023 drone survey of the Site (Six West)

5.4.1.1 Study Area Land Use

The March 2020 (Figure 5-2) aerial provides the baseline for land use prior to the start of the review period. The March 2020 aerial is compared to the merged October 2023 survey and March 2022 aerial (Figure 5-3), for land use changes within the 500m buffer from the Site boundary.

Three main land uses have been identified within the Site and the study area (500 m from the Site boundary). These are the agricultural and single-house residential lands, the R410 road and other quarry operations. The lands to the north and west can be characterised as rural in nature, with land uses in the area being agricultural and single-house residential. Sheep rearing and grazing of cattle are the main activities in the area. The R410 road passes through the 500 m buffer to the

southwest of the Site and the lands immediately to the east and south of the Site are largely taken up by quarrying activities operated by unrelated parties.

Between the 2020 and 2023 aerials, the R410 road and surrounding land use has remained unchanged. Between 2020 and 2023 there has been the addition of a single house dwelling and planting of trees, as shown in Figure 5-3. Within the Site boundary, there was re-growth of vegetation over the screening berms, constructed at the western access point to the Site in order to create a buffer to the gas main running through the Site. There has also been changes to the internal site track layout at this access point. A berm and buffer to segregate a silt pond located north of the Site was developed during 2020 and the pond was closed off by the October 2023 aerial. The silt pond to the southeast of the process area can be seen to be filling during the assessment period. This silt pond is in an area where shallow sands and gravels had been extracted down to the competent bedrock.

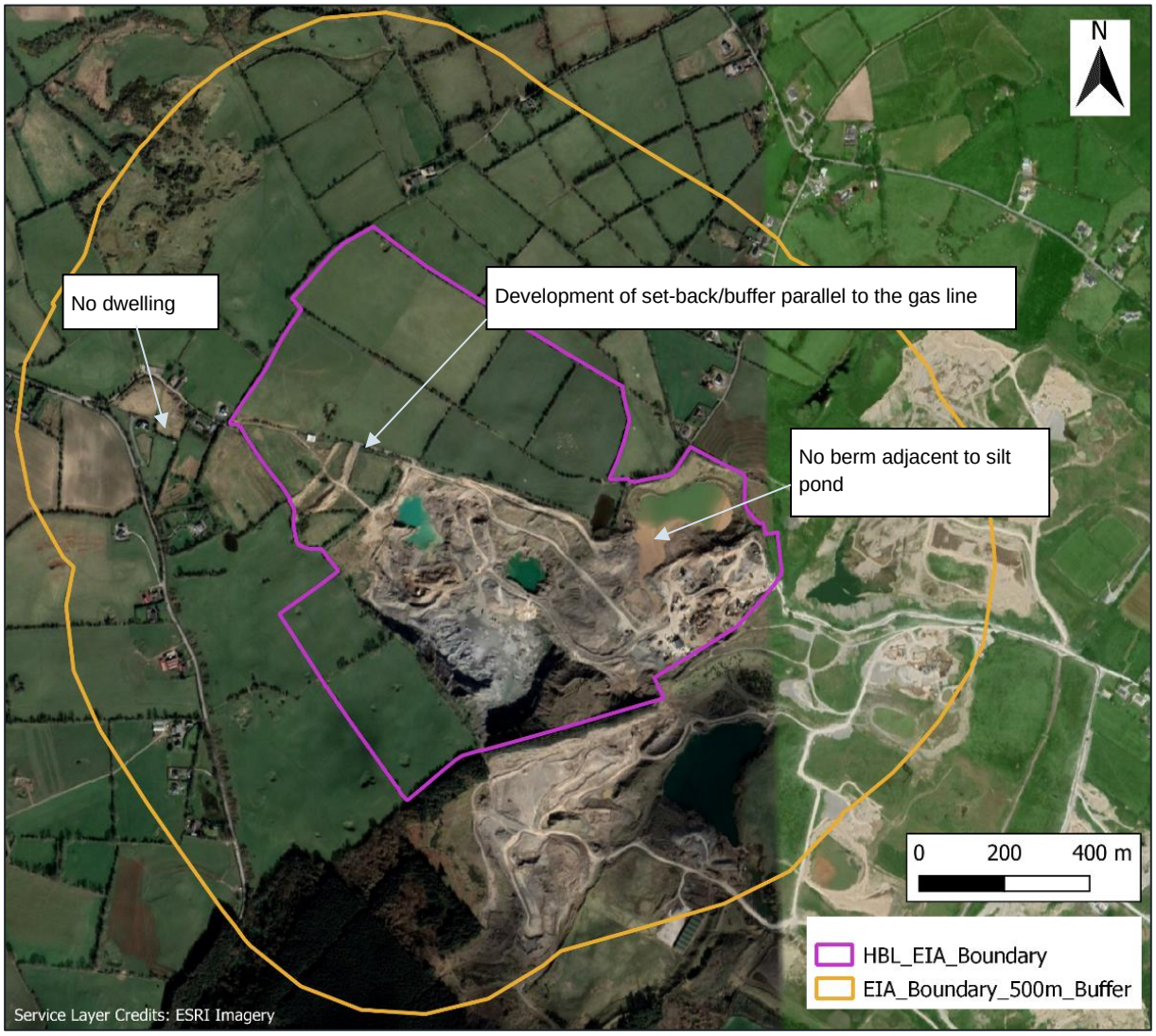

Figure 5-2 - Land Use in March 2020 with 500 m Site Buffer

Figure 5-3 - Land Use in October 2023 and March 2022 with 500 m Site Buffer

5.4.1.2 Changes in Quarry Area

The quarry area and surrounding land is presented for available imagery in Figure 5-4, Figure 5-5, Figure 5-6, Figure 5-7 and Figure 5-8 below, with the outline of the quarry depicted. Approximate areas of change have been calculated below for the purposes of the assessment in this chapter. These areas occur within the Substitute Consent application boundary. The quarried area remained consistent between March 2020 and March 2022 at ca. 37.3 ha (0.373 km^2). This is due to quarrying focusing on removal of the previously blasted greywacke rock in the centre of the quarry. There is then an increase in quarry area to ca. 37.8 ha (0.378 km^2) in January 2023 (Figure 5-7) and a further increase to ca. 38.8 ha (0.388 km^2) in October 2023 (Figure 5-8). This increase in area is associated with expansion within the northwest corner of the Site boundary, with digging of the sands and gravels. Digging did not occur outside of the Site boundary over the reporting period.

Figure 5-4 – Quarry Area During March 2020 from Google Earth Imagery

Figure 5-5 – Quarry Area During June 2020 from Google Earth Imagery

Figure 5-6 - Quarry Area During March 2022 from ESRI World Imagery

Figure 5-7 - Quarry Area During January 2023 from Drone Survey

Figure 5-8 - Quarry Area During October 2023 from Drone Survey

5.4.1.3 Quarry Elevations

Detailed elevation data from within the quarry is available from surveys over the review period. The January 2023 and October 2023 surveys are presented in Figure 5-10 and Figure 5-11 respectively. As a baseline comparison, these are compared to the elevation contours from a survey in February 2019 (Figure 5-9). Note that the February 2019 contours are presented alongside the March 2020 aerial photography, so have some discrepancies.

The elevation contours in February 2019, prior to the review period, show that the deepest part of the quarry was at 190 mAOD, in the location of Pond K2 in the northern corner of the quarry. The central area, excavated into the greywacke bedrock had an elevation of 201 mAOD.

The elevation contours from the January 2023 survey show that the deepest part of the quarry was at 190 mAOD, in the location of Pond K2 in the northern corner of the quarry. This shows that extraction activities did not deepen this section of the quarry in the four years since the February 2019 aerial. Excavation of greywacke bedrock in the central and southern sections of the quarry lowered the floor to 195 mAOD.

In the latest October 2023 survey, the deepest part of the quarry is currently at 188 mAOD, in the centre of the quarry within the greywacke bedrock. The elevation of 192 mAOD in the vicinity of Pond K2 is the result of increased surface water following heavy rainfall. There is therefore little change in geometry in this part of the quarry.

It is estimated that ca. 1 Mt of rock and sand and gravel was excavated from the Site each year over the review period.

The potential impacts on groundwater from excavation of the bedrock to the 188 mAOD level are addressed in Chapter 6.0 Water of this rEIAR. It should be noted however, that the water table was not encountered with extraction of rock to this depth.

