6

WATER

6 WATER

6.1 INTRODUCTION

This chapter of the Environmental Impact Assessment Report (EIAR) provides an assessment of the hydrological (surface water) and hydrogeological (groundwater) aspects of the Hudson Brothers Ltd Kildare quarry (the 'Site') in support of an application under Section 37L of the Planning and Development Act, as amended, for continuation and extension of quarrying activities at the Site. This assessment characterises the pre-extension baseline conditions and gives consideration to the potential effects of extension and restoration upon the surrounding surface water and groundwater environments.

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.

6.1.1 TECHNICAL SCOPE

The technical scope of this assessment is to consider the potential impacts and effects that extension of the quarry and post-operational restoration at the Site (as detailed in Chapter 2.0, Project Description), may have on the water environment. This assessment considers the potential sources of change resulting from potential future activities at the Site on hydrological and hydrogeological receptors. It considers water levels, flow regimes, water resources and uses, water quality, flood risk and water management.

This assessment also identifies potential secondary effects of changes in the water environment on land, people, ecology (including water dependent habitats or ecological receptors) and infrastructure, which are considered further in the following chapters of the rEIAR:

- Chapter 3.0 – Populations and Human Health,
- Chapter 4.0 – Ecology and Biodiversity,
- Chapter 13.0 – Material Assets,
- Chapter 15.0 – Interactions.

This chapter also addresses the potential secondary effects of changes in land quality on water quality. As such, it draws on the assessment presented in the Land, Soils and Geology section of this report (Chapter 5.0).

6.1.2 GEOGRAPHICAL AND TEMPORAL SCOPE

The geographical study area for the assessment covers the area within the EIA boundary (Site) and a buffer zone that nominally extends to 500 m from the boundary (Figure 6-1). However, where deemed appropriate, the buffer zone is increased to allow for identification of downstream or downgradient hydraulic connectivity with off-Site water features or users that may be affected by Site related activities.

The temporal scope of the assessment covers current 'baseline conditions' of the Site and draws on available historical information. The assessment aims to establish the baseline water environment conditions at the Site and then assess what impacts the proposed extension of quarrying activities and subsequent restoration will have on the Site and surrounding environment. The extent of the proposed extension of quarrying activities is displayed on Figure 6-1 (Section 37 Boundary).

Under the current programme of the Proposed Development, the extraction phase will last for 13 - 15 years, which will provide for fluctuations in market demands for the aggregate extracted from the Site. The duration of the extraction phase is therefore classified as 'medium-term' by the Environmental Protection Agency's (EPA) 2022 'Guidelines on the information to be contained in environmental impact assessment reports'. The Proposed Development totals a remaining volume of ca. 8,708,900 m^3 (13,218,200 tonnes) of combined sands and gravels and rock. This is made up of ca. 5,544,900 m^3 (8,317,350 tonnes) of sands and gravels and ca. 1,960,345 m^3 (4,900,860tonnes) of rock.

The restoration phase of the Proposed Development will follow the extraction phase and will be 2 - 3 years in duration, which is 'short-term' - those lasting from one to seven years (EPA, 2022).

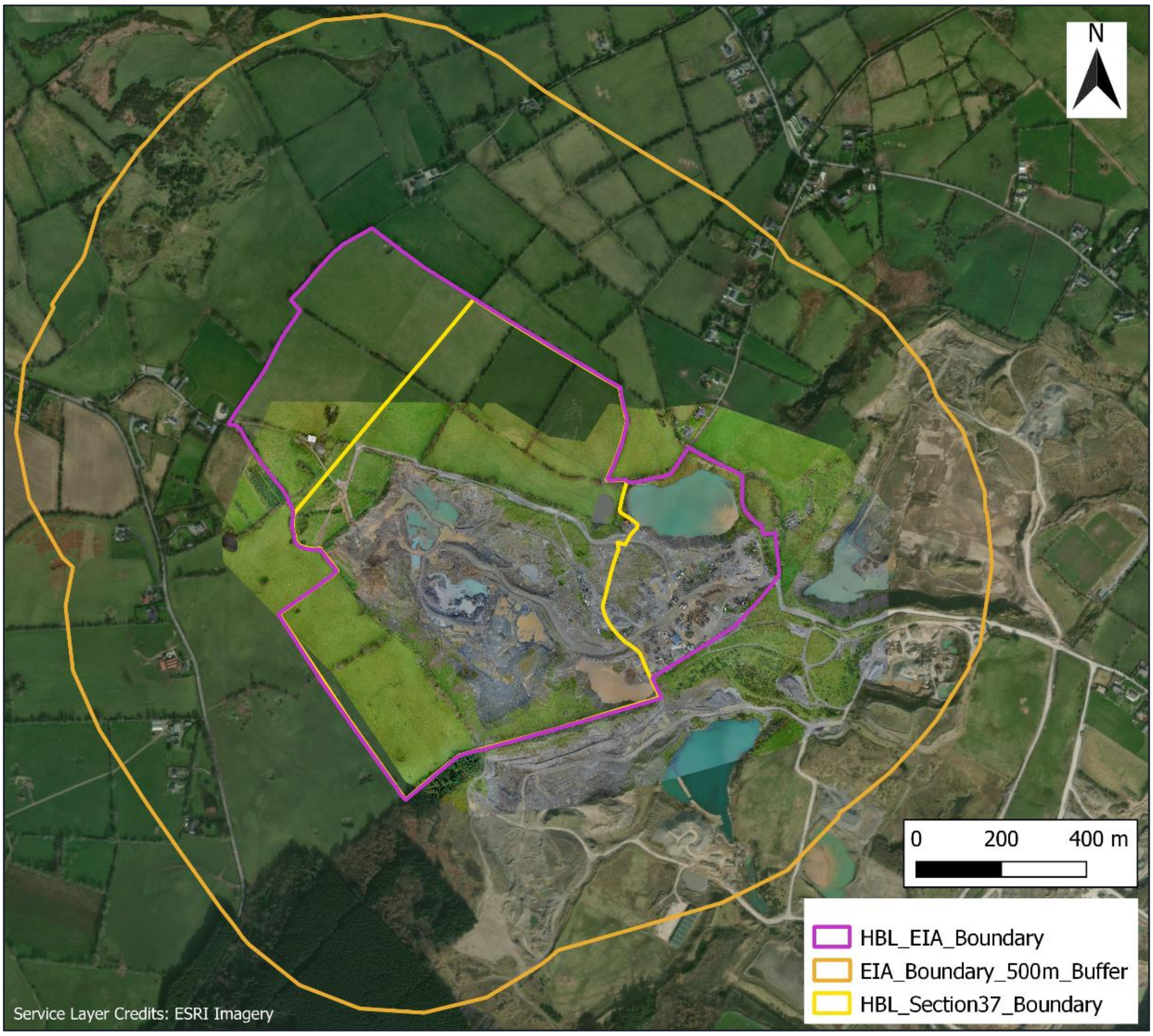

Figure 6-1 – EIA Site Boundary, Section 37 Boundary and 500m Buffer

6.2 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 the water environment that has guided the focus of the assessment.

6.2.1 LEGISLATION

This assessment has been made with cognisance of relevant guidance, advice and legislation relating to the water environment, including but not limited to:

- The Local Government (Water Pollution) Act 1977 (as amended) and associated Statutory Instrument Regulations made under that Act outline the general prohibition of entry of polluting matter to water, the requirement to licence both trade and sewage effluent discharges, licencing of water abstractions, controlling discharges to aquifers, and notification of accidental damages.
- The European Union (EU) Water Framework Directive (WFD) (2000/60/EC) is the European legislation that establishes a framework for the protection of groundwater and surface water, including the establishment of river basin districts, the requirement to prevent further deterioration by preventing or limiting inputs of pollutants into groundwater, reducing pollution, and promoting sustainable water use. The Groundwater Daughter Directive (GWDD) (2006/118/EC) sits beneath the WFD and relates to water protection and management. It establishes measures to prevent and control groundwater pollution, including criteria for assessing good chemical status and identifying trends.
- The WFD and GWDD have been transposed into Irish law by means of many Regulations. These Regulations cover governance, the shape of the WFD characterisation, monitoring, and status assessment programmes in terms of assigning responsibilities for the monitoring of different water categories, determining the quality elements and undertaking the characterisation and classification assessments. They include, but are not limited to, the following:

  - European Communities (Water Policy) Regulations 2003 and its subsequent amendments,
  - European Communities Environmental Objectives (Surface Waters) Regulations, 2009 and its subsequent amendments,
  - European Communities Environmental Objectives (Groundwater) Regulations, 2010 and its subsequent amendments,
  - European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations 2011.

  Many of these regulations contain threshold values or environmental quality standards which, when exceeded, can reflect a degradation in water quality. A degradation in water quality can be reflective of negative effects caused by the development, but it should be noted that a poor water quality can be naturally occurring due to the environmental setting.

- The EU Directive on the Assessment and Management of Flood Risks (2007/60/EC) is transposed into Irish law by the European Communities (Assessment and Management of Flood Risks) Regulations 2010 and its subsequent amendment. The aim of the legislation is to reduce the adverse consequences of flooding on human health and the environment, and it outlines the requirements for flood risk assessments to be completed as part of the planning process.

6.2.2 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”.

At a national level, the River Basin Management Plan (RBMP) for Ireland 2018-2021 (Department of Housing, Planning and Local Government, 2018) outlines the measures that will be taken to improve the water quality in Ireland’s groundwater and surface water. This plan focuses on the following priorities:

- Ensuring compliance with relevant EU legislation,
- Preventing deterioration,
- Meeting the objectives for designated protected areas,
- Protecting high-status waters,
- Implementing targeted actions and pilot schemes in focused sub-catchments aimed at targeting water bodies close to meeting their objectives and addressing more complex issues that will build knowledge for the next cycle in the RBMP.

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:

- **IN P2** – (It is the policy of KCC to) Ensure the protection and enhancement of water quality throughout Kildare in accordance with the EU WFD and facilitate the implementation of the associated programme of measures in the River Basin Management Plan 2018-2021 (and subsequent updates).
- **IN O5** – (It is the objective of KCC to) Manage, protect, and enhance surface water and groundwater quality to meet the requirements of the EU Water Framework Directive.
- **IN O8** – (It is the objective of KCC to) Support the implementation of Irish Water’s Water Safety Plans to ensure that public drinking water sources and their contributing catchments are protected from pollution.
- **IN O19** – (It is the objective of KCC to) Ensure that existing and permitted private wastewater treatment plants are operated in compliance with their wastewater discharge licenses, to protect water quality.
- **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 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).*
- **RD O50** – (It is the objective of KCC to) Ensure the satisfactory and sensitive re-instatement and/or re-use of disused quarries and extraction facilities, where active extraction use has ceased.

6.2.3 RELEVANT GUIDANCE

Guidance relating to the EIA process that has been used to guide the assessment of potential impacts to the water environment and the identification of relevant mitigation includes:

- AA-EQS - European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272/2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/2019)

- GTV - Groundwater Regulations (SI No. 9 of 2010 as updated by SI No. 366 of 2016)
- Relevant European Commission guidance – Guidance on the Preparation of the Environmental Impact Assessment Report (2017).
- EPA Guidelines on the Information to be Contained in Environmental Impact Assessment Reports, Environmental Protection Agency (May 2022).
- 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 (NRA) 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).
- The National Roads Authority (NRA) Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan (2007) in relation to impact mitigation.
- Institute of Geologists of Ireland (IGI) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (April 2013).
- CIRIA C532: Control of water pollution from construction sites. Guidance for consultants and contractors (2001).
- CIRIA C741: Environmental Good Practice on Site (2015, Fourth Edition) in relation to source of impact and mitigation.
- CIRIA C750: Groundwater control – design and practice (2016, Second Edition).
- 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.

6.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

This section presents the method used to assess the potential impacts and effects of the Proposed Development and associated activities at the Site on the water environment, and to identify potential secondary effects from changes to the water environment. It establishes the stages of the assessment, and the qualitative criteria used to assess impact magnitude and determine the level of effect significance.

6.3.1 SOURCES OF INFORMATION

The assessment has been carried out using the following sources of information:

- Site walkovers of the Site in 2023;
- Field monitoring and sampling campaigns carried out over 2023;
- Correspondence with the Applicant/Site Owner and Site staff;
- Desktop reviews of the previous impact assessment by Golder (2020);
- Desktop reviews of literature and publicly available information (including interactive mapping services);
- Review of historic surface water monitoring information provided by the EPA;
- Review of drone surveys (aerial imagery and topography) carried out in January 2023 and October 2023; and

- Review of publicly available aerial imagery (ESRI and Google Earth) for 2022.

6.3.2 QUALITATIVE ASSESSMENT METHOD

The assessment of potential effects has been undertaken using the qualitative assessment method outlined below. The assessment is supported by the available baseline condition information, historical records of Site activities, previous hydrological and hydrogeological studies, historical monitoring data and recent monitoring and survey data collected to supplement the historical dataset. The assessment follows a staged approach with a summary of the stages involved below:

1) Confirm baseline conditions – using available recent monitoring data supported by historical monitoring data where available. 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.
3) Qualitatively characterise the magnitude of impacts on the receptors – describe what potential changes may occur to each receptor because of Site activities, 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 initial effect significance of each potential impact on each sensitive receptor.
5) Consider the need for mitigation measures if it is considered necessary to further reduce the initial magnitude of any impact and associated effect significance.
6) Assess the residual impact magnitude and residual effect significance after all mitigation measures are applied.
7) Identify any monitoring that may be required to measure the success of the mitigation measures.

Stages 1 and 2 have been completed using published literature, guidance, and available information specific to the Proposed Development, which is presented in Chapter 3.0 of this EIAR. 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 draft Guidelines on the Information to be Contained in EIARs (EPA, 2022), with some modifications based on the additional guidance outlined in Section 6.2.3, such as those by the NRA and IGI. The descriptions for sensitivity of receptors are provided in Table 6-1 and the descriptions for magnitude of impact are provided in Table 6-2.

The potential for an impact to occur 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 6-1 – 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. – Human health. – WFD river designation of ‘High’ and in hydraulic connectivity with the Site. – Regionally important aquifer with multiple wellfields. – Inner source protection area for a regional resource. – Regionally important potable water source supplying >2500 homes (surface water or aquifer). – Floodplain protecting more than 50 residential or commercial properties or nationally important infrastructure (e.g. motorways/national roads) from flooding.
Medium	Medium or high importance and rarity, regional scale, limited potential for substitution. For example: – Regionally important sites. – Regionally important aquifer. – WFD river designation of ‘Good’ or ‘Moderate’” and in hydraulic connectivity with the Site. – Outer source protection area for a regional resource. – Locally important potable water source supplying >1000 homes (surface water or aquifer). – Floodplain protecting between 6 and 50 residential or commercial properties or regionally important infrastructure (e.g. regional roads) from flooding.
Low	Low or medium importance and rarity, local scale. For example: – Locally important aquifer. – WFD river designation of ‘Poor’ or ‘Bad’ and in hydraulic connectivity with the Site. – Outer source protection area for a local resource. – Local potable water source supplying >50 homes (surface water or aquifer). – Floodplain protecting between 2 and 5 residential or commercial properties or locally important infrastructure (e.g. local roads) from flooding.
Negligible	Very low importance and rarity, local scale. For example: – Environmental equilibrium is stable and is resilient to impacts that are greater than natural fluctuations, without detriment to its present character. – Poorly productive aquifer. – Any WFD river quality designation not in hydraulic connectivity with the Site. – Local potable water source supplying <50 homes (surface water or aquifer). – Floodplain protecting up to 1 residential or commercial properties from flooding.

Table 6-2 – 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. • Significant pollution of the water environment, as defined by: – A breach of, or failure to meet any statutory quality standard for the water environment at an appropriate pollution assessment point. – A breach of, or a failure to meet, any operational standard adopted by EPA for the protection of the water environment. – Pollution results in an increase in treatment required for an existing drinking water supply. – Pollution results in an increased level of treatment required of water abstracted for industrial purposes. – Pollution results in deterioration in the status of a water body, failure to meet good status objectives defined by the Water Framework Directive, or failure of a protected drinking water area to meet its objectives as defined by the Water Framework Directive. – There is a significant and sustained upwards trend in concentration of pollutants in groundwater being affected by the land in question. • There is a material and adverse impact on the economic, social and/or amenity use associated with a particular water environment.
	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 occurs as a direct result of the activities on Site and is likely to occur at or near the Site 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 Site activities result in a change in groundwater quality, which then has an indirect impact on surface water quality and/or users of the water, such as human health or ecology). Indirect impacts can occur within the study area or away from the Site.

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. For example, impacts to groundwater quality from contamination may only last as long as the source of the impacts is present. If it is removed, groundwater quality may naturally improve or could be remediated.

6.3.3 SIGNIFICANCE CRITERIA

The approach followed to derive effects significance from receptor value and magnitude of impacts (Stage 4) is shown in Table 6-3. Where Table 6-3 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 6-4.

Table 6-3 – 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 6-4 – 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.

Following the assessment of the current level of effect significance, mitigation measures are presented that will be used to further avoid, prevent, or reduce the magnitude of the impact (Stage 5). If necessary, the significance of the effect considering the mitigation measures is then assessed (Stage 6) to give the residual effect significance. Any monitoring that will be required to measure the success of the mitigation measures is included (Stage 7) (see Section 6.12).

The effects of the Proposed Development are also considered cumulatively, with those that could foreseeably result from other known developments, that have the potential to take place within the study area (see Section 6.11 and Chapter 14.0 Interactions).

6.4 BASELINE CONDITIONS

This Section presents a summary of the baseline conditions for the water environment (hydrology, hydrogeology, and flooding). Detailed information about land use, soils and geology and ground conditions at the Site is included in Chapter 5.0, Land, Soils and Geology.

6.4.1 SITE SETTING

The Site is on lands at Athgarrett, Philipstown and Redbog, Red Lane, Co. Kildare, along the Kildare/Wicklow border. Access to the Site is via the N81 National Road, and through the Hudson Brothers Limited Wicklow site, to the southeast. Regionally, the nearest town is Blessington, which is located approximately 2 km to the south of the Site. Beyond this there are several other small towns and the suburbs of Dublin.

The Red Bog SAC is located approximately 257 m northeast of the Site and is a similar elevation (approximately 260 mAOD), to the highest point within the Site.

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.

Aerial photography which shows the quarry, and the surrounding land use is presented in Chapter 5.0, Land, Soils and Geology.

6.4.2 SITE LAYOUT

A detailed description of the Site layout and infrastructure is presented in Chapter 2.0 (Project Description). Only key information relevant to the water environment is detailed below.

The Site comprises lands which are currently used for quarrying activities. Approximate areas of have been calculated for the purposes of the assessment in this chapter. These areas occur within the Section 37L application boundary. The current extent of the quarry (including extraction, plant and ancillary areas) is ca. 38.8 ha (0.388 km^2) in area.

The Site 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 in an artificial pond and recycled for processing. This recycling process is discussed further in Section 6.4.4 of this Chapter.

6.4.3 SITE TOPOGRAPHY

The Site sits within a valley that slopes to the northwest and is shouldered by a high peak (at ca. 346 mAOD) to the north of the Site and Red Bog SAC, and a smaller peak to the south of the Site, in the area of Glen Ding Wood and Deer Park Plantation (at ca. 286 mAOD).

The Site is on the northwestern side of a saddle between the two peaks. On the southeastern side of the saddle are the adjacent quarries and the topography slopes down towards Blessington town and the Poulaphouca Reservoir.

The topography at the Site boundary peaks at ca. 271 mAOD and ca. 264 mAOD in the northeastern and southeastern corners respectively and drops to a low of ca. 205 mAOD on the western boundary.

6.4.4 SITE WATER REQUIREMENTS AND MANAGEMENT

At the present time, rock is processed at the quarry face and does not require the use of water, except for dust suppression. Sands and gravels are transferred to the east of the Site where they are processed. Processing includes pre-screening, washing and crushing of the aggregate material in a closed-circuit Aggregate Processing Plant (Figure 6-2). The water abstracted from Pond K2 (Figure 6-3), passes through the Water Treatment Plant before being sent to the Maintenance Shed and Aggregate Processing Plant.

Water for the processing of the sands and gravels is abstracted from Pond K2, following the decommissioning of Pond K1 (identified as ‘Pond K’ in previous applications/reports), which was drained and infilled with stone by October 2023. There are two pumps abstracting from Pond K2, which operate at 1,000 L/min and 500 L/min and can be run independently or simultaneously. The Water Treatment Plant does not use all the water pumped from Pond K2. There are blow off valves and ballcocks used to regulate abstraction when it is not required for use. The water that is not used is therefore returned to Pond K2.

The 1,000 L/min capacity pump runs during operating hours, between 0700 hours and 1800 hours, Monday to Friday and between 0700 hours and 1300 hours on Saturdays (61 hours operating time per week). This gives a maximum output of 660 m^3/d (3,660 m^3 per week), without using the smaller capacity pump. The amount of water used at the Aggregate Processing Plant is dictated by a number of variables, which include wet weather and the quality of the raw material feed. On wet days less water is required as rainwater is harvested from the yard. On days when the silt content of the raw material is high, the demand for water is higher as more water is needed to transport the silt to the lagoon.

Water is estimated to be used at an average daily rate of between ca. 150 m^3/d and ca. 300 m^3/d (average ca. 225 m^3/d) for processing. The average daily water requirements for the Site are ca. 276 m^3/d, consisting of ca. 225 m^3/d for aggregate processing, ca. 50 m^3/d for dust suppression during dry periods and ca. 1 m^3/d for welfare facilities (as provided from mains supply). This equates to ca. 75,900 m^3/yr (based on a 266 day working year).

No formal discharge takes place from the Site, with most of the water used on-site in the processing of sands and gravels in a closed-circuit system. Silt laden water from the Aggregate Processing Plant is discharged to a silt pond (for use in future restoration). The overflow from the silt pond recirculates as surface water back to the clean water pump in Pond K2, at the base of the eastern part of the quarry, via a trench. The only water that is lost off site, is the water that is transported out with the washed products.

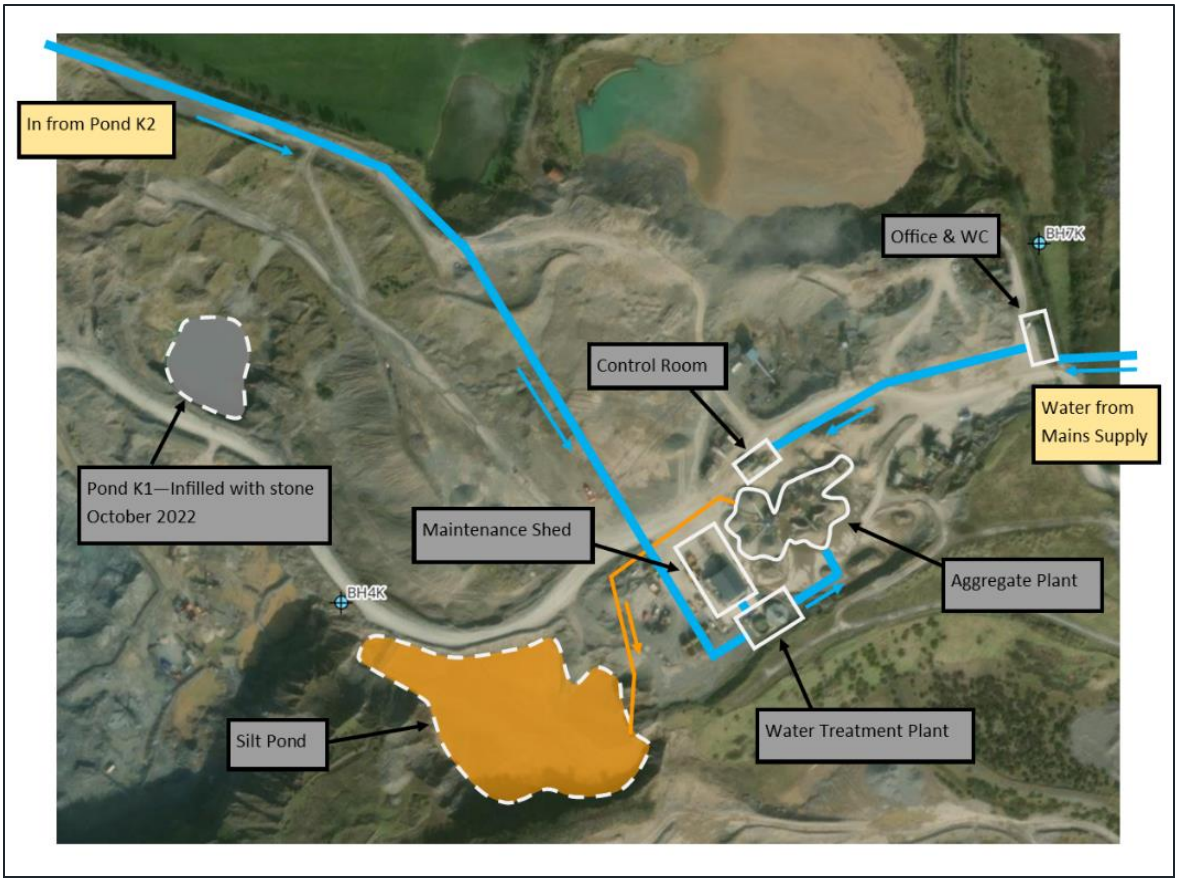

Figure 6-2 – Site Water Management in the Eastern Area of the Site

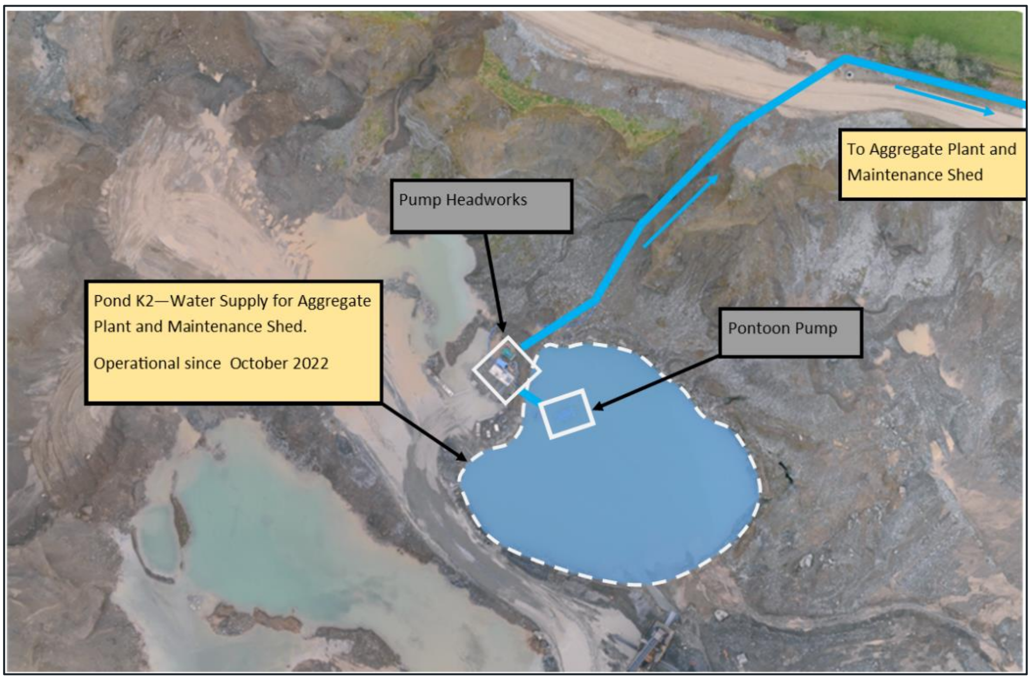

Figure 6-3 – Site Water Management in the Western Area of the Site

The water management system for the Site can be divided into the following components:

- Rainfall that falls on extraction areas recirculates to Pond K2 or percolates naturally into the ground,
- Rainfall and surface run-off from the Maintenance Shed area is collected and passes through a hydrocarbon interceptor prior to discharge to a soak-away,
- Water sourced from Pond K2 is used as a top-up supply for aggregate washing at the Aggregate Processing Plant which operates as a closed-circuit system,
- Water sourced from Pond K2 is used for dust suppression as required,
- Silt is pumped from the Aggregate Processing Plant closed circuit system to a Silt Pond,
- Overflow from the silt pond recirculates (as surface water) back to the clean water pump in Pond K2, at the base of the eastern part of the quarry,
- Welfare facilities at the at the Office/Canteen and the Control Room (permitted under Reg. Ref. 07/267) with holding tanks periodically emptied by a licenced contractor (plan to upgrade to a Oakstown BAF 6PE wastewater treatment system, which will be subject of a future planning application),
- An existing Oakstown BAF 6 PE wastewater treatment system treats foul water from the Maintenance Shed (system was included in the 2019 retention application KCC Reg. Ref.: 19/1230),
- Water for welfare facilities in the Maintenance Shed is supplied from Pond K2 and treated with associated UV Water Treatment System (process discussed in Chapter 2.0 Project Description), and supplied from a public supply in terms of the Office/Canteen and the Control Room,
- Road going trucks travelling to and from this site access the local road network through the Applicant’s Wicklow site, where a wheel wash and weighbridge are in operation.

6.4.5 GEOLOGY

The underlying geology of the Site is presented in Chapter 5.0 of this EIAR. A brief summary of the geology is provided below.

6.4.5.1 SOILS

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

6.4.5.2 SUPERFICIAL DEPOSITS

The Site and surrounding region is underlain by glacial deposits ranging from tills to glaciofluvial sands and gravels with glaciolacustrine deposits. Glacial and fluvial deposits (the Blessington Gravels) are generally thick in the area, with deposits commonly > 30 m in thickness. Borehole logs from the Site indicate the drift (overburden, and sands and gravels) 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. Monitoring well locations are presented in Figure 6-13 later in this Chapter.

6.4.5.3 BEDROCK

The underlying bedrock geology consists of the Glen Ding Formation comprising of dark green to grey greywackes and shales to the west; and the Slate Quarries Formation to the east, which comprises of predominantly dark grey slate, with minor interbedded greywackes. Approximately 600 m northwest of the Site, a major northeast-trending fault (the Athgarrett Fault) occurs. The bedrock relative to the site boundary is presented in Figure 6-4 below. Borehole logs indicate bedrock dips in a westerly to south-westerly direction across Site, with an elevation change of 52 m over 885 m from BH2K to BH9K. The bedrock also dips to the east from the eastern boundary of the Site. This is with the presence of the Blessington Delta quaternary deposits and topography change towards the Poulaphouca Reservoir to the southeast.

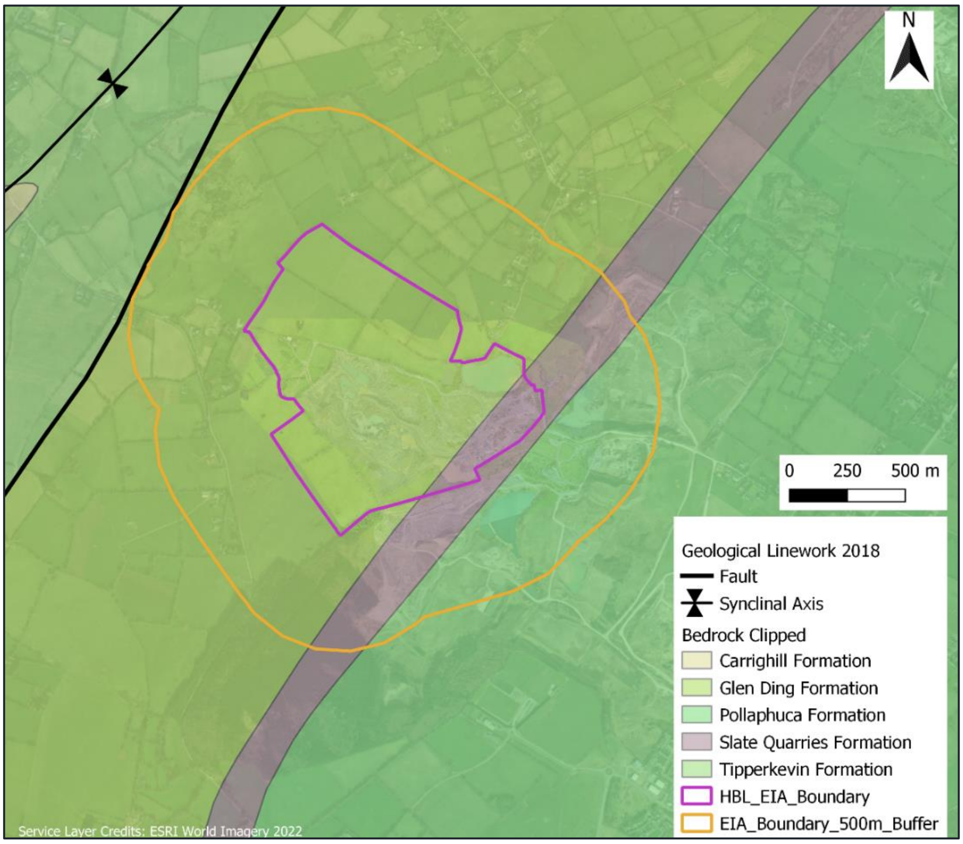

Figure 6-4 - Bedrock Geology Overlay

6.4.6 RAINFALL AND CLIMATE DATA

Table 6-5 below presents rainfall data recorded at the Blessington (Hempstown) meteorological station (number 8623), which is located ca. 1 km east of the Site, for the period 2004 to August 2022 (Met Eireann, 2023). Historical data is not available for Blessington (Hempstown) meteorological station beyond August 2022. Brittas (Glenaraneen) meteorological station (number 7923), which is ca. 7.8 km northeast of the Site, has been used for data from the period September 2022 to July 2023 (Met Eireann, 2023).

The annual rainfall recorded consistently fluctuates through the dataset, with a calculated average of 996.7 mm/a and a range of 1271 (2012) to 843 (2018) mm/a (excluding 2023). There is no clear increasing or decreasing trend in rainfall over this timeframe. The long-term historical average (1990 to 2022) of 955 mm/a, from Blessington (Hempstown) meteorological station, is slightly lower than the more recent average, from data presented in Table 6-5.

GSI mapping (2023) indicates an effective rainfall (rainfall minus actual evapotranspiration) value of 543 mm/a for the area.

Table 6-5 – Monthly Rainfall Totals

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Rainfall (mm/a)	947	855	962	1065	1228	1246	888	941	1271	862
Year	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Rainfall (mm/a)	1153	991	869	908	843	1055	1012	921	924	615.1

6.4.7 SURFACE WATER – HYDROLOGY

The Site is located within the South-Eastern River Basin District, Hydrometric Area 09. The WFD (Water Framework Directive) designations split the Site between the River Sub-Basin Morell_020 (Sub-Catchment Liffey_SC_070_09_14) to the north and River Sub-Basin Liffey_040 (Sub-Catchment Liffey_SC_020_09_12) to the south. This indicates that a catchment divide occurs across the Site as depicted in Figure 6-5. The catchment divide closely follows the northeast trending saddle on which the Site is situated.

Figure 6-5 - Sub-Basin and Sub-Catchment Divide Across the Site (EPA, 2022)

6.4.7.1 Local Surface Water Features and Flows

The surface water bodies and river network in the area surrounding the Site is shown in Figure 6-6. The closest surface water feature to the Site is a small naturally occurring pond on the northern edge of the quarry, situated at ca. 250m AOD. The pond is believed to be a natural feature used periodically as a water supply for livestock. Further northeast of the Site is the Red Bog, a designated Special Area of Conservation (SAC), situated at an elevation of ca. 260 mAOD. The Red Bog SAC is understood to be perched above the main water table, due to a clay rich layer in the underlying sands and gravels at this location (GSI, 2017). The Red Bog SAC is largely recharged by rainwater percolating through the topsoil and unsaturated sand. The local surface water features are labelled on Figure 6-6 below.

No streams occur within the Site boundary due to the permeable nature of the underlying sands and gravels. The initial characterisation for the Blessington Groundwater Boundary (GWB) (Appendix 6E) indicates that the interaction between surface water and groundwater is complex, due in part to the presence of silt and clay lenses throughout the deposits, providing areas of perched water within the aquifer. Local streams tend to be discontinuous, sinking below the surface where the sand and gravel deposits are highly permeable, and the water table is below the river stage.

In the lower lying areas and at distance from the Site, streams are more prevalent, and are most likely fed by groundwater baseflow (Figure 6-6). Rainwater falling to the south and east of the Site would naturally be expected to feed into the Poulaphouca Reservoir. The Poulaphouca Reservoir lies ca. 2.2 km southeast of the Site and is designated as a Special Protection Area (SPA) and National Heritage Area (NHA). It is an important water resource as it supplies County Dublin with drinking water.

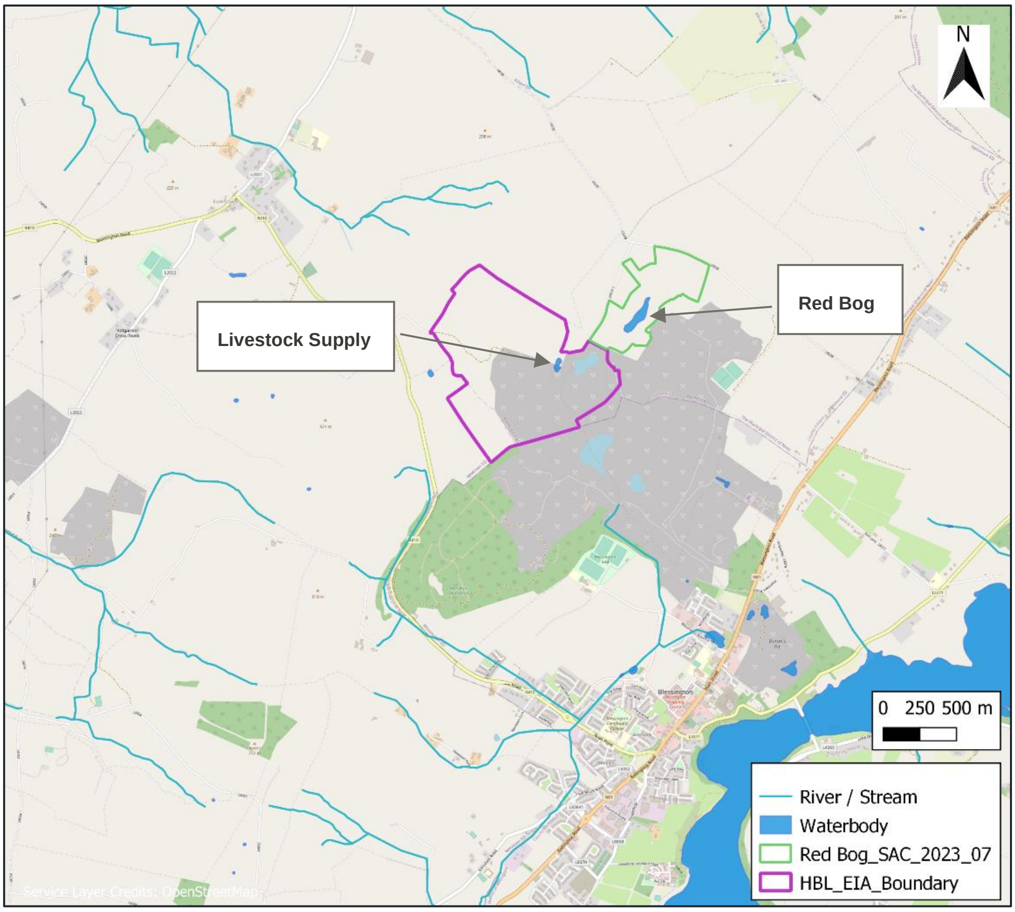

Figure 6-6 - Local Surface Water Bodies and River Network in the Vicinity of the Site

6.4.7.2 Site Surface Water

The latest aerial imagery of the Site from October 2023 is presented in Figure 6-7. There was significant rainfall in September and October 2023 (112.5 mm and 116 mm recorded at Casement Aerodrome ca. 13 km northeast of the Site), preceding the survey. This survey was undertaken in the days following Storm Babet, which resulted in the significant amount of surface water across the Site.

In the October 2023 aerial, used process water that is pumped into the silt pond has flowed to the lower level of the quarry to a secondary impoundmment and displays as a large, pooled feature. This is the result of the high rainfall causing a higher level in the silt pond, requiring increased overflow into the quarry. In the centre of the quarry, rainwater collected at the lowest excavated level, within the greywacke rock. This is due to this area being the deepest excavation into the bedrock at 188 mAOD. Site visits in November and December have since reported that this pooled water has dried completely, confirming that there is no potential groundwater component. There is significant surface water surrounding Pond K2, which connects to other pooled overflow water in the vicinity following the high rainfall in October 2023. Continued abstraction from Pond K2 for processing and reduced rainfall has since allowed water levels to drop in the area, with water now contained within the banks of Pond K2 (as reported in the recent site visits). However, there continues to be pooled water surrounding Pond K2.

HBL have confirmed that pumping is not required to remove pooled water and allow deeper extraction of the rock material in the centre of the quarry. This confirms that the confined aquifer within the greywacke has not been intercepted, with dry quarrying continuing to take place (following retreat of pooled rainwater).

Figure 6-7 - Site Aerial with Surface Water in October 2023 (Images from site survey)

6.4.7.3 Red Bog SAC Water Elevations

The location of the Reg Bog SAC is shown in Figure 6-6. A Levelogger was deployed in the Red Bog SAC to assess the seasonal water elevation. This installed Levelogger records the water level on an hourly basis. It was necessary to install the Levelogger on the side of the Red Bog water feature due to health and safety access issues while downloading data during times of higher water levels. Drier seasonal lows are therefore not captured. However, visual inspections of Red Bog during times of low water levels indicated that water levels were slightly lower than the logger.

The level data (mAOD) has been displayed in Figure 6-8. A seasonal trend in the data recorded is evident, with higher water levels corresponding to the months with higher rainfall. The Red Bog water levels respond instantaneously to rainfall events, indicating that the surface water feature is largely recharged by direct rainfall and infiltration through shallow soils. A steep decline in water levels following the rainfall events shows that a proportion of the water held in Red Bog recharges the surrounding sands and gravels.

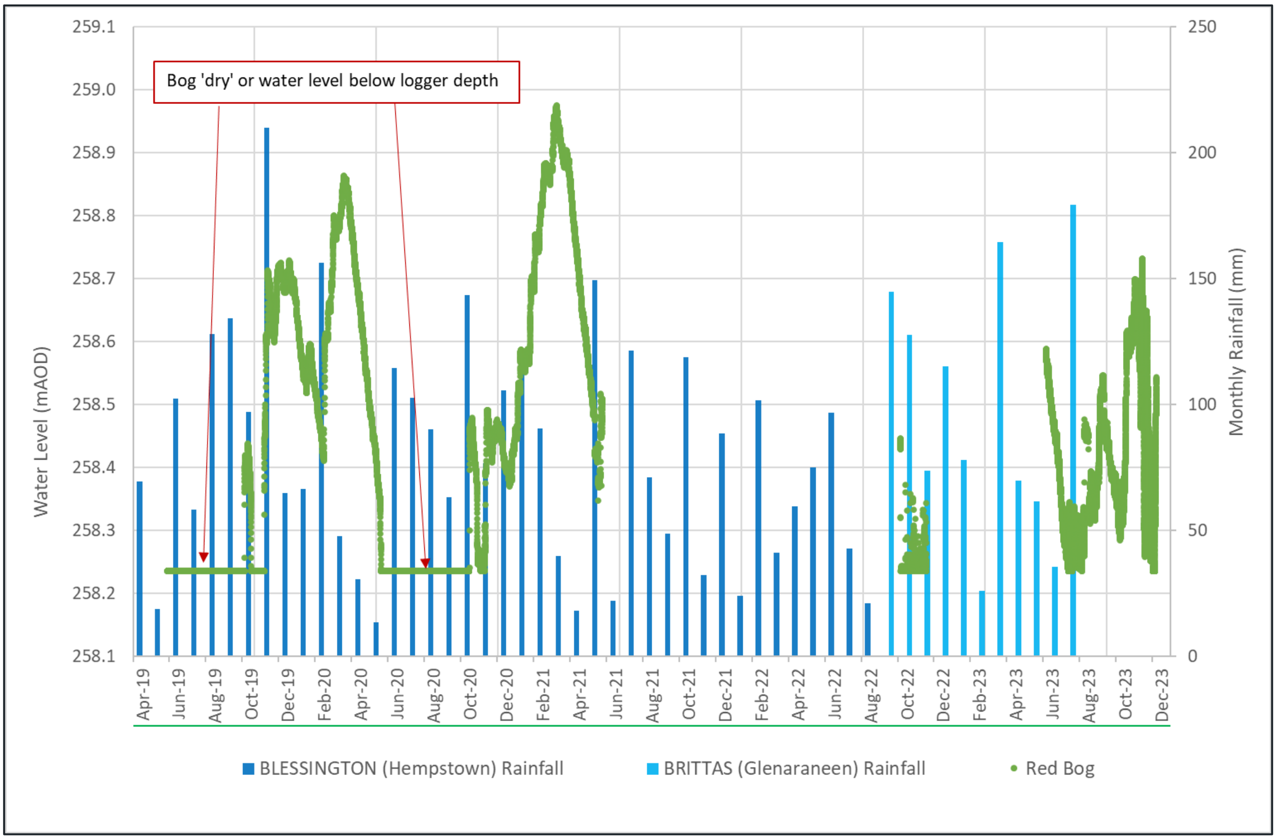

Figure 6-8 – Red Bog SAC Water Level Elevation (mAOD) and Monthly Rainfall

6.4.7.4 Local Surface Water Quality

The current local surface water quality has been derived using publicly available data from the EPA Geo Portal website.

The WFD Status (2013-2018) and latest (2022) River Quality (Q) Values of surface water features in the vicinity of the Site, as assigned by the EPA, are shown in Figure 6-9 and summarised in Table 6-6.

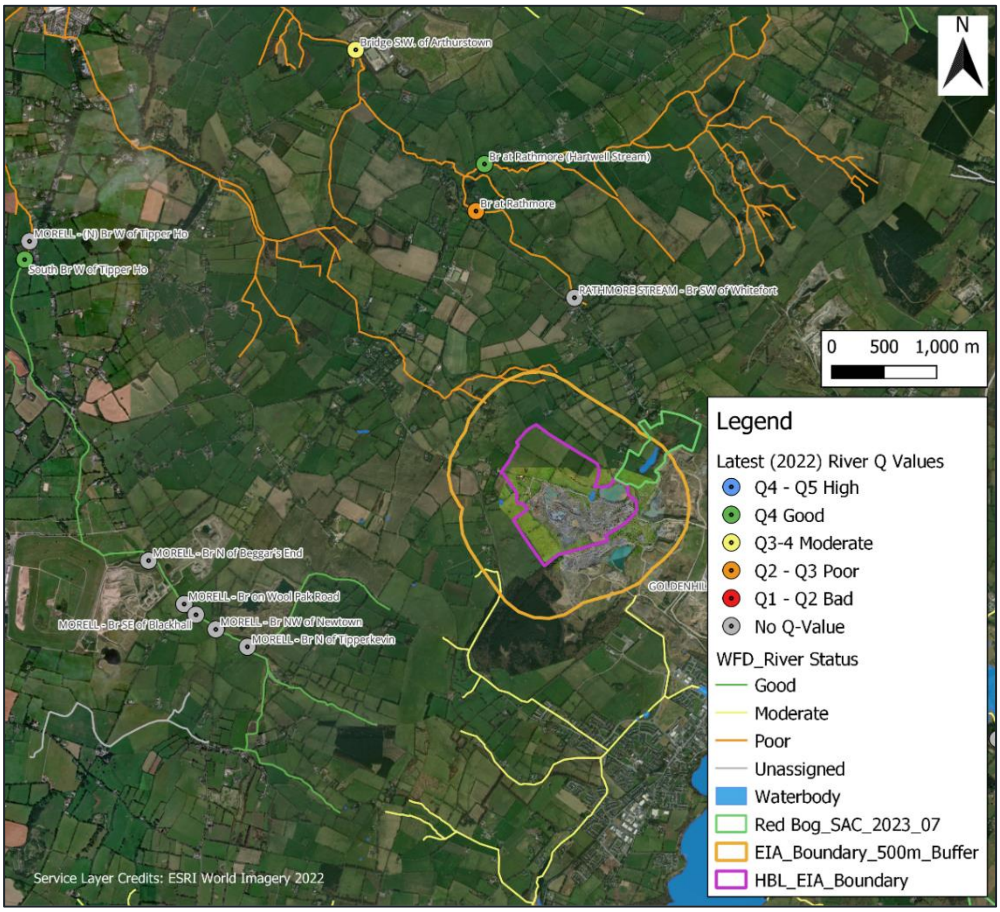

Figure 6-9 - Local River WFD Status, EPA River Quality Values and EPA Monitoring Stations (after EPA, 2022)

To the north of the Site, the Rathmore Stream (which is a tributary of River Morell) is classified as ‘poor’ under the WFD (2013-2018) Status. The most recent River Quality (Q) status varies between Q3 ‘poor’ and Q4 ‘good’ for the Rathmore Stream. The Q3 ‘poor’ status was recorded in 2016 so may not be reflective of current conditions. Q4 ‘good’ and Q3-4 ‘moderate’ statuses were recorded in 2022.

To the southwest of the Site, the River Morell (which is a tributary to the Liffey River system) is classified as ‘good’ under the WFD (2013-2018) Status. This is an improvement with the section (Morell_010) being classified as ‘moderate’ under the WFD (2010-2015) Status. The most recent River Quality (Q) status is Q4 ‘good’, recorded in 2022.

Table 6-6 - Summary of WFD Status and Latest River Q Value in Surface Water Features Close to Site (EPA, 2022)

River Name	WFD Status (2013-2018)	Station Name	River Q Value (year recorded)
Rathmore_010	Poor	Br at Rathmore	3 – Poor (2016)
Rathmore_010	Poor	Br at Rathmore (Hartwell Stream)	4 – Good (2022)
Rathmore_010	Poor	Bridge S.W. of Arthurstown	3-4 – Moderate (2022)
Morell_010	Good	South Br W of Tipper Ho	4 Good (2022)

EPA surface water quality monitoring data from 2007 to 2023 is available from three monitoring stations along the River Morell; South Br W of Tipper Ho (09M010060), Bridge in Johnstown (09M010100) and Br N.E. of Sherlockstown (09M010150). These stations are all downstream of the Site at distances of 5 km, 6.4 km and 9 km respectively.

The EPA dataset (downloaded from EPA Catchments website) includes a small range of parameters for assessing the surface water quality; total ammonia, biological oxygen demand (BOD), conductivity, dissolved oxygen, nitrate, nitrite, ortho-phosphate, pH, temperature, and total oxidised nitrogen (TON). A tabulated and graphical summary of this data by year is presented in Appendix 6A (Table 6A-1 and Figure 6A-1).

Surface water screening for the tested parameters is generally not available (under EQS guidelines), however, the following observations have been made:

- Conductivity and temperature have shown a slight historical increasing trend for all locations. Conductivity has increased from ~600 to ~700 µS/cm since 2007 but has remained relatively stable over the reporting period.
- Dissolved oxygen (in mg/l and % saturation) has shown a steady historical decline and over the reporting period for all locations. The current dissolved oxygen remains high, however. The decline from 2007 to present has been from ~12 mg/l to ~10.5 mg/l. The % saturation declined from ~106 to ~97 from 2008 to present.
- Nitrate (as N) has continued an increasing trend over the reporting period, following the start of a rise in 2017. The current maximum (2022) is 4 mg/l (Bridge in Johnstown).
- Nitrite (as N) was below detection until 2019. A rising trend since 2019 has resulted in the current (2022) maximum of 13 mg/l (Bridge in Johnstown). The river monitoring station closest to the site (South Br W of Tipper Ho) shows the lowest nitrite value of 6.9 mg/l.
- There is no correlation between the water quality at the stations for the River Morell and their proximity to the Site. The trends of Nitrate and Nitrite are likely in response to changes in land use, with the application of fertilisers, rather than from any site activities.

6.4.7.5 Site Surface Water Quality

Water is used in the processing of sand and gravel in a closed circuit 'wet' aggregate processing plant, where water is recycled throughout the process, as discussed in Section 6.4.4 alongside the water schematic. Silt laden water is disposed of in the silt lagoon, where the silt settles out over time. The excess water is allowed to drain (along with rainwater) into Pond K2, within the base of the quarry, where it then recirculates via the pontoon pump for use in processing.

Sampling of Pond K1 ceased in November 2023, with the pond being decommissioned and all process water being sourced from Pond K2. Sampling of Pond K2 is conducted on a quarterly basis (starting in 2023), with in-situ field water quality parameters tested and laboratory analysis conducted.

Field Water Quality

The representative averages for field parameters are presented in Table 6-7 for the artificial ponds. Full field water quality results are presented in Appendix 6B. Field parameters for Pond K1 and Pond K2 are within normal ranges for these locations.

Table 6-7 – Representative Field Parameter 2023 Averages from Artificial Ponds

Monitoring ID	Average pH	Average Conductivity (µS/cm)	Average Temperature (°C)
Pond K1	7.73	495.7	9.9
Pond K2	7.86	420.2	10.2

Laboratory Water Quality

Full laboratory results are presented in Appendix 6A (Table 6A-2 to Table 6A-6), which includes quarterly results over 2023. The laboratory certificates for the 2023 results are included in Appendix 6C. Laboratory reports refer to samples taken from 'Pond L'. This has been renamed 'Pond K2' as to be consistent with the nomenclature used for the Site. 'Pond K' was originally termed as reference to the pond located in the HBL Kildare site and has been renamed as 'Pond K1'.

The laboratory results for the artificial ponds are screened against AA-EQS (surface water) guidelines. The water in Pond K1 and Pond K2 is understood to have no connection with the groundwater.

Although the arsenic in Pond K2 was elevated in September 2023 (11.1 µg/l), it did not exceed the AA-EQS guideline for surface water (50 µg/l).

Elevated arsenic concentrations are interpreted by WSP to be naturally occurring rather than related to plant or facilities at the Site. Arsenic is not utilised on site in reagents or for inputs to plant site processes.

Arsenic is often naturally elevated in groundwater hosted in greywacke or shales, with poorly productive bedrock having increased probability of higher concentrations (McGrory et al., 2017). The observed values in September 2023 are minor when compared to the relevant guidelines. Results from November 2023 (Table 6A-5) show that arsenic concentration in Pond K2 has reduced (5.3 µg/l), indicating there is no increasing trend in arsenic.

The groundwater table within the greywacke and shale bedrock has not been encountered with quarrying activities, as no dewatering has taken place to date. It is possible, therefore, that the elevated arsenic in Pond K2 has come from an isolated pocket of water within the bedrock, which has been released with excavation. Alternatively, it is possible that arsenic has been mobilised from the surrounding soils with rainfall and concentrated in Pond K2, at the base of the quarry.

6.4.8 GROUNDWATER – HYDROGEOLOGY

Based on a review of borehole logs (Appendix 6D), site conditions and published information, it is understood that two hydrogeological units underlie the Site; Permeable sands and gravels - Locally important aquifer - Lg; and Low permeability greywackes and shales of the Glen Ding Formation in the west and of the Slate Quarries Formation in the east - Poor aquifer - Pu. The GSI aquifer designation (GSI, 2023) for the sand and gravel and bedrock aquifers underlying the Site is shown in Figure 6-10.

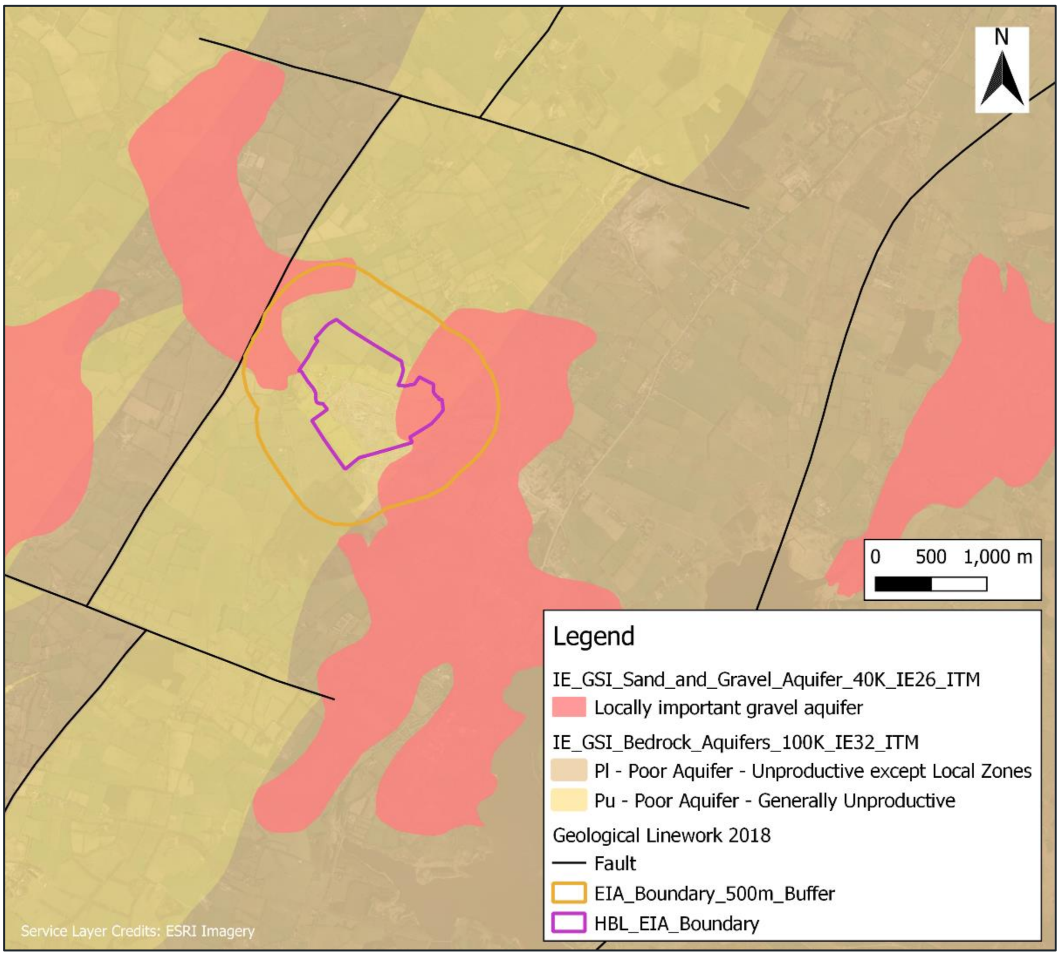

Figure 6-10 – Aquifer Designation Map (GSI, 2023)

6.4.8.1 LOCAL AQUIFERS AND THEIR PROPERTIES

Sand and Gravel Aquifer

The Site is underlain by the Blessington Gravels (IE_EA_G_047) (refer to GSI website), which have been sub-divided into the WFD (Water Framework Directive) and GWDTE-Red Bog of Kildare (SAC000397) (IE_EA_G_085). The Blessington Gravels have been classified as a locally important sand and gravel aquifer (Lg) (GSI, 2023) (Figure 6-10). Appendix 6E provides a summary of the Initial Characterization for the Blessington GWB (GSI).

Quaternary sediments play an important role in the groundwater flow regime of the region. Where sufficiently thick deposits of sand and gravel deposits overlie bedrock, these subsoil units can be classified as an intergranular aquifer. This classification is made as these units have significant hydraulic characteristics, such as high permeability, high potential for recharge and provide additional storage to underlying bedrock aquifers. The GSI classify sand and gravel deposits as aquifers when they have a minimum of 1 km^2 aerial extent and 5 m vertical saturated thickness (locally important sand and gravel aquifer, Aquifer Code Lg) and a minimum of 10 km^2 aerial extent and 5 m vertical saturated thickness (regionally important sand and gravel aquifer, Aquifer Code Rg).

Large amounts of clay fines recorded in the sands and gravels (as seen in the borehole logs in Appendix 6D), indicate that the permeability of this unit is variable across site and has resulted in perched water features.

Bedrock Aquifer

The bedrock aquifer underlying the Site has been characterised as ‘Pu’, a poor bedrock aquifer which is generally unproductive (Figure 6-10).

A ‘Pu’ poor aquifer is described by the GSI (GSI, 2017) as:

- Generally unproductive with few poorly connected fractures, fissures and joints;
- Having a shallow weathered zone of slightly higher permeability (top few meters), which decreases with depth;
- Having poor aquifer storage, short flow paths (tens of m’s) and low recharge acceptance;
- The presence of higher permeability fault zones is rare; and
- Groundwater baseflow contribution to surface water features is very limited.

Former site investigations carried out east of the quarry in the Glen Ding Formation revealed bulk bedrock permeability’s of 3.2 x 10-7 and 1.7 x 10-7 m/s respectively (WYG, 2004).

Groundwater Vulnerability

Groundwater Vulnerability (DELG/EPA/GSI, 1999) defines how easily groundwater may be contaminated by human activities. According to the GSI online mapping tool (GSI, 2023) the footprint of the Site is classified as ‘High’ (Figure 6-11). This is appropriate given the thin nature of the sands and gravels overlying the bedrock greywacke aquifer beneath the Site. The groundwater vulnerability classification has not taken into account the presence of bedrock now at the surface within the base of the quarry, as a result of extraction.

The higher topographies to the northeast and northwest of the Site are characterised as having rock at or near the surface. These peaks form the main areas of recharge for the bedrock aquifer (along weathered horizons) and overlying sands and gravels.

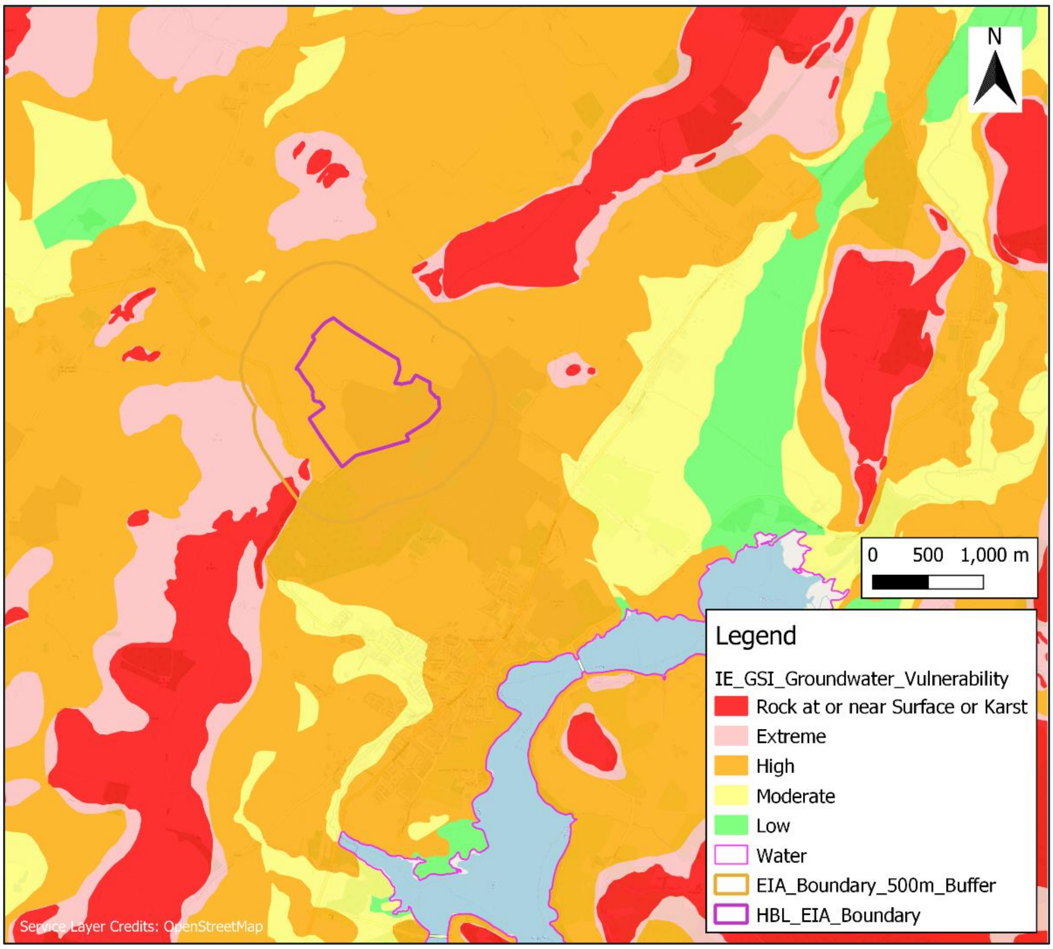

Figure 6-11 - Groundwater Vulnerability Map (GSI, 2023)

Groundwater Recharge

GSI mapping indicates an effective rainfall of approximately 543 mm/year across the majority of the Site. Soils and subsoils under the footprint of the Site are classified by the GSI website as being high permeability and well drained, with a potential recharge coefficient of 85%.

However, the ability of the bedrock aquifer to accept all available groundwater recharge is considered to be low to moderate from northwest to southeast across the Site. The groundwater recharge map in Figure 6-12 presents a maximum allowable estimated recharge to bedrock of 100 mm/year in the northwest (over the majority of the Site), and 462 mm/year in the southeast.

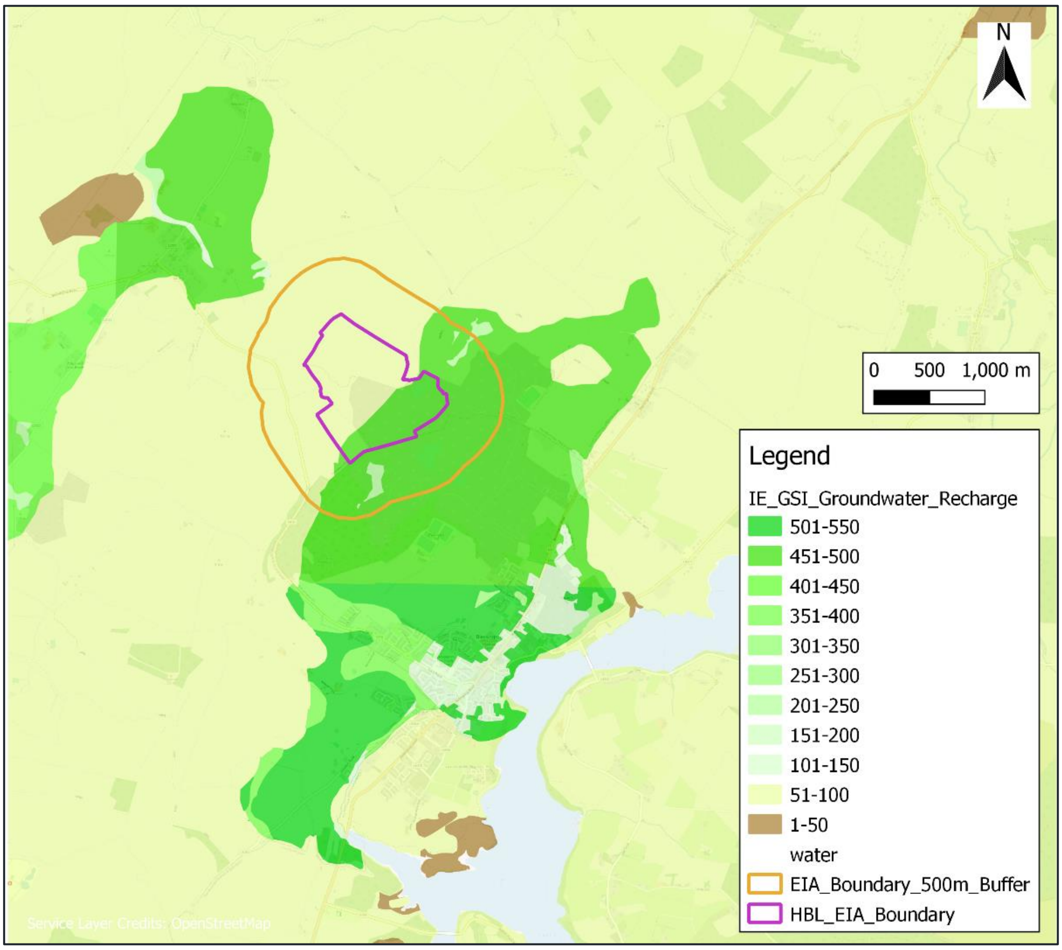

Figure 6-12 - Groundwater Recharge Map (GSI, 2023)

6.4.9 GROUNDWATER ELEVATION INVESTIGATIONS

There have previously been six existing monitoring wells reported. Since then, two additional bores (BH9K and BH10K) were installed (in September 2023) to provide further information on the underlying geology, groundwater quality and groundwater elevation. The locations of the existing and abandoned monitoring wells are presented in Figure 6-13 and details on water strike and lithology provided in Table 6-8. The depth of the water strikes for each monitoring well show that the main aquifer beneath the Site is confined at depth within the bedrock. This is indicated by the static water level rising by between 3 and 20 m from the water strike depth noted with drilling.