Figure 5-9 - Survey Contours February 2019 and Imagery March 2020

Figure 5-10 - Survey Contours and Imagery January 2023

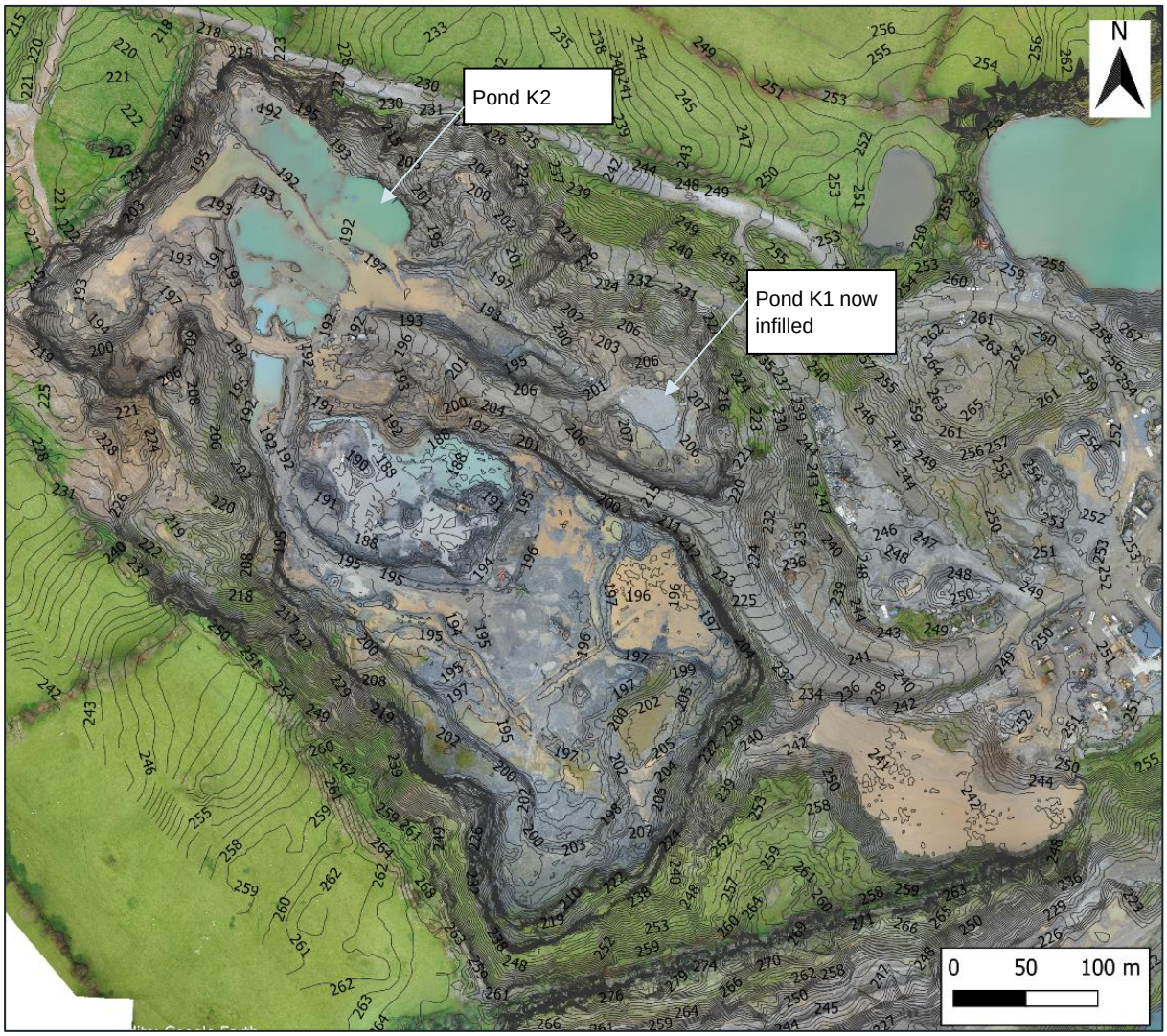

Figure 5-11 - Survey Contours and Imagery October 2023

5.4.2 SUPERFICIAL GEOLOGY (SOIL AND QUATERNARY SEDIMENTS)

There are limited soils remaining in-situ in the existing extraction area due to the ongoing extraction activities onsite. The process plant is composed of made ground (e.g. concrete pads, hard standing and concrete foundation areas for the plant area) overlying natural ground (soils). The areas north and west of the Site containing agricultural fields are underlain by natural ground.

A review of the EPA's online map viewer (EPA, 2023) maps soil cover over the entire Site area (Figure 5-12), however, as stated previously this soil map is more representative of the original baseline soils prior to activities within the extraction area.

Teagasc have designated the dominant soils underlying the Site as being shallow well drained mineral soils derived from mainly basic parent materials (BminSW).

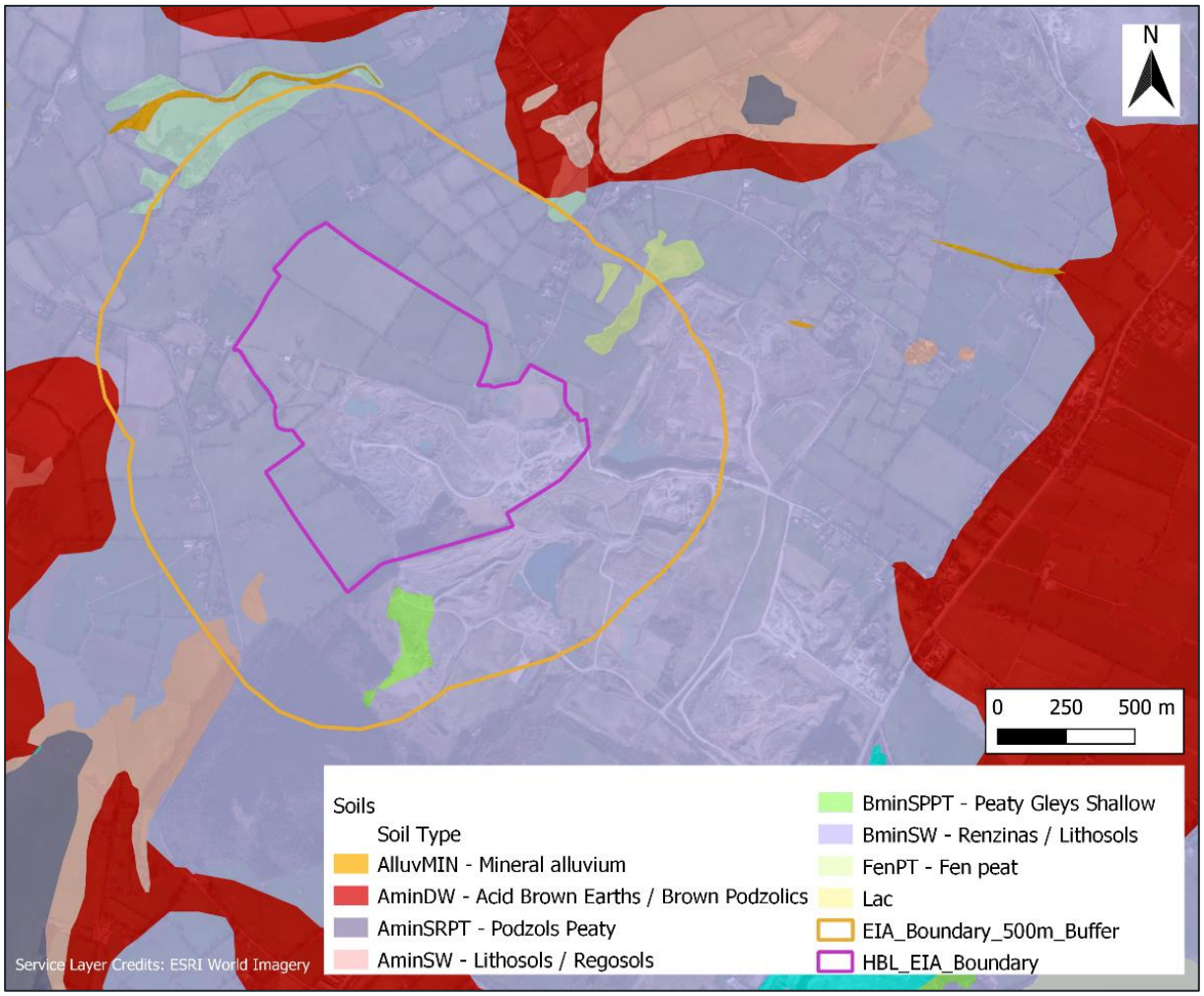

Figure 5-12 - Soil Mapping (EPA, 2023) overlain on the March 2022 Aerial

The Site and surrounding region are covered in glacial deposits (Figure 5-13) ranging from tills to glaciofluvial sands and gravels with glaciolacustrine deposits near the Poulaphouca Reservoir (GSI, 2003). The drift deposits across the Site were laid down during the Quaternary Period. The Quaternary Period is the final or upper period of the Cenozoic and marks the period of the Ice Age which began about 1.6 million years ago, and the postglacial period which extends to the present day. Most of the drift material was laid down directly from the margin of the ice sheets as they moved across the land or by glacial melt waters from the retreating ice sheets. Regionally there appears to be no pattern or trend to drift thickness.

The dominant sediment in the area is gravel; the largest accumulation of gravel occupies an area of ca. 7.5 km^2 on both sides of the Wicklow/Kildare county boundary, just north and west of Blessington (GSI, 2003). Glacial and fluvial deposits are generally thick in the area; deposits are commonly greater than 30 m in thickness and reach thicknesses of greater than 70 m in the Blessington and Curragh areas. North of Blessington a small area is covered by a chert-rich till, which is characterised by a clayey and silty matrix containing limestone and shale clasts. The glaciofluvial sand and gravel deposits to the north and west of the Poulaphouca Reservoir have thicknesses of up to 14 m and locally overlie gravely deposits. To the west, south and east of

Blessington there are lower Palaeozoic tills characterised by a generally silty to silty sandy texture (GSI, 2003).

Locally, the Quaternary deposits across the Site increase in thickness to the southwest. Borehole logs from the Site indicate the drift thickness ranges from ca. 5 to 6 m (BH8K and BH2K respectively) to the north of the Site to ca. 41 to 43.5 m (BH9K and BH6K) to the southwest of the Site. The borehole logs indicate that the Quaternary deposits consist of unsorted materials, comprising sand, gravel, clay and siltstone with some limestone clasts encountered to the northeast of the Site.