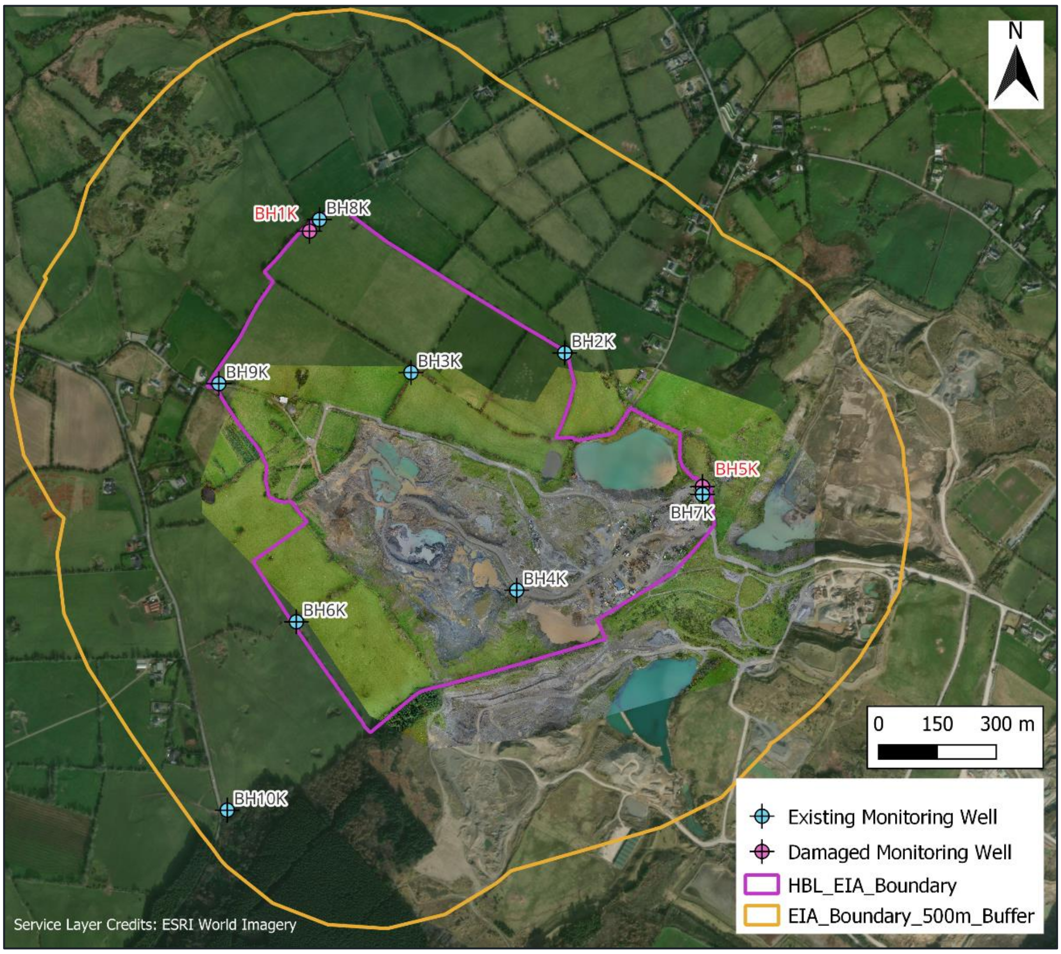

Figure 6-13 - Monitoring Well Locations

Table 6-8 – 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	>100.0	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

6.4.9.1 Groundwater Elevations

Manual groundwater elevations in Metres Above Ordnance Datum (mAOD) since January 2020 are displayed in Figure 6-14 for the existing monitoring wells shown in Figure 6-13. Since January 2023, the frequency of recording water levels has been increased with monthly visits to site.

Water levels have remained relatively stable, which is reflective of the confined nature of the groundwater within fractures and seams of the bedrock greywacke and slate. There are no rising or falling trends in any of the monitoring wells. There are two likely outlying water levels recorded in January 2023 for BH7K and in November 2023 for recently installed BH10K. The December 2023 reading for BH10K indicates that the water level is more consistent with the September 2023 readings (following install of the monitoring well).

Water levels respond to the March 2023 rainfall event when there was a total of 164.5 mm over the month. The biggest response is shown in BH8K, with a sharp rise in level of 1.37 m. This sharp rise indicates a component of direct rainfall recharge and good connectivity between the siltstone aquifer and overlying sands and gravels at this location. A rise in water levels of 1.33 m in BH7K over a period of 3 months indicates slower groundwater recharge through the overlying sands and gravels and into the bedrock. The steady rise in water levels in this monitoring well is consistent with it being at a higher elevation (to the northeast of the Site), within an area of recharge.

Monitoring wells BH2K and BH6K show very little response to rainfall. This indicates that they receive little recharge due to having water contained within poorly connected fractures deep within the slate (as in BH2K), or by being overlain with a clay rich unit of sands and gravels (as in BH6K).

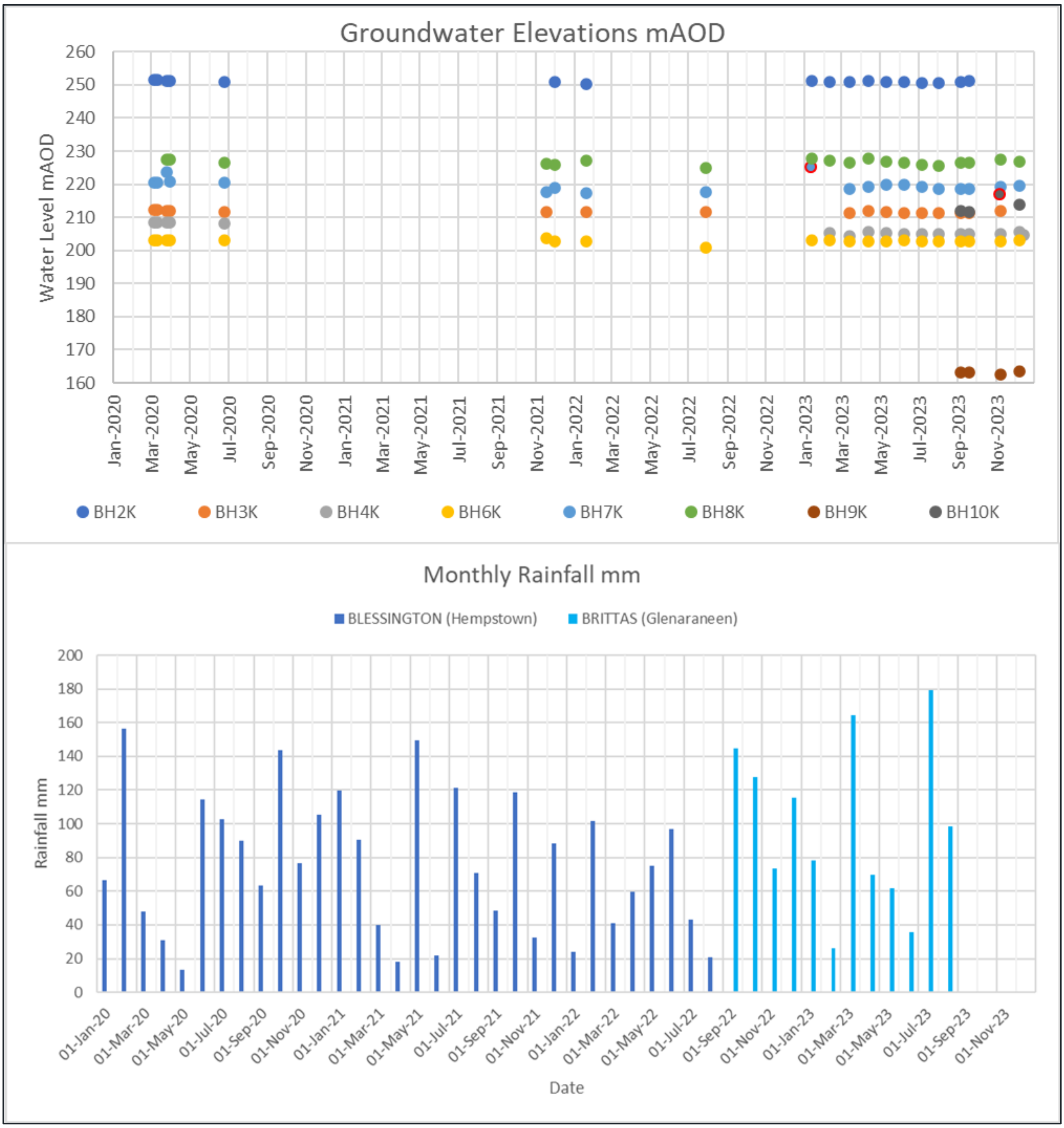

Figure 6-14 - Groundwater Elevations Over Period 2020-2023

The available groundwater levels show no indication of drawdown and there are no declining trends with recent activities at the Site. This confirms that there has not been any active dewatering with quarrying activities of the sands and gravels or greywacke bedrock. This also confirms that quarrying activities have not intercepted the groundwater confined within the greywacke or siltstone bedrock, even though they have continued beneath the previously stated maximum winter groundwater elevation of 200 mAOD (Golder, 2020).

Groundwater Contours

Groundwater contours generated for September 2023 indicate that groundwater movement is in a south-westerly to easterly direction across Site (Figure 6-15). Recent water levels from BH10K indicate that there is a groundwater high beneath Glen Ding Wood to the southwest of Site. This forms a secondary area of recharge, in addition to the topographical high northeast of site. A deep groundwater level recorded in BH9K (of ca. 164 mAOD) has steepened the groundwater gradient in this area in comparison to the previous understanding (Golder, 2020). A comparison to the colour banded elevation in Figure 6-16 gives a clear representation of the close relationship between the topographical highs and areas of recharge and direction of flow.

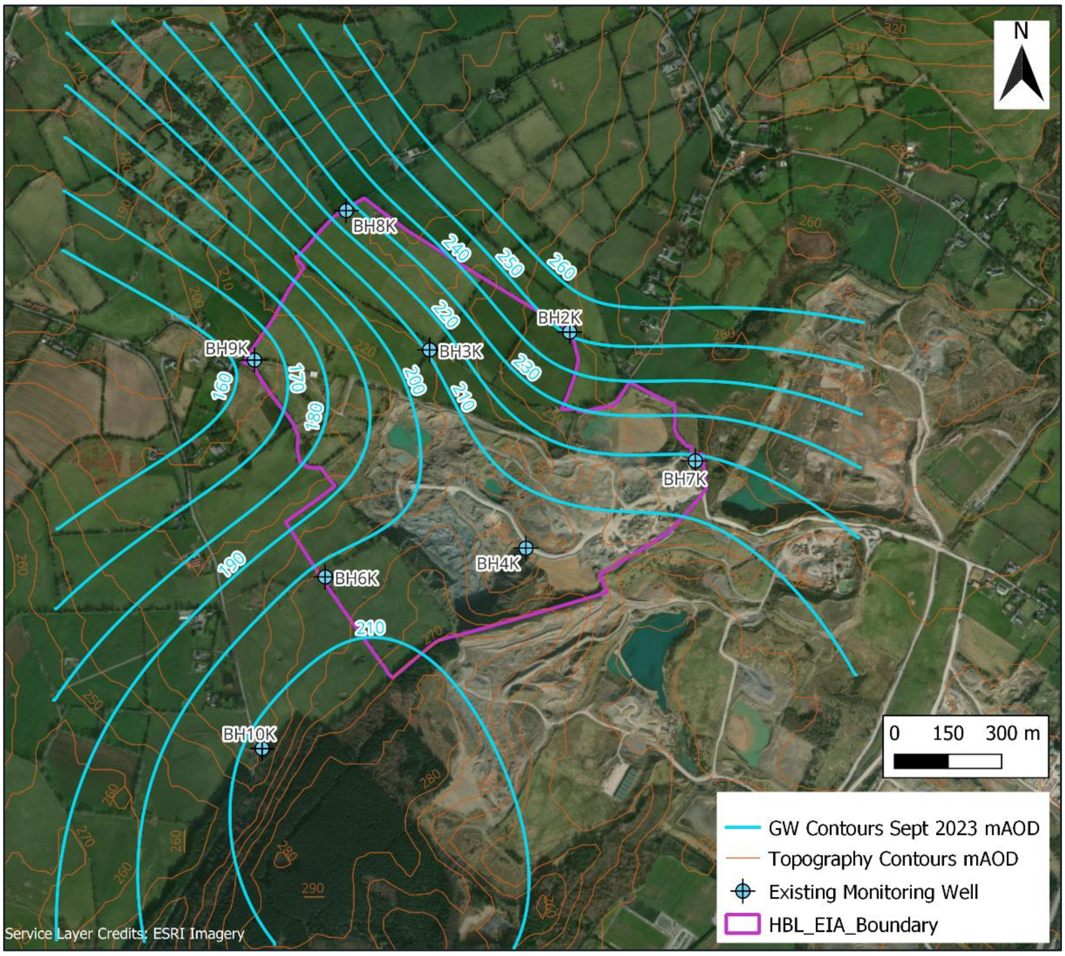

Figure 6-15 - Groundwater Contours September 2023 with aerial and Topography

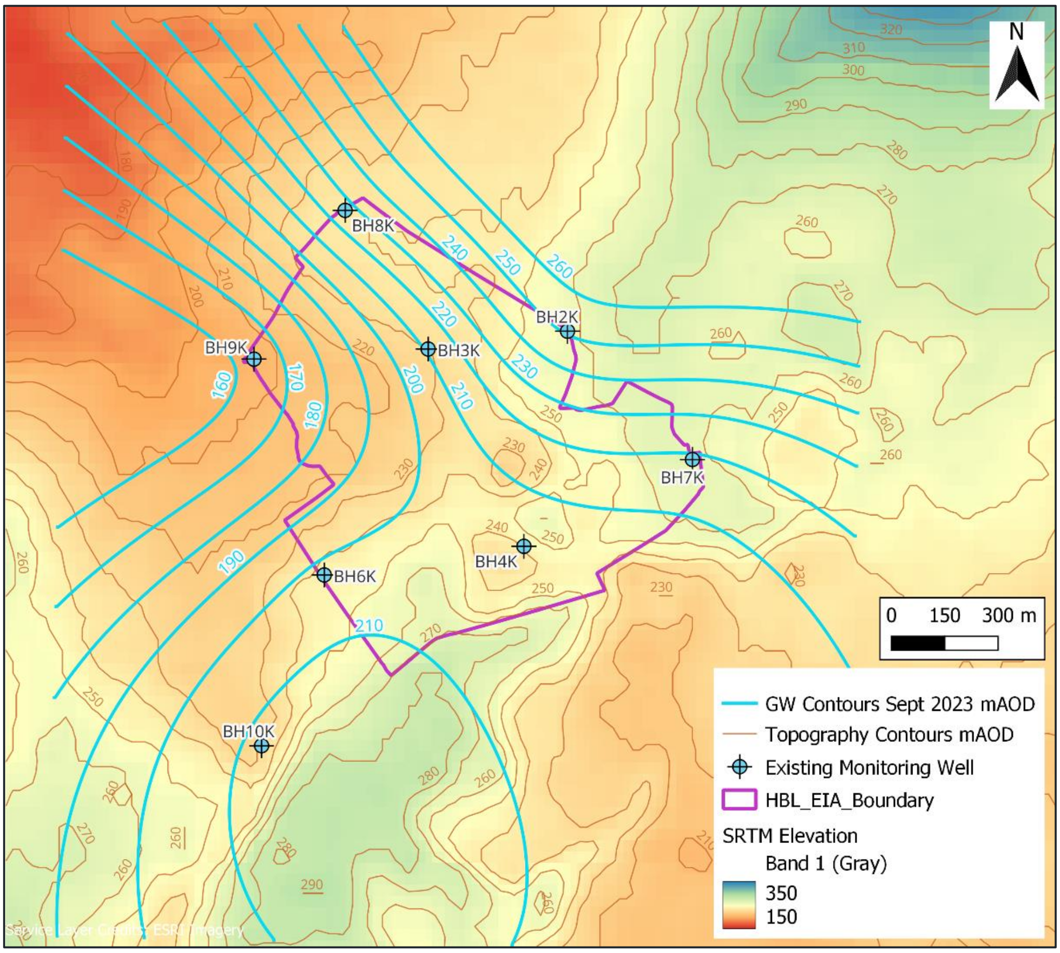

Figure 6-16 - Groundwater Contours September 2023 with Topography

6.4.10 LOCAL GROUNDWATER QUALITY

There are a total of eight existing groundwater monitoring wells (Figure 6-13) used to monitor groundwater quality across the Site. Water quality samples for both laboratory analysis and in-situ field water quality were recorded on a quarterly basis in 2023 (January, May, September, November and December). Samples were collected for all available monitoring wells. Sampling is generally not possible from BH3K due to there being insufficient head of water within the base of the bore, and sampling is not possible from BH4K due to the water level being too deep to pump a sample and there being no information on the screened interval of the installation.

Representative field water quality results are presented in Table 6-9 for monitoring wells. Full laboratory results are presented in Appendix 6A (Table 6A-2 to Table 6A-6) with comparison to relevant threshold values.

6.4.10.1 Field Water Quality

Representative average field water quality parameters are presented below for 2023. The full table of results is presented in Appendix 6B.

Table 6-9 – Representative Field Parameter 2023 Averages from Monitoring Wells

Monitoring Well ID	Average pH	Average Conductivity (µS/cm)	Average Temperature (°C)	Average DO (mg/L)	Average Redox (ORP) (mV)
BH2K	7.28	542.2	10.7	27.9	99.4
BH6K	7.23	595.9	11.5	61.5	164.9
BH7K	7.38	502.0	13.2	53.8	173.0
BH8K	7.32	520.5	11.7	50.3	167.7
BH9K	7.41	499.2	12.8	86.1	231.8
BH10K	8.05	441.2	12.2	29.3	184.2

As can be seen in the above table the electrical conductivity values for all samples measured are well below the groundwater threshold value (GTV) of 1,875 µS/cm. The DO and Redox values indicate the groundwater to be well oxygenated and displays aerobic characteristics (all redox values are positive), noting that BH2K and BH10K are lower than the other samples. The lower DO in BH2K and BH10K could be related to the depth at which the groundwater is confined in the bedrock in at these locations (20 m and 13 m into the bedrock in BH2K and BH10K respectively). Temperature and pH are within normal ranges for the site. The results for DO in May 2023 are consistently low across site (Table 6B-1). Testing in September and November 2023 shows a return to the expected range.

6.4.10.2 Laboratory Water Quality

Laboratory analysis was undertaken on a quarterly basis over 2023, with results from January, May, September, November and December. Full laboratory results are presented in Appendix 6A, Table 6A-2 to Table 6A-6. The laboratory certificates for the results are included in Appendix 6C.

The laboratory results for groundwater are screened against GTV (groundwater) guidelines. A summary of the screening exceedances is presented below in Table 6-10.

Nitrate as NO3 exceeded the GTV guideline (37.5 mg/l) in BH6K for every quarter of 2023. The elevated Nitrate levels are consistent with historical data, and values consistently remain between 50-60 mg/l indicating that this may be caused by off-Site activities, such as applying fertiliser to agricultural land. Nitrate as NO3 was previously recorded in BH6K at 55.9 mg/l (12/08/2019) and 55.7 mg/l (25/03/2020), as reported in the 2020 EIAR, and was reported to be ‘due to agricultural practices taking place on the pastureland surrounding the borehole, for example, the spreading of artificial manure’ (Golder, 2020).

The GTV guideline for arsenic (7.5 µg/l) was met on one occasion the sample from BH10K (7.5 µg/l).

Elevated arsenic concentrations are interpreted by WSP to be naturally occurring rather than related to plant or facilities at the Site. Arsenic is not utilised on site in reagents or for inputs to plant site processes.

Arsenic is often naturally elevated in groundwater hosted in greywacke or shales, with poorly productive bedrock having increased probability of higher concentrations (McGrory et al., 2017). The observed value in September 2023 is minor when compared to the relevant guidelines. Results from November 2023 (Table 6A-5) show that arsenic concentration reduced to 2.6 µg/l in BH10K, indicating there is no increasing trend in arsenic. The distance of BH10K from the quarry indicates that the rise in arsenic is naturally occurring rather than related to quarrying activities, which would also present as spikes in arsenic in monitoring wells closer to the quarry. BH10K is also upgradient (in relation to groundwater flow Figure 6-15) from the Site, so any contaminant source from the Site would not migrate to this location under the current flow regime.

In September 2023 (**Error! Reference source not found.**) GRO (>C8-C12) and GRO (>C4-C12) are slightly above detection limits for bores BH6K, BH9K and BH10K, with a range of 19 to 34 µg/l. The elevated GRO in the range of C8-C12 indicates a suspected hydrocarbon source of petrol rather than diesel (EPH (C8-C40) was <10). These bores are some distance (250-700 m) from the quarry, and the petrol source indicates that it is not related to quarrying at the Site, (as a spill on Site is more likely to be diesel from the mobile plant). The results for hydrocarbons in November 2023 (Table 6A-5) are all below detection limit. Further investigation indicated that the hydrocarbon source was introduced into the samples with sampling, either from the sampling equipment or PPE. This is confirmed by a small range between the sites and all sites showing detection within the same monitoring round, rather than sequential changes, with migration of a contaminant plume.

Groundwater contours and elevations (Figure 6-15 and Figure 6-16) indicate that any contaminant source originating from Site would move with the gradient to the west but not to BH10K, as it is at a higher groundwater elevation than that across the Site. BH10K would therefore not intercept any hydrocarbon spill (or other contaminant plume) originating from the Site.

Table 6-10 – Summary of Screening Exceedances in 2023

Parameter	Units	GTV	BH6K					BH10K
			Jan-23	May-23	Sept-23	Nov-23	Dec-23	Sept-23
Nitrate as NO_3	mg/l	37.5	58.8	56.6	55.1	56.9	55.1	-
Arsenic	µg/l	7.5	-	-	-	-	-	7.5

In summary, whilst Nitrate, Arsenic and hydrocarbons show some elevated concentrations in the samples taken, there is no evidence of migration of elevated analytes from the Site in groundwater, and therefore there is no perceived degradation of off-Site groundwater quality due to the activities at the Site.

6.4.11 DESIGNATED SITES

The Site is within the WFD Red Bog of Kildare (SAC000397) groundwater body and surface water catchment for Liffey and Dublin Bay with streams feeding Poulaphouca Reservoir.

On a regional scale, GSI mapping (2023) indicates that there are no groundwater source protection zones within the Site boundary. The nearest groundwater source protection zones are located ca. 5.5 km to the north of Site for the Kilteel Group Water Scheme and ca. 0.5 km south of the Site for the Blessington Public Supply Scheme (Figure 6-17). The Blessington public supply is reported to be supported by both surface water (from the Poulaphouca Reservoir) and groundwater abstraction from the 'Blessington Gravels' groundwater body (GSI, 2003). The area of the Red Bog SAC is also presented in Figure 6-17.

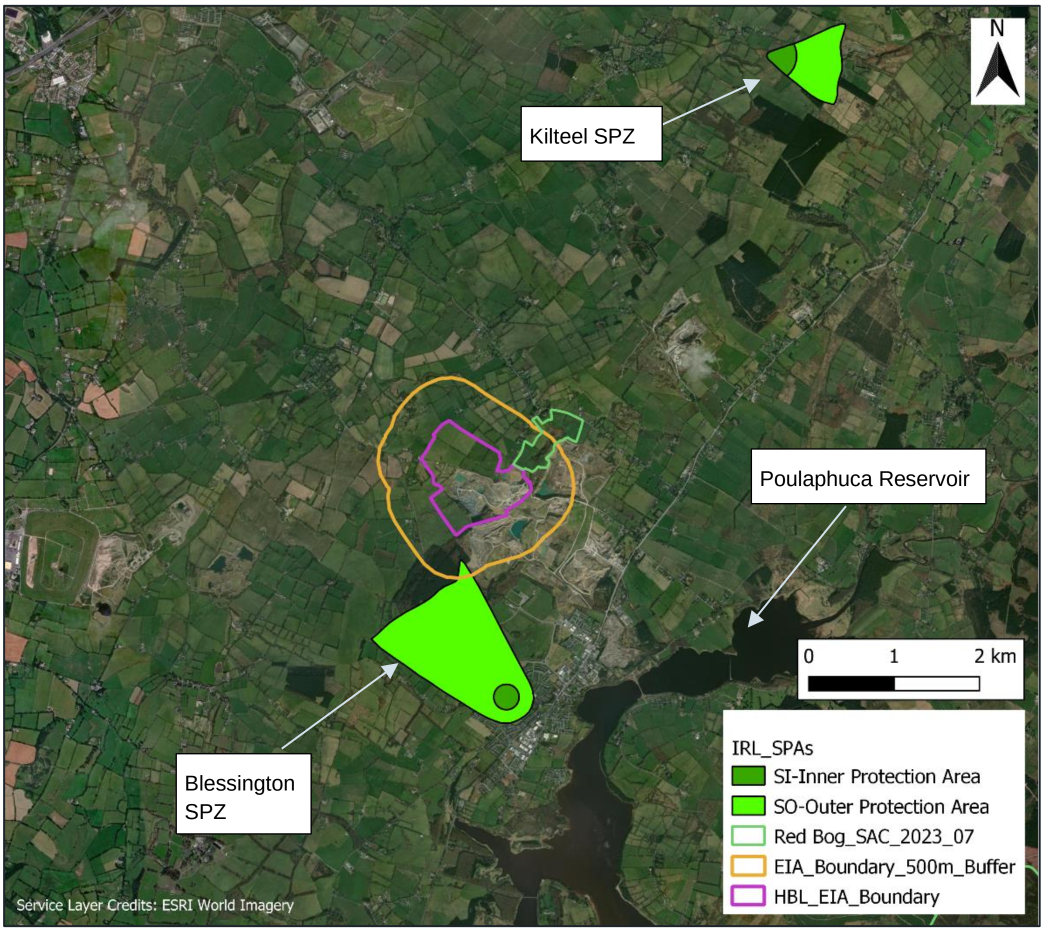

Figure 6-17 - Source Protection Zones (SPZ) near Site (GSI, 2023) and Red Bog SAC

6.4.12 FLOOD RISK

Surface water flood risk maps published by the Office of Public Works ('OPW') show that the Site is not located within a potential flood plain (OPW, 2023). This is expected given the topographical high to the south of the Site, which separates it from the nearby watercourses. The nearest watercourses to the Site are unnamed streams to the south (ca. 750 m south of the Site boundary), which flows away from the Site to the south, feeding into the Poulaphuca Reservoir.

The closest reported areas for recurring historic flood events are located 1.3 km northwest of the Site at Eadestown Cemetery and 2.4 km north of the Site in Rathcoole. These locations are at elevations of 172 m and 167 m respectively, so do not pose a risk of flooding at the Site.

The perched water feature of Red Bog SAC has not been known to flood historically and there are limited surface water inputs to the feature, based on its high elevation.

Within the Site boundary, captured rainfall has been observed to pond at the topographical low points of the excavated area (see Section 6.4.7 on surface water). The depth and spatial extent of the ponded areas have varied with changes to the geometry of the quarry floor throughout the life of the quarry. Following high rainfall events, water currently collects in the central mined greywacke at an elevation of 188 mAOD and in the western end of the quarry, in the area of Pond K2, at 190 mAOD. Pond K2 is also fed by overflow from the silt pond and surface run off. Flooding in the central greywacke area has been shown to be temporary, as ponded water recedes fully, sometime after the rainfall event.

6.4.13 LOCAL WATER USERS

The location of private wells within 150 m of the Site are shown in Figure 6-18. All five wells are located to the north of the Site and within the greywacke groundwater aquifer unit, which is classed by the GSI (2023) as “Poor Aquifer – bedrock which is generally unproductive” (Pu). This is the same greywacke unit that underlies the majority of the Site and has been excavated. There has been no blasting of this unit since 2020.

As all of the wells within 150 m of the Site are located to the north of the Site, the nearest extraction activities are within the overlying sands and gravels (ca. 450 m southeast), as no bedrock extraction is undertaken in this area of the quarry. The Section 37 boundary is displayed on Figure 6-18 below. The northern extension area will see removal of sands and gravels to the western edge of the Section 37 boundary, to ca. 280 m from the cluster of western private wells and ca. 290 m from the northern private well. The final extracted depth is planned to be above the anticipated bedrock depth in these areas.

Bedrock extraction to date has taken place in the central section of the quarry, which is ca. 600 m distance from the private wells. Site operations continue to take place above the water table as dry workings. However, some perched water is encountered in the sands and gravels overlying the bedrock as small, discrete and confined bodies (GSI - Initial Characterization for the Blessington GWB). Future proposed extraction in the north and south will involve some removal of greywacke bedrock. This proposed to take place to a depth of 200 mAOD, to avoid the possibility of intercepting the confined aquifer.

The Pu category of the bedrock aquifer indicates that water flow paths will only be over tens of metres and it is unlikely that rock extraction activities, which will take place at ca. 450 m distance, in the proposed western extension area of the quarry, will impact on flow paths at the private wells, especially as extraction will be above the confined aquifer.

Monitoring wells BH8K and BH9K monitor the confined bedrock aquifer, which is also understood to be targeted by the nearby private wells. Any changes in quality (deteriorating trends) or quantity (declining water levels) of groundwater, which could impact private wells will therefore be detected in monitoring wells BH8K and BH9K. Access to construction borelogs from the private wells would help confirm that they are in the same geological units as the monitoring wells.

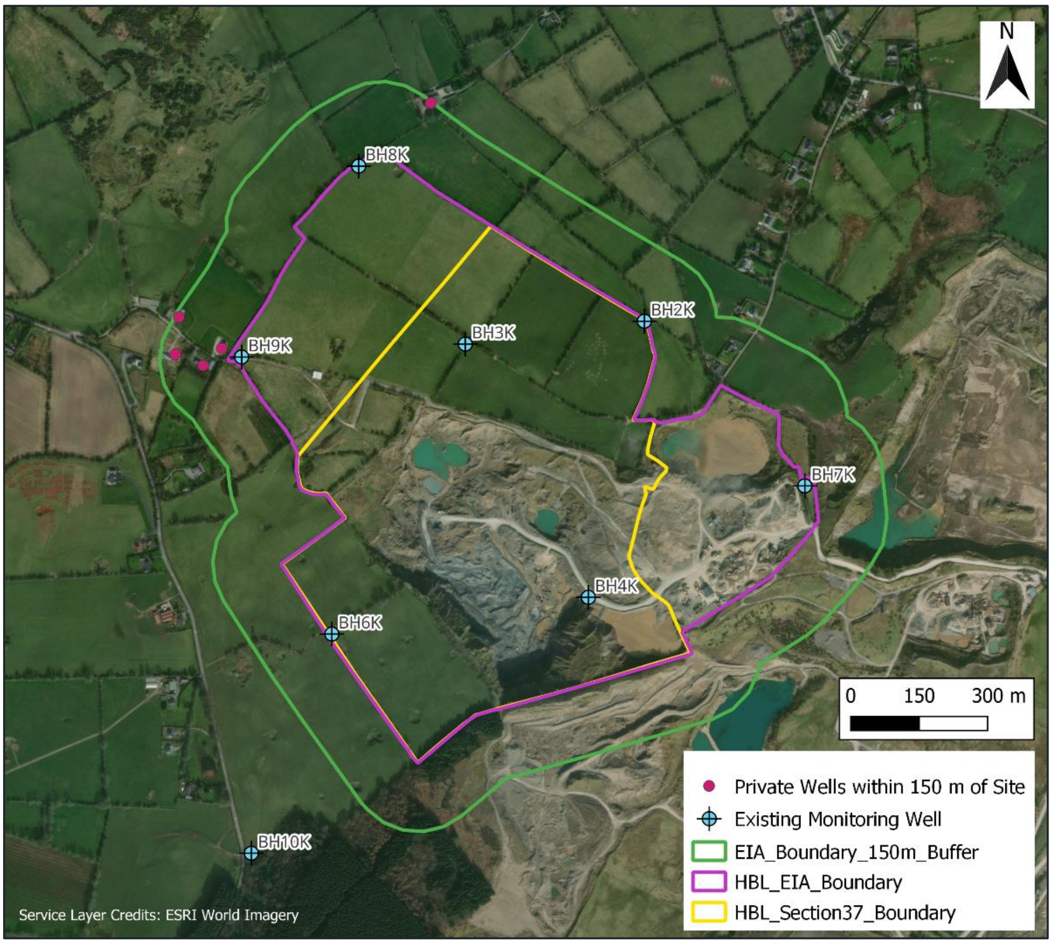

Figure 6-18 - Location of Private Wells within 150 m of the Site

6.4.14 WATER BALANCE

The climate/meteorological data for the Site is presented in Chapter 8.0 of this EIAR. Casement Aerodrome is considered the most applicable station for determination of water balance calculations. However, more accurate rainfall values for the Site have been used from Blessington (Hempstown), which is located ca. 1 km to the east of the Site and BRITTAS (Glenaraneen), which is located ca. 7.8 km northeast of the Site.

Using the rainfall data from Blessington (Hempstown) weather station and the potential evapotranspiration data for Casement Aerodrome Synoptic Station, the effective rainfall for the Site has been calculated (Table 6-11) over a three-year period (2020 to 2023).

As presented below, the annual average rainfall for the Site is 982 mm/annum over the three-year period. The average rainfall has been taken from September 2020 to August 2023 due to more recent data not being available. The total potential evapotranspiration is 582 mm/annum (Casement Aerodrome), from September 2020 to August 2023. On an annual basis, ca. 519.5 mm of rainwater can potentially recharge the aquifer underlying the Site. The extent of the current operational Site area is ca. 38.8 ha (or 388,000 m^2), which includes the quarry, plant and ancillary areas. The recharge to groundwater is taken from Section 6.4.8.1, as the lower value of 100 mm/yr. The reason for not taking into account the higher recharge value of 462 mm/yr assigned to the southeastern area of the quarry, is that this is related to the Blessington Delta deposits, which have either not been seen to the same extent as mapped or have been removed with extraction.

Table 6-11 - Estimated Annual Average Water Balance (mean values are between 2020 - 2023)

Parameter	Annual Average
(1) Estimated Area of Operational Site (m^2)	388,000 m^2
(2) Mean Annual Precipitation (mm)	982 mm
(3) Annual Potential Evapotranspiration (mm)	582 mm
(4) Actual Evapotranspiration (mm) 90% of (3)	523.8 mm
(5) Effective Annual Precipitation (mm) (2)-(4)	458.2 mm
(6) Recharge to groundwater (mm) (GSI, 2023)	100 mm
(7) Available rainfall (mm) (5) – (6)	358.2 mm
(8) Available water (m^3) (1) x (7)	138,981 m^3
(9) Current Estimated Average Daily Volume of Water used on Site (inc. public supply)	276 m^3
(10) Current Estimated Average Annual Volume of Water used on Site	75,900 m^3
(11) Residual ponded water (8) – (10)	63,981 m^3

The simplistic Site-wide water balance estimates that the annual Site water requirement (75,900 m^3) is met with the annual average recharge volume over the review period (138,981 m^3). The residual ponded water value is likely to be an over-estimation. It is possible that the recharge to groundwater is higher than 100 mm/yr. The presence of residual ponded water does, however, support the general increase in size of the pooled surface water around Pond K2.

The Site water continues to be sourced from Pond K2 (for aggregate processing, dust suppression and the welfare facilities at the Maintenance Shed) and the mains Public Supply (for the welfare facilities at the Office/Canteen and Control Room). It is, however, noted that operational water use is not well defined and recorded measurements would provide greater insight.

6.4.15 FUTURE CLIMATE TRENDS

Future climate change could alter the water environment at the Site by changing temperatures, recharge rates, flood risk and sea levels, and by affecting demand from public water supplies.

Current climate trends indicate an increase in winter precipitation (particularly in December) across all areas of Ireland and decreased precipitation in June. There is some evidence of an increase in the frequency of extreme precipitation events (20 mm or more per day) in the northwest (EPA, 2005).

Based on simulations, higher annual rainfall amounts will occur more consistently in the future than in the present climate, with warmer average summer and winter temperatures (EPA, 2005).

Changes in rainfall patterns and frequency could alter run-off and discharge patterns, groundwater recharge, the mobilisation of suspended solids and flooding. The large amounts of pooled surface water, seen following the October 2023 rainfall events, could therefore become a more frequent occurrence.

Longer and drier periods combined with higher temperatures could lead to increased potential for drought, which could affect future water resource availability (for both surface water process supply within the quarry and groundwater supply for private well users). Changes in future water resource availability and demand (with changes in population) could increase the relative importance of surface water and groundwater.

6.5 CONCEPTUAL MODEL

This section describes the conceptual hydrogeological model for the Site summarising the information contained in Section 6.4 above.

Rainwater falling to the Site provides recharge over the entire area. In the lower ground and at distance from the Site, streams are more abundant, and these are most likely fed by groundwater baseflow. Given the relatively high permeability of the sands and gravels in the area, most drainage appears to be subterraneous (via groundwater), especially below the higher ground. Groundwater is interpreted to move within the sands and gravels and along bedding planes and fractures in the bedrock. However, locally areas of perched water occur within the sands and gravels, as can be seen by the presence of surface features at the surface (e.g. Red Bog and other ponds). The water table is confined within the bedrock aquifer in the vicinity of the Site. This contrasts with understanding in the previous conceptual model, which stated that the aquifer was unconfined.

Owing to the thickness of the sands and gravels and the absence of surface water channels in the region, it is considered that this area represents a recharge zone for the underlying aquifer. Groundwater flow is considered to continue in a general south-westerly direction (Figure 6-15) and discharge to the local stream network further to the northwest.

The Hydrological and Hydrogeological Conceptual Model for the Site may be summarised as follows:

- Recharge occurs over the entire area;
- A confined groundwater flow within the bedrock, predominantly through interconnected fractures;
- Perched water occurs throughout the sands and gravels, confined by silt/clay lenses;
- An unconfined flow through permeable zones within the sands and gravels;
- Sands and gravels are in limited hydraulic continuity with the underlying bedrock. This is indicated by the confined nature of the bedrock aquifer, possibly due to a lack of connected fractures near the top of the unit;
- Permeability also decreases with depth in bedrock, the effective base of the bedrock aquifer is conservatively assumed at ca. 20 to 30 m below the rock-head (top of rock); and
- Groundwater discharges to local streams to the southwest.

Two conceptual cross-sections have been drawn to represent the current (October 2023) condition of the Site. The location of the two sections are presented in Figure 6-19.

Figure 6-20 shows the current southwest to northeast conceptual cross-section through the Site (with ground elevation taken from the latest survey). This is drawn through the centre of the quarried greywacke, where the quarry is at its deepest. The water level is displayed on the cross-section as the inferred piezometric surface (level water would rise to were the bedrock aquifer intercepted). It is clear that this represents the confined aquifer within the bedrock as quarrying below this level has not created flooding of the quarry floor. This cross-section includes the proposed northern and western extension areas.

Figure 6-21 shows the conceptual hydrogeological model along the length of the Site, from the Northwest to Southeast (with ground elevation taken from the latest survey). This cross-section includes the proposed northern extension area.

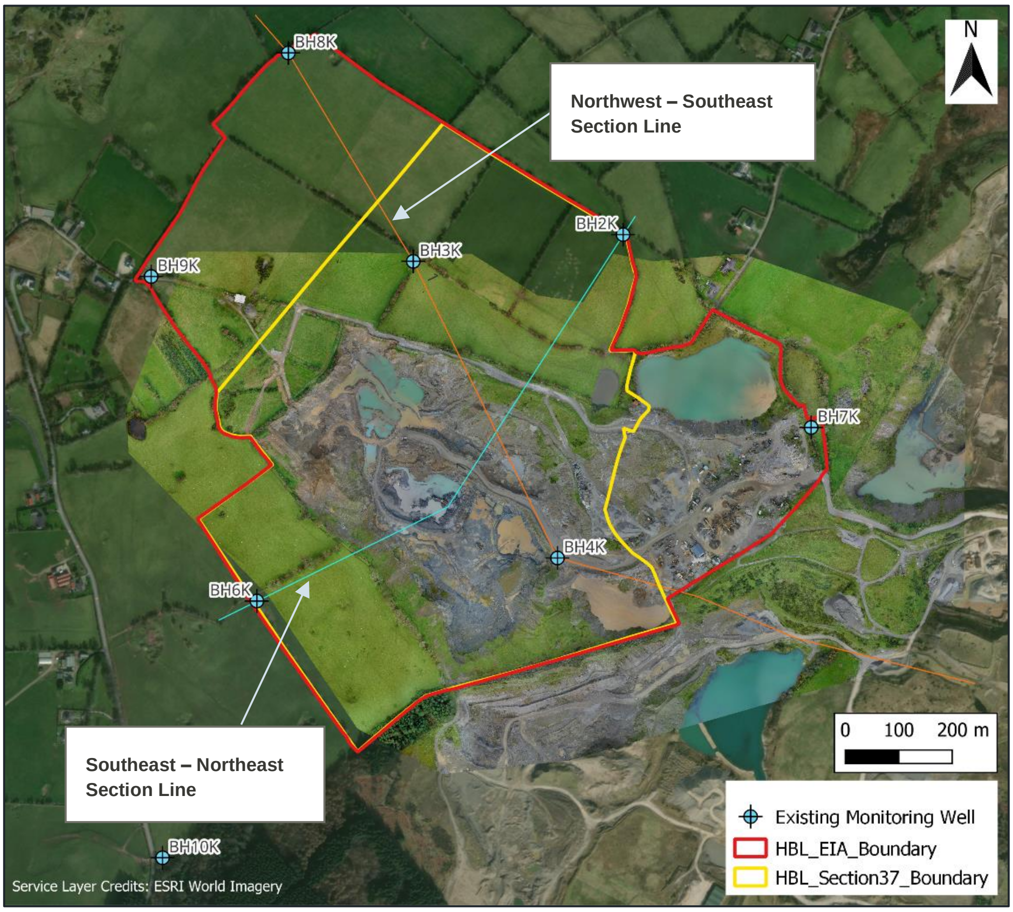

Figure 6-19 - Conceptual Model Section Lines

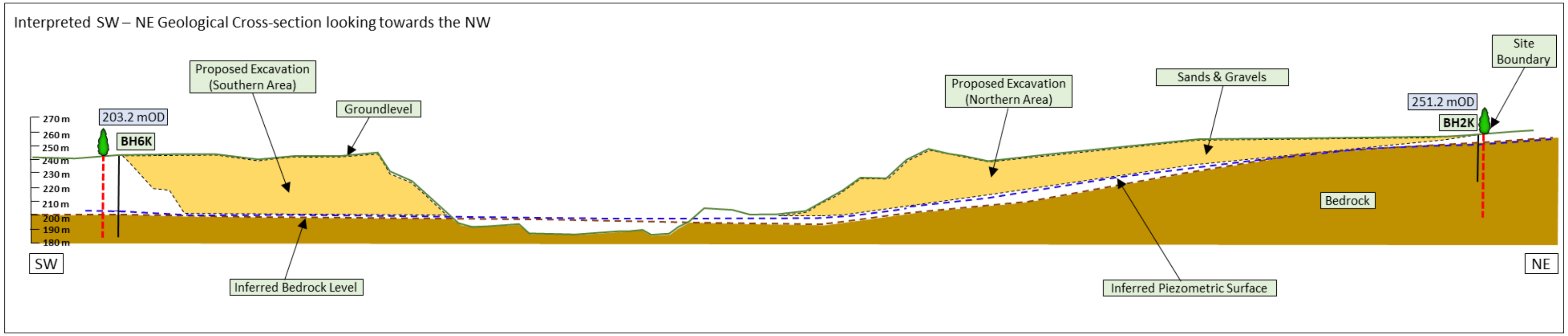

Figure 6-20 - Southwest – Northeast cross-section showing Conceptual Hydrogeological Model for the Site (2023)

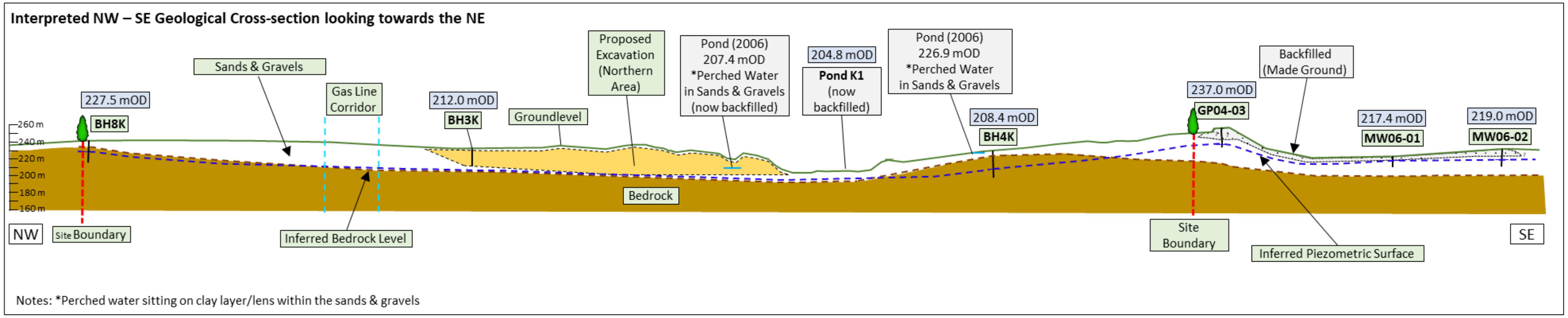

Figure 6-21 - Northwest - Southeast cross-section showing Conceptual Hydrogeological Model for the Site (2023)

6.6 SELECTION OF SENSITIVE RECEPTORS

The nearest surface water features to the Site are unnamed streams to the south (ca. 1.3 km south-west of the Site boundary), the Red Bog SAC (ca. 240 m to the northeast), Poulaphouca Reservoir (ca. 2.2 km east of the boundary) and a small pond located at the northern boundary of the Site. These features are either up hydraulic gradient and/or not linked to the Site by any surface water features, and as such, are not at risk of potential pollution from the Site.

Considering the conceptual model for the Site presented in Section 6.5 and the methodology for assessment presented in Section 6.3, the receptors and their assigned sensitivity are presented in Table 6-12 below.

Table 6-12 – Water Receptors

Receptor	Importance and Reasoning	Sensitivity
Groundwater - quality and availability due to use as a resource and wider regulatory requirement to maintain good quality status	Bedrock under the Site is classified as a poorly productive aquifer with limited fracture connectivity (tens of metres). Local supplies are generally low yield, supporting single household domestic properties, targeting the bedrock. Extraction has not resulted in the need to dewater from the bedrock. Isolated perched water in the sands and gravels may have been dewatered.	Negligible
Surface Water - quality and availability due to use as a resource and wider regulatory requirement to maintain good quality status.	The tributaries to the River Morell are ca. 1.3 km downstream to the northwest of the quarry workings. There are no surface water features connecting the site to the tributaries. The tributaries receive some groundwater baseflow, however.	Low
Flooding – changes in presence and water flows for on-Site plant and infrastructure.	Quarrying into the confined water table within the bedrock has the potential to cause flooding. Site not in surface water flood area. Large accumulations of ponded water following rainfall events, however, with no evidence of plant being affected. Overflow of silt pond required following heavy rain.	Medium
Flooding – changes in presence and impacts of water flows on infrastructure immediately adjacent and downstream of the Site.	The quarry is not situated in a flood plain and is situated on a topographical high. The R410 road is ca. 600 m downstream from the quarry area. There are no discharges of water from the quarry to the surface.	N/A (no pathway)
Human Health – existing off-Site water users, water availability and quality	Existing water well users are located adjacent to the Site and source water from the bedrock aquifer. The bedrock aquifer has not been encountered with quarrying, however, and there has been no observed deteriorating trend in groundwater quality.	N/A (no pathway)

	Public mains water supply to the Site but not in hydraulic connectivity with surface or groundwater.	
Red Bog SAC - degradation of protected sites due to changes in water quality or quantity	Red Bog is ca. 240 m to the northeast of the site. Red Bog is a perched water feature and not reliant on the bedrock aquifer beneath the Site. Red Bog is also up hydraulic gradient from the Site so would not be at risk of migration of contaminants.	N/A (no pathway)

6.7 CHARACTERISTICS OF THE DEVELOPMENT

The characteristics of the Proposed Development with regards to water are previously outlined in Sections 6.4.1 to 6.4.4.

6.7.1.1 Proposed Development Plans

The current plans for the quarry involve two further stages of work:

- Operational Phase - extension of the northern and western extraction areas,
- Restoration Phase - restoration of the Site in-line with the proposed restoration plan.

The Proposed Development consists of further development of the quarry over the Section 37L application area (ca. 64.0 ha) that will progress laterally into the sands and gravels in the northern and western extraction areas. The proposed areas for extraction are presented Chapter 2.0 (Project Description) and summarised in Figure 6-22 below.

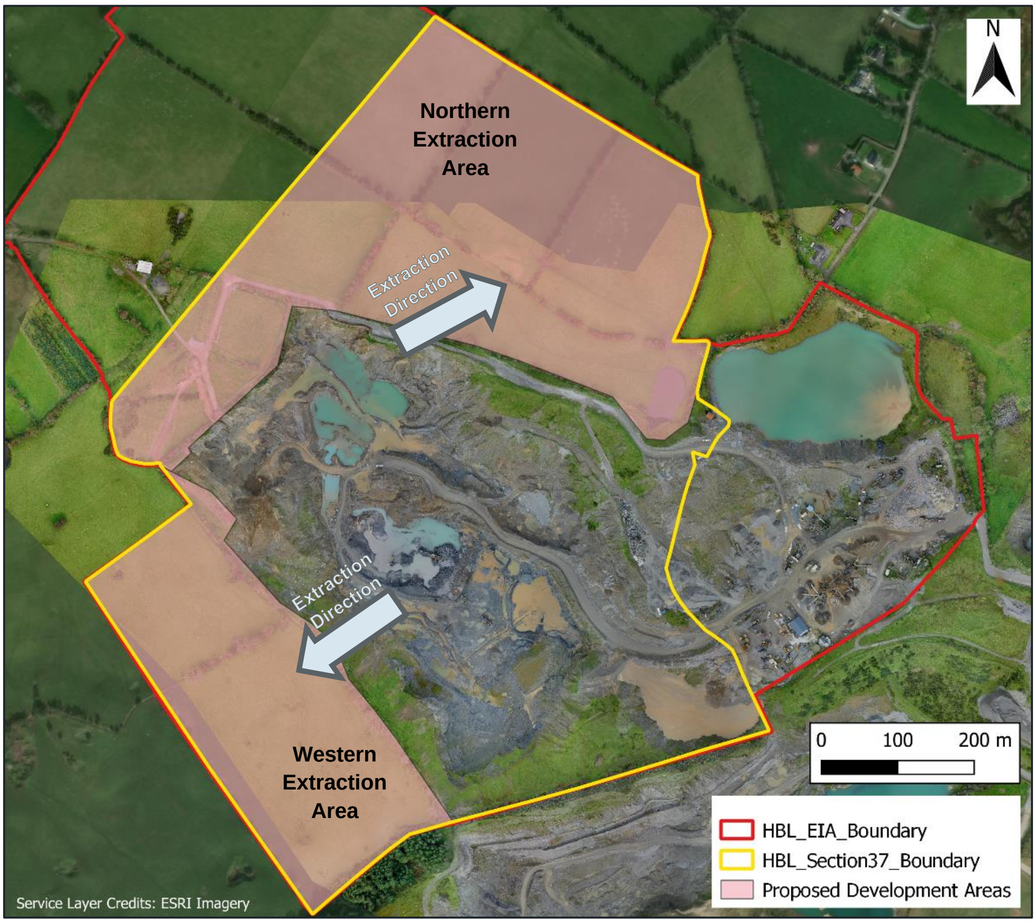

Figure 6-22 - Proposed Extraction Areas

It is proposed to extend the quarry void to the north by ca. 21.2 ha. (0.212 km^2), with the base of the excavated area rising from 215 mAOD in the vicinity of BH3K to 252 mAOD in the vicinity of BH2K (which is 1 m above the highest recorded groundwater level). This is consistent with the anticipated bedrock elevation and orientation. Only sand and gravel is proposed to be extracted in this area. . The proposed extraction will not extend all the way to the S.37L boundary and will stop at the topographical high with safety/screening berms being constructed along the perimeter. This will screen the quarry visually and also screen operational noise from the residential properties to the east of this area. With the working face progressing in an easterly direction there will be reduced noise impact for the residential areas. This is discussed further in Chapter 9.0 Noise and Vibration.

It is proposed to extend the quarry void to the south by ca. 10.2 ha. (0.102 km^2) at a final average depth of approximately 200 mAOD. The 200 mAOD is interpreted as the level below which there is increased risk of intercepting the confined aquifer within the greywacke bedrock. Sand and gravel and rock will be extracted from this area. Where extraction of greywacke in the centre of the quarry is already at 188 mAOD, there is to be some lateral extension to level the area and continue extraction of the valuable rock to this depth. Extraction in this area to 188 mAOD has proven that there has been no interception of the confined aquifer.

The restoration proposal includes restoration to agricultural and amenity use upon completion of the proposed extraction. The proposal duration is 15-18 years to reflect the anticipated extraction of remaining reserve over 13 - 15 years, dependent on market conditions and a further 2 - 3 years for restoration.

Plant, ancillary storage tanks, infrastructure and buildings in the eastern area will be removed as part of the restoration works.

6.7.2 EMBEDDED MITIGATION

To avoid the potential impacts to the water environment during activities at the Site, embedded design and commonly undertaken good practice mitigation measures are in place, which include:

- Excavation is not to take place below the groundwater table (confined aquifer);
- Runoff from the floor (and faces) of all areas of the extraction area slope towards a low elevation point, with trenches helping water to collect in Pond K2 and surrounding area;
- There is no discharge to surface water as aggregate processing takes place in a closed-circuit system with top-up water sourced from Pond K2, with the only water lost off-Site in the washed product or percolate to ground;
- Wash water generated by the process plant is discharged into the silt pond. The silt pond is located above the groundwater table and is not in direct connection;
- Wheel washing is undertaken to reduce the depositing of material on the surrounding road network, which could get into the water environment. Maintenance is undertaken to de-silt the wheel wash facilities and avoid overflows of wash water;
- Mobile plant maintenance activities use a concrete hardstanding apron (with associated interceptor) – at the Maintenance Shed. Spill kits are maintained on site to deal with all spills and leaks, and spill training is provided to relevant staff members;
- Refuelling takes place on hardstanding in a designated area of the Site and plant is well maintained to prevent uncontained releases of hydrocarbons to the ground;
- All plant and machinery utilised in the quarrying process is and will continue to be regularly serviced and maintained;
- Hydrocarbons are stored in bunded tanks on an impermeable hardstanding surface. All diesel fuel and hydraulic fluid is stored in bunded fuel tanks; and
- Monitoring of groundwater and surface water quality using available monitoring wells and artificial ponds, to ensure that no pollution of groundwater or surface water is occurring.

When assessing and evaluating the potential effects of the Proposed Development on the water environment, these embedded mitigation measures are taken into consideration.

6.8 POTENTIAL EFFECTS

The main activities which will be conducted during the future development of the Site, and may cause an impact upon the water environment are as follows:

- Quarrying activities (e.g. blasting of bedrock, excavation of quarry, movement of material),
- Crushing and washing of excavated rock,
- Use and parking of mechanical plant on the Site for excavation activities,
- Storage of hydrocarbons associated with the refuelling,
- Use of welfare facilities and holding tank.

Although there is already embedded mitigation in the Site infrastructure and design, activities at the Site still have potential to cause the following impacts:

- Changes in groundwater or surface water quality due to blasting, excavation, crushing or washing activities,
- Changes in surface water or groundwater quality from wastewater generated by on-Site welfare, holding tank and wheel wash facilities,
- Changes in surface water or groundwater quality from uncontrolled material storage,
- Changes in surface water or ground water quality caused by hydrocarbon leaks from fuel storage tanks or the unmanaged spillage of fuels or lubricants from Site plant or vehicles,
- Increased flooding risk due to elevated rainfall and/or discharge of silt laden process water into the silt pond, resulting in uncontrolled overflow to the quarry floor.

6.8.1 EVALUATION OF POTENTIAL EFFECTS

Using the methodology set out in Section 6.3 and the potential effects detailed above, an evaluation and assessment of the potential effects on the identified sensitive receptors is presented in Table 6-13. This assessment takes the embedded mitigation into consideration.

The magnitudes associated with the potential impacts at the Site are assigned either a negligible or low value due to:

- Monitoring of groundwater and surface water quality in the available monitoring wells and artificial ponds has not detected any deteriorating trends to date;
- Limited off-Site hydraulic connectivity of groundwater, due to not encountering the confined aquifer, has prevented the migration of any (possible) contaminants from the Site;
- Historically low or undetected concentrations of hydrocarbons in groundwater and surface water;
- No exceedances of surface water EQS threshold values for inland waters and generally good quality of water in the River Morell observed; and
- No significant flooding of the Site as a result of intercepting the bedrock aquifer or an uncontrolled release from the silt pond.

Combined with the negligible, low or medium sensitivity of the identified receptors, the potential adverse effects caused by the Site are mostly imperceptible or slight.

Table 6-13 - Evaluation of Initial Impacts and their Effect Significance taking into account embedded mitigation

Receptor	Sensitivity	Source of Impact/Description of Change	Impact Magnitude	Level of Effect
Groundwater	Negligible	Changes in quality due to blasting, excavation, crushing or washing activities.	Negligible	Imperceptible
Groundwater	Negligible	Changes in quality from wastewater generated by on-Site welfare, holding tank and wheel wash facilities.	Negligible	Imperceptible
Groundwater	Negligible	Changes in quality from uncontrolled material storage.	Negligible	Imperceptible
Groundwater	Negligible	Changes in quality caused by hydrocarbon leaks from fuel storage tanks or the unmanaged	Negligible	Imperceptible

		spillage of fuels or lubricants from Site plant or vehicles.		
Surface water	Low	Changes in quality due to excavation, crushing or washing activities.	Negligible	Imperceptible
Surface water	Low	Changes in quality from wastewater generated by on-Site welfare, holding tank and wheel wash facilities.	Negligible	Imperceptible
Surface water	Low	Changes in quality from uncontrolled material storage.	Negligible	Imperceptible
Surface water	Low	Changes in quality caused by hydrocarbon leaks from fuel storage tanks or the unmanaged spillage of fuels or lubricants from Site plant or vehicles.	Negligible	Imperceptible
Flooding	Medium	Increased flooding risk due to elevated rainfall and/or discharge of silt laden process water into the silt pond, resulting in uncontrolled overflow to the quarry floor.	Low	Slight
Flooding	Medium	Interception of confined bedrock aquifer causing flooding of the pit, impacting plant / equipment.	Negligible	Imperceptible

6.9 MITIGATION MEASURES

Additional mitigation and/or management is intended to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment. The initial assessment of potential effects (considering embedded mitigation) has not identified any significant adverse effects. However, to further mitigate the initial effects associated with the water environment, the following additional mitigation will take place:

- Extraction of greywacke in the central area should remain at a level of 188 mAOD in the absence of further understanding of the localised level of the confined water level, as there will be increasing risk that the water confined within the bedrock will be intercepted. Some lateral extension in the central greywacke is planned to level the area and continue extraction of the valuable rock to this depth.
- Extraction of sand and gravel in the proposed northern and western extension areas should be undertaken to the proposed levels in the absence of further understanding of the localised groundwater levels in each area;
- Future phasing of the quarried depth is to consider the anticipated depth to the aquifer for each area of the quarry. Borehole logs and quarrying to 188 mAOD have shown that the aquifer is confined in the bedrock and this depth is variable across the Site. The water strike depth in the monitoring wells is more important than the static water level in determining the depth at which groundwater will be encountered;
- Boreholes to be installed to help better define the depth to the bedrock aquifer and variations across Site. BH3K to be replaced with a bore that intercepts the bedrock aquifer;

- The silt pond should have a geotechnical assessment and be inspected regularly for signs of any structural defects that may cause a leak of material or failure; and
- The silt pond is to be moved into the base of the quarry. This will allow the silt pond to cover a larger area to reduce overflow requirement.

6.10 RESIDUAL EFFECTS

A summary of the sources of impact, predicted magnitudes of residual impact (accounting for embedded mitigation and additional mitigation) and subsequent residual effect significance is presented in Table 6-14.

In all cases the residual level of effect is no greater than *Slight*.

Table 6-14 – Evaluation of Impacts and their Effect Significance

Receptor	Source of Impact - Description of Change	Duration	Impact Magnitude / Level of Effect	Summary of Mitigation (embedded and additional)	Residual Impact Magnitude / Level of Effect
Groundwater	Changes in quality due to blasting, excavation, crushing or washing activities.	Temporary, Reversible	Negligible / Imperceptible	Additional bores to better define aquifer. No excavation into the bedrock aquifer. Will maintain low connectivity with groundwater. Third-party wells incorporated into monitoring program.	Negligible / Imperceptible
Groundwater	Changes in quality from wastewater generated by on-Site welfare, holding tank and wheel wash facilities.	Temporary, Reversible	Negligible / Imperceptible	Sewage effluent treatment systems maintained.	Negligible / Imperceptible
Groundwater	Changes in quality from uncontrolled material storage.	Temporary, Reversible	Negligible / Imperceptible	Hydrocarbons will be stored in bunded tanks on an impermeable hardstanding surface.	Negligible / Imperceptible
Groundwater	Changes in quality caused by hydrocarbon leaks from fuel storage tanks or the unmanaged spillage of fuels or lubricants from Site plant or vehicles.	Temporary, Reversible	Low / Imperceptible	Mobile plant maintenance activities will use a dedicated concrete hardstanding apron (with associated interceptor). Emergency spill kit will be available for use.	Negligible / Imperceptible
Surface water	Changes in quality due to excavation, crushing or washing activities.	Temporary, Reversible	Negligible / Imperceptible	Quarterly monitoring of surface water quality within Pond K2.	Negligible / Imperceptible
Surface water	Changes in quality from wastewater generated by on-Site	Temporary, Reversible	Negligible / Imperceptible	Sewage effluent treatment systems maintained.	Negligible / Imperceptible

	welfare, holding tank and wheel wash facilities.				
Surface water	Changes in quality from uncontrolled material storage.	Temporary, Reversible	Negligible / Imperceptible	Hydrocarbons will be stored in bunded tanks on an impermeable hardstanding surface.	Negligible / Imperceptible
Surface water	Changes in quality caused by hydrocarbon leaks from fuel storage tanks or the unmanaged spillage of fuels or lubricants from Site plant or vehicles.	Temporary, Reversible	Negligible / Imperceptible	Mobile plant maintenance activities will use a dedicated concrete hardstanding apron (with associated interceptor). Emergency spill kit will be available for use.	Negligible / Imperceptible
Flooding	Increased flooding risk due to elevated rainfall and/or discharge of silt laden process water into the silt pond, resulting in uncontrolled overflow to the quarry floor.	Temporary, Reversible	Low / Moderate	Silt pond to be moved to the base of the quarry, with expanded capacity.	Negligible / Slight
Flooding	Interception of confined bedrock aquifer causing flooding.	Permanent, Reversible	Low / Moderate	Additional bores to better define aquifer. No excavation into the bedrock aquifer. Will maintain low connectivity with groundwater.	Negligible / Slight

6.11 CUMULATIVE EFFECTS

Extraction at the Site takes place above the water table and will continue to do so, with no discharge to surface water taking place. With the successful implementation of mitigation measures at the Site, and with the Site extracting materials from above the water table, no cumulative impacts on the local surface water or groundwater environments are anticipated. This is in terms of current and proposed activities at the Site, and in relation to the possible cumulative impacts from other quarries within the area.

6.12 MONITORING

The monitoring programme is to continue at the Site for the following:

- Groundwater level – groundwater levels should be monitored at the eight existing monitoring well locations (Figure 6-13) on a quarterly basis;
- Surface Water level – water levels within the Red Bog SAC should be taken with the logger downloaded periodically;
- Groundwater quality – groundwater quality monitored biannually. Monitoring should be completed at the seven borehole locations (with the exclusion of BH4K); and
- Surface Water quality – surface water quality from Pond K2 monitored biannually.

6.13 DIFFICULTIES ENCOUNTERED

During this assessment the following have been noted which have caused difficulty in assessing the impacts on the water environment retrospectively, although they are not considered likely to have affected the outcome of the assessment:

- There was no groundwater or surface water sampling for water quality between December 2021 and January 2023. Sampling is now undertaken on a quarterly basis, which is over the biannual commitment.
- BH3K could not be sampled due to the water level being consistently below the base of the bore. A replacement monitoring well is to be installed to allow monitoring of the bedrock aquifer in this location,
- BH4K could not be sampled from due to the depth to the water level,
- Water usage rates are not measured on-Site and are therefore estimated. HBL to assess feasibility of recording of Site water usage from Pond K2. This would require the installation of a flowmeter on the line from Pond K2.

6.14 CONSIDERATION OF THIRD-PARTY SUBMISSIONS MADE DURING THE HBL 2020 PLANNING APPLICATION (KCC REG. REF.: 20/532)

Following the submission of the 2020 planning application (KCC Reg. Ref.: 20/532) a number of third-party submissions were received by KCC. These third-party submissions were considered as part of the Further Information response submitted to KCC prior to the invalidation of the application in September 2020. In the compilation of this section these submissions, concerns and points of note have been addressed in this assessment. Table 6-15 below provides a general summary of submissions relevant to this section and details where or how this item has been considered.

Table 6-15 - KCC Reg. Ref.: 20/532 Third-Party Submissions Items Relevant to the Water Assessment.