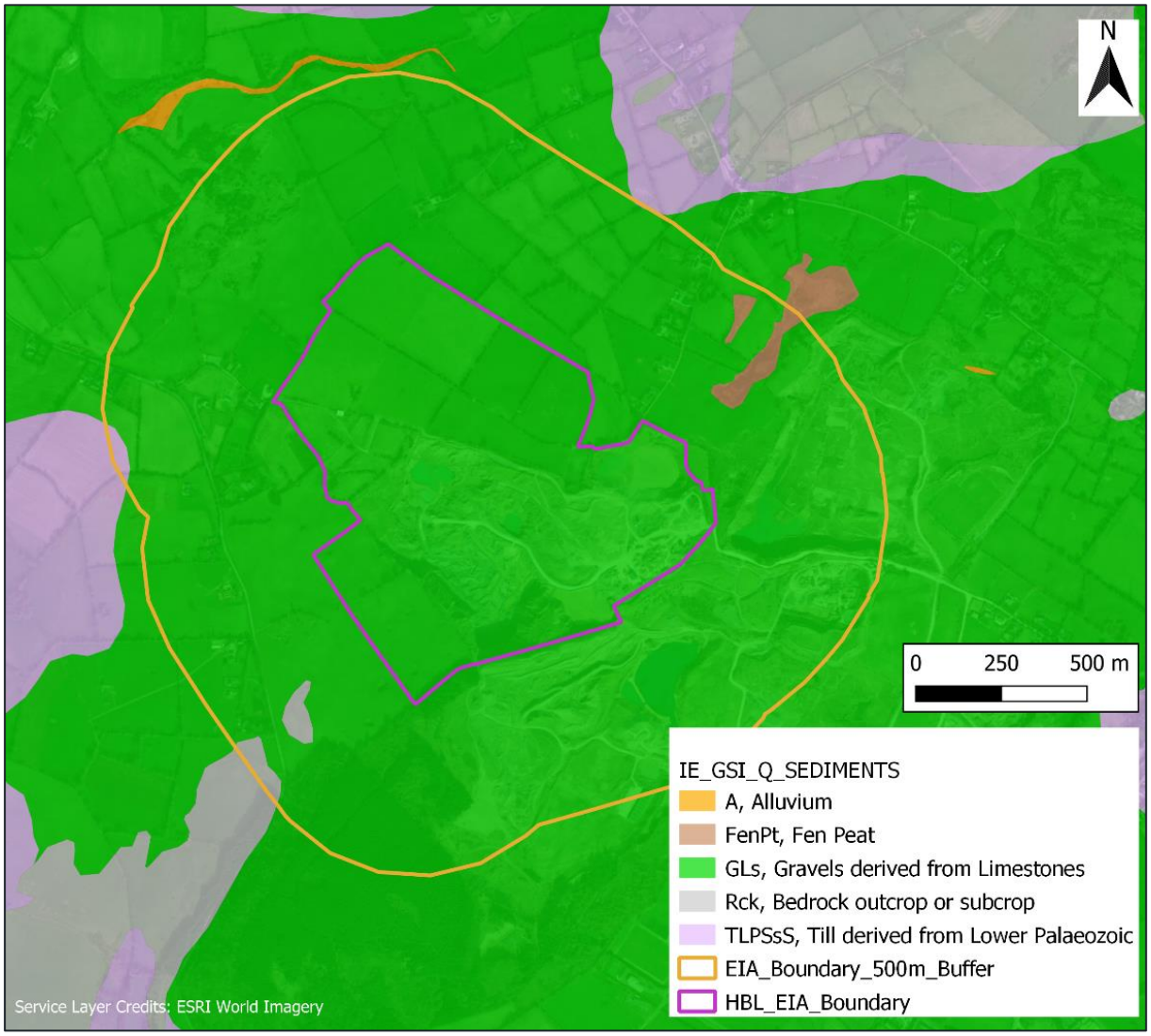

Figure 5-13 - Underlying Quaternary Sediments (subsoil) (GSI, 2022) overlain on the March 2022 Aerial

5.4.3 BEDROCK GEOLOGY

The underlying bedrock geology in the region comprises of sedimentary rocks and low-grade metamorphic rocks of the Kilcullen Group. The Kilcullen Group rocks are Silurian in age and are divided into five formations, two of which are present underlying the Site (the Glen Ding Formation to the west and Slate Quarries Formation to the east) (Figure 5-14).

The Glen Ding Formation consists of dark green to grey greywackes and shales making up Bouma ‘a’ and ‘b’ turbidite units that are distinctly more chloritic and fledsphatic than the other formations, probably accounting for a regional lithogeochemical contrast across the Slate Quarries Formation-Glen Ding Formation contact.

The Slate Quarries Formation consists of predominantly dark grey slate, with minor interbedded greywackes. The greywackes consist of Bouma "ae" turbidite units, with "a" intervals generally finer-grained than in the Pollaphuca Formation which occurs further to the east.

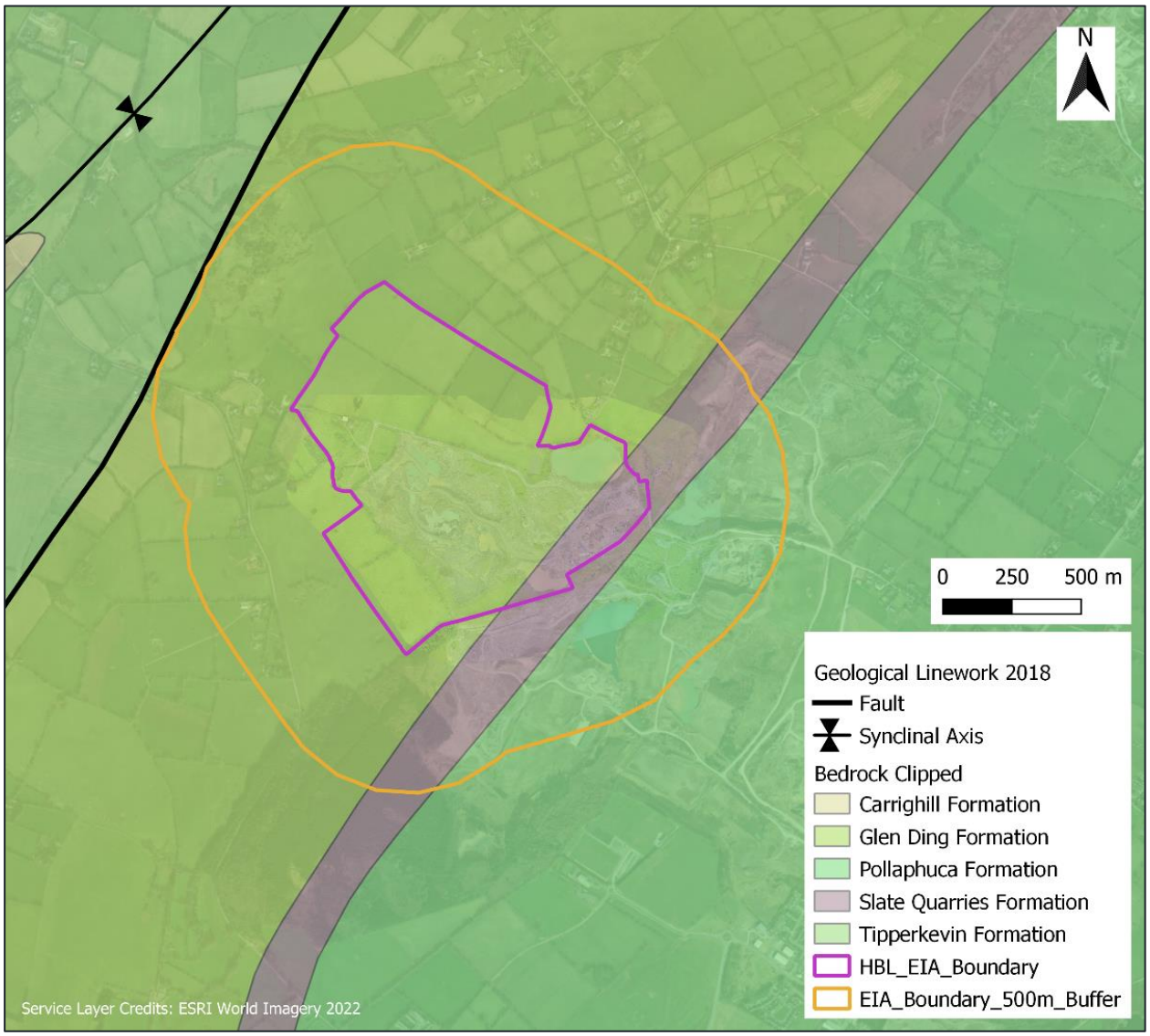

Figure 5-14 - Underlying Bedrock Geology (GSI, 2022) overlain on the March 2022 Aerial

5.4.4 SITE INVESTIGATIONS

The locations of the existing and damaged monitoring wells over the assessment period are presented in Figure 5-15, alongside bedrock elevations (mAOD) for each existing well. The survey details of the monitoring wells are presented in

Table 5-5 and a summary of the monitoring well findings is presented in Table 5-6, with individual borehole logs provided in Appendix 5A.