Submission Item Summary	Comment
Water supply and potential pollution of private wells;	No interception of groundwater requiring dewatering and no deterioration of groundwater quality. See sections; 6.4.9, 6.4.10, 6.4.13
Residential amenity;	No deteriorating trends in groundwater quality or quantity. See sections; ; 6.4.9, 6.4.10
Hydrological and impact on the water table;	No impact on the water table as it has not been encountered, with no requirement for dewatering. See section; 6.4.9
Mention to be made of private wells within 150m of the boundary of the site. Any wells identified should be sampled prior to the commencement of works to extend the extraction facility. Sampling should be undertaken at least biannually during the extraction period and twice within the first year following cessation of operations on site to establish if there are any changes in water quality;	No sampling of private wells undertaken due to access issues. Feasibility to be addressed going forwards. However, HBL already have two actively monitored wells within 200 m of the private wells. See section; 6.4.13

Testing in private wells within 150m of the subject site;	As above. No sampling of private wells undertaken due to access issues. Feasibility to be addressed going forwards. See section; 6.4.13
Previous concerns by HSE at the veracity of water quality monitoring;	Refer to Appendix 6C for Lab certificates
Monitoring on its own is not a mitigation;	Monitoring will indicate the need for action. It is an indicator of good practice.
No surface water sampling takes place at the site.	Surface water samples taken from artificial ponds, which collect rainwater and recycled process water. Perched water feature to the north of the site will be removed with northern extension of quarry. Deterioration in quality of the Red Bog SAC would more likely be in response to activities at up-gradient sites and not activities on the Site itself. See sections; 6.4.7.2, 6.4.7.3, 6.4.7.5
HSE recommend no excavation will take place below the water table;	The main aquifer is confined within the bedrock. This has not been encountered with excavation above this depth. See sections; 6.4.9.5, 6.5

6.15 REFERENCES

AA-EQS - European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272/2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/2019).

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EPA Geo Portal website. https://gis.epa.ie/GetData/Download. Accessed October 2023.

Geological Survey of Ireland - online aquifer classification & vulnerability. www.gsi.ie (2017) Accessed October 2023.

GTV - Groundwater Regulations (SI No. 9 of 2010 as updated by SI No. 366 of 2016).

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Historical rainfall data for Blessington (Hempstown) and Brittas (Glenaraneen). https://www.met.ie/climate/available-data/historical-data. Accessed December 2023.

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Appendix 6A

LABORATORY WATER QUALITY

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Table 6A-1 – Summary of Available River Laboratory Water Quality (2007 to 2023)

River Monitoring Station ID	River Monitoring Station Name	Year	Analyte	No of Samples	Minimum	Maximum	Average	Units
RS09M010060	South Br W of Tipper Ho	2007	Ammonia-Total (as N)	6	<0.03	0.03	0.02	mg/l
RS09M010060	South Br W of Tipper Ho	2008	Ammonia-Total (as N)	6	<0.03	0.02	0.01	mg/l
RS09M010060	South Br W of Tipper Ho	2009	Ammonia-Total (as N)	6	<0.03	0.04	0.01	mg/l
RS09M010060	South Br W of Tipper Ho	2010	Ammonia-Total (as N)	6	<0.03	<0.03	<0.03	mg/l
RS09M010060	South Br W of Tipper Ho	2011	Ammonia-Total (as N)	6	<0.03	0.05	0.01	mg/l
RS09M010060	South Br W of Tipper Ho	2012	Ammonia-Total (as N)	5	<0.03	<0.03	<0.03	mg/l
RS09M010060	South Br W of Tipper Ho	2013	Ammonia-Total (as N)	4	<0.03	<0.03	<0.03	mg/l
RS09M010060	South Br W of Tipper Ho	2014	Ammonia-Total (as N)	5	0.01	0.01	0.01	mg/l
RS09M010060	South Br W of Tipper Ho	2015	Ammonia-Total (as N)	6	0.01	0.06	0.03	mg/l
RS09M010060	South Br W of Tipper Ho	2016	Ammonia-Total (as N)	5	<0.03	0.07	0.02	mg/l
RS09M010060	South Br W of Tipper Ho	2017	Ammonia-Total (as N)	5	<0.03	0.04	0.02	mg/l
RS09M010060	South Br W of Tipper Ho	2018	Ammonia-Total (as N)	5	<0.03	0.02	0.01	mg/l
RS09M010060	South Br W of Tipper Ho	2019	Ammonia-Total (as N)	5	<0.03	0.01	0.01	mg/l
RS09M010060	South Br W of Tipper Ho	2020	Ammonia-Total (as N)	5	<0.03	0.03	0.01	mg/l
RS09M010060	South Br W of Tipper Ho	2021	Ammonia-Total (as N)	5	<0.03	<0.03	<0.03	mg/l
RS09M010060	South Br W of Tipper Ho	2022	Ammonia-Total (as N)	5	<0.03	<0.03	<0.03	mg/l

RS09M010060	South Br W of Tipper Ho	2023	Ammonia-Total (as N)	3	<0.03	0.02	0.01	mg/l
RS09M010060	South Br W of Tipper Ho	2016	BOD - 5 days (Total)	5	<1	4	0.8	mg/l
RS09M010060	South Br W of Tipper Ho	2017	BOD - 5 days (Total)	5	<1	1	0.2	mg/l
RS09M010060	South Br W of Tipper Ho	2018	BOD - 5 days (Total)	5	<1	<1	<1	mg/l
RS09M010060	South Br W of Tipper Ho	2019	BOD - 5 days (Total)	5	<1	<1	<1	mg/l
RS09M010060	South Br W of Tipper Ho	2020	BOD - 5 days (Total)	5	<1	<1	<1	mg/l
RS09M010060	South Br W of Tipper Ho	2021	BOD - 5 days (Total)	5	<1	<1	<1	mg/l
RS09M010060	South Br W of Tipper Ho	2022	BOD - 5 days (Total)	5	<1	<1	<1	mg/l
RS09M010060	South Br W of Tipper Ho	2023	BOD - 5 days (Total)	3	<1	<1	<1	mg/l
RS09M010060	South Br W of Tipper Ho	2007	Conductivity	6	519	551	536	µS/cm
RS09M010060	South Br W of Tipper Ho	2008	Conductivity	6	524	556	541	µS/cm
RS09M010060	South Br W of Tipper Ho	2009	Conductivity	6	420	565	523	µS/cm
RS09M010060	South Br W of Tipper Ho	2010	Conductivity	6	544	564	554	µS/cm
RS09M010060	South Br W of Tipper Ho	2011	Conductivity	6	541	596	560	µS/cm
RS09M010060	South Br W of Tipper Ho	2012	Conductivity	5	532	565	553	µS/cm
RS09M010060	South Br W of Tipper Ho	2013	Conductivity	4	530	559	545	µS/cm
RS09M010060	South Br W of Tipper Ho	2014	Conductivity	6	527	563	548	µS/cm
RS09M010060	South Br W of Tipper Ho	2015	Conductivity	6	551	573	563	µS/cm
RS09M010060	South Br W of Tipper Ho	2016	Conductivity	5	482	625	571	µS/cm
RS09M010060	South Br W of Tipper Ho	2017	Conductivity	5	589	622	601	µS/cm
RS09M010060	South Br W of Tipper Ho	2018	Conductivity	5	623	692	653	µS/cm

RS09M010060	South Br W of Tipper Ho	2019	Conductivity	4	634	681	648	µS/cm
RS09M010060	South Br W of Tipper Ho	2020	Conductivity	5	641	699	667	µS/cm
RS09M010060	South Br W of Tipper Ho	2021	Conductivity	5	641	684	668	µS/cm
RS09M010060	South Br W of Tipper Ho	2022	Conductivity	5	615	716	670	µS/cm
RS09M010060	South Br W of Tipper Ho	2023	Conductivity	3	645	675	658	µS/cm
RS09M010060	South Br W of Tipper Ho	2007	Dissolved Oxygen	4	10.1	12.3	10.9	mg/l
RS09M010060	South Br W of Tipper Ho	2008	Dissolved Oxygen	6	10.4	11.6	11.2	mg/l
RS09M010060	South Br W of Tipper Ho	2009	Dissolved Oxygen	5	9.8	12.4	10.8	mg/l
RS09M010060	South Br W of Tipper Ho	2010	Dissolved Oxygen	5	10.5	11.6	10.9	mg/l
RS09M010060	South Br W of Tipper Ho	2011	Dissolved Oxygen	6	9.5	11.2	10.2	mg/l
RS09M010060	South Br W of Tipper Ho	2012	Dissolved Oxygen	5	9.7	11.7	10.5	mg/l
RS09M010060	South Br W of Tipper Ho	2013	Dissolved Oxygen	4	10	11.5	10.9	mg/l
RS09M010060	South Br W of Tipper Ho	2014	Dissolved Oxygen	6	9.9	12.4	10.9	mg/l
RS09M010060	South Br W of Tipper Ho	2015	Dissolved Oxygen	6	9.7	11.2	10.7	mg/l
RS09M010060	South Br W of Tipper Ho	2016	Dissolved Oxygen	5	9.6	12.4	10.5	mg/l
RS09M010060	South Br W of Tipper Ho	2017	Dissolved Oxygen	5	9.8	12.1	10.5	mg/l
RS09M010060	South Br W of Tipper Ho	2018	Dissolved Oxygen	5	10.1	12.8	11.0	mg/l
RS09M010060	South Br W of Tipper Ho	2019	Dissolved Oxygen	5	9	12.1	10.6	mg/l
RS09M010060	South Br W of Tipper Ho	2020	Dissolved Oxygen	5	9.5	10.6	10.3	mg/l
RS09M010060	South Br W of Tipper Ho	2021	Dissolved Oxygen	5	9	11.4	10.0	mg/l
RS09M010060	South Br W of Tipper Ho	2022	Dissolved Oxygen	5	9.6	11.5	10.4	mg/l

RS09M010060	South Br W of Tipper Ho	2023	Dissolved Oxygen	3	8.3	10.6	9.2	mg/l
RS09M010060	South Br W of Tipper Ho	2008	Dissolved Oxygen %	6	97	102	100	% Saturation
RS09M010060	South Br W of Tipper Ho	2009	Dissolved Oxygen %	5	93	106	98	% Saturation
RS09M010060	South Br W of Tipper Ho	2010	Dissolved Oxygen %	5	93	101	97	% Saturation
RS09M010060	South Br W of Tipper Ho	2011	Dissolved Oxygen %	6	88	100	92	% Saturation
RS09M010060	South Br W of Tipper Ho	2012	Dissolved Oxygen %	5	86	102	92	% Saturation
RS09M010060	South Br W of Tipper Ho	2013	Dissolved Oxygen %	4	94	108	100	% Saturation
RS09M010060	South Br W of Tipper Ho	2014	Dissolved Oxygen %	6	93	102	98	% Saturation
RS09M010060	South Br W of Tipper Ho	2015	Dissolved Oxygen %	6	95	97	96	% Saturation
RS09M010060	South Br W of Tipper Ho	2016	Dissolved Oxygen %	5	87	104	96	% Saturation
RS09M010060	South Br W of Tipper Ho	2017	Dissolved Oxygen %	5	97	104	100	% Saturation
RS09M010060	South Br W of Tipper Ho	2018	Dissolved Oxygen %	5	100	110	104	% Saturation
RS09M010060	South Br W of Tipper Ho	2019	Dissolved Oxygen %	5	87	106	96	% Saturation
RS09M010060	South Br W of Tipper Ho	2020	Dissolved Oxygen %	5	94	101	98	% Saturation
RS09M010060	South Br W of Tipper Ho	2021	Dissolved Oxygen %	5	86	100	92	% Saturation
RS09M010060	South Br W of Tipper Ho	2022	Dissolved Oxygen %	5	92	99	95	% Saturation

RS09M010060	South Br W of Tipper Ho	2023	Dissolved Oxygen %	3	80	99	89	% Saturation
RS09M010060	South Br W of Tipper Ho	2007	Nitrate (as N)	6	2.40	3.15	2.86	mg/l
RS09M010060	South Br W of Tipper Ho	2008	Nitrate (as N)	6	2.56	3.57	2.93	mg/l
RS09M010060	South Br W of Tipper Ho	2009	Nitrate (as N)	6	1.40	3.85	2.98	mg/l
RS09M010060	South Br W of Tipper Ho	2010	Nitrate (as N)	6	2.32	3.25	2.83	mg/l
RS09M010060	South Br W of Tipper Ho	2011	Nitrate (as N)	6	2.15	3.53	2.86	mg/l
RS09M010060	South Br W of Tipper Ho	2012	Nitrate (as N)	5	2.04	2.60	2.41	mg/l
RS09M010060	South Br W of Tipper Ho	2013	Nitrate (as N)	4	2.00	2.84	2.49	mg/l
RS09M010060	South Br W of Tipper Ho	2014	Nitrate (as N)	5	2.19	2.56	2.32	mg/l
RS09M010060	South Br W of Tipper Ho	2015	Nitrate (as N)	6	2.52	3.26	2.89	mg/l
RS09M010060	South Br W of Tipper Ho	2016	Nitrate (as N)	5	1.99	2.97	2.68	mg/l
RS09M010060	South Br W of Tipper Ho	2017	Nitrate (as N)	5	2.32	2.91	2.70	mg/l
RS09M010060	South Br W of Tipper Ho	2018	Nitrate (as N)	5	2.36	3.26	2.92	mg/l
RS09M010060	South Br W of Tipper Ho	2019	Nitrate (as N)	5	2.02	3.08	2.62	mg/l
RS09M010060	South Br W of Tipper Ho	2020	Nitrate (as N)	5	2.70	3.80	3.34	mg/l
RS09M010060	South Br W of Tipper Ho	2021	Nitrate (as N)	5	3.10	3.90	3.54	mg/l
RS09M010060	South Br W of Tipper Ho	2022	Nitrate (as N)	5	1.90	4.00	3.18	mg/l
RS09M010060	South Br W of Tipper Ho	2007	Nitrite (as N)	6	<0.005	0.016	0.004	mg/l
RS09M010060	South Br W of Tipper Ho	2008	Nitrite (as N)	6	<0.005	0.012	0.002	mg/l
RS09M010060	South Br W of Tipper Ho	2009	Nitrite (as N)	6	<0.005	<0.005	<0.005	mg/l
RS09M010060	South Br W of Tipper Ho	2010	Nitrite (as N)	6	<0.005	<0.005	<0.005	mg/l

RS09M010060	South Br W of Tipper Ho	2011	Nitrite (as N)	6	<0.005	0.011	0.002	mg/l
RS09M010060	South Br W of Tipper Ho	2012	Nitrite (as N)	5	<0.005	<0.005	<0.005	mg/l
RS09M010060	South Br W of Tipper Ho	2013	Nitrite (as N)	4	<0.005	<0.005	<0.005	mg/l
RS09M010060	South Br W of Tipper Ho	2014	Nitrite (as N)	5	<0.005	<0.005	<0.005	mg/l
RS09M010060	South Br W of Tipper Ho	2015	Nitrite (as N)	6	<0.005	<0.005	<0.005	mg/l
RS09M010060	South Br W of Tipper Ho	2016	Nitrite (as N)	5	<0.005	0.006	0.001	mg/l
RS09M010060	South Br W of Tipper Ho	2017	Nitrite (as N)	5	<0.005	<0.005	<0.005	mg/l
RS09M010060	South Br W of Tipper Ho	2018	Nitrite (as N)	5	<0.005	<0.005	<0.005	mg/l
RS09M010060	South Br W of Tipper Ho	2019	Nitrite (as N)	5	<0.005	<0.005	<0.005	mg/l
RS09M010060	South Br W of Tipper Ho	2020	Nitrite (as N)	5	<0.005	<0.005	<0.005	mg/l
RS09M010060	South Br W of Tipper Ho	2021	Nitrite (as N)	5	<0.005	<0.005	<0.005	mg/l
RS09M010060	South Br W of Tipper Ho	2022	Nitrite (as N)	5	<0.005	6.93	1.386	mg/l
RS09M010060	South Br W of Tipper Ho	2007	ortho-Phosphate (as P)	6	<0.03	0.22	0.04	mg/l
RS09M010060	South Br W of Tipper Ho	2008	ortho-Phosphate (as P)	4	<0.03	0.02	0.01	mg/l
RS09M010060	South Br W of Tipper Ho	2009	ortho-Phosphate (as P)	3	<0.03	0.09	0.03	mg/l
RS09M010060	South Br W of Tipper Ho	2010	ortho-Phosphate (as P)	6	<0.03	0.04	0.01	mg/l
RS09M010060	South Br W of Tipper Ho	2011	ortho-Phosphate (as P)	6	<0.03	<0.03	<0.03	mg/l
RS09M010060	South Br W of Tipper Ho	2012	ortho-Phosphate (as P)	5	<0.03	<0.03	<0.03	mg/l
RS09M010060	South Br W of Tipper Ho	2013	ortho-Phosphate (as P)	4	<0.03	<0.03	<0.03	mg/l
RS09M010060	South Br W of Tipper Ho	2014	ortho-Phosphate (as P)	5	<0.03	0.01	0.00	mg/l
RS09M010060	South Br W of Tipper Ho	2015	ortho-Phosphate (as P)	6	<0.03	0.01	0.00	mg/l

RS09M010060	South Br W of Tipper Ho	2016	ortho-Phosphate (as P)	5	<0.03	0.13	0.03	mg/l
RS09M010060	South Br W of Tipper Ho	2017	ortho-Phosphate (as P)	5	<0.03	0.05	0.02	mg/l
RS09M010060	South Br W of Tipper Ho	2018	ortho-Phosphate (as P)	5	<0.03	0.03	0.01	mg/l
RS09M010060	South Br W of Tipper Ho	2019	ortho-Phosphate (as P)	5	<0.03	0.02	0.01	mg/l
RS09M010060	South Br W of Tipper Ho	2020	ortho-Phosphate (as P)	5	<0.03	0.01	0.01	mg/l
RS09M010060	South Br W of Tipper Ho	2021	ortho-Phosphate (as P)	5	<0.03	0.01	0.00	mg/l
RS09M010060	South Br W of Tipper Ho	2022	ortho-Phosphate (as P)	5	<0.03	0.03	0.01	mg/l
RS09M010060	South Br W of Tipper Ho	2023	ortho-Phosphate (as P)	3	<0.03	0.04	0.02	mg/l
RS09M010060	South Br W of Tipper Ho	2007	pH	6	8.0	8.1	8.0	pH units
RS09M010060	South Br W of Tipper Ho	2008	pH	6	8.0	8.2	8.1	pH units
RS09M010060	South Br W of Tipper Ho	2009	pH	6	7.9	8.2	8.1	pH units
RS09M010060	South Br W of Tipper Ho	2010	pH	6	7.9	8.1	8.0	pH units
RS09M010060	South Br W of Tipper Ho	2011	pH	6	7.9	8.1	8.0	pH units
RS09M010060	South Br W of Tipper Ho	2012	pH	5	7.9	8.0	7.9	pH units
RS09M010060	South Br W of Tipper Ho	2013	pH	4	8.0	8.2	8.1	pH units
RS09M010060	South Br W of Tipper Ho	2014	pH	6	7.9	8.1	8.0	pH units
RS09M010060	South Br W of Tipper Ho	2015	pH	6	7.9	8.0	8.0	pH units
RS09M010060	South Br W of Tipper Ho	2016	pH	5	7.4	8.0	7.8	pH units
RS09M010060	South Br W of Tipper Ho	2017	pH	5	7.9	8.0	8.0	pH units
RS09M010060	South Br W of Tipper Ho	2018	pH	5	7.9	8.1	8.0	pH units
RS09M010060	South Br W of Tipper Ho	2019	pH	5	8.0	8.2	8.1	pH units

RS09M010060	South Br W of Tipper Ho	2020	pH	5	7.9	8.1	8.0	pH units
RS09M010060	South Br W of Tipper Ho	2021	pH	5	7.8	8.0	7.9	pH units
RS09M010060	South Br W of Tipper Ho	2022	pH	5	7.9	8.0	8.0	pH units
RS09M010060	South Br W of Tipper Ho	2023	pH	3	7.8	8.0	7.9	pH units
RS09M010060	South Br W of Tipper Ho	2007	Temperature	6	5.6	12.1	9.7	°C
RS09M010060	South Br W of Tipper Ho	2008	Temperature	6	6.6	12.5	9.4	°C
RS09M010060	South Br W of Tipper Ho	2009	Temperature	6	7.7	12.3	10.2	°C
RS09M010060	South Br W of Tipper Ho	2010	Temperature	6	6.3	12.5	9.1	°C
RS09M010060	South Br W of Tipper Ho	2011	Temperature	6	8.2	12.3	10.4	°C
RS09M010060	South Br W of Tipper Ho	2012	Temperature	5	6.4	11.3	8.9	°C
RS09M010060	South Br W of Tipper Ho	2013	Temperature	4	7.3	13.9	10.4	°C
RS09M010060	South Br W of Tipper Ho	2014	Temperature	6	6.2	14.1	10.3	°C
RS09M010060	South Br W of Tipper Ho	2015	Temperature	6	7.5	13.6	10.3	°C
RS09M010060	South Br W of Tipper Ho	2016	Temperature	5	7.4	13.5	11.1	°C
RS09M010060	South Br W of Tipper Ho	2017	Temperature	5	8.4	15.1	11.7	°C
RS09M010060	South Br W of Tipper Ho	2018	Temperature	5	5.6	14.8	11.0	°C
RS09M010060	South Br W of Tipper Ho	2019	Temperature	5	7.5	12.8	9.8	°C
RS09M010060	South Br W of Tipper Ho	2020	Temperature	5	10.2	14.9	12.5	°C
RS09M010060	South Br W of Tipper Ho	2021	Temperature	5	9.3	14.3	11.5	°C
RS09M010060	South Br W of Tipper Ho	2022	Temperature	5	7.3	13.4	10.8	°C
RS09M010060	South Br W of Tipper Ho	2023	Temperature	3	11.2	16.0	13.5	°C

RS09M010060	South Br W of Tipper Ho	2007	Total Oxidised Nitrogen (as N)	6	2.41	3.16	2.87	mg/l
RS09M010060	South Br W of Tipper Ho	2008	Total Oxidised Nitrogen (as N)	6	2.56	3.57	2.93	mg/l
RS09M010060	South Br W of Tipper Ho	2009	Total Oxidised Nitrogen (as N)	6	1.41	3.85	2.99	mg/l
RS09M010060	South Br W of Tipper Ho	2010	Total Oxidised Nitrogen (as N)	6	2.33	3.25	2.83	mg/l
RS09M010060	South Br W of Tipper Ho	2011	Total Oxidised Nitrogen (as N)	6	2.16	3.54	2.86	mg/l
RS09M010060	South Br W of Tipper Ho	2012	Total Oxidised Nitrogen (as N)	5	2.05	2.61	2.42	mg/l
RS09M010060	South Br W of Tipper Ho	2013	Total Oxidised Nitrogen (as N)	4	2.01	2.84	2.50	mg/l
RS09M010060	South Br W of Tipper Ho	2014	Total Oxidised Nitrogen (as N)	5	2.19	2.56	2.32	mg/l
RS09M010060	South Br W of Tipper Ho	2015	Total Oxidised Nitrogen (as N)	6	2.52	3.26	2.90	mg/l
RS09M010060	South Br W of Tipper Ho	2016	Total Oxidised Nitrogen (as N)	5	2.00	2.97	2.69	mg/l
RS09M010060	South Br W of Tipper Ho	2017	Total Oxidised Nitrogen (as N)	5	2.32	2.92	2.70	mg/l
RS09M010060	South Br W of Tipper Ho	2018	Total Oxidised Nitrogen (as N)	5	2.36	3.26	2.92	mg/l
RS09M010060	South Br W of Tipper Ho	2019	Total Oxidised Nitrogen (as N)	5	2.02	3.08	2.63	mg/l
RS09M010060	South Br W of Tipper Ho	2020	Total Oxidised Nitrogen (as N)	5	2.70	3.80	3.34	mg/l
RS09M010060	South Br W of Tipper Ho	2021	Total Oxidised Nitrogen (as N)	5	3.10	3.90	3.54	mg/l
RS09M010060	South Br W of Tipper Ho	2022	Total Oxidised Nitrogen (as N)	5	1.90	4.00	3.18	mg/l
RS09M010060	South Br W of Tipper Ho	2023	Total Oxidised Nitrogen (as N)	3	2.90	3.50	3.30	mg/l
RS09M010100	Bridge in Johnstown	2007	Ammonia-Total (as N)	6	0.01	0.03	0.02	mg/l
RS09M010100	Bridge in Johnstown	2008	Ammonia-Total (as N)	6	<0.03	0.04	0.02	mg/l
RS09M010100	Bridge in Johnstown	2009	Ammonia-Total (as N)	6	<0.03	0.05	0.01	mg/l
RS09M010100	Bridge in Johnstown	2010	Ammonia-Total (as N)	6	<0.03	0.2	0.07	mg/l

RS09M010100	Bridge in Johnstown	2011	Ammonia-Total (as N)	6	<0.03	0.04	0.02	mg/l
RS09M010100	Bridge in Johnstown	2012	Ammonia-Total (as N)	5	<0.03	0.04	0.03	mg/l
RS09M010100	Bridge in Johnstown	2013	Ammonia-Total (as N)	4	<0.03	0.06	0.02	mg/l
RS09M010100	Bridge in Johnstown	2014	Ammonia-Total (as N)	5	0.01	0.02	0.01	mg/l
RS09M010100	Bridge in Johnstown	2015	Ammonia-Total (as N)	6	0.01	0.03	0.02	mg/l
RS09M010100	Bridge in Johnstown	2016	Ammonia-Total (as N)	5	0.01	0.06	0.03	mg/l
RS09M010100	Bridge in Johnstown	2017	Ammonia-Total (as N)	5	<0.03	0.03	0.02	mg/l
RS09M010100	Bridge in Johnstown	2018	Ammonia-Total (as N)	5	<0.03	0.04	0.01	mg/l
RS09M010100	Bridge in Johnstown	2019	Ammonia-Total (as N)	5	0.01	0.03	0.02	mg/l
RS09M010100	Bridge in Johnstown	2020	Ammonia-Total (as N)	5	<0.03	0.025	0.01	mg/l
RS09M010100	Bridge in Johnstown	2021	Ammonia-Total (as N)	5	<0.03	0.13	0.03	mg/l
RS09M010100	Bridge in Johnstown	2022	Ammonia-Total (as N)	5	<0.03	0.032	0.01	mg/l
RS09M010100	Bridge in Johnstown	2023	Ammonia-Total (as N)	3	<0.03	0.023	0.01	mg/l
RS09M010100	Bridge in Johnstown	2016	BOD - 5 days (Total)	5	<1	3	0.6	mg/l
RS09M010100	Bridge in Johnstown	2017	BOD - 5 days (Total)	5	<1	1	0.2	mg/l
RS09M010100	Bridge in Johnstown	2018	BOD - 5 days (Total)	5	<1	1	0.2	mg/l
RS09M010100	Bridge in Johnstown	2019	BOD - 5 days (Total)	5	<1	<1	<1	mg/l
RS09M010100	Bridge in Johnstown	2020	BOD - 5 days (Total)	5	<1	<1	<1	mg/l
RS09M010100	Bridge in Johnstown	2021	BOD - 5 days (Total)	5	<1	2.4	0.5	mg/l
RS09M010100	Bridge in Johnstown	2022	BOD - 5 days (Total)	5	<1	<1	<1	mg/l
RS09M010100	Bridge in Johnstown	2023	BOD - 5 days (Total)	3	<1	<1	<1	mg/l

RS09M010100	Bridge in Johnstown	2007	Conductivity	6	591	643	612	µS/cm
RS09M010100	Bridge in Johnstown	2008	Conductivity	6	588	621	607	µS/cm
RS09M010100	Bridge in Johnstown	2009	Conductivity	6	475	623	589	µS/cm
RS09M010100	Bridge in Johnstown	2010	Conductivity	6	596	645	610	µS/cm
RS09M010100	Bridge in Johnstown	2011	Conductivity	6	533	622	580	µS/cm
RS09M010100	Bridge in Johnstown	2012	Conductivity	5	566	605	587	µS/cm
RS09M010100	Bridge in Johnstown	2013	Conductivity	4	550	584	571	µS/cm
RS09M010100	Bridge in Johnstown	2014	Conductivity	6	557	584	574	µS/cm
RS09M010100	Bridge in Johnstown	2015	Conductivity	6	539	602	571	µS/cm
RS09M010100	Bridge in Johnstown	2016	Conductivity	5	476	683	589	µS/cm
RS09M010100	Bridge in Johnstown	2017	Conductivity	5	556	629	594	µS/cm
RS09M010100	Bridge in Johnstown	2018	Conductivity	5	607	685	639	µS/cm
RS09M010100	Bridge in Johnstown	2019	Conductivity	4	630	681	659	µS/cm
RS09M010100	Bridge in Johnstown	2020	Conductivity	5	656	688	667	µS/cm
RS09M010100	Bridge in Johnstown	2021	Conductivity	5	662	680	669	µS/cm
RS09M010100	Bridge in Johnstown	2022	Conductivity	5	663	693	673	µS/cm
RS09M010100	Bridge in Johnstown	2023	Conductivity	3	660	675	666	µS/cm
RS09M010100	Bridge in Johnstown	2007	Dissolved Oxygen	6	9.1	12	10.1	mg/l
RS09M010100	Bridge in Johnstown	2008	Dissolved Oxygen	6	10.2	13.2	11.4	mg/l
RS09M010100	Bridge in Johnstown	2009	Dissolved Oxygen	5	9.5	12.6	10.5	mg/l
RS09M010100	Bridge in Johnstown	2010	Dissolved Oxygen	5	10.3	11.7	11.0	mg/l

RS09M010100	Bridge in Johnstown	2011	Dissolved Oxygen	6	9.5	11.9	10.4	mg/l
RS09M010100	Bridge in Johnstown	2012	Dissolved Oxygen	5	9.7	11.6	10.8	mg/l
RS09M010100	Bridge in Johnstown	2013	Dissolved Oxygen	4	10	11.4	10.9	mg/l
RS09M010100	Bridge in Johnstown	2014	Dissolved Oxygen	6	10.4	13	11.4	mg/l
RS09M010100	Bridge in Johnstown	2015	Dissolved Oxygen	6	10	12	11.1	mg/l
RS09M010100	Bridge in Johnstown	2016	Dissolved Oxygen	5	10.5	12.9	11.6	mg/l
RS09M010100	Bridge in Johnstown	2017	Dissolved Oxygen	5	9.8	12.6	11.0	mg/l
RS09M010100	Bridge in Johnstown	2018	Dissolved Oxygen	5	10.2	12.5	11.0	mg/l
RS09M010100	Bridge in Johnstown	2019	Dissolved Oxygen	5	9.7	12.3	11.1	mg/l
RS09M010100	Bridge in Johnstown	2020	Dissolved Oxygen	5	9.6	11.8	10.8	mg/l
RS09M010100	Bridge in Johnstown	2021	Dissolved Oxygen	5	9.7	11.8	10.7	mg/l
RS09M010100	Bridge in Johnstown	2022	Dissolved Oxygen	5	9.7	11.7	10.5	mg/l
RS09M010100	Bridge in Johnstown	2023	Dissolved Oxygen	3	8.8	10.9	9.8	mg/l
RS09M010100	Bridge in Johnstown	2008	Dissolved Oxygen %	6	97	112	100	% Saturation
RS09M010100	Bridge in Johnstown	2009	Dissolved Oxygen %	5	89	105	94	% Saturation
RS09M010100	Bridge in Johnstown	2010	Dissolved Oxygen %	5	93	103	97	% Saturation
RS09M010100	Bridge in Johnstown	2011	Dissolved Oxygen %	6	88	106	95	% Saturation
RS09M010100	Bridge in Johnstown	2012	Dissolved Oxygen %	5	86	100	94	% Saturation
RS09M010100	Bridge in Johnstown	2013	Dissolved Oxygen %	4	94	104	99	% Saturation

RS09M010100	Bridge in Johnstown	2014	Dissolved Oxygen %	6	97	103	101	% Saturation
RS09M010100	Bridge in Johnstown	2015	Dissolved Oxygen %	6	97	104	100	% Saturation
RS09M010100	Bridge in Johnstown	2016	Dissolved Oxygen %	5	96	112	103	% Saturation
RS09M010100	Bridge in Johnstown	2017	Dissolved Oxygen %	5	98	124	106	% Saturation
RS09M010100	Bridge in Johnstown	2018	Dissolved Oxygen %	5	104	108	106	% Saturation
RS09M010100	Bridge in Johnstown	2019	Dissolved Oxygen %	5	93	106	100	% Saturation
RS09M010100	Bridge in Johnstown	2020	Dissolved Oxygen %	5	96	111	101	% Saturation
RS09M010100	Bridge in Johnstown	2021	Dissolved Oxygen %	5	93	105	98	% Saturation
RS09M010100	Bridge in Johnstown	2022	Dissolved Oxygen %	5	92	106	97	% Saturation
RS09M010100	Bridge in Johnstown	2023	Dissolved Oxygen %	3	86	100	95	% Saturation
RS09M010100	Bridge in Johnstown	2007	Nitrate (as N)	6	2.80	4.04	3.52	mg/l
RS09M010100	Bridge in Johnstown	2008	Nitrate (as N)	6	2.68	3.91	3.39	mg/l
RS09M010100	Bridge in Johnstown	2009	Nitrate (as N)	6	1.65	3.97	3.41	mg/l
RS09M010100	Bridge in Johnstown	2010	Nitrate (as N)	6	2.90	4.11	3.47	mg/l
RS09M010100	Bridge in Johnstown	2011	Nitrate (as N)	6	2.39	3.59	3.14	mg/l
RS09M010100	Bridge in Johnstown	2012	Nitrate (as N)	5	2.30	3.00	2.70	mg/l
RS09M010100	Bridge in Johnstown	2013	Nitrate (as N)	4	2.24	3.04	2.79	mg/l
RS09M010100	Bridge in Johnstown	2014	Nitrate (as N)	5	2.23	2.77	2.51	mg/l