Two monitoring wells (BH9K and BH10K) were installed by HBL during the assessment period (installed early September 2023). BH9K encountered a 41 m thick sand and gravel unit, indicating that the Quaternary deposits are deeper than previously understood to the west of the Site. BH10K encountered 18 m of sands and gravels above bedrock, which indicates that the thickness of the Quaternary deposits is highly variable over short distances, as they are 43.5 m thick in BH6K, 510 m to the northeast. The previous EIAR assessment (Golder, 2020), stated that the bedrock interface appears to be relatively flat, possibly dipping gently eastwards. With the addition of BH9K and BH10K, the bedrock is shown to dip in a more westerly to south-westerly direction (from BH2K and BH4K), with an elevation change of 52 m over 885 m from BH2K to BH9K. The elevation of bedrock in BH7K (218.4 mAOD) confirms that the bedrock also dips to the east (as in the previous assessment), with BH4K forming the bedrock high within the quarried area. The overlying quaternary deposits thicken into neighbouring developments and towards the Poulaphouca Reservoir to the southeast.

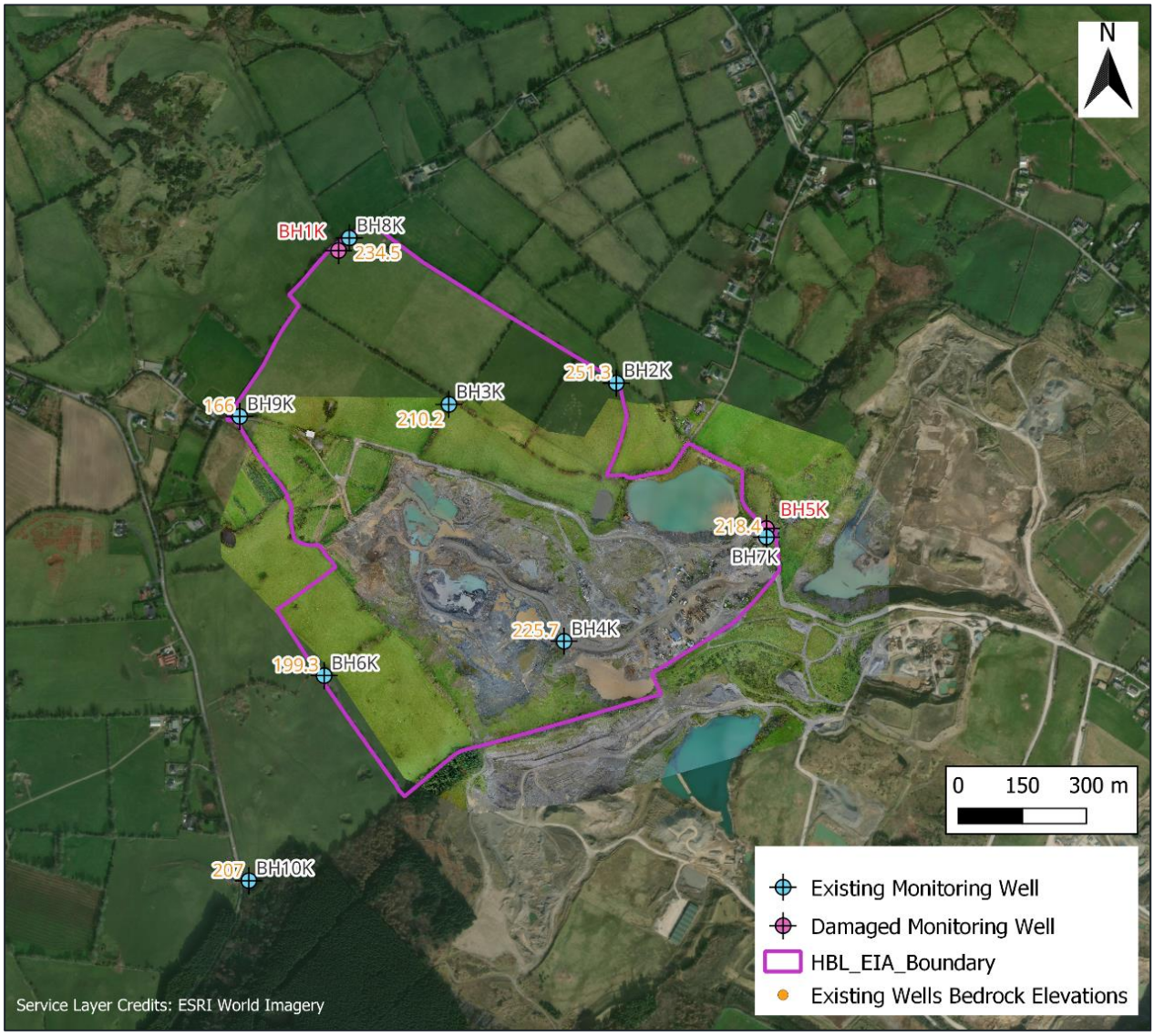

Figure 5-15 - HBL Monitoring Wells and Bedrock Elevations (orange text, mAOD)

Table 5-5 – Monitoring Well Locations

Monitoring Well ID	Easting (ITM)	Northing (ITM)	Ground Elevation (m AOD)
BH1K (damaged)	696604	717378	236.61
BH2K	697261	717082	257.27
BH3K	696870	717024	229.24
BH4K	697151	716476	229.19
BH5K (damaged)	697620	716749	263.48
BH6K	696591	716385	242.82
BH7K - replaces BH5K	697620	716729	263.38
BH8K - replaces BH1K	696629	717408	239.48
BH9K	696381	716986	205.53
BH10K	696424	715902	224.90

Table 5-6 – Monitoring Well Construction and Lithology

Monitoring Well ID	Monitoring Well Depth (m)	Depth to Base of Overburden (m)	First Water Strike Depth (m)	Lithology Interval Summary (m)
BH1K (damaged)	19.0	< 0.3	16.0	< 0.3 Overburden < 0.3 – 3.0 Sands & Gravels 3.0 – 19.0 Siltstone
BH2K	34.0	2.0	26.0	0.0 - 2.0 Overburden 2.0 - 6.0 Sands & Gravels 6.0 - 34.0 Greywacke
BH3K	19.0	3.0	12.6	0.0 - 3.0 Overburden 3.0 - 19.0 Sands & Gravels
BH4K	>100	3.5	20.6	0.0 - 3.5 Sands & Gravels 3.5 - 100.0 Greywacke
BH5K (damaged)	34.0	2.0	N/A	0.0 - 2.0 Overburden 2.0 - 32.8 Sands & Gravels 32.8 - 34.0 Greywacke
BH6K	59.0	2.0	51.0	0 - 2.0 Overburden 2.0 - 43.5 Sands & Gravels 43.50 - 59.0 Greywacke
BH7K	63.0	2.0	48.0	0 - 2.0 Overburden 2.0 - 45.0 Sands & Gravels 45.0 - 63.0 Greywacke
BH8K	25.5	< 0.3	18.5	< 0.3 Overburden < 0.3 - 5 Sands & Gravels 5.0 - 25.5 Siltstone

BH9K	61	0.5	52	0 - 0.5 Overburden 0.5 – 41 Sands & Gravels 41 – 61 Siltstone
BH10K	36	1.0	31	0 - 1.0 Overburden 1.0 - 18.0 Sands & Gravels 18.0 - 36.0 Greywacke

5.4.5 GEOLOGICAL ASSETS AND HERITAGE

The GSI have published a list of Geological Heritage Sites in Co. Kildare, these sites are also reflected in the Kildare County Development Plan. The Site lies adjacent to 3 Geological Heritage Sites (1 in Kildare and 2 in Wicklow):

- KE006 Glen Ding: Dry Glacial Channel: A heavily wooded glacial spillway displaying a pronounced curved channel running approximately northeast-southwest along the R410 road for about 1.5 km,
- WW022 Glen Ding: Deep Channel formed by Meltwater Erosion: Glen Ding is up to 50 m deep and has a U-shaped profile, typical of meltwater channels,
- WW012 Blessington Delta: A large accumulation of sands and gravels which has been quarried extensively. A high, striking example of a dry sand and gravel ridge, standing proud of the surrounding landscape.

Further consideration has been given to the Blessington Delta as it is immediately adjacent to the Site along its southern boundary. The Blessington Delta, as defined by the GSI (2014) is approximately 5 km long and up to 1.5 km wide. It is described as a “large accumulation of sands and gravels, which has been quarried extensively”. It is noted by the GSI as a Geological Heritage site (site code WW012) and is proposed to be a Natural Heritage Area. However, a review of the National Parks and Wildlife Service (NPWS) data notes it is not yet formally classed as either a proposed Natural Heritage Area or Natural Heritage Area. Figure 5-16 below shows the Blessington Delta in relation to the Site. The delta lies largely within neighbouring quarries and Glen Ding Woods to the south and does not extend within the Site boundary. Glen Ding is also noted as a Geological Heritage area, however, there is little exposure of this ‘dry glacial channel’ due to high levels of vegetation and the abundance of glacial sediment (GSI 2014).