RS09M010100	Bridge in Johnstown	2015	Nitrate (as N)	6	2.63	3.08	2.88	mg/l
RS09M010100	Bridge in Johnstown	2016	Nitrate (as N)	5	1.76	2.94	2.66	mg/l
RS09M010100	Bridge in Johnstown	2017	Nitrate (as N)	5	2.31	2.74	2.58	mg/l
RS09M010100	Bridge in Johnstown	2018	Nitrate (as N)	5	2.53	3.23	2.88	mg/l
RS09M010100	Bridge in Johnstown	2019	Nitrate (as N)	5	2.20	3.08	2.72	mg/l
RS09M010100	Bridge in Johnstown	2020	Nitrate (as N)	5	2.90	3.70	3.32	mg/l
RS09M010100	Bridge in Johnstown	2021	Nitrate (as N)	5	3.10	3.80	3.42	mg/l
RS09M010100	Bridge in Johnstown	2022	Nitrate (as N)	5	2.00	4.00	3.18	mg/l
RS09M010100	Bridge in Johnstown	2007	Nitrite (as N)	6	<0.005	0.028	0.007	mg/l
RS09M010100	Bridge in Johnstown	2008	Nitrite (as N)	6	<0.005	0.009	0.005	mg/l
RS09M010100	Bridge in Johnstown	2009	Nitrite (as N)	6	<0.005	0.005	0.002	mg/l
RS09M010100	Bridge in Johnstown	2010	Nitrite (as N)	6	<0.005	0.03	0.017	mg/l
RS09M010100	Bridge in Johnstown	2011	Nitrite (as N)	6	<0.005	0.01	0.004	mg/l
RS09M010100	Bridge in Johnstown	2012	Nitrite (as N)	5	<0.005	0.006	0.003	mg/l
RS09M010100	Bridge in Johnstown	2013	Nitrite (as N)	4	<0.005	0.007	0.004	mg/l
RS09M010100	Bridge in Johnstown	2014	Nitrite (as N)	5	<0.005	0.006	0.002	mg/l
RS09M010100	Bridge in Johnstown	2015	Nitrite (as N)	6	<0.005	0.006	0.002	mg/l
RS09M010100	Bridge in Johnstown	2016	Nitrite (as N)	5	<0.005	0.005	0.001	mg/l
RS09M010100	Bridge in Johnstown	2017	Nitrite (as N)	5	<0.005	0.009	0.002	mg/l
RS09M010100	Bridge in Johnstown	2018	Nitrite (as N)	5	<0.005	0.005	0.001	mg/l
RS09M010100	Bridge in Johnstown	2019	Nitrite (as N)	5	<0.005	<0.005	<0.005	mg/l

RS09M010100	Bridge in Johnstown	2020	Nitrite (as N)	5	<0.005	5.64	1.966	mg/l
RS09M010100	Bridge in Johnstown	2021	Nitrite (as N)	5	<0.005	4.63	0.926	mg/l
RS09M010100	Bridge in Johnstown	2022	Nitrite (as N)	5	<0.005	13	4.528	mg/l
RS09M010100	Bridge in Johnstown	2007	ortho-Phosphate (as P)	6	<0.03	0.07	0.02	mg/l
RS09M010100	Bridge in Johnstown	2008	ortho-Phosphate (as P)	4	<0.03	0.01	0.01	mg/l
RS09M010100	Bridge in Johnstown	2009	ortho-Phosphate (as P)	3	<0.03	0.06	0.02	mg/l
RS09M010100	Bridge in Johnstown	2010	ortho-Phosphate (as P)	6	<0.03	<0.03	<0.03	mg/l
RS09M010100	Bridge in Johnstown	2011	ortho-Phosphate (as P)	6	<0.03	<0.03	<0.03	mg/l
RS09M010100	Bridge in Johnstown	2012	ortho-Phosphate (as P)	5	<0.03	<0.03	<0.03	mg/l
RS09M010100	Bridge in Johnstown	2013	ortho-Phosphate (as P)	4	<0.03	<0.03	<0.03	mg/l
RS09M010100	Bridge in Johnstown	2014	ortho-Phosphate (as P)	5	<0.03	0.01	0.00	mg/l
RS09M010100	Bridge in Johnstown	2015	ortho-Phosphate (as P)	6	<0.03	0.02	0.01	mg/l
RS09M010100	Bridge in Johnstown	2016	ortho-Phosphate (as P)	5	<0.03	0.07	0.02	mg/l
RS09M010100	Bridge in Johnstown	2017	ortho-Phosphate (as P)	5	0.01	0.12	0.05	mg/l
RS09M010100	Bridge in Johnstown	2018	ortho-Phosphate (as P)	5	<0.03	0.03	0.01	mg/l
RS09M010100	Bridge in Johnstown	2019	ortho-Phosphate (as P)	5	<0.03	0.04	0.02	mg/l
RS09M010100	Bridge in Johnstown	2020	ortho-Phosphate (as P)	5	<0.03	0.01	0.00	mg/l
RS09M010100	Bridge in Johnstown	2021	ortho-Phosphate (as P)	5	<0.03	0.04	0.01	mg/l
RS09M010100	Bridge in Johnstown	2022	ortho-Phosphate (as P)	5	0.02	0.05	0.03	mg/l
RS09M010100	Bridge in Johnstown	2023	ortho-Phosphate (as P)	3	0.02	0.03	0.03	mg/l
RS09M010100	Bridge in Johnstown	2007	pH	6	7.9	8.1	8.0	pH units

RS09M010100	Bridge in Johnstown	2008	pH	6	8.0	8.2	8.1	pH units
RS09M010100	Bridge in Johnstown	2009	pH	6	7.9	8.2	8.1	pH units
RS09M010100	Bridge in Johnstown	2010	pH	6	8.0	8.1	8.1	pH units
RS09M010100	Bridge in Johnstown	2011	pH	6	8.1	8.1	8.1	pH units
RS09M010100	Bridge in Johnstown	2012	pH	5	8.0	8.2	8.1	pH units
RS09M010100	Bridge in Johnstown	2013	pH	4	8.0	8.2	8.1	pH units
RS09M010100	Bridge in Johnstown	2014	pH	6	8.1	8.2	8.2	pH units
RS09M010100	Bridge in Johnstown	2015	pH	6	8.2	8.2	8.2	pH units
RS09M010100	Bridge in Johnstown	2016	pH	5	7.9	8.3	8.1	pH units
RS09M010100	Bridge in Johnstown	2017	pH	5	8.2	8.2	8.2	pH units
RS09M010100	Bridge in Johnstown	2018	pH	5	8.0	8.2	8.1	pH units
RS09M010100	Bridge in Johnstown	2019	pH	5	8.1	8.4	8.2	pH units
RS09M010100	Bridge in Johnstown	2020	pH	5	8.1	8.1	8.1	pH units
RS09M010100	Bridge in Johnstown	2021	pH	5	8.1	8.2	8.2	pH units
RS09M010100	Bridge in Johnstown	2022	pH	5	8.1	8.2	8.1	pH units
RS09M010100	Bridge in Johnstown	2023	pH	3	8.1	8.2	8.2	pH units
RS09M010100	Bridge in Johnstown	2007	Temperature	6	6.1	12.6	10.0	°C
RS09M010100	Bridge in Johnstown	2008	Temperature	6	7.0	12.2	9.3	°C
RS09M010100	Bridge in Johnstown	2009	Temperature	6	7.5	11.9	9.9	°C
RS09M010100	Bridge in Johnstown	2010	Temperature	6	5.8	11.8	8.9	°C
RS09M010100	Bridge in Johnstown	2011	Temperature	6	8.4	12.0	10.4	°C

RS09M010100	Bridge in Johnstown	2012	Temperature	5	6.1	11.4	8.8	°C
RS09M010100	Bridge in Johnstown	2013	Temperature	4	7.0	14.0	10.4	°C
RS09M010100	Bridge in Johnstown	2014	Temperature	6	4.6	13.9	10.0	°C
RS09M010100	Bridge in Johnstown	2015	Temperature	6	7.0	14.6	10.3	°C
RS09M010100	Bridge in Johnstown	2016	Temperature	5	6.6	12.2	10.5	°C
RS09M010100	Bridge in Johnstown	2017	Temperature	5	9.3	16.1	12.4	°C
RS09M010100	Bridge in Johnstown	2018	Temperature	5	5.9	15.4	11.5	°C
RS09M010100	Bridge in Johnstown	2019	Temperature	5	8.1	13.0	10.2	°C
RS09M010100	Bridge in Johnstown	2020	Temperature	5	9.7	14.9	12.2	°C
RS09M010100	Bridge in Johnstown	2021	Temperature	5	9.2	14.3	11.3	°C
RS09M010100	Bridge in Johnstown	2022	Temperature	5	7.1	14.2	10.9	°C
RS09M010100	Bridge in Johnstown	2023	Temperature	3	10.8	15.3	13.4	°C
RS09M010100	Bridge in Johnstown	2007	Total Oxidised Nitrogen (as N)	6	2.81	4.05	3.53	mg/l
RS09M010100	Bridge in Johnstown	2008	Total Oxidised Nitrogen (as N)	6	2.69	3.92	3.39	mg/l
RS09M010100	Bridge in Johnstown	2009	Total Oxidised Nitrogen (as N)	6	1.66	3.98	3.41	mg/l
RS09M010100	Bridge in Johnstown	2010	Total Oxidised Nitrogen (as N)	6	2.92	4.14	3.48	mg/l
RS09M010100	Bridge in Johnstown	2011	Total Oxidised Nitrogen (as N)	6	2.40	3.60	3.15	mg/l
RS09M010100	Bridge in Johnstown	2012	Total Oxidised Nitrogen (as N)	5	2.31	3.00	2.70	mg/l
RS09M010100	Bridge in Johnstown	2013	Total Oxidised Nitrogen (as N)	4	2.24	3.05	2.80	mg/l
RS09M010100	Bridge in Johnstown	2014	Total Oxidised Nitrogen (as N)	5	2.23	2.77	2.51	mg/l
RS09M010100	Bridge in Johnstown	2015	Total Oxidised Nitrogen (as N)	6	2.63	3.08	2.89	mg/l

RS09M010100	Bridge in Johnstown	2016	Total Oxidised Nitrogen (as N)	5	1.76	2.94	2.66	mg/l
RS09M010100	Bridge in Johnstown	2017	Total Oxidised Nitrogen (as N)	5	2.32	2.74	2.58	mg/l
RS09M010100	Bridge in Johnstown	2018	Total Oxidised Nitrogen (as N)	5	2.54	3.23	2.88	mg/l
RS09M010100	Bridge in Johnstown	2019	Total Oxidised Nitrogen (as N)	5	2.20	3.08	2.72	mg/l
RS09M010100	Bridge in Johnstown	2020	Total Oxidised Nitrogen (as N)	5	2.90	3.70	3.32	mg/l
RS09M010100	Bridge in Johnstown	2021	Total Oxidised Nitrogen (as N)	5	3.10	3.80	3.42	mg/l
RS09M010100	Bridge in Johnstown	2022	Total Oxidised Nitrogen (as N)	5	2.00	4.00	3.18	mg/l
RS09M010100	Bridge in Johnstown	2023	Total Oxidised Nitrogen (as N)	3	2.80	3.40	3.03	mg/l
RS09M010150	Br N.E. of Sherlockstown	2007	Ammonia-Total (as N)	6	0.03	0.49	0.12	mg/l
RS09M010150	Br N.E. of Sherlockstown	2008	Ammonia-Total (as N)	6	0.01	0.09	0.04	mg/l
RS09M010150	Br N.E. of Sherlockstown	2009	Ammonia-Total (as N)	6	<0.03	0.1	0.03	mg/l
RS09M010150	Br N.E. of Sherlockstown	2010	Ammonia-Total (as N)	6	<0.03	0.22	0.07	mg/l
RS09M010150	Br N.E. of Sherlockstown	2011	Ammonia-Total (as N)	6	<0.03	0.03	0.01	mg/l
RS09M010150	Br N.E. of Sherlockstown	2012	Ammonia-Total (as N)	5	<0.03	0.04	0.01	mg/l
RS09M010150	Br N.E. of Sherlockstown	2013	Ammonia-Total (as N)	4	<0.03	0.04	0.02	mg/l
RS09M010150	Br N.E. of Sherlockstown	2014	Ammonia-Total (as N)	5	0.01	0.03	0.01	mg/l
RS09M010150	Br N.E. of Sherlockstown	2015	Ammonia-Total (as N)	6	0.01	0.04	0.02	mg/l
RS09M010150	Br N.E. of Sherlockstown	2016	Ammonia-Total (as N)	5	0.01	0.04	0.02	mg/l
RS09M010150	Br N.E. of Sherlockstown	2017	Ammonia-Total (as N)	5	<0.03	0.01	0.01	mg/l
RS09M010150	Br N.E. of Sherlockstown	2018	Ammonia-Total (as N)	5	<0.03	0.02	0.00	mg/l
RS09M010150	Br N.E. of Sherlockstown	2019	Ammonia-Total (as N)	5	<0.03	0.03	0.02	mg/l

RS09M010150	Br N.E. of Sherlockstown	2020	Ammonia-Total (as N)	5	<0.03	0.026	0.01	mg/l
RS09M010150	Br N.E. of Sherlockstown	2021	Ammonia-Total (as N)	5	<0.03	0.021	0.01	mg/l
RS09M010150	Br N.E. of Sherlockstown	2022	Ammonia-Total (as N)	5	<0.03	<0.03	<0.03	mg/l
RS09M010150	Br N.E. of Sherlockstown	2023	Ammonia-Total (as N)	3	<0.03	0.03	0.01	mg/l
RS09M010150	Br N.E. of Sherlockstown	2016	BOD - 5 days (Total)	5	<1	4	1	mg/l
RS09M010150	Br N.E. of Sherlockstown	2017	BOD - 5 days (Total)	5	<1	1	0.2	mg/l
RS09M010150	Br N.E. of Sherlockstown	2018	BOD - 5 days (Total)	5	<1	<1	<1	mg/l
RS09M010150	Br N.E. of Sherlockstown	2019	BOD - 5 days (Total)	5	<1	<1	<1	mg/l
RS09M010150	Br N.E. of Sherlockstown	2020	BOD - 5 days (Total)	5	<1	<1	<1	mg/l
RS09M010150	Br N.E. of Sherlockstown	2021	BOD - 5 days (Total)	5	<1	<1	<1	mg/l
RS09M010150	Br N.E. of Sherlockstown	2022	BOD - 5 days (Total)	5	<1	<1	<1	mg/l
RS09M010150	Br N.E. of Sherlockstown	2023	BOD - 5 days (Total)	3	<1	<1	<1	mg/l
RS09M010150	Br N.E. of Sherlockstown	2007	Conductivity	6	555	583	573	µS/cm
RS09M010150	Br N.E. of Sherlockstown	2008	Conductivity	6	571	600	586	µS/cm
RS09M010150	Br N.E. of Sherlockstown	2009	Conductivity	6	402	594	549	µS/cm
RS09M010150	Br N.E. of Sherlockstown	2010	Conductivity	6	568	630	590	µS/cm
RS09M010150	Br N.E. of Sherlockstown	2011	Conductivity	6	547	571	560	µS/cm
RS09M010150	Br N.E. of Sherlockstown	2012	Conductivity	5	544	587	568	µS/cm
RS09M010150	Br N.E. of Sherlockstown	2013	Conductivity	4	533	553	543	µS/cm
RS09M010150	Br N.E. of Sherlockstown	2014	Conductivity	6	534	577	558	µS/cm
RS09M010150	Br N.E. of Sherlockstown	2015	Conductivity	6	545	579	570	µS/cm

RS09M010150	Br N.E. of Sherlockstown	2016	Conductivity	5	481	645	570	µS/cm
RS09M010150	Br N.E. of Sherlockstown	2017	Conductivity	5	575	622	597	µS/cm
RS09M010150	Br N.E. of Sherlockstown	2018	Conductivity	5	604	671	634	µS/cm
RS09M010150	Br N.E. of Sherlockstown	2019	Conductivity	4	616	662	642	µS/cm
RS09M010150	Br N.E. of Sherlockstown	2020	Conductivity	5	618	650	632	µS/cm
RS09M010150	Br N.E. of Sherlockstown	2021	Conductivity	5	618	644	635	µS/cm
RS09M010150	Br N.E. of Sherlockstown	2022	Conductivity	5	616	655	636	µS/cm
RS09M010150	Br N.E. of Sherlockstown	2023	Conductivity	3	645	681	658	µS/cm
RS09M010150	Br N.E. of Sherlockstown	2007	Dissolved Oxygen	6	9.3	12.5	10.5	mg/l
RS09M010150	Br N.E. of Sherlockstown	2008	Dissolved Oxygen	6	10.3	13.1	11.7	mg/l
RS09M010150	Br N.E. of Sherlockstown	2009	Dissolved Oxygen	5	10	12.5	10.9	mg/l
RS09M010150	Br N.E. of Sherlockstown	2010	Dissolved Oxygen	5	10.4	11.9	11.0	mg/l
RS09M010150	Br N.E. of Sherlockstown	2011	Dissolved Oxygen	6	9.6	12.2	10.7	mg/l
RS09M010150	Br N.E. of Sherlockstown	2012	Dissolved Oxygen	5	10.5	12.3	11.5	mg/l
RS09M010150	Br N.E. of Sherlockstown	2013	Dissolved Oxygen	4	10.1	11.5	10.8	mg/l
RS09M010150	Br N.E. of Sherlockstown	2014	Dissolved Oxygen	6	10.2	12.4	11.1	mg/l
RS09M010150	Br N.E. of Sherlockstown	2015	Dissolved Oxygen	6	9.9	11.6	10.9	mg/l
RS09M010150	Br N.E. of Sherlockstown	2016	Dissolved Oxygen	5	10.4	12.4	11.5	mg/l
RS09M010150	Br N.E. of Sherlockstown	2017	Dissolved Oxygen	5	10.4	13	11.3	mg/l
RS09M010150	Br N.E. of Sherlockstown	2018	Dissolved Oxygen	5	10.1	13.4	11.2	mg/l
RS09M010150	Br N.E. of Sherlockstown	2019	Dissolved Oxygen	5	9.2	12.7	11.1	mg/l

RS09M010150	Br N.E. of Sherlockstown	2020	Dissolved Oxygen	5	9.4	11.3	10.5	mg/l
RS09M010150	Br N.E. of Sherlockstown	2021	Dissolved Oxygen	5	9.8	11.5	10.7	mg/l
RS09M010150	Br N.E. of Sherlockstown	2022	Dissolved Oxygen	5	9.7	12	10.7	mg/l
RS09M010150	Br N.E. of Sherlockstown	2023	Dissolved Oxygen	3	9	10.6	9.7	mg/l
RS09M010150	Br N.E. of Sherlockstown	2008	Dissolved Oxygen %	6	98	106	101	% Saturation
RS09M010150	Br N.E. of Sherlockstown	2009	Dissolved Oxygen %	5	95	104	98	% Saturation
RS09M010150	Br N.E. of Sherlockstown	2010	Dissolved Oxygen %	5	95	98	97	% Saturation
RS09M010150	Br N.E. of Sherlockstown	2011	Dissolved Oxygen %	6	90	110	97	% Saturation
RS09M010150	Br N.E. of Sherlockstown	2012	Dissolved Oxygen %	5	94	106	99	% Saturation
RS09M010150	Br N.E. of Sherlockstown	2013	Dissolved Oxygen %	4	96	101	98	% Saturation
RS09M010150	Br N.E. of Sherlockstown	2014	Dissolved Oxygen %	6	97	103	99	% Saturation
RS09M010150	Br N.E. of Sherlockstown	2015	Dissolved Oxygen %	6	96	101	99	% Saturation
RS09M010150	Br N.E. of Sherlockstown	2016	Dissolved Oxygen %	5	96	111	102	% Saturation
RS09M010150	Br N.E. of Sherlockstown	2017	Dissolved Oxygen %	5	99	111	104	% Saturation
RS09M010150	Br N.E. of Sherlockstown	2018	Dissolved Oxygen %	5	96	109	103	% Saturation
RS09M010150	Br N.E. of Sherlockstown	2019	Dissolved Oxygen %	5	92	108	100	% Saturation
RS09M010150	Br N.E. of Sherlockstown	2020	Dissolved Oxygen %	5	95	104	99	% Saturation

RS09M010150	Br N.E. of Sherlockstown	2021	Dissolved Oxygen %	5	95	100	98	% Saturation
RS09M010150	Br N.E. of Sherlockstown	2022	Dissolved Oxygen %	5	94	104	98	% Saturation
RS09M010150	Br N.E. of Sherlockstown	2023	Dissolved Oxygen %	3	91	97	94	% Saturation
RS09M010150	Br N.E. of Sherlockstown	2007	Nitrate (as N)	6	2.38	3.76	3.09	mg/l
RS09M010150	Br N.E. of Sherlockstown	2008	Nitrate (as N)	6	2.41	3.66	3.15	mg/l
RS09M010150	Br N.E. of Sherlockstown	2009	Nitrate (as N)	6	1.38	3.33	2.81	mg/l
RS09M010150	Br N.E. of Sherlockstown	2010	Nitrate (as N)	6	2.49	3.44	2.95	mg/l
RS09M010150	Br N.E. of Sherlockstown	2011	Nitrate (as N)	6	2.07	2.98	2.77	mg/l
RS09M010150	Br N.E. of Sherlockstown	2012	Nitrate (as N)	5	1.85	2.65	2.30	mg/l
RS09M010150	Br N.E. of Sherlockstown	2013	Nitrate (as N)	4	1.92	2.50	2.31	mg/l
RS09M010150	Br N.E. of Sherlockstown	2014	Nitrate (as N)	5	1.96	2.86	2.24	mg/l
RS09M010150	Br N.E. of Sherlockstown	2015	Nitrate (as N)	6	2.27	2.88	2.57	mg/l
RS09M010150	Br N.E. of Sherlockstown	2016	Nitrate (as N)	5	1.56	2.45	2.12	mg/l
RS09M010150	Br N.E. of Sherlockstown	2017	Nitrate (as N)	5	1.93	2.33	2.15	mg/l
RS09M010150	Br N.E. of Sherlockstown	2018	Nitrate (as N)	5	2.36	2.66	2.52	mg/l
RS09M010150	Br N.E. of Sherlockstown	2019	Nitrate (as N)	5	1.54	2.48	2.16	mg/l
RS09M010150	Br N.E. of Sherlockstown	2020	Nitrate (as N)	5	2.40	3.10	2.70	mg/l
RS09M010150	Br N.E. of Sherlockstown	2021	Nitrate (as N)	5	2.70	3.10	2.88	mg/l
RS09M010150	Br N.E. of Sherlockstown	2022	Nitrate (as N)	5	2.20	3.60	2.82	mg/l
RS09M010150	Br N.E. of Sherlockstown	2007	Nitrite (as N)	6	0.010	0.031	0.017	mg/l

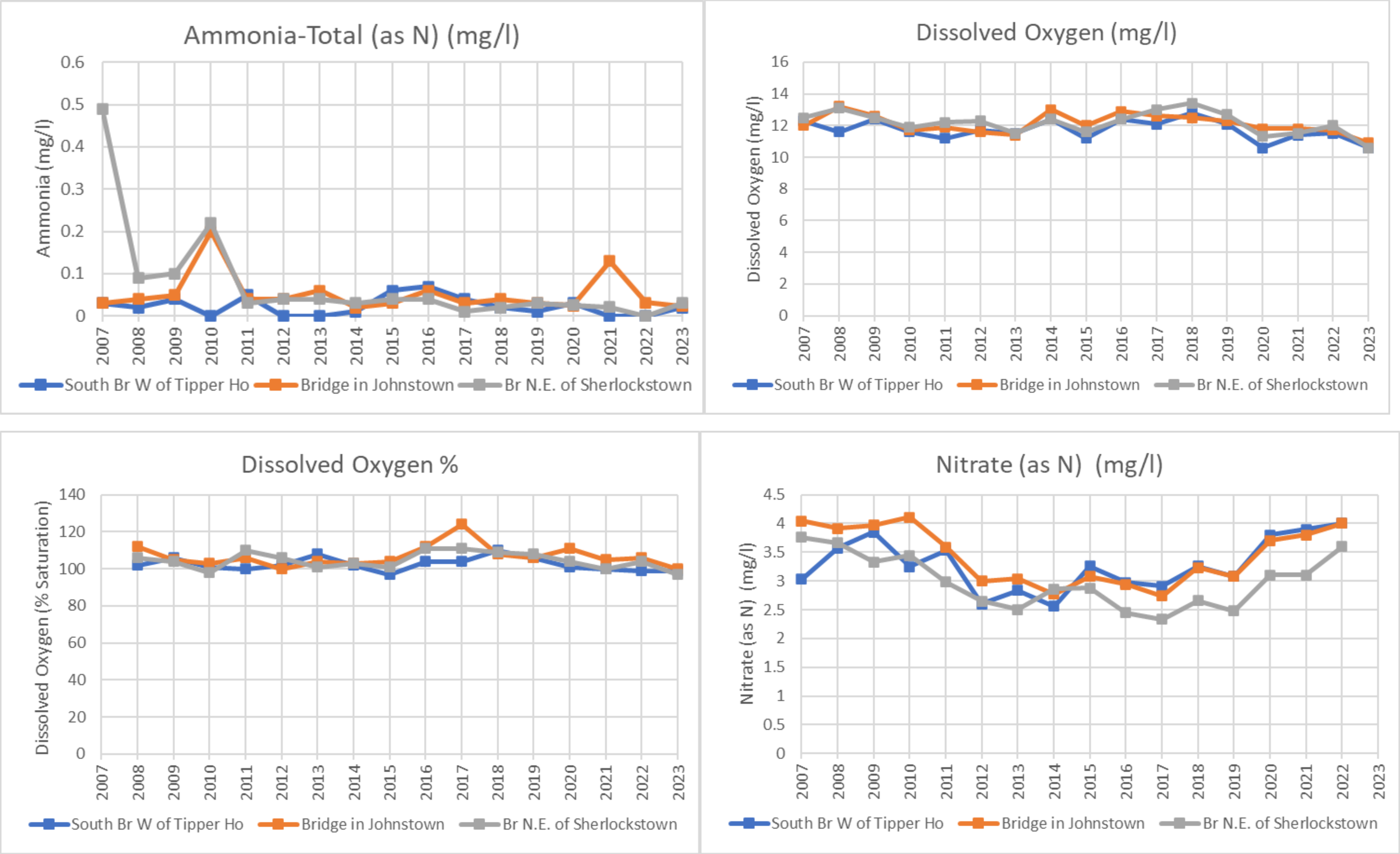
RS09M010150	Br N.E. of Sherlockstown	2008	Nitrite (as N)	6	0.011	0.015	0.014	mg/l
RS09M010150	Br N.E. of Sherlockstown	2009	Nitrite (as N)	6	0.007	0.014	0.009	mg/l
RS09M010150	Br N.E. of Sherlockstown	2010	Nitrite (as N)	6	0.008	0.034	0.016	mg/l
RS09M010150	Br N.E. of Sherlockstown	2011	Nitrite (as N)	6	<0.005	0.015	0.007	mg/l
RS09M010150	Br N.E. of Sherlockstown	2012	Nitrite (as N)	5	0.005	0.007	0.006	mg/l
RS09M010150	Br N.E. of Sherlockstown	2013	Nitrite (as N)	4	<0.005	0.009	0.004	mg/l
RS09M010150	Br N.E. of Sherlockstown	2014	Nitrite (as N)	5	<0.005	0.007	0.004	mg/l
RS09M010150	Br N.E. of Sherlockstown	2015	Nitrite (as N)	6	<0.005	0.008	0.005	mg/l
RS09M010150	Br N.E. of Sherlockstown	2016	Nitrite (as N)	5	<0.005	0.006	0.001	mg/l
RS09M010150	Br N.E. of Sherlockstown	2017	Nitrite (as N)	5	<0.005	<0.005	<0.005	mg/l
RS09M010150	Br N.E. of Sherlockstown	2018	Nitrite (as N)	5	<0.005	0.005	0.002	mg/l
RS09M010150	Br N.E. of Sherlockstown	2019	Nitrite (as N)	5	<0.005	0.007	0.001	mg/l
RS09M010150	Br N.E. of Sherlockstown	2020	Nitrite (as N)	5	<0.005	5.430	2.936	mg/l
RS09M010150	Br N.E. of Sherlockstown	2021	Nitrite (as N)	5	<0.005	5.500	1.100	mg/l
RS09M010150	Br N.E. of Sherlockstown	2022	Nitrite (as N)	5	<0.005	11.900	3.236	mg/l
RS09M010150	Br N.E. of Sherlockstown	2007	ortho-Phosphate (as P)	6	<0.03	0.05	0.03	mg/l
RS09M010150	Br N.E. of Sherlockstown	2008	ortho-Phosphate (as P)	4	<0.03	0.02	0.01	mg/l
RS09M010150	Br N.E. of Sherlockstown	2009	ortho-Phosphate (as P)	3	<0.03	0.06	0.02	mg/l
RS09M010150	Br N.E. of Sherlockstown	2010	ortho-Phosphate (as P)	6	<0.03	<0.03	<0.03	mg/l
RS09M010150	Br N.E. of Sherlockstown	2011	ortho-Phosphate (as P)	6	<0.03	<0.03	<0.03	mg/l
RS09M010150	Br N.E. of Sherlockstown	2012	ortho-Phosphate (as P)	5	<0.03	<0.03	<0.03	mg/l

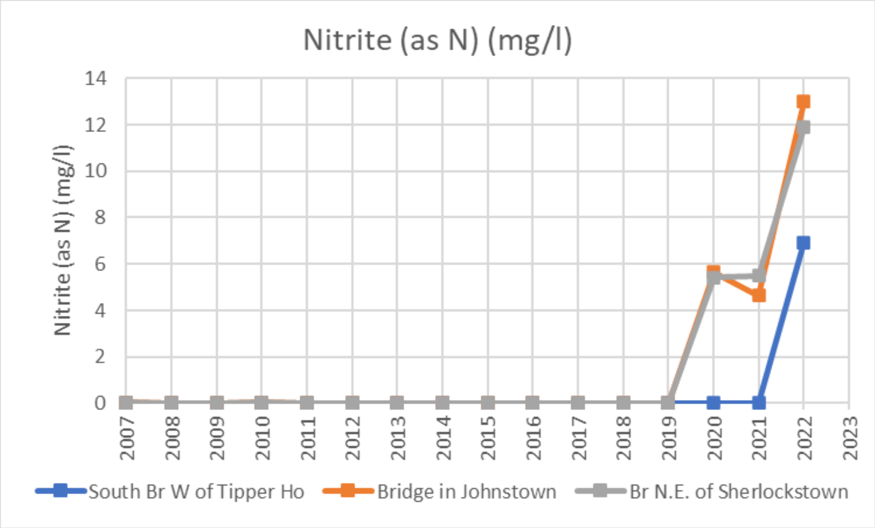
RS09M010150	Br N.E. of Sherlockstown	2013	ortho-Phosphate (as P)	4	<0.03	<0.03	<0.03	mg/l
RS09M010150	Br N.E. of Sherlockstown	2014	ortho-Phosphate (as P)	5	<0.03	0.02	0.01	mg/l
RS09M010150	Br N.E. of Sherlockstown	2015	ortho-Phosphate (as P)	6	<0.03	0.02	0.01	mg/l
RS09M010150	Br N.E. of Sherlockstown	2016	ortho-Phosphate (as P)	5	<0.03	0.09	0.03	mg/l
RS09M010150	Br N.E. of Sherlockstown	2017	ortho-Phosphate (as P)	5	<0.03	0.07	0.03	mg/l
RS09M010150	Br N.E. of Sherlockstown	2018	ortho-Phosphate (as P)	5	<0.03	0.02	0.00	mg/l
RS09M010150	Br N.E. of Sherlockstown	2019	ortho-Phosphate (as P)	5	<0.03	0.05	0.02	mg/l
RS09M010150	Br N.E. of Sherlockstown	2020	ortho-Phosphate (as P)	5	<0.03	0.02	0.01	mg/l
RS09M010150	Br N.E. of Sherlockstown	2021	ortho-Phosphate (as P)	5	<0.03	0.02	0.01	mg/l
RS09M010150	Br N.E. of Sherlockstown	2022	ortho-Phosphate (as P)	5	0.02	0.03	0.02	mg/l
RS09M010150	Br N.E. of Sherlockstown	2023	ortho-Phosphate (as P)	3	0.02	0.03	0.02	mg/l
RS09M010150	Br N.E. of Sherlockstown	2007	pH	6	8.0	8.2	8.1	pH units
RS09M010150	Br N.E. of Sherlockstown	2008	pH	6	8.1	8.2	8.2	pH units
RS09M010150	Br N.E. of Sherlockstown	2009	pH	6	8.0	8.2	8.2	pH units
RS09M010150	Br N.E. of Sherlockstown	2010	pH	6	8.1	8.2	8.2	pH units
RS09M010150	Br N.E. of Sherlockstown	2011	pH	6	8.1	8.2	8.2	pH units
RS09M010150	Br N.E. of Sherlockstown	2012	pH	5	8.1	8.2	8.1	pH units
RS09M010150	Br N.E. of Sherlockstown	2013	pH	4	8.1	8.2	8.2	pH units
RS09M010150	Br N.E. of Sherlockstown	2014	pH	6	8.2	8.2	8.2	pH units
RS09M010150	Br N.E. of Sherlockstown	2015	pH	6	8.2	8.3	8.2	pH units
RS09M010150	Br N.E. of Sherlockstown	2016	pH	5	8.0	8.2	8.1	pH units