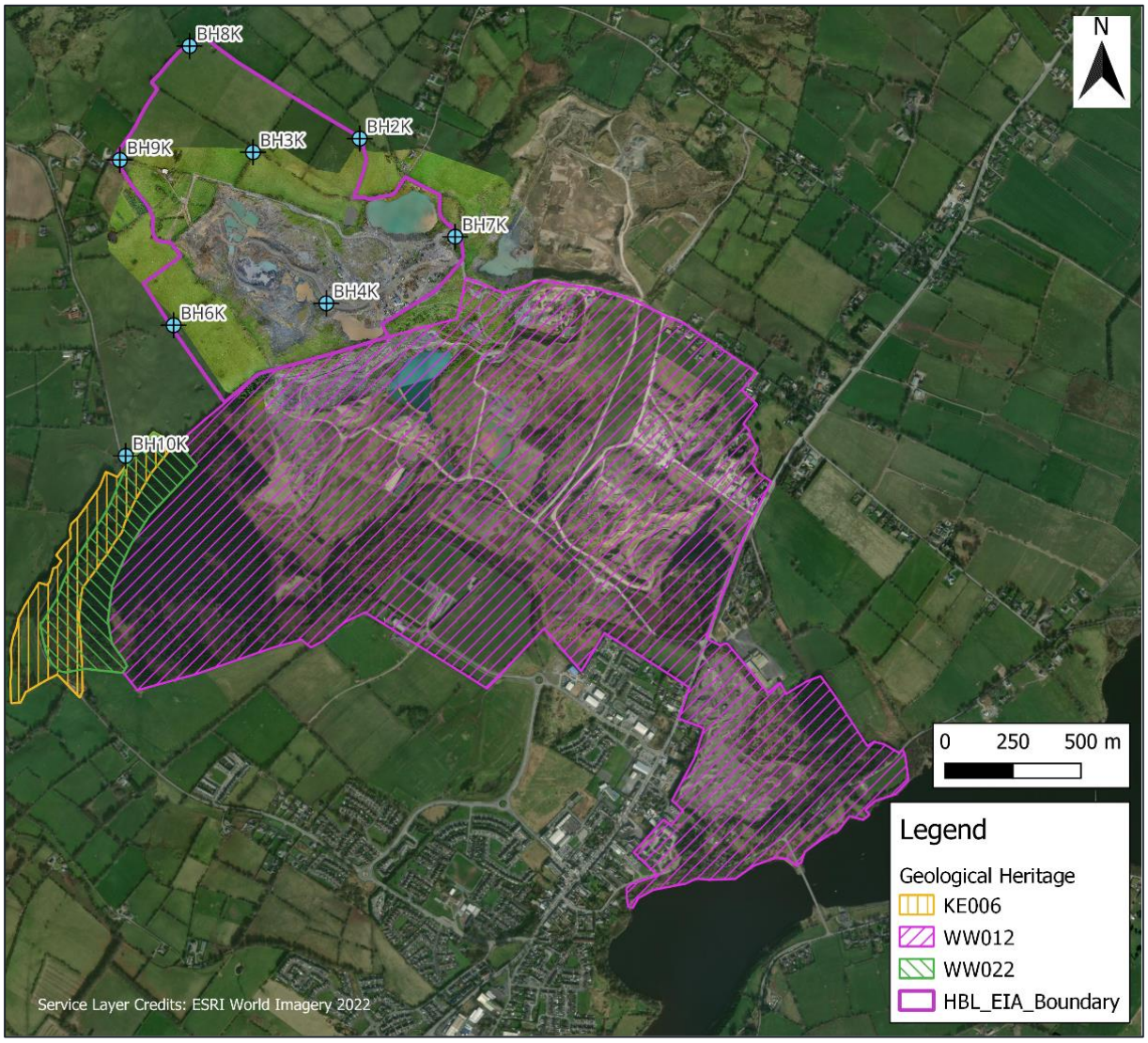

Figure 5-16 - Geological Heritage Sites (GSI 2023)

5.4.6 GEOHAZARDS

A review of the GSI's landslide susceptibility classification layer (GSI, 2023) indicates that the Site is in an area of low seismic activity and the importance of this attribute is considered to be Low.

The risk of instability of soils and/or bedrock which would result in a partial collapse of material can occur in a quarry environment.

Toe protection (catch-berms) is required to be put in place along the bottoms of non-active/production faces. Non-active/production faces should have their access blocked off with berms/bunds and relevant warning signage.

Silt from the water treatment plant is deposited in a silt pond located in the southern part of the quarry. The silt pond is located where the competent greywacke bedrock is at its shallowest (3.5 m deep at BH4K). The silt pond has been previously excavated down to the depth of the competent bedrock. The pond is allowed to overflow to the base of the quarry to help prevent against over-filling. The silt naturally lines the pond, preventing water from seeping into the surrounding superficial deposits or bedrock, which has the potential to lead to instability issues. The silt pond

overflow is set within competent bedrock and the bedrock dips gently to the southeast, away from the quarry edge, helping to negate any instability risks.

The extraction plan has incorporated industry standard for slope design, thus mitigating any potential geotechnical / geohazard risks and the existing quarry is well maintained and managed. Therefore, the magnitude of the impact is considered to be Negligible.

Further assessment of geotechnical hazards has been provided in Section 14.0 (Major Accidents and Disasters) of this rEIAR.

5.4.7 RADON

The Radon Map for Ireland (EPA, 2023) indicates that the Site and study area are located in an area where 1 in 10 homes are estimated to be above the radon reference level. A High Radon Area is classified by the EPA as any area where it is predicted that 10% or more of homes will exceed the Reference Level of 200 becquerel per cubic metre (Bq/m3). As radon is a naturally occurring gas derived from the decay of uranium in rocks and soils which is geologically controlled, the radon reference level during the assessment period is unlikely to have differed from the current reference level.

5.5 SELECTION OF SENSITIVE RECEPTORS

The changes in land use (Section 5.4.1) during the assessment period show that only ca. 1.5 ha of land was disturbed outside of the baseline quarry footprint from March/June 2020, and within the permission boundary for the KCC Reg. Ref.: 07267 application. This land was mostly on the fringes of the quarry and not used for agriculture. All the extraction over the period remained within the Site boundary.

The topsoil is very thin, of low importance and has low economic value and has largely been removed from the quarried area prior to the assessment period.

The superficial deposits and bedrock geology beneath the Site are of medium/high economic value, both locally and regionally. The area is designated by Aggregate Potential Mapping (GSI, 2016) as being of ‘Very High’ crushed rock aggregate potential and therefore provides a valuable economic resource. Superficial and bedrock geology was removed with quarrying. However, the bedrock had no special designation and is common in the area.

Human receptors within the area (including workers onsite) had the potential to be impacted by the activities, which have occurred onsite and will be considered in the context of the human health receptor.

Geological heritage areas are mapped adjacent to the Site boundary. There is potential for the units associated with these sites to extend beyond the mapped boundary. There are both positive and negative impacts in exposing geologically important sequences. A positive indirect impact is that the sequence could be recorded and studied further, bolstering existing knowledge for a site deemed to be one of the most glacially important sites in Ireland. Uncovering the sequences could also be considered a negative indirect impact, as part of the sequence would be removed and lost during extraction activities. Importance of this feature is low as extraction largely took place within the bedrock that underlies the Blessington Delta heritage feature, composed of Quaternary deposits.

Table 5-7 – Soil, Land and Geology Receptors

Receptor	Importance and Reasoning
Land (agricultural land) including quality and use	Low (no designation, low potential and value for agricultural uses)
Topsoil at the Site and within the study area	Negligible (no designation, no rarity, local importance)
Superficial deposits (sands and gravels) at the Site and within the study area	Medium (no designation, no rarity, medium/high economic importance)
Bedrock Geology at the Site and within the study area	Medium (no designation, no rarity, medium/high economic importance)
Human health at the Site and within the study area	High (human health receptor)
Geological Heritage	Low (Associated with Quaternary deposits and designated areas)

5.6 CHARACTERISTICS OF THE DEVELOPMENT

The current Substitute Consent application consists of a quarry over an area of ca. 71.9 ha, with and internal operational area of ca. 38.8 ha (includes extraction area, processing plant, silt pond and welfare facilities) with a current depth of approximately 188 mAOD into the greywacke rock.

Over the assessment period, the extraction area within the quarry expanded by ca. 1.5 ha, from ca. 37.3 ha in March 2020 to ca. 38.8 ha in October 2023, with extension into the sands and gravels in the northwest corner of the quarry. The depth of the central quarry floor increased from 201 mAOD in 2020 to 188 mAOD with extraction of the greywacke bedrock. The northern corner of the quarry (in the vicinity of Pond K2) remained at 190 mAOD over the review period. Deepening of this section of the quarry is unlikely due to the accumulation of surface water.

The sands and gravels were dug with excavators, whilst the previously blasted rock was broken up and extracted by a mechanical digger (excavator), in line with current EPA and DCCAE Guidelines.

The excavated sands and gravels were washed, screened, and processed through a fixed closed-circuit aggregate processing plant, located in the eastern part of the Site. Processed sand and gravel continued to be stockpiled adjacent to the aggregate plant prior to being transported to market by road going trucks.

The excavated rock material continued to be processed on the quarry floor by mobile crushing, screening, and associated plant before being stockpiled into specific graded aggregate stockpiles. Crushed rock aggregate was transported to market by road going trucks.

Blasting of rock was not undertaken over the assessment period. Excavation into the sands and gravels and bedrock remained above the water table, with no requirement for dewatering (as discussed in Chapter 6.0 Water).

5.6.1 EMBEDDED MITIGATION

The initial assessment of the significance of potential effects resulting from the Development takes into consideration any embedded design and implemented Site management practices undertaken

during the assessment period of September 2020 to present. The elements of the Development design and good working practices that reduce the potential for impacts to soils and geology included the following:

- Site operations are managed with relevant health and Safety legislation (Safety, Health & Welfare at Work Act (2005, as amended); and the Mines and Quarries Act (1965, as amended)) and subsequent Quarries Regulations relating to safety health and safety, training, appropriate site management;
- Fencing is actively maintained at the Site to ensure that the risk of injury to people and livestock is minimised. The entrance gate is locked and controlled by management;
- Exposed edges in the quarry are protected with safety berms;
- Wheel wash for all vehicles exiting the quarry and sweeper cleaning the roads;
- Generators are maintained regularly, and any leakages are repaired;
- Refuelling and the addition of hydraulic oils or lubricants to vehicles or generators takes place on-site in designated areas. All plant and machinery are serviced regularly; and
- Extraction to remain above the water table to avoid the requirement for dewatering.

5.7 POTENTIAL EFFECTS

The main potential impacts and associated effects that are considered and assessed in the following sections relate to:

Activities or events that might have impacted land quality (e.g. leaks and spills from machinery or stored substances, or discharges);
Change of land use/land take (i.e. loss of agricultural lands);
Loss of superficial deposits and bedrock;
Destabilisation and/or subsidence of unconsolidated soils, sub-soils or rock faces; and
Activities that have led to loss or exposure of geological sequences associated with heritage sites.

5.7.1 LAND QUALITY

Fuel and other substance leaks or spills from stored substances or from machinery/equipment used during development could have affected the chemistry of the soil (where it was still in-situ) or infiltrated the groundwater through the sands and gravels or bedrock.

A review of water quality during the assessment period (refer to Chapter 6.0 Water) indicates that groundwater quality is generally good. In this Chapter, the magnitudes associated with the potential impacts at the Site were assigned as *Negligible* due to:

- Low or undetected concentrations of hydrocarbons in groundwater throughout the review period. Low levels of hydrocarbons detected but proven to be due to cross-contamination with sampling technique, rather than migration of hydrocarbons within the groundwater from the Site. Hydrocarbons remained undetected in surface water throughout the review period,
- No off-site connectivity of surface water due to it being captured during the assessment period in Pond K and Pond K2 for recycling and use on Site in processing and at the maintenance shed. Surface water is only lost to evaporation or infiltration into the sands and gravels / bedrock aquifers and not removed from the Site.

- Limited off-site connectivity of groundwater as quarrying has not encountered the significant water strikes associated with the water table within the bedrock. Isolated pockets of perched groundwater are likely to have been intercepted in the sands and gravels and bedrock.
- River Waterbody WFD Status for 2016-2021 ranging from Good to Poor for the River Morell. However, there were no exceedances of surface water EQS threshold values for inland waters and generally good quality of water in the River Morell observed throughout the review period (Appendix 6A of Chapter 6.0, Water)

5.7.2 CHANGE OF LAND USE / LAND TAKE

Land in the immediate vicinity of the Site is either agricultural (pastoral) or used for quarrying. There is ca. 45 ha of land used for agriculture within the Site EIA boundary. The Kildare County Development Plan 2023-2029 indicates that 113,765 ha of land is farmed in Kildare with a significant fall off in agricultural employment over the past number of years (Kildare County Council, 2023). The importance of this attribute is therefore considered to be *Low*.

There was the extension of quarrying activities to the northwest of the main pit, into the sands and gravels. This totalled an area of 1.5 ha over the review period. This land was within the Site boundary and was not used for agriculture at the beginning of, or within the review period.

Any removed topsoil has been stored in screening berms and mounds. Landscaped berms to the northwest of the Site have been shown to become re-vegetated by the end of the reporting period. The magnitude of the impact on land use is therefore considered to be *Negligible.*

5.7.3 LOSS OF SUPERFICIAL DEPOSITS AND BEDROCK

Topsoil within the Site boundary was used in the creation of screening berms and will be stored and reused during the restoration process to create biological diverse habitats. The impact on the topsoil can therefore be considered temporary in nature and is *Low (adverse).*

By the nature of quarrying, the sub-soil as sands and gravels and greywacke bedrock were removed with quarrying, which resulted in a direct and irreversible impact on the Site. However, the removed material has a medium to high resource potential and will be used in future construction projects. Over the review period there has been a fairly low volume of sands and gravels removed, the impact of this is therefore *Low*. Over the review period, there appears to be a higher removal of bedrock. The impact of this is therefore *Medium* (Table 5-8).

The Site is in an area of high economic geology and the importance of this attribute is considered to be high (beneficial), in terms of provision of jobs to the local workforce and boost to the economy.

5.7.4 GEOTECHNICAL INSTABILITY

The Site is in an area of low seismic activity and the importance of this attribute is considered to be Low.

There were no geotechnical incidents, which would include collapse of a wall or surface, recorded over the review period. Therefore, the magnitude of the impact is *Negligible*.

5.7.5 GEOLOGICAL HERITAGE

The heritage sites to the south of the Site are associated with the Glen Ding Channels and Blessington Delta, comprised of deep sequences of Quaternary deposits. The Development had no

direct impacts on the Blessington Delta or Glen Ding Channels as extraction activities did not extend into the designated areas. Therefore, the magnitude of the impact is *Negligible*.

There have not been any indirect impacts on the heritage sites with uncovering of associated sequences within the Site boundary. Mining activities within the bedrock over the reporting period occurred at ca. 200 m from the designated sites and the bedrock underlies the sequences of interest. Mining activities within the Quaternary deposits (which have the potential to host the associated sequences) occurred at ca. 400 m from the designated sites, in the western corner of the Site. No sequences associated with heritage sites were uncovered with removal of the sands and gravels. With future progression of quarrying activities, exposed faces are to be assessed for potential heritage site sequences.

5.7.6 EVALUATION OF EFFECTS

The evaluation of effects considers the predicted impact magnitude combined with receptor sensitivity. The evaluation of effect significance for each of the receptors (taking account of embedded mitigation) discussed above is presented in Table 5-8. Table 5-8 only includes those sources of impact that may result in a low to high initial impact magnitude. Land quality, human health, geohazards and geological heritage are therefore not included in the table.

Table 5-8 – Evaluation of Impacts and their Effect Significance taking into account embedded mitigation

Receptor	Sensitivity	Source of Impact / Description of Change	Impact Magnitude	Level of Effect
Land (agricultural) use	Low	Change in land use by the advancement of the extraction area	Negligible	Imperceptible
Topsoil at the Site and within the study area	Negligible	Removal of topsoil at the Site	Low	Imperceptible
Superficial deposits (sub-soils) at the Site and within the Study Area	Medium	Removal of superficial deposits at the Site	Low	Slight
Bedrock Geology at the Site and within the study area	Medium	Removal of bedrock at the Site	Medium	Moderate

5.8 REMEDIAL MEASURES REQUIRED

There are no effects on the land, soils and geology from the activities on the Site that require remedial measures.

5.9 RESIDUAL EFFECTS

The assessment concludes that the existing Development has not given rise to significant adverse effects on the land, soil or geology at or surrounding the Site during the assessment period of September 2020 to present. In all cases the residual adverse effect is Not Significant and not greater than Slight.

5.10 CUMULATIVE EFFECTS

There are no cumulative impacts on the land, soils and geology envisaged in terms of the activities at the Site over the reporting period.

Cumulatively, the potential impacts of quarrying at the Site on the Blessington Delta are considered to be imperceptible based on current data (the known Geological Heritage area) and the extraction of the bedrock, which isn't part of the Blessington Delta sequence. There is however the possibility that neighbouring quarrying activities adjacent to the Site have impacted the geological heritage sequences as they are situated within the Blessington Delta site.

5.11 MONITORING

The ongoing monitoring programme at the Site will include regular stability surveys of the quarry faces and the silt pond. Monitoring of groundwater quality in monitoring wells and water quality within artificial ponds will be conducted quarterly. Drone surveys will be conducted when necessary to determine quarried depths and extents are consistent with those planned and approved.

5.12 SUMMARY AND CONCLUSIONS

This assessment considers the potential impacts and effects on the land, soils and geology over the review period from September 2020 to present.

The main receptors that could be affected by changes to the land, soils and geology due to the Development through the review period were identified and potential effects were assessed. A Slight residual level of affect with the removal of rock and sands and gravels is attributed. This removal of economically valuable material is inherent with any quarrying activity.

Known design and embedded mitigation measures were considered during the initial assessment of impacts and effects.

5.13 REFERENCES

EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Reports, Environmental Protection Agency (May 2022).

Guidelines to the Safety, Health and Welfare at Work (Quarries) Regulations 2020

Golder 2020. Revised EIAR and NTS

EPA online map viewer (EPA, 2023)

GSI online map viewer (GSI, 2023)

Aggregate Potential Mapping online map viewer (GSI, 2016)

Appendix 5A

BORELOGS

GOLDER

Client : Hudson Brothers Ltd

Hole No. **BH1K**

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started : 18/01/2006 **Completed :** 18/01/2006

Logged by : GB

Ground Level (mAOD) :

Co-ordinates : E 696604.2 N 717377.9

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
							(3.00)	Dark brown slightly moist sandy gravelly TOPSOIL
							3.00	
							(3.00)	Grey argillaceous SILTSTONE
							6.00	
							(4.00)	Very weathered dark grey argillaceous SILTSTONE
							10.00	
▼1							(9.00)	Weathered dark grey SILTSTONE Groundwater encountered at 16m bgl.
							19.00	*End of Hole at 19.00m*

Remarks :
Bedrock at 3m bgl.
Groundwater encountered at 16m bgl.
End of hole at 19m bgl.
Installation: 0 - 11m bgl plain, 11 - 19m bgl slots.

Checked By: BB

Scale 1:100

GAUKENV+GEO(1) April 2008

GOLDER

Client : Hudson Brothers Ltd

Hole No. **BH2K**

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started : 16/01/2006 **Completed :** 16/01/2006

Logged by : GB

Ground Level (mAOD) : 257.27

Co-ordinates : E 697261.3 N 717081.8

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
					255.27		(2.00) 2.00	Light brown damp sandy CLAY
					251.27		(4.00) 6.00	Grey mottled brown sandy gravelly CLAY
							(28.00)	Light grey shattered GREYWACKE. Angular to sub-angular clasts, more rounded with depth.