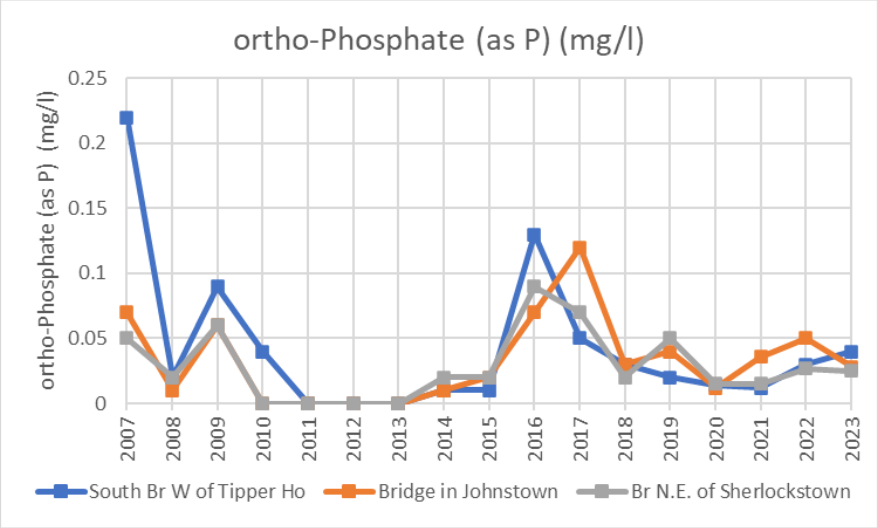
RS09M010150	Br N.E. of Sherlockstown	2017	pH	5	8.0	8.3	8.2	pH units
RS09M010150	Br N.E. of Sherlockstown	2018	pH	5	7.9	8.3	8.1	pH units
RS09M010150	Br N.E. of Sherlockstown	2019	pH	5	8.0	8.4	8.2	pH units
RS09M010150	Br N.E. of Sherlockstown	2020	pH	5	8.0	8.2	8.1	pH units
RS09M010150	Br N.E. of Sherlockstown	2021	pH	5	8.1	8.2	8.2	pH units
RS09M010150	Br N.E. of Sherlockstown	2022	pH	5	8.2	8.2	8.2	pH units
RS09M010150	Br N.E. of Sherlockstown	2023	pH	3	8.2	8.2	8.2	pH units
RS09M010150	Br N.E. of Sherlockstown	2007	Temperature	6	5.1	13.4	10.1	°C
RS09M010150	Br N.E. of Sherlockstown	2008	Temperature	6	6.3	12.7	9.0	°C
RS09M010150	Br N.E. of Sherlockstown	2009	Temperature	6	6.4	13.0	10.0	°C
RS09M010150	Br N.E. of Sherlockstown	2010	Temperature	6	5.4	12.8	9.0	°C
RS09M010150	Br N.E. of Sherlockstown	2011	Temperature	6	8.4	12.6	10.7	°C
RS09M010150	Br N.E. of Sherlockstown	2012	Temperature	5	4.8	12.2	8.7	°C
RS09M010150	Br N.E. of Sherlockstown	2013	Temperature	4	6.9	14.5	10.6	°C
RS09M010150	Br N.E. of Sherlockstown	2014	Temperature	6	6.2	14.3	10.4	°C
RS09M010150	Br N.E. of Sherlockstown	2015	Temperature	6	7.1	15.2	10.9	°C
RS09M010150	Br N.E. of Sherlockstown	2016	Temperature	5	7.1	12.9	10.3	°C
RS09M010150	Br N.E. of Sherlockstown	2017	Temperature	5	6.2	14.7	10.4	°C
RS09M010150	Br N.E. of Sherlockstown	2018	Temperature	5	4.0	13.2	10.0	°C
RS09M010150	Br N.E. of Sherlockstown	2019	Temperature	5	7.3	14.9	10.2	°C
RS09M010150	Br N.E. of Sherlockstown	2020	Temperature	5	9.3	15.6	12.5	°C

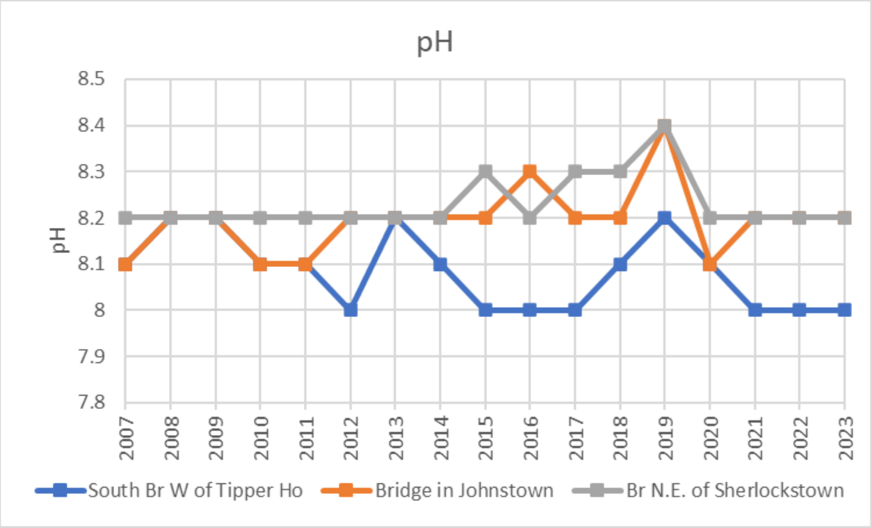
RS09M010150	Br N.E. of Sherlockstown	2021	Temperature	5	8.8	14.6	11.2	°C
RS09M010150	Br N.E. of Sherlockstown	2022	Temperature	5	6.3	15.0	11.1	°C
RS09M010150	Br N.E. of Sherlockstown	2023	Temperature	3	10.6	15.9	13.5	°C
RS09M010150	Br N.E. of Sherlockstown	2007	Total Oxidised Nitrogen (as N)	6	2.41	3.77	3.10	mg/l
RS09M010150	Br N.E. of Sherlockstown	2008	Total Oxidised Nitrogen (as N)	6	2.42	3.68	3.16	mg/l
RS09M010150	Br N.E. of Sherlockstown	2009	Total Oxidised Nitrogen (as N)	6	1.39	3.34	2.81	mg/l
RS09M010150	Br N.E. of Sherlockstown	2010	Total Oxidised Nitrogen (as N)	6	2.52	3.46	2.96	mg/l
RS09M010150	Br N.E. of Sherlockstown	2011	Total Oxidised Nitrogen (as N)	6	2.08	2.99	2.78	mg/l
RS09M010150	Br N.E. of Sherlockstown	2012	Total Oxidised Nitrogen (as N)	5	1.86	2.65	2.30	mg/l
RS09M010150	Br N.E. of Sherlockstown	2013	Total Oxidised Nitrogen (as N)	4	1.93	2.51	2.32	mg/l
RS09M010150	Br N.E. of Sherlockstown	2014	Total Oxidised Nitrogen (as N)	5	1.97	2.87	2.25	mg/l
RS09M010150	Br N.E. of Sherlockstown	2015	Total Oxidised Nitrogen (as N)	6	2.28	2.89	2.58	mg/l
RS09M010150	Br N.E. of Sherlockstown	2016	Total Oxidised Nitrogen (as N)	5	1.56	2.45	2.12	mg/l
RS09M010150	Br N.E. of Sherlockstown	2017	Total Oxidised Nitrogen (as N)	5	1.94	2.34	2.16	mg/l
RS09M010150	Br N.E. of Sherlockstown	2018	Total Oxidised Nitrogen (as N)	5	2.37	2.67	2.52	mg/l
RS09M010150	Br N.E. of Sherlockstown	2019	Total Oxidised Nitrogen (as N)	5	1.55	2.48	2.16	mg/l
RS09M010150	Br N.E. of Sherlockstown	2020	Total Oxidised Nitrogen (as N)	5	2.40	3.10	2.70	mg/l
RS09M010150	Br N.E. of Sherlockstown	2021	Total Oxidised Nitrogen (as N)	5	2.70	3.10	2.88	mg/l
RS09M010150	Br N.E. of Sherlockstown	2022	Total Oxidised Nitrogen (as N)	5	2.20	3.70	2.84	mg/l
RS09M010150	Br N.E. of Sherlockstown	2023	Total Oxidised Nitrogen (as N)	3	2.20	2.90	2.63	mg/l

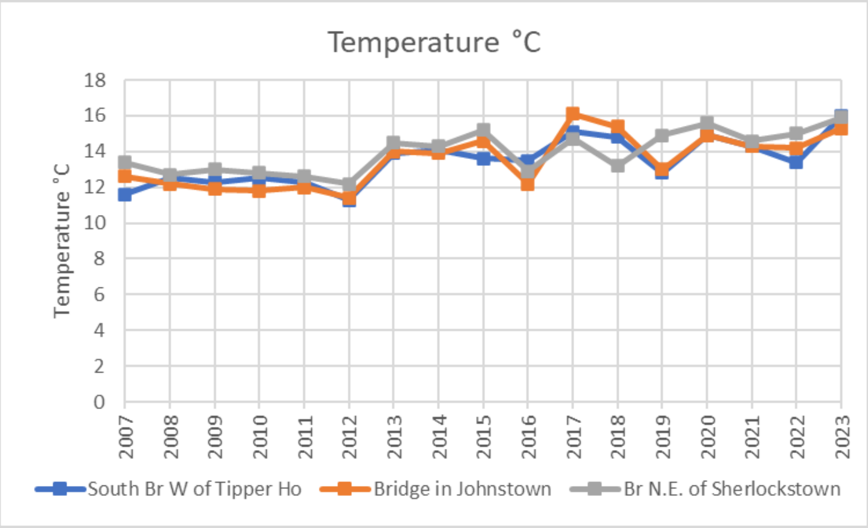
Figure 6A-1 - Time Series Graphs for River Water Quality Parameters Max Values (2007 to 2023)




Nitrite (as N) (mg/l)
Nitrite (as N) (mg/l)
0
2
4
6
8
10
12
14
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
South Br W of Tipper Ho
Bridge in Johnstown
Br N.E. of Sherlockstown


ortho-Phosphate (as P) (mg/l)
ortho-Phosphate (as P) (mg/l)
0
0.05
0.1
0.15
0.2
0.25
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
South Br W of Tipper Ho
Bridge in Johnstown
Br N.E. of Sherlockstown


pH
pH
7.8
7.9
8
8.1
8.2
8.3
8.4
8.5
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
South Br W of Tipper Ho
Bridge in Johnstown
Br N.E. of Sherlockstown


Temperature °C
Temperature °C
0
2
4
6
8
10
12
14
16
18
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
South Br W of Tipper Ho
Bridge in Johnstown
Br N.E. of Sherlockstown

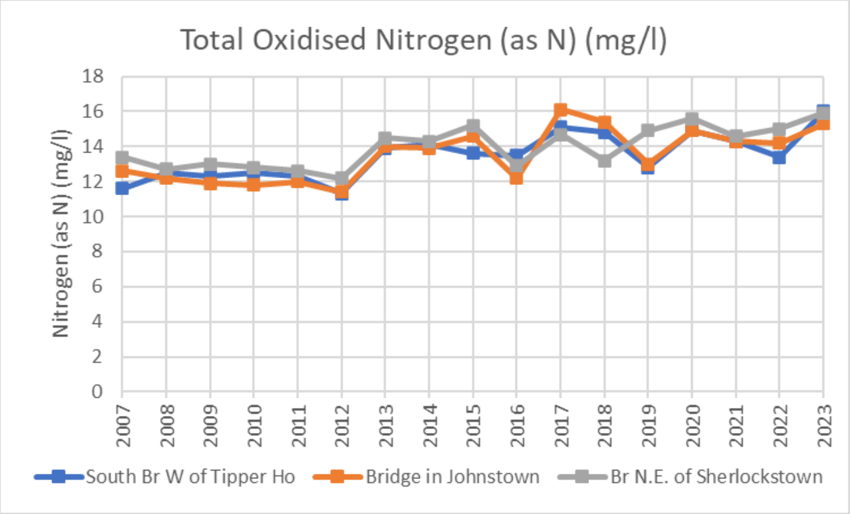

Total Oxidised Nitrogen (as N) (mg/l)
Nitrogen (as N) (mg/l)
0
2
4
6
8
10
12
14
16
18
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
South Br W of Tipper Ho
Bridge in Johnstown
Br N.E. of Sherlockstown

Table 6A-2 - Laboratory Results - January 2023

Parameter	Units	GTV [1]	BH2K	BH6K	BH7K	BH8K	AA-EQS[2]	Pond K2	Pond K1
Sulphate as SO$_4$	mg/l	187.5	15.7	21.9	13.5	5.3	-	22.7	20.4
Chloride	mg/l	187.5	13.7	21.6	14.1	4.8	-	9.5	10.7
Nitrate as NO$_3$	mg/l	37.5	0.5	58.9	18.9	11.1	-	5.4	7.7
Nitrate as NO$_2$	mg/l	0.375	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02
Ortho Phosphate as PO$_4$	mg/l		<0.06	<0.06	0.12	<0.06	-	<0.06	<0.06
Ammoniacal Nitrogen as N	mg/l		0.05	<0.03	<0.03	<0.03	-	0.05	0.05
Hexavalent Chromium	µg/l	7.5	<6	<6	<6	<6	3.4	<6	<6
Total Dissolved Chromium III	µg/l		<6	<6	<6	<6	-	<6	<6
Total Alkalinity as CaCO$_3$	mg/l		382	398	322	382	-	178	220
COD (Settled)	mg/l		14	9	<7	<7	-	<7	<7
Total Suspended Solids	mg/l		2150	1760	3499	1184	-	150	73
Dissolved Arsenic	µg/l	7.5	4.5	4	<2.5	4.8	50	5.5	<2.5
Dissolved Barium	µg/l		225	60	91	25	-	64	80
Dissolved Beryllium	µg/l		<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5
Dissolved Boron	µg/l	750	<12	<12	13	<12	-	<12	<12
Dissolved Cadmium	µg/l	3.75	0.6	<0.5	<0.5	<0.5	0.25	<0.5	<0.5
Dissolved Calcium	mg/l		75.7	137.7	98.8	136.8	-	64.2	80.7

Total Dissolved Chromium	µg/l	37.5	<1.5	<1.5	<1.5	<1.5	3.4	<1.5	<1.5
Dissolved Copper	µg/l	1500	<7	<7	<7	<7	5 or 30	<7	<7
Dissolved Lead	µg/l	18.75	<5	<5	<5	<5	1.2	<5	<5
Dissolved Magnesium	mg/l		30.8	14.4	9.3	7.8	-	8	9.5
Dissolved Mercury	µg/l	0.75	<1	<1	<1	<1	0.05	<1	<1
Dissolved Nickel	µg/l	15	7	<2	<2	<2	4	<2	<2
Dissolved Potassium	mg/l		1.5	0.6	2	0.7	-	1.4	1.1
Dissolved Selenium	µg/l		<3	<3	<3	<3	-	<3	<3
Dissolved Sodium	mg/l	150	16.8	10.6	9.7	6.7	-	7.3	8.2
Dissolved Vanadium	µg/l		<1.5	<1.5	<1.5	<1.5	-	<1.5	<1.5
Dissolved Zinc	µg/l	75	6	<3	3	<3	8, 50 or 100	5	7
Methyl Tertiary Butyl Ether	µg/l	10	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1
Benzene	µg/l	0.75	<0.5	<0.5	<0.5	<0.5	10	<0.5	<0.5
Toluene	µg/l	525	<5	<5	<5	<5	10	<5	<5
Ethylbenzene	µg/l		<1	<1	<1	<1	-	<1	<1
m/p-Xylene	µg/l		<2	<2	<2	<2	10	<2	<2
o-Xylene	µg/l		<1	<1	<1	<1	10	<1	<1
GRO (>C4-C8)	µg/l		<10	<10	<10	<10	-	<10	<10
GRO (>C8-C12)	µg/l		<10	<10	<10	<10	-	<10	<10

GRO (>C4-C12)	µg/l		<10	<10	<10	<10	-	<10	<10
EPH (C8-C40)	µg/l		<10	<10	<10	<10	-	<10	<10

1 Groundwater Regulations 2010 (S.I. No. 9 of 2010) and amendment S.I. No. 366/2016.

2 S.I. No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations 2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/2019.

Table 6A-3 - Laboratory Results - May 2023

Parameter	Units	GTV [1]	BH2K	BH6K	BH7K	BH8K	AA-EQS[2]	Pond K2	Pond K1
Sulphate as SO_4	mg/l	187.5	17.4	18.7	17	5.3	-	21.1	20.9
Chloride	mg/l	187.5	14.5	21.4	13.8	5.2	-	10.5	11.2
Nitrate as NO_3	mg/l	37.5	0.7	56.6	14.8	4.7	-	11.9	9.9
Nitrate as NO_2	mg/l	0.375	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.06
Ortho Phosphate as PO_4	mg/l		<0.06	0.08	<0.06	0.44	-	<0.06	11.2
Ammoniacal Nitrogen as N	mg/l		<0.03	<0.03	<0.03	<0.03	-	<0.03	<0.03
Hexavalent Chromium	µg/l	7.5	<0.06	<0.06	<0.06	<0.06	3.4	<0.06	<0.06
Total Dissolved Chromium III	µg/l		<6	<6	<6	<6	-	<6	<6
Total Alkalinity as $CaCO_3$	mg/l		498	408	286	412	-	206	262
COD (Settled)	mg/l		<7	<7	30	9	-	<7	<7
Total Suspended Solids	mg/l		4467	1915	834	3179	-	24	16
Dissolved Arsenic	µg/l	7.5	2.8	<2.5	<2.5	<2.5	50	<2.5	<2.5
Dissolved Barium	µg/l		202	64	107	7	-	82	96
Dissolved Beryllium	µg/l		<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5
Dissolved Boron	µg/l	750	<12	<12	<12	<12	-	<12	<12
Dissolved Cadmium	µg/l	3.75	<0.5	<0.5	<0.5	<0.5	0.25	<0.5	<0.5
Dissolved Calcium	mg/l		72.6	135.2	98.3	130.9	-	72.2	89.4

Total Dissolved Chromium	µg/l	37.5	<1.5	<1.5	<1.5	<1.5	3.4	<1.5	<1.5
Dissolved Copper	µg/l	1500	<7	<7	<7	<7	5 or 30	<7	<7
Dissolved Lead	µg/l	18.75	<5	<5	<5	<5	1.2	<5	<5
Dissolved Magnesium	mg/l		30.4	14.4	8.5	7.7	-	9.9	10.8
Dissolved Mercury	µg/l	0.75	<1	<1	<1	<1	0.05	<1	<1
Dissolved Nickel	µg/l	15	<2	<2	<2	<2	4	<2	<2
Dissolved Potassium	mg/l		1.4	0.6	2.7	0.7	-	1	1.1
Dissolved Selenium	µg/l		<3	<3	<3	<3	-	<3	<3
Dissolved Sodium	mg/l	150	14.8	10	9.1	6.2	-	7.7	8.5
Dissolved Vanadium	µg/l		<1.5	<1.5	<1.5	<1.5	-	<1.5	<1.5
Dissolved Zinc	µg/l	75	<3	<3	<3	<3	8, 50 or 100	<3	3
Methyl Tertiary Butyl Ether	µg/l	10	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1
Benzene	µg/l	0.75	<0.5	<0.5	<0.5	<0.5	10	<0.5	<0.5
Toluene	µg/l	525	<5	<5	<5	<5	10	<5	<5
Ethylbenzene	µg/l		<1	<1	<1	<1	-	<1	<1
m/p-Xylene	µg/l		<2	<2	<2	<2	10	<2	<2
o-Xylene	µg/l		<1	<1	<1	<1	10	<1	<1
GRO (>C4-C8)	µg/l		<10	<10	<10	<10	-	<10	<10
GRO (>C8-C12)	µg/l		<10	<10	<10	<10	-	<10	<10

GRO (>C4-C12)	µg/l		<10	<10	<10	<10	-	<10	<10
EPH (C8-C40)	µg/l		<10	<10	<10	<10	-	<10	<10

1 Groundwater Regulations 2010 (S.I. No. 9 of 2010) and amendment S.I. No. 366/2016.

2 S.I. No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations 2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/2019.

Table 6A-4 - Laboratory Results - September 2023

Parameter	Units	GTV [1]	BH6K	BH7K	BH8K	BH9K	BH10K	AA-EQS[2]	Pond K2
Sulphate as SO_4	mg/l	187.5	18.5	15.8	5.5	18.3	37.4	-	30.7
Chloride	mg/l	187.5	21.7	14.2	5.6	24.4	52.8	-	6.4
Nitrate as NO_3	mg/l	37.5	55.1	16	6	28.8	3.9	-	3.7
Nitrate as NO_2	mg/l	0.375	<0.02	<0.02	<0.02	<0.02	0.26	-	<0.02
Ortho Phosphate as PO_4	mg/l		<0.06	<0.06	0.08	<0.06	<0.06	-	<0.06
Ammoniacal Nitrogen as N	mg/l		0.03	<0.03	<0.03	0.03	0.04	-	<0.03
Hexavalent Chromium	µg/l	7.5	<6	<6	<6	<6	<6	3.4	<6
Total Dissolved Chromium III	µg/l		<6	<6	<6	<6	<6	-	<6
Total Alkalinity as $CaCO_3$	mg/l		348	280	390	334	246	-	144
COD (Settled)	mg/l		10	<7	8	<7	<7	-	10
Total Suspended Solids	mg/l		356	55	3188	21	25	-	34
Dissolved Arsenic	µg/l	7.5	<2.5	<2.5	<2.5	2.6	7.5	50	11.1
Dissolved Barium	µg/l		68	107	18	21	12	-	40
Dissolved Beryllium	µg/l		<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5
Dissolved Boron	µg/l	750	<12	15	<12	17	211	-	<12
Dissolved Cadmium	µg/l	3.75	<0.5	<0.5	<0.5	<0.5	<0.5	0.25	<0.03
Dissolved Calcium	mg/l		131.7	101.9	129.5	122.3	27.5	-	54.5

Total Dissolved Chromium	µg/l	37.5	<1.5	<1.5	<1.5	<1.5	<1.5	3.4	<1.5
Dissolved Copper	µg/l	1500	<7	<7	<7	<7	<7	5 or 30	<3
Dissolved Lead	µg/l	18.75	<5	<5	<5	<5	<5	1.2	<0.4
Dissolved Magnesium	mg/l		13.8	8.5	7.4	11.9	16.3	-	8.2
Dissolved Mercury	µg/l	0.75	<1	<1	<1	<1	<1	0.05	-
Dissolved Nickel	µg/l	15	4	<2	<2	<2	<2	4	<2
Dissolved Potassium	mg/l		0.7	3.1	0.7	0.9	7.2	-	1.2
Dissolved Selenium	µg/l		<3	<3	<3	<3	46	-	<3
Dissolved Sodium	mg/l	150	10.4	9.7	6.6	11.2	89.6	-	5.9
Dissolved Vanadium	µg/l		<1.5	<1.5	<1.5	<1.5	<1.5	-	<1.5
Dissolved Zinc	µg/l	75	11	19	<3	9	6	8, 50 or 100	<3
Methyl Tertiary Butyl Ether	µg/l	10	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1
Benzene	µg/l	0.75	<0.5	<0.5	<0.5	<0.5	<0.5	10	<0.5
Toluene	µg/l	525	<5	<5	<5	8	<5	10	<5
Ethylbenzene	µg/l		1	<1	<1	1	2	-	<1
m/p-Xylene	µg/l		4	<2	<2	6	6	10	<2
o-Xylene	µg/l		4	<1	<1	2	2	10	<1
GRO (>C4-C8)	µg/l		<10	<10	<10	10	<10	-	<10
GRO (>C8-C12)	µg/l		24	<10	<10	24	19	-	<10

GRO (>C4-C12)	µg/l		24	<10	<10	34	19	-	<10
EPH (C8-C40)	µg/l		<10	<10	<10	<10	<10	-	<10

1 Groundwater Regulations 2010 (S.I. No. 9 of 2010) and amendment S.I. No. 366/2016.

2 S.I. No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations 2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/201

Table 6A-5 - Laboratory Results – November 2023

Parameter	Units	GTV [1]	BH6K	BH7K	BH8K	BH9K	BH10K	AA-EQS[2]	Pond K2
Sulphate as SO_4	mg/l	187.5	17.9	17.6	4.4	17.3	33.4	-	22.7
Chloride	mg/l	187.5	22	14.5	5.5	24.3	40.3	-	10
Nitrate as NO_3	mg/l	37.5	56.9	18.8	4.5	28.7	2.6	-	5.9
Nitrate as NO_2	mg/l	0.375	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02
Ortho Phosphate as PO_4	mg/l		0.07	<0.06	0.1	<0.06	0.07	-	<0.06
Ammoniacal Nitrogen as N	mg/l		<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03
Hexavalent Chromium	µg/l	7.5	<6	<6	<6	<6	<6	3.4	<6
Total Dissolved Chromium III	µg/l		<6	<6	<6	<6	<6	-	<6
Total Alkalinity as $CaCO_3$	mg/l		350	242	380	284	220	-	194
COD (Settled)	mg/l		<7	<7	<7	<7	<7	-	<7
Total Suspended Solids	mg/l		73	<10	179	235	<10	-	12
Dissolved Arsenic	µg/l	7.5	<2.5	<2.5	<2.5	<2.5	2.7	50	5.3
Dissolved Barium	µg/l		72	109	<3	15	10	-	73
Dissolved Beryllium	µg/l		<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5
Dissolved Boron	µg/l	750	<12	<12	<12	<12	185	-	<12
Dissolved Cadmium	µg/l	3.75	<0.5	<0.5	<0.5	<0.5	<0.5	0.25	<0.03
Dissolved Calcium	mg/l		139.1	103.9	134.7	125.9	28.5	-	76.6
Total Dissolved Chromium	µg/l	37.5	<1.5	<1.5	<1.5	<1.5	<1.5	3.4	<1.5

Dissolved Copper	µg/l	1500	<7	<7	<7	<7	<7	5 or 30	<3
Dissolved Lead	µg/l	18.75	<5	<5	<5	<5	<5	1.2	<0.4
Dissolved Magnesium	mg/l		14	8.3	7.4	10.8	18.5	-	9.7
Dissolved Mercury	µg/l	0.75	<1	<1	<1	<1	<1	0.05	-
Dissolved Nickel	µg/l	15	<2	<2	<2	<2	<2	4	<2
Dissolved Potassium	mg/l		0.7	3.2	0.7	0.8	6.7	-	1.1
Dissolved Selenium	µg/l		<3	<3	<3	<3	22	-	<3
Dissolved Sodium	mg/l	150	10.2	9.4	6.2	9.9	74.5	-	7.7
Dissolved Vanadium	µg/l		<1.5	<1.5	<1.5	<1.5	1.9	-	<1.5
Dissolved Zinc	µg/l	75	<3	<3	<3	<3	<3	8, 50 or 100	<3
Methyl Tertiary Butyl Ether	µg/l	10	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1
Benzene	µg/l	0.75	<0.5	<0.5	<0.5	<0.5	<0.5	10	<0.5
Toluene	µg/l	525	<5	<5	<5	<5	<5	10	<5
Ethylbenzene	µg/l		<1	<1	<1	<1	<1	-	<1
m/p-Xylene	µg/l		<2	<2	<2	<2	<2	10	<2
o-Xylene	µg/l		<1	<1	<1	<1	<1	10	<1
GRO (>C4-C8)	µg/l		<10	<10	<10	<10	<10	-	<10
GRO (>C8-C12)	µg/l		<10	<10	<10	<10	<10	-	<10
GRO (>C4-C12)	µg/l		<10	<10	<10	<10	<10	-	<10
EPH (C8-C40)	µg/l		<10	<10	<10	<10	<10	-	<10

1 Groundwater Regulations 2010 (S.I. No. 9 of 2010) and amendment S.I. No. 366/2016.

[2] S.I. No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations 2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/201

Table 6A-6 - Laboratory Results - December 2023

Parameter	Units	GTV[1]	BH6K	BH7K	BH8K	BH9K	BH10K	AA-EQS[2]	Pond K2
Sulphate as SO_4	mg/l	187.5	17.4	18.8	8.5	19.7	30.9	-	21.4
Chloride	mg/l	187.5	21.4	13.7	5.6	23.1	35	-	9.6
Nitrate as NO_3	mg/l	37.5	55.1	13.8	4.9	28.5	0.8	-	6.6
Nitrate as NO_2	mg/l	0.375	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02
Ortho Phosphate as PO_4	mg/l		<0.06	<0.06	<0.06	<0.06	<0.06	-	<0.06
Ammoniacal Nitrogen as N	mg/l		<0.03	0.05	0.03	0.03	0.04	-	<0.03
Hexavalent Chromium	µg/l	7.5	<2	<2	<2	<2	<2	3.4	<2
Total Dissolved Chromium III	µg/l		<6	8	<6	<6	<6	-	<6
Total Alkalinity as $CaCO_3$	mg/l		328	260	368	322	206	-	212
COD (Settled)	mg/l		14	13	18	14	15	-	14
Total Suspended Solids	mg/l		146	307	1314	157	16	-	<10
Dissolved Arsenic	µg/l	7.5	<2.5	2.8	<2.5	<2.5	<2.5	50	<2.5
Dissolved Barium	µg/l		67	99	4	13	8	-	72
Dissolved Beryllium	µg/l		<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5
Dissolved Boron	µg/l	750	<12	18	<12	<12	178	-	<12
Dissolved Cadmium	µg/l	3.75	<0.5	<0.5	<0.5	<0.5	<0.5	0.25	<0.03
Dissolved Calcium	mg/l		136.4	97	134.6	129.3	27.7	-	74.5
Total Dissolved Chromium	µg/l	37.5	<1.5	7.8	<1.5	<1.5	<1.5	3.4	<1.5
Dissolved Copper	µg/l	1500	<7	<7	<7	<7	<7	5 or 30	<3

Dissolved Lead	µg/l	18.75	<5	<5	<5	<5	<5	1.2	<0.4
Dissolved Magnesium	mg/l		14.5	8	7.9	11.2	17.5	-	10.1
Dissolved Mercury	µg/l	0.75	<1	<1	<1	<1	<1	0.05	<0.01
Dissolved Nickel	µg/l	15	<2	<2	<2	<2	<2	4	<2
Dissolved Potassium	mg/l		0.6	3.2	0.7	0.7	5.3	-	1
Dissolved Selenium	µg/l		<3	<3	<3	<3	21	-	<3
Dissolved Sodium	mg/l	150	10.9	10.2	7.1	10.8	63.8	-	8.4
Dissolved Vanadium	µg/l		<1.5	<1.5	<1.5	<1.5	<1.5	-	<1.5
Dissolved Zinc	µg/l	75	<3	<3	<3	<3	3	8, 50 or 100	6
Methyl Tertiary Butyl Ether	µg/l	10	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1
Benzene	µg/l	0.75	<0.5	<0.5	<0.5	<0.5	<0.5	10	<0.5
Toluene	µg/l	525	<5	<5	<5	<5	<5	10	<5
Ethylbenzene	µg/l		<1	<1	<1	<1	<1	-	<1
m/p-Xylene	µg/l		<2	<2	<2	<2	<2	10	<2
o-Xylene	µg/l		<1	<1	<1	<1	<1	10	<1
GRO (>C4-C8)	µg/l		<10	<10	<10	<10	<10	-	<10
GRO (>C8-C12)	µg/l		<10	<10	<10	<10	<10	-	<10
GRO (>C4-C12)	µg/l		<10	<10	<10	<10	<10	-	<10
EPH (C8-C40)	µg/l		<10	<10	<10	<10	<10	-	<10

1 Groundwater Regulations 2010 (S.I. No. 9 of 2010) and amendment S.I. No. 366/2016.

2 S.I. No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations 2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/2

Appendix 6B

FIELD WATER QUALITY RESULTS

Table 6B-1 – Field Water Quality Results Monitoring Wells

Monitoring Well ID	Date	pH	Conductivity (µS/cm)	Temperature (°C)	DO (mg/L)	Redox (ORP) (mV)
BH2K	12-Jan-23	7.25	562.4	9.6	77.6	36.7
BH6K	12-Jan-23	7.27	760	9.8	68.3	29.2
BH7K	12-Jan-23	7.29	553.9	9.9	73.3	40.5
BH8K	12-Jan-23	7.06	670.9	9.2	71.3	33.5
BH2K	10-May-23	7.25	614	11.4	2.39	97.9
BH6K	10-May-23	7.23	562	11	8.9	231.3
BH7K	10-May-23	7.28	570	11.1	9.01	179.5
BH8K	10-May-23	7.15	668	11.3	9.24	201.1
BH2K	31-May-23	7.33	450.1	11.1	3.66	163.6
BH6K	31-May-23	7.19	589	12.7	79.9	137.9
BH7K	31-May-23	7.62	553	20.6	9.13	186.3
BH8K	31-May-23	8.05	360	14.7	10.14	149.6
BH6K	19-Sep-23	7.3	572	14.5	79.3	209.5
BH7K	19-Sep-23	7.5	467.5	15.8	94.4	232.7
BH8K	19-Sep-23	7.2	480.4	12.9	80	245.8
BH9K	19-Sep-23	7.51	539	16	90.3	242.6
BH10K	19-Sep-23	7.98	503	14.7	38.7	201.9
BH6K	08-Nov-23	7.17	496.3	9.4	70.9	216.5
BH7K	08-Nov-23	7.19	365.5	8.7	83.2	225.9
BH8K	08-Nov-23	7.12	423	10.3	80.7	208.3
BH9K	08-Nov-23	7.31	459.3	9.5	81.9	221
BH10K	08-Nov-23	8.12	379.3	9.7	19.9	166.4

Table 6B-2 – Field Water Quality Results Artificial Ponds

Monitoring ID	Date	pH	Conductivity (µS/cm)	Temperature (°C)
Lagoon L	12-Jan-23	7.93	386.7	6.4
Lagoon K	12-Jan-23	7.9	467.4	6.4
Lagoon L	10-May-23	7.78	453.6	14
Lagoon K	10-May-23	7.56	524	13.3
Lagoon L	31-May-23	8.07	251.8	20
Lagoon K	31-May-23	7.65	462.1	16.9
Lagoon L	19-Sep-23	8.12	273.2	16.4
Lagoon L	08-Nov-23	7.9	281	8.2
Lagoon L	08_Dec-23	8.04	320.1	7.9

Appendix 6C

LABRATORY CERTIFICATES

Element Materials Technology
Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