Remarks :
Bedrock at 6m bgl.
Groundwater encountered at 26m bgl.
End of hole at 34m bgl.
Installation: 0 - 24m bgl plain, 24 - 34m bgl slots.

Checked By: BB

Scale 1:100

GALKEN\+GEO(1) April 2008

GOLDER

Client : Hudson Brothers Ltd

Hole No. **BH2K**

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started : 16/01/2006 **Completed :** 16/01/2006

Logged by : GB

Ground Level (mAOD) : 257.27

Co-ordinates : E 697261.3 N 717081.8

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
								Light grey shattered GREYWACKE. Angular to sub-angular clasts, more rounded with depth.
1								Groundwater encountered at 26m bgl.
					223.27		34.00	*End of Hole at 34.00m*

Remarks :
Bedrock at 6m bgl.
Groundwater encountered at 26m bgl.
End of hole at 34m bgl.
Installation: 0 - 24m bgl plain, 24 - 34m bgl slots.

Checked By: BB

Scale 1:100

GALKENV+GEO(1) April 2008

GOLDER

Client : Hudson Brothers Ltd

Hole No. **BH3K**

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started : 19/01/2006 **Completed :** 19/01/2006

Logged by : GB

Ground Level (mAOD) : 229.24

Co-ordinates : E 696870.1 N 717023.9

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
							(3.00)	Light to dark brown sandy CLAY
					226.24		3.00	
							(3.00)	Brown and grey SAND & GRAVEL
					223.24		6.00	
							(13.00)	Light to dark brown SAND & GRAVEL with angular to sub-angular clasts
1								Groundwater encountered at 12.6m bgl.
					210.24		19.00	
								End of Hole at 19.00m

Remarks :
Bedrock not encountered.
Groundwater encountered at 12.6m bgl.
End of hole at 19m bgl.
Installation: 0 - 11m bgl plain, 11 - 19m bgl slots.

Checked By: BB

Scale 1:100

GAUKEN\+GEO(1) April 2008

GOLDER

	Client : Hudson Brothers Ltd	**Hole No.** **BH4K**
Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare	**Project :** Hudson Bros. Planning and EIAR	**Project No :** 19115799
Equipment & Methods : Unknown	**Contractor :** **Date Started :** **Completed :** **Logged by :** Unknown	**Ground Level (mAOD) :** 229.19 **Co-ordinates :** E 697151.1 N 716476.2

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
							(3.50)	Brown silty sandy Gravel
					225.69		3.50	
								Light grey GREYWACKE

Remarks :
Borehole drilled prior to Golder involvement. Log created from visual inspection of location and adjacent quarry pit geology.
Bedrock encountered at approx. 3.5m bgl.
Groundwater encountered at 20.6m bgl.
End of hole at an unknown depth >100m bgl.
Installation unknown.

Checked By: BB

Scale 1:100

GALKENV+GEO(1) April 2008

GOLDER

Client : Hudson Brothers Ltd

Hole No. **BH4K**

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started : **Completed :**

Logged by : Unknown

Ground Level (mAOD) : 229.19

Co-ordinates : E 697151.1 N 716476.2

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
1								Light grey GREYWACKE Groundwater encountered at 20.6m bgl.

Remarks :
Borehole drilled prior to Golder involvement. Log created from visual inspection of location and adjacent quarry pit geology.
Bedrock encountered at approx. 3.5m bgl.
Groundwater encountered at 20.6m bgl.
End of hole at an unknown depth >100m bgl.
Installation unknown.

Checked By: BB

Scale 1:100

GALKENV+GEO(1) April 2008

GOLDER	Client : Hudson Brothers Ltd	Hole No. **BH4K**
Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare	**Project :** Hudson Bros. Planning and EIAR	**Project No :** 19115799
Equipment & Methods : Unknown	**Contractor :** **Date Started :** **Completed :** **Logged by :** Unknown	**Ground Level (mAOD) :** 229.19 **Co-ordinates :** E 697151.1 N 716476.2

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
							(96.50)	Light grey GREYWACKE

Remarks :
Borehole drilled prior to Golder involvement. Log created from visual inspection of location and adjacent quarry pit geology.
Bedrock encountered at approx. 3.5m bgl.
Groundwater encountered at 20.6m bgl.
End of hole at an unknown depth >100m bgl.
Installation unknown.

Checked By: BB

Scale 1:100

GOLDER

Client : Hudson Brothers Ltd

Hole No. **BH4K**

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started : **Completed :**

Logged by : Unknown

Ground Level (mAOD) : 229.19

Co-ordinates : E 697151.1 N 716476.2

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
								Light grey GREYWACKE

Remarks :
Borehole drilled prior to Golder involvement. Log created from visual inspection of location and adjacent quarry pit geology.
Bedrock encountered at approx. 3.5m bgl.
Groundwater encountered at 20.6m bgl.
End of hole at an unknown depth >100m bgl.
Installation unknown.

Checked By: BB

Scale 1:100

GALKENV+GEO(1) April 2008

GOLDER

Client : Hudson Brothers Ltd

Hole No. **BH4K**

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started : **Completed :**

Logged by : Unknown

Ground Level (mAOD) : 229.19

Co-ordinates : E 697151.1 N 716476.2

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
								Light grey GREYWACKE
					129.19		100.00	End of borehole at an unknown depth >100m bgl.

Remarks :
Borehole drilled prior to Golder involvement. Log created from visual inspection of location and adjacent quarry pit geology.
Bedrock encountered at approx. 3.5m bgl.
Groundwater encountered at 20.6m bgl.
End of hole at an unknown depth >100m bgl.
Installation unknown.

Checked By: BB

Scale 1:100

GALKENV+GEO(1) April 2008

GOLDER

Client : Hudson Brothers Ltd

Hole No. **BH5K**

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started : 16/01/2006 **Completed :** 16/01/2006

Logged by : GB

Ground Level (mAOD) : 263.40

Co-ordinates : E 697619.6 N 716749.2

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
							(2.00)	Dark brown sandy gravelly CLAY
					261.40		2.00	
							(8.00)	Light to dark brown dry SAND & GRAVEL. Gravel is between 10mm and 15mm in size.
					253.40		10.00	
								Light to dark brown dry SAND & GRAVEL. Large gravel being returned.

Remarks :
Bedrock at 32.8m bgl.
Groundwater not encountered.
End of hole at 34m bgl.
Installation 0 - 31m bgl plain, 31 - 34m bgl slots.

Checked By: BB

Scale 1:100

GAUKEN/+GEO(1) April 2008

GOLDER

Client : Hudson Brothers Ltd

Hole No. **BH5K**

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Unknown

Contractor :

Date Started : 16/01/2006 **Completed :** 16/01/2006

Logged by : GB

Ground Level (mAOD) : 263.40

Co-ordinates : E 697619.6 N 716749.2

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
							(22.80)	Light to dark brown dry SAND & GRAVEL. Large gravel being returned.
					230.60		32.80	
							(1.20)	Dark to light grey fine grained GREYWACKE
					229.40		34.00	
								End of Hole at 34.00m

Remarks :
Bedrock at 32.8m bgl.
Groundwater not encountered.
End of hole at 34m bgl.
Installation 0 - 31m bgl plain, 31 - 34m bgl slots.

Checked By: BB

Scale 1:100

GAUKEN\+GEO(1) April 2008

GOLDER

Client : Hudson Brothers Ltd

Hole No. **BH6K**

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Rotary Drill Rig

Contractor : JS Drilling

Date Started : 22/07/2019 **Completed :** 22/07/2019

Logged by : MBD

Ground Level (mAOD) : 242.82

Co-ordinates : E 696590.6 N 716384.7

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
					240.82		(2.00) 2.00	Overburden comprising CLAY
								Interlayered SAND & GRAVEL

Remarks :
Bedrock at 43.5m bgl.
Groundwater encountered at 51m bgl.
End of hole at 59m bgl.
Installation: 0 - 38m bgl plain, 38 - 59m bgl slots.

Checked By: BB

Scale 1:100

GOLDER	Client : Hudson Brothers Ltd	Hole No. **BH6K**
Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare	**Project :** Hudson Bros. Planning and EIAR	**Project No :** 19115799
Equipment & Methods : Rotary Drill Rig	**Contractor :** JS Drilling **Date Started :** 22/07/2019 **Completed :** 22/07/2019 **Logged by :** MBD	**Ground Level (mAOD) :** 242.82 **Co-ordinates :** E 696590.6 N 716384.7

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
							(41.50)	Interlayered SAND & GRAVEL

Remarks :
Bedrock at 43.5m bgl.
Groundwater encountered at 51m bgl.
End of hole at 59m bgl.
Installation: 0 - 38m bgl plain, 38 - 59m bgl slots.

Checked By: BB

Scale 1:100

GAUKEN\+GEO(1) April 2008

GOLDER

Client : Hudson Brothers Ltd

Hole No. **BH6K**

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Rotary Drill Rig

Contractor : JS Drilling

Date Started : 22/07/2019 **Completed :** 22/07/2019

Logged by : MBD

Ground Level (mAOD) : 242.82

Co-ordinates : E 696590.6 N 716384.7

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
								Interlayered SAND & GRAVEL
					199.32		43.50	
								GREYWACKE - reddish brown arisings
▼1							(15.50)	Groundwater encountered at 51m bgl.
					183.82		59.00	
								End of Hole at 59.00m

Remarks :
Bedrock at 43.5m bgl.
Groundwater encountered at 51m bgl.
End of hole at 59m bgl.
Installation: 0 - 38m bgl plain, 38 - 59m bgl slots.

Checked By: BB

Scale 1:100

GAUKEN\+GEO(1) April 2008

GOLDER

Client : Hudson Brothers Ltd

Hole No. **BH7K**

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Rotary Drill Rig

Contractor : JS Drilling

Date Started : 18/07/2019 **Completed :** 18/07/2019

Logged by : MBD

Ground Level (mAOD) : 263.38

Co-ordinates : E 697620.1 N 716729.3

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
					261.38		(2.00) 2.00	Overburden comprising CLAY
								Interlayered SAND & GRAVEL

Remarks :
Bedrock at 45m bgl.
Groundwater encountered at 48m bgl.
End of hole at 63m bgl.
Installation: 0 - 43m bgl plain, 43 - 63m bgl slots.

Checked By: BB

Scale 1:100

GAUKEN\+GEO(1) April 2008

GOLDER	Client : Hudson Brothers Ltd	Hole No. **BH7K**
Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare	**Project :** Hudson Bros. Planning and EIAR	**Project No :** 19115799
Equipment & Methods : Rotary Drill Rig	**Contractor :** JS Drilling **Date Started :** 18/07/2019 **Completed :** 18/07/2019 **Logged by :** MBD	**Ground Level (mAOD) :** 263.38 **Co-ordinates :** E 697620.1 N 716729.3

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
							(43.00)	Interlayered SAND & GRAVEL

Remarks :
Bedrock at 45m bgl.
Groundwater encountered at 48m bgl.
End of hole at 63m bgl.
Installation: 0 - 43m bgl plain, 43 - 63m bgl slots.

Checked By: BB

Scale 1:100

GAUKENV+GEO(1) April 2008

GOLDER	Client : Hudson Brothers Ltd	Hole No. **BH7K**
Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare	**Project :** Hudson Bros. Planning and EIAR	**Project No :** 19115799
Equipment & Methods : Rotary Drill Rig	**Contractor :** JS Drilling **Date Started :** 18/07/2019 **Completed :** 18/07/2019 **Logged by :** MBD	**Ground Level (mAOD) :** 263.38 **Co-ordinates :** E 697620.1 N 716729.3

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
								Interlayered SAND & GRAVEL
					218.38		45.00	
								GREYWACKE
▼1								Groundwater encountered at 48m bgl.
							(18.00)	

Remarks :
Bedrock at 45m bgl.
Groundwater encountered at 48m bgl.
End of hole at 63m bgl.
Installation: 0 - 43m bgl plain, 43 - 63m bgl slots.

Checked By: BB

Scale 1:100

GALKEN\+GEO(1) April 2008

GOLDER

Client : Hudson Brothers Ltd

Hole No. **BH7K**

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Rotary Drill Rig

Contractor : JS Drilling

Date Started : 18/07/2019 **Completed :** 18/07/2019

Logged by : MBD

Ground Level (mAOD) : 263.38

Co-ordinates : E 697620.1 N 716729.3

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
								GREYWACKE
					200.38		63.00	*End of Hole at 63.00m*

Remarks :
Bedrock at 45m bgl.
Groundwater encountered at 48m bgl.
End of hole at 63m bgl.
Installation: 0 - 43m bgl plain, 43 - 63m bgl slots.

Checked By: BB

Scale 1:100

GAUKENV+GEO(1) April 2008

GOLDER

Client : Hudson Brothers Ltd

Hole No. **BH8K**

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Rotary Drill Rig

Contractor : Aidan Dempsey Drilling

Date Started : 23/03/2020 **Completed :** 24/03/2020

Logged by : JM

Ground Level (mAOD) : 239.48

Co-ordinates : E 696628.7 N 717407.9

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
					235.48		(4.00) 4.00	Slightly clayey SAND & GRAVEL. Sand is fine to coarse. Gravel is fine to medium subrounded to subangular
					234.48		(1.00) 5.00	Very sandy very gravelly CLAY
					233.98		5.50	Weathered SILTSTONE
					231.48		(2.50) 8.00	Brown SILTSTONE
▼1							(17.50)	Brown to bluey grey SILTSTONE Groundwater encountered at 18.5m bgl.

Remarks :
Bedrock at 5.5m bgl.
Groundwater encountered at 18.5m bgl and rose to 12.25m bgl (drill bit still in hole).
End of hole at 25.5m bgl.
Installation: 0 - 16.5m bgl plain, 16.5 - 25.5m bgl slots.

Checked By: BB

Scale 1:100

GAUKEN\+GEO(1) April 2008

GOLDER

Client : Hudson Brothers Ltd

Hole No. **BH8K**

Site : Hudson Quarry, Philipstown and Redbog, Co. Kildare

Project : Hudson Bros. Planning and EIAR

Project No : 19115799

Equipment & Methods : Rotary Drill Rig

Contractor : Aidan Dempsey Drilling

Date Started : 23/03/2020 **Completed :** 24/03/2020

Logged by : JM

Ground Level (mAOD) : 239.48

Co-ordinates : E 696628.7 N 717407.9

WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
								Brown to bluey grey SILTSTONE
					213.98		25.50	*End of Hole at 25.50m*

Remarks :
Bedrock at 5.5m bgl.
Groundwater encountered at 18.5m bgl and rose to 12.25m bgl (drill bit still in hole).
End of hole at 25.5m bgl.
Installation: 0 - 16.5m bgl plain, 16.5 - 25.5m bgl slots.

Checked By: BB

Scale 1:100

GAUKEN\+GEO(1) April 2008

	Client : Hudson Brothers Limited	**Hole No.** **BH09K**
Site : Old Paddocks, Kildare	**Project :** Hudson Env Support	**Project No :** 41000087
Equipment & Methods : Reich Drill 650W	**Contractor :** Aiden Dempsey **Date Started :** 22/08/2023 **Completed :** 29/08/2023 **Logged by :** EG	**Ground Level (mAOD) :** 205.53 **Co-ordinates :** E 296439.0 N 216988.0

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES: Sample Top (m)	SPT 'N' Value	Sample Type	PID	STRATA RECORD: Level (mAOD)	Legend	Depth (Thickness) m	Description
						205.03		0.50	Orangey brown slightly gravelly slightly sandy clay. Gravel was fine to coarse, mostly subrounded. Sand was medium to coarse.
								(3.50)	Grey-brown slightly clayey very sandy GRAVELS. Gravels are fine to coarse subrounded. Sand is medium to fine.
						201.53		4.00	
								(7.00)	Light brown silty SAND AND GRAVELS. Gravels are fine to medium subrounded. Sands are fine to coarse
						194.53		11.00	
								(4.00)	Slightly clayey gravelly SAND. Sands are fine to coarse. Gravels are fine to medium subrounded.
						190.53		15.00	Drilling becoming harder with depth from 14.0 m bGL
								(9.00)	Brown sandy gravelly CLAY. Gravels are medium subrounded to subangular. Sands are fine to coarse.
						181.53		24.00	
								(17.00)	Brown clayey SAND and GRAVEL.Gravels are fine to medium subrounded. Sands are fine to medium.
						164.53		41.00	
								(3.00)	Brown MUDSTONE
						161.53		44.00	
								(16.00)	Greyish blue SILTSTONE.
▼1									Waterstrike at 54m
						145.53		60.00	

End of Hole at 60.00m

Remarks :
Bedrock at 60m bgl.
Groundwater encountered at 54m bgl.
End of hole at 60m bgl.
Installation: 1-50m bgl plain, 50-59m bgl slots

Checked By: GF

Scale 1:301

GAUK ENV+GEOTECH April 2008

	Client : Hudson Brothers Limited	**Hole No.** **BH10K**
Site : Old Paddocks, Kildare	**Project :** Hudson Env Support	**Project No :** 41000087
Equipment & Methods : Reich Drill 650W	**Contractor :** Aiden Dempsey **Date Started :** 29/08/2023 **Completed :** 31/08/2023 **Logged by :** EG	**Ground Level (mAOD) :** 224.90 **Co-ordinates :** E 296474.0 N 215897.0

WATER/ PROGRESS	INSTALLATION /BACKFILL	SAMPLES: Sample Top (m)	SPT 'N' Value	Sample Type	PID	STRATA RECORD: Level (mAOD)	Legend	Depth (Thickness) m	Description
						223.90		1.00	Grass over TOPSOIL comprising light orangey brown slightly gravelly slightly sandy clay.
						222.90		2.00	Slightly sandy very gravelly CLAY. Gravels are coarse subrounded. Sand is fine to coarse.
								(5.00)	Brown clayey gravelly SAND. Sand is fine to coarse. Gravels are fine to coarse subrounded.
						217.90		7.00	
								(5.00)	Grey clayey SAND AND GRAVELS. Gravels are fine to medium subrounded. Sands are fine to coarse.
						212.90		12.00	
								(6.00)	Light brown silty GRAVELS. Gravels are medium subrounded.
						206.90		18.00	
1								(18.00)	Mottled greyish black GREYWACKE. Waterstrike at 31m
						188.90		36.00	*End of Hole at 36.00m*

Remarks :
Bedrock at 36m bgl.
Groundwater encountered at 31m bgl.
End of hole at 36m bgl.
Installation: 1-29m bgl plain, 29-36m bgl slots

Checked By: GF

Scale 1:301

GAUK ENV+GEOTECH April 2008