P: +44 (0) 1244 833780
F: +44 (0) 1244 833781

W: www.element.com

Golder Associates Ltd
Town Centre House
Dublin Road
Naas
Co Kildare
Ireland

Attention : Emma Gilmartin

Date : 23rd January, 2023

Your reference : WON 410000987

Our reference : Test Report 23/713 Batch 1

Location : Hudsons

Date samples received : 18th January, 2023

Status : Final Report

Issue : 1

Six samples were received for analysis on 18th January, 2023 of which six were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Boden

Paul Boden BSc

Senior Project Manager

Client Name: Golder Associates Ltd
Reference: WON 410000987
Location: Hudsons
Contact: Emma Gilmartin
EMT Job No: 23/713

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	25-30	31-36					LOD/LOR	Units	Method No.
Sample ID	BH2	BH8	BH7	BH6	LAGOON L	LAGOON K							
Depth													
COC No / misc													
Containers	V H HNUF P G	V H HNUF P G	V H HN P G	V H HNUF P G	V H HN P G	V H HN P G							
Sample Date	12/01/2023	12/01/2023	12/01/2023	13/01/2023	12/01/2023	12/01/2023							
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Surface Water	Surface Water							
Batch Number	1	1	1	1	1	1							
Date of Receipt	18/01/2023	18/01/2023	18/01/2023	18/01/2023	18/01/2023	18/01/2023							
Dissolved Arsenic #	4.5	4.8	<2.5	4.0	5.5	<2.5					<2.5	ug/l	TM30/PM14
Dissolved Barium #	225	25	91	60	64	80					<3	ug/l	TM30/PM14
Dissolved Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					<0.5	ug/l	TM30/PM14
Dissolved Boron	<12	<12	13	<12	<12	<12					<12	ug/l	TM30/PM14
Dissolved Cadmium #	0.6	<0.5	<0.5	<0.5	<0.5	<0.5					<0.5	ug/l	TM30/PM14
Dissolved Calcium #	75.7	136.8	98.8	137.7	64.2	80.7					<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5					<1.5	ug/l	TM30/PM14
Dissolved Copper #	<7	<7	<7	<7	<7	<7					<7	ug/l	TM30/PM14
Dissolved Lead #	<5	<5	<5	<5	<5	<5					<5	ug/l	TM30/PM14
Dissolved Magnesium #	30.8	7.8	9.3	14.4	8.0	9.5					<0.1	mg/l	TM30/PM14
Dissolved Mercury #	<1	<1	<1	<1	<1	<1					<1	ug/l	TM30/PM14
Dissolved Nickel #	7	<2	<2	<2	<2	<2					<2	ug/l	TM30/PM14
Dissolved Potassium #	1.5	0.7	2.0	0.6	1.4	1.1					<0.1	mg/l	TM30/PM14
Dissolved Selenium #	<3	<3	<3	<3	<3	<3					<3	ug/l	TM30/PM14
Dissolved Sodium #	16.8	6.7	9.7	10.6	7.3	8.2					<0.1	mg/l	TM30/PM14
Dissolved Vanadium #	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5					<1.5	ug/l	TM30/PM14
Dissolved Zinc #	6	<3	3	<3	5	7					<3	ug/l	TM30/PM14
Methyl Tertiary Butyl Ether #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					<0.1	ug/l	TM15/PM10
Benzene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					<0.5	ug/l	TM15/PM10
Toluene #	<5	<5	<5	<5	<5	<5					<5	ug/l	TM15/PM10
Ethylbenzene #	<1	<1	<1	<1	<1	<1					<1	ug/l	TM15/PM10
m/p-Xylene #	<2	<2	<2	<2	<2	<2					<2	ug/l	TM15/PM10
o-Xylene #	<1	<1	<1	<1	<1	<1					<1	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	99	96	93	102	99	84					<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	97	96	93	97	97	84					<0	%	TM15/PM10
GRO (>C4-C8) #	<10	<10	<10	<10	<10	<10					<10	ug/l	TM36/PM12
GRO (>C8-C12) #	<10	<10	<10	<10	<10	<10					<10	ug/l	TM36/PM12
GRO (>C4-C12) #	<10	<10	<10	<10	<10	<10					<10	ug/l	TM36/PM12
EPH (C8-C40) #	<10	<10	<10	<10	<10	<10					<10	ug/l	TM5/PM30
Sulphate as SO4 #	15.7	5.3	13.5	21.9	22.7	20.4					<0.5	mg/l	TM38/PM0
Chloride #	13.7	4.8	14.1	21.6	9.5	10.7					<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	0.5	11.1	18.9	58.9	5.4	7.7					<0.2	mg/l	TM38/PM0
Nitrite as NO2 #	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02					<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4 #	<0.06	<0.06	0.12	<0.06	<0.06	<0.06					<0.06	mg/l	TM38/PM0
Ammoniacal Nitrogen as N #	0.05	<0.03	<0.03	<0.03	0.05	0.05					<0.03	mg/l	TM38/PM0
Hexavalent Chromium	<6	<6	<6	<6	<6	<6					<6	ug/l	TM38/PM0
Total Dissolved Chromium III	<6	<6	<6	<6	<6	<6					<6	ug/l	TM0/PM0
Total Alkalinity as CaCO3 #	382	382	322	398	178	220					<1	mg/l	TM75/PM0

Client Name: Golder Associates Ltd
Reference: WON 410000987
Location: Hudsons
Contact: Emma Gilmartin
EMT Job No: 23/713

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	25-30	31-36							
Sample ID	BH2	BH8	BH7	BH6	LAGOON L	LAGOON K							
Depth													
COC No / misc													
Containers	V H HNUF P G	V H HNUF P G	V H HN P G	V H HNUF P G	V H HN P G	V H HN P G							
Sample Date	12/01/2023	12/01/2023	12/01/2023	13/01/2023	12/01/2023	12/01/2023							
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water	Surface Water	Surface Water							
Batch Number	1	1	1	1	1	1					LOD/LOR	Units	Method No.
Date of Receipt	18/01/2023	18/01/2023	18/01/2023	18/01/2023	18/01/2023	18/01/2023							
COD (Settled)#	14	<7	<7	9	<7	<7					<7	mg/l	TM57/PM0
Total Suspended Solids#	2150	1184	3499	1760	150	73					<10	mg/l	TM37/PM0

Client Name:	Golder Associates Ltd
Reference:	WON 410000987
Location:	Hudsons
Contact:	Emma Gilmartin

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 23/713						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.

Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 23/713

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.
Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 23/713

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM0	Not available	PM0	No preparation is required.				
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.				
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified				
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified	Yes			
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM37	Modified methods - TSS: USEPA 160.2 (1983), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS	PM0	No preparation is required.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.	Yes			

EMT Job No: 23/713

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM57	Modified US EPA Method 410.4. (Rev. 2.0 1993) Comparable with ISO 15705:2002. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometerically.	PM0	No preparation is required.	Yes			
TM75	Modified US EPA method 310.1 (1978). Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			

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WSP Environmental
Town Centre House
Dublin Road
Naas
Co Kildare
Ireland

Attention : Kevin McGillycuddy

Date : 9th June, 2023

Your reference : Hudsons GW & SW Monitoring

Our reference : Test Report 23/7515 Batch 1

Location : Hudsons

Date samples received : 12th May, 2023

Status : Final Report

Issue : 2

Six samples were received for analysis on 12th May, 2023 of which six were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Reissued with updated EPH results for EMT samples 13-18 and 19-24. This report supersedes all previous versions.

Authorised By:

Simon Gomery BSc
Project Manager

Client Name:	WSP Environmental	**Report :** **Liquid**
Reference:	Hudsons GW & SW Monitoring	
Location:	Hudsons	
Contact:	Kevin McGillycuddy	**Liquids/products:** V=40ml vial, G=glass bottle, P=plastic bottle
EMT Job No:	23/7515	$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HNO_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	25-30	31-36					LOD/LOR	Units	Method No.
Sample ID	LAGOON L	LAGOON K	BH2	BH7	BH8	BH6							
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HNUF P G	V H HNUF P G							
Sample Date	10/05/2023	10/05/2023	10/05/2023	10/05/2023	10/05/2023	10/05/2023							
Sample Type	Surface Water	Surface Water	Ground Water	Ground Water	Ground Water	Ground Water							
Batch Number	1	1	1	1	1	1							
Date of Receipt	12/05/2023	12/05/2023	12/05/2023	12/05/2023	12/05/2023	12/05/2023							
Dissolved Arsenic#	<2.5	<2.5	2.8	<2.5	<2.5	<2.5					<2.5	ug/l	TM30/PM14
Dissolved Barium#	82	96	202	107	7	64					<3	ug/l	TM30/PM14
Dissolved Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					<0.5	ug/l	TM30/PM14
Dissolved Boron	<12	<12	<12	<12	<12	<12					<12	ug/l	TM30/PM14
Dissolved Cadmium#	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					<0.5	ug/l	TM30/PM14
Dissolved Calcium#	72.2	89.4	72.6	98.3	130.9	135.2					<0.2	mg/l	TM30/PM14
Total Dissolved Chromium#	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5					<1.5	ug/l	TM30/PM14
Dissolved Copper#	<7	<7	<7	<7	<7	<7					<7	ug/l	TM30/PM14
Dissolved Lead#	<5	<5	<5	<5	<5	<5					<5	ug/l	TM30/PM14
Dissolved Magnesium#	9.9	10.8	30.4	8.5	7.7	14.4					<0.1	mg/l	TM30/PM14
Dissolved Mercury#	<1	<1	<1	<1	<1	<1					<1	ug/l	TM30/PM14
Dissolved Nickel#	<2	<2	<2	<2	<2	<2					<2	ug/l	TM30/PM14
Dissolved Potassium#	1.0	1.1	1.4	2.7	0.7	0.6					<0.1	mg/l	TM30/PM14
Dissolved Selenium#	<3	<3	<3	<3	<3	<3					<3	ug/l	TM30/PM14
Dissolved Sodium#	7.7	8.5	14.8	9.1	6.2	10.0					<0.1	mg/l	TM30/PM14
Dissolved Vanadium#	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5					<1.5	ug/l	TM30/PM14
Dissolved Zinc#	<3	3	<3	<3	<3	<3					<3	ug/l	TM30/PM14
Methyl Tertiary Butyl Ether#	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					<0.1	ug/l	TM15/PM10
Benzene#	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					<0.5	ug/l	TM15/PM10
Toluene#	<5	<5	<5	<5	<5	<5					<5	ug/l	TM15/PM10
Ethylbenzene#	<1	<1	<1	<1	<1	<1					<1	ug/l	TM15/PM10
m/p-Xylene#	<2	<2	<2	<2	<2	<2					<2	ug/l	TM15/PM10
o-Xylene#	<1	<1	<1	<1	<1	<1					<1	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	107	119	115	111	124	86					<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	108	117	112	104	120	87					<0	%	TM15/PM10
GRO (>C4-C8)#	<10	<10	<10	<10	<10	<10					<10	ug/l	TM36/PM12
GRO (>C8-C12)#	<10	<10	<10	<10	<10	<10					<10	ug/l	TM36/PM12
GRO (>C4-C12)#	<10	<10	<10	<10	<10	<10					<10	ug/l	TM36/PM12
EPH (C8-C40)#	<10	<10	<10	<10	<10	<10					<10	ug/l	TM5/PM30
Sulphate as SO4#	21.1	20.9	17.4	17.0	5.3	18.7					<0.5	mg/l	TM38/PM0
Chloride#	10.5	11.2	14.5	13.8	5.2	21.4					<0.3	mg/l	TM38/PM0
Nitrate as NO3#	11.9	9.9	0.7	14.8	4.7	56.6					<0.2	mg/l	TM38/PM0
Nitrite as NO2#	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02					<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4#	<0.06	<0.06	<0.06	<0.06	0.44	0.08					<0.06	mg/l	TM38/PM0
Ammoniacal Nitrogen as N#	<0.03	<0.03	0.06	<0.03	0.03	0.03					<0.03	mg/l	TM38/PM0
Hexavalent Chromium	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006					<0.006	mg/l	TM38/PM0
Total Dissolved Chromium III	<6	<6	<6	<6	<6	<6					<6	ug/l	TM0/PM0
Total Alkalinity as CaCO3#	206	262	498	286	412	408					<1	mg/l	TM75/PM0

Client Name: WSP Environmental
Reference: Hudsons GW & SW Monitoring
Location: Hudsons
Contact: Kevin McGillycuddy
EMT Job No: 23/7515

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	25-30	31-36					LOD/LOR	Units	Method No.
Sample ID	LAGOON L	LAGOON K	BH2	BH7	BH8	BH6							
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HNUF P G	V H HNUF P G							
Sample Date	10/05/2023	10/05/2023	10/05/2023	10/05/2023	10/05/2023	10/05/2023							
Sample Type	Surface Water	Surface Water	Ground Water	Ground Water	Ground Water	Ground Water							
Batch Number	1	1	1	1	1	1							
Date of Receipt	12/05/2023	12/05/2023	12/05/2023	12/05/2023	12/05/2023	12/05/2023							
COD (Settled) #	<7	<7	<7	30	9	<7					<7	mg/l	TM57/PM0
Total Suspended Solids #	24	16	4467	834	3179	1915					<10	mg/l	TM37/PM0

Client Name: WSP Environmental
Reference: Hudsons GW & SW Monitoring
Location: Hudsons
Contact: Kevin McGillycuddy

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 23/7515						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.

Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 23/7515

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a requirement of our Accreditation Body for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.
Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above quantitative calibration range. The result should be considered the minimum value and is indicative only. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 23/7515

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM0	Not available	PM0	No preparation is required.				
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.				
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified				
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified	Yes			
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM37	Modified methods - TSS: USEPA 160.2 (1983), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS	PM0	No preparation is required.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.	Yes			

EMT Job No: 23/7515

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM57	Modified US EPA Method 410.4. (Rev. 2.0 1993) Comparable with ISO 15705:2002. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometerically.	PM0	No preparation is required.	Yes			
TM75	Modified US EPA method 310.1 (1978). Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			

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WSP Environmental
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UKAS TESTING 4225

Attention : Ruth Treacy

Date : 17th October, 2023

Your reference : 41000087

Our reference : Test Report 23/15698 Batch 1

Location : Hudsons

Date samples received : 22nd September, 2023

Status : Final Report

Issue : 2

Six samples were received for analysis on 22nd September, 2023 of which six were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

The greenhouse gas emissions generated (in Carbon – Co2e) to obtain the results in this report are estimated as:

Scope 1&2 emissions - 11.077 kg of CO2

Scope 1&2&3 emissions - 26.178 kg of CO2

Report reissued after investigation into the EPH result for EMT sample 19-24. This report supersedes all previous versions.

Authorised By:

Simon Gomery BSc
Senior Project Manager

Client Name: WSP Environmental
Reference: 41000087
Location: Hudsons
Contact: Ruth Treacy
EMT Job No: 23/15698

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	25-30	31-36					LOD/LOR	Units	Method No.
Sample ID	BH10	BH6	LAGOON L	BH9	BH8	BH7							
Depth													
COC No / misc													
Containers	V H HNUF P G	V H HNUF P G	V H HNUF P G	V H HNUF P G	V H HNUF P G	V H HNUF P G							
Sample Date	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023							
Sample Type	Ground Water	Ground Water	Surface Water	Ground Water	Ground Water	Ground Water							
Batch Number	1	1	1	1	1	1							
Date of Receipt	22/09/2023	22/09/2023	22/09/2023	22/09/2023	22/09/2023	22/09/2023							
Dissolved Arsenic #	7.5	<2.5	11.1	2.6	<2.5	<2.5					<2.5	ug/l	TM30/PM14
Dissolved Barium #	12	68	40	21	18	107					<3	ug/l	TM30/PM14
Dissolved Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					<0.5	ug/l	TM30/PM14
Dissolved Boron	211	<12	<12	17	<12	15					<12	ug/l	TM30/PM14
Dissolved Cadmium #	-	-	<0.03	-	-	-					<0.03	ug/l	TM30/PM14
Dissolved Cadmium #	<0.5	<0.5	-	<0.5	<0.5	<0.5					<0.5	ug/l	TM30/PM14
Dissolved Calcium #	27.5	131.7	54.5	122.3	129.5	101.9					<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5					<1.5	ug/l	TM30/PM14
Dissolved Copper #	-	-	<3	-	-	-					<3	ug/l	TM30/PM14
Dissolved Copper #	<7	<7	-	<7	<7	<7					<7	ug/l	TM30/PM14
Dissolved Lead #	-	-	<0.4	-	-	-					<0.4	ug/l	TM30/PM14
Dissolved Lead #	<5	<5	-	<5	<5	<5					<5	ug/l	TM30/PM14
Dissolved Magnesium #	16.3	13.8	8.2	11.9	7.4	8.5					<0.1	mg/l	TM30/PM14
Dissolved Mercury #	<1	<1	-	<1	<1	<1					<1	ug/l	TM30/PM14
Dissolved Nickel #	<2	4	<2	<2	<2	<2					<2	ug/l	TM30/PM14
Dissolved Potassium #	7.2	0.7	1.2	0.9	0.7	3.1					<0.1	mg/l	TM30/PM14
Dissolved Selenium #	46	<3	<3	<3	<3	<3					<3	ug/l	TM30/PM14
Dissolved Sodium #	89.6	10.4	5.9	11.2	6.6	9.7					<0.1	mg/l	TM30/PM14
Dissolved Vanadium #	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5					<1.5	ug/l	TM30/PM14
Dissolved Zinc #	6	11	<3	9	<3	19					<3	ug/l	TM30/PM14
Mercury Dissolved by CVAF #	-	-	<0.01	-	-	-					<0.01	ug/l	TM61/PM0
Methyl Tertiary Butyl Ether #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					<0.1	ug/l	TM15/PM10
Benzene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5					<0.5	ug/l	TM15/PM10
Toluene #	<5	<5	<5	8	<5	<5					<5	ug/l	TM15/PM10
Ethylbenzene #	2	1	<1	1	<1	<1					<1	ug/l	TM15/PM10
m/p-Xylene #	6	4	<2	6	<2	<2					<2	ug/l	TM15/PM10
o-Xylene #	2	4	<1	2	<1	<1					<1	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	106	104	104	100	101	101					<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	96	98	98	93	93	105					<0	%	TM15/PM10
GRO (>C4-C8) #	<10	<10	<10	10	<10	<10					<10	ug/l	TM36/PM12
GRO (>C8-C12) #	19	24	<10	24	<10	<10					<10	ug/l	TM36/PM12
GRO (>C4-C12) #	19	24	<10	34	<10	<10					<10	ug/l	TM36/PM12
EPH (C8-C40) #	<10	<10	<10	<10	<10	<10					<10	ug/l	TM5/PM30
Sulphate as SO4 #	37.4	18.5	30.7	18.3	5.5	15.8					<0.5	mg/l	TM38/PM0
Chloride #	52.8	21.7	6.4	24.4	5.6	14.2					<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	3.9	55.1	3.7	28.8	6.0	16.0					<0.2	mg/l	TM38/PM0
Nitrite as NO2 #	0.26	<0.02	<0.02	<0.02	<0.02	<0.02					<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4 #	<0.06	<0.06	<0.06	<0.06	0.08	<0.06					<0.06	mg/l	TM38/PM0
Ammoniacal Nitrogen as N #	0.04	0.03	<0.03	0.03	<0.03	<0.03					<0.03	mg/l	TM38/PM0

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: WSP Environmental
Reference: 41000087
Location: Hudsons
Contact: Ruth Treacy
EMT Job No: 23/15698

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	25-30	31-36					LOD/LOR	Units	Method No.
Sample ID	BH10	BH6	LAGOON L	BH9	BH8	BH7							
Depth													
COC No / misc													
Containers	V H HNUF P G	V H HNUF P G	V H HNUF P G	V H HNUF P G	V H HNUF P G	V H HNUF P G							
Sample Date	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023							
Sample Type	Ground Water	Ground Water	Surface Water	Ground Water	Ground Water	Ground Water							
Batch Number	1	1	1	1	1	1							
Date of Receipt	22/09/2023	22/09/2023	22/09/2023	22/09/2023	22/09/2023	22/09/2023							
Hexavalent Chromium	<6	<6	<6	<6	<6	<6					<6	ug/l	TM38/PM0
Total Dissolved Chromium III	<6	<6	<6	<6	<6	<6					<6	ug/l	TM0/PM0
Total Alkalinity as CaCO3 #	246	348	144	334	390	280					<1	mg/l	TM75/PM0
COD (Settled) #	<7	10	10	<7	8	<7					<7	mg/l	TM57/PM0
Total Suspended Solids #	25	356	34	21	3188	55					<10	mg/l	TM37/PM0

Client Name:	WSP Environmental
Reference:	41000087
Location:	Hudsons
Contact:	Ruth Treacy

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 23/15698						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.
It is a requirement under ISO 17025 that we inform clients if samples are deviating i.e. outside what is expected. A deviating sample indicates that the sample 'may' be compromised but not necessarily will be compromised. The result is still accredited and our analytical reports will still show accreditation on the relevant analytes.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 23/15698

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a requirement of our Accreditation Body for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.
Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above quantitative calibration range. The result should be considered the minimum value and is indicative only. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM0	Not available	PM0	No preparation is required.				
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.				
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified				
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified	Yes			
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM37	Modified methods - TSS: USEPA 160.2 (1983), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS	PM0	No preparation is required.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.	Yes			

EMT Job No: 23/15698

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM57	Modified US EPA Method 410.4. (Rev. 2.0 1993) Comparable with ISO 15705:2002. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometerically.	PM0	No preparation is required.	Yes			
TM61	Determination of Mercury by Cold Vapour Atomic Fluorescence - WATERS: Modified USEPA Method 245.7, Rev 2, Feb 2005. SOILS: Modified USEPA Method 7471B, Rev.2, Feb 2007	PM0	No preparation is required.	Yes			
TM75	Modified US EPA method 310.1 (1978). Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			

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ilac-MRA

UKAS TESTING 4225

bsi ISO 14001 Environmental Management CERTIFIED

Attention :	Trevor Montague
Date :	23rd November, 2023
Your reference :	HUDSONS
Our reference :	Test Report 23/18868 Batch 1
Location :	Hudsons
Date samples received :	10th November, 2023
Status :	Final Report
Issue :	1

Eight samples were received for analysis on 10th November, 2023 of which eight were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

The greenhouse gas emissions generated (in Carbon – Co2e) to obtain the results in this report are estimated as:

Scope 1&2 emissions - 15.132 kg of CO2

Scope 1&2&3 emissions - 35.76 kg of CO2

Authorised By:

S. Go

Simon Gomery BSc
Senior Project Manager

Client Name: WSP Environmental
Reference: HUDSONS
Location: Hudsons
Contact: Trevor Montague
EMT Job No: 23/18868

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	25-30	31-36	37-42	43-44			LOD/LOR	Units	Method No.
Sample ID	LAGOON L	BH7	BH7 D	BH6	BH8	BH10	BH9	TRIP BLANK					
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G	G V					
Sample Date	08/11/2023	08/11/2023	08/11/2023	08/11/2023	08/11/2023	08/11/2023	08/11/2023	08/11/2023					
Sample Type	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	10/11/2023	10/11/2023	10/11/2023	10/11/2023	10/11/2023	10/11/2023	10/11/2023	10/11/2023					
Dissolved Arsenic #	5.3	<2.5	<2.5	<2.5	<2.5	2.7	<2.5	<2.5			<2.5	ug/l	TM30/PM14
Dissolved Barium #	73	115	109	72	<3	10	15	<3			<3	ug/l	TM30/PM14
Dissolved Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	ug/l	TM30/PM14
Dissolved Boron	<12	<12	<12	<12	<12	185	<12	<12			<12	ug/l	TM30/PM14
Dissolved Cadmium #	<0.03	-	-	-	-	-	-	-			<0.03	ug/l	TM30/PM14
Dissolved Cadmium #	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	ug/l	TM30/PM14
Dissolved Calcium #	76.6	99.3	103.9	139.1	134.7	28.5	125.9	<0.2			<0.2	mg/l	TM30/PM14
Total Dissolved Chromium #	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5			<1.5	ug/l	TM30/PM14
Dissolved Copper #	<3	-	-	-	-	-	-	-			<3	ug/l	TM30/PM14
Dissolved Copper #	-	<7	<7	<7	<7	<7	<7	<7			<7	ug/l	TM30/PM14
Dissolved Lead #	<0.4	-	-	-	-	-	-	-			<0.4	ug/l	TM30/PM14
Dissolved Lead #	-	<5	<5	<5	<5	<5	<5	<5			<5	ug/l	TM30/PM14
Dissolved Magnesium #	9.7	8.2	8.3	14.0	7.4	18.5	10.8	<0.1			<0.1	mg/l	TM30/PM14
Dissolved Mercury #	-	<1	<1	<1	<1	<1	<1	<1			<1	ug/l	TM30/PM14
Dissolved Nickel #	<2	<2	<2	<2	<2	<2	<2	<2			<2	ug/l	TM30/PM14
Dissolved Potassium #	1.1	2.7	3.2	0.7	0.7	6.7	0.8	<0.1			<0.1	mg/l	TM30/PM14
Dissolved Selenium #	<3	<3	<3	<3	<3	22	<3	<3			<3	ug/l	TM30/PM14
Dissolved Sodium #	7.7	9.0	9.4	10.2	6.2	74.5	9.9	0.4			<0.1	mg/l	TM30/PM14
Dissolved Vanadium #	<1.5	<1.5	<1.5	<1.5	<1.5	1.9	<1.5	<1.5			<1.5	ug/l	TM30/PM14
Dissolved Zinc #	<3	<3	<3	<3	<3	<3	<3	3			<3	ug/l	TM30/PM14
Mercury Dissolved by CVAF #	<0.01	-	-	-	-	-	-	-			<0.01	ug/l	TM61/PM0
Methyl Tertiary Butyl Ether #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	ug/l	TM15/PM10
Benzene #	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	ug/l	TM15/PM10
Toluene #	<5	<5	<5	<5	<5	<5	<5	<5			<5	ug/l	TM15/PM10
Ethylbenzene #	<1	<1	<1	<1	<1	<1	<1	<1			<1	ug/l	TM15/PM10
m/p-Xylene #	<2	<2	<2	<2	<2	<2	<2	<2			<2	ug/l	TM15/PM10
o-Xylene #	<1	<1	<1	<1	<1	<1	<1	<1			<1	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	98	101	103	101	103	103	103	102			<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	101	102	103	99	100	103	103	108			<0	%	TM15/PM10
GRO (>C4-C8) #	<10	<10	<10	<10	<10	<10	<10	<10			<10	ug/l	TM36/PM12
GRO (>C8-C12) #	<10	<10	<10	<10	<10	<10	<10	<10			<10	ug/l	TM36/PM12
GRO (>C4-C12) #	<10	<10	<10	<10	<10	<10	<10	<10			<10	ug/l	TM36/PM12
EPH (C8-C40) #	<10	<10	<10	<10	<10	<10	<10	<10			<10	ug/l	TM5/PM30
Sulphate as SO4 #	22.7	16.5	17.6	17.9	4.4	33.4	17.3	<0.5			<0.5	mg/l	TM38/PM0
Chloride #	10.0	14.5	14.5	22.0	5.5	40.3	24.3	<0.3			<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	5.9	14.5	18.8	56.9	4.5	2.6	28.7	<0.2			<0.2	mg/l	TM38/PM0
Nitrite as NO2 #	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02			<0.02	mg/l	TM38/PM0
Ortho Phosphate as PO4 #	<0.06	<0.06	<0.06	0.07	0.10	0.07	<0.06	<0.06			<0.06	mg/l	TM38/PM0
Ammoniacal Nitrogen as N #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03			<0.03	mg/l	TM38/PM0

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name:	WSP Environmental
Reference:	HUDSONS
Location:	Hudsons
Contact:	Trevor Montague
EMT Job No:	23/18868

Report : **Liquid**

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24	25-30	31-36	37-42	43-44					
Sample ID	LAGOON L	BH7	BH7 D	BH6	BH8	BH10	BH9	TRIP BLANK					
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G	V H HN P G	G V					
Sample Date	08/11/2023	08/11/2023	08/11/2023	08/11/2023	08/11/2023	08/11/2023	08/11/2023	08/11/2023					
Sample Type	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water					
Batch Number	1	1	1	1	1	1	1	1			LOD/LOR	Units	Method No.
Date of Receipt	10/11/2023	10/11/2023	10/11/2023	10/11/2023	10/11/2023	10/11/2023	10/11/2023	10/11/2023					
Hexavalent Chromium	<6	<6	<6	<6	<6	<6	<6	NDP			<6	ug/l	TM38/PM0
Total Dissolved Chromium III	<6	<6	<6	<6	<6	<6	<6	NDP			<6	ug/l	TM0/PM0
Total Alkalinity as CaCO3 #	194	270	242	350	380	220	284	6			<1	mg/l	TM75/PM0
COD (Settled) #	<7	<7	<7	<7	<7	<7	<7	<7			<7	mg/l	TM57/PM0
Total Suspended Solids #	12	<10	<10	73	179	<10	235	<10			<10	mg/l	TM37/PM0

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: WSP Environmental
Reference: HUDSONS
Location: Hudsons
Contact: Trevor Montague

Matrix : Liquid

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Method No.	NDP Reason
23/18868	1	TRIP BLANK		43-44	TM38/PM0	Sample unsuitable for this test
23/18868	1	TRIP BLANK		43-44	TM0/PM0	Sample unsuitable for this test

Client Name: WSP Environmental
Reference: HUDSONS
Location: Hudsons
Contact: Trevor Montague

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 23/18868						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.
It is a requirement under ISO 17025 that we inform clients if samples are deviating i.e. outside what is expected. A deviating sample indicates that the sample 'may' be compromised but not necessarily will be compromised. The result is still accredited and our analytical reports will still show accreditation on the relevant analytes.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 23/18868

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a requirement of our Accreditation Body for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.
Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above quantitative calibration range. The result should be considered the minimum value and is indicative only. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 23/18868

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM0	Not available	PM0	No preparation is required.				
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.				
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified				
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified	Yes			
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM37	Modified methods - TSS: USEPA 160.2 (1983), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS	PM0	No preparation is required.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.	Yes			

EMT Job No: 23/18868

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM57	Modified US EPA Method 410.4. (Rev. 2.0 1993) Comparable with ISO 15705:2002. Chemical Oxygen Demand is determined by hot digestion with Potassium Dichromate and measured spectrophotometerically.	PM0	No preparation is required.	Yes			
TM61	Determination of Mercury by Cold Vapour Atomic Fluorescence - WATERS: Modified USEPA Method 245.7, Rev 2, Feb 2005. SOILS: Modified USEPA Method 7471B, Rev.2, Feb 2007	PM0	No preparation is required.	Yes			
TM75	Modified US EPA method 310.1 (1978). Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			

Appendix 6D

BOREHOLE LOGS

L

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) 3.00	Dark brown slightly moist sandy gravelly TOPSOIL
							(3.00) 6.00	Grey argillaceous SILTSTONE
							(4.00) 10.00	Very weathered dark grey argillaceous SILTSTONE
1							(9.00) 19.00	Weathered dark grey SILTSTONE Groundwater encountered at 16m bgl.
								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

GALKENV+GEO(1) April 2008

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

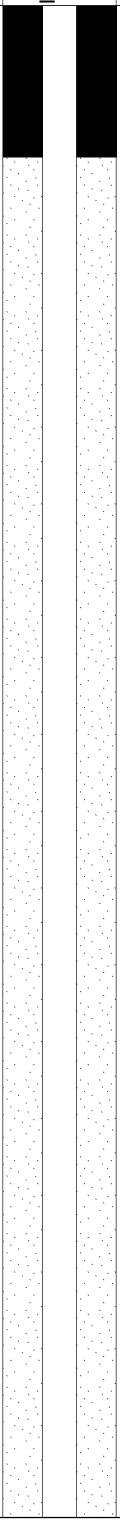
Contractor :

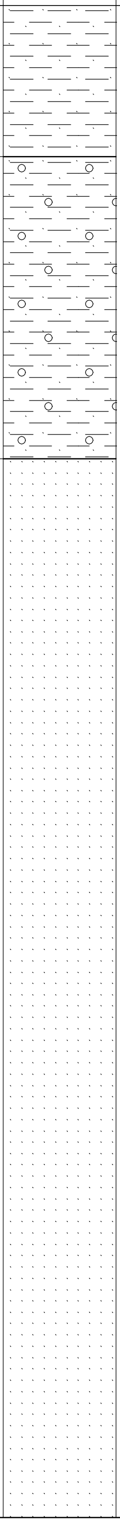
Date Started : 16/01/2006 **Completed :** 16/01/2006

Logged by : GB

Ground Level (mAOD) : 257.27

Co-ordinates : E 697261.3 N 717081.8





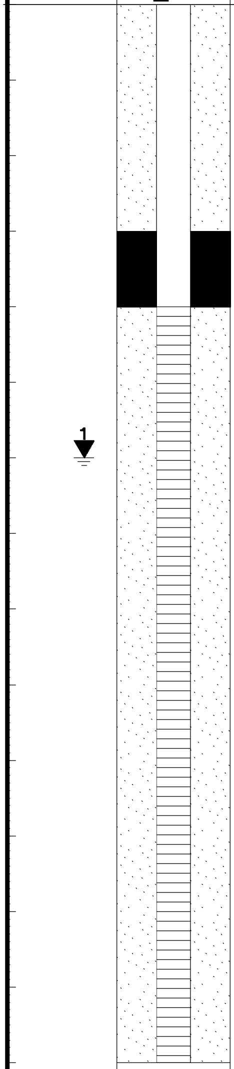
WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results: SPT 'N'	SAMPLES: Sample Type	SAMPLES: PID	STRATA RECORD: Level (mAOD)	Legend	Depth (Thickness) m	Description
							(2.00)	Light brown damp sandy CLAY
					255.27		2.00	
							(4.00)	Grey mottled brown sandy gravelly CLAY
					251.27		6.00	
							(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

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

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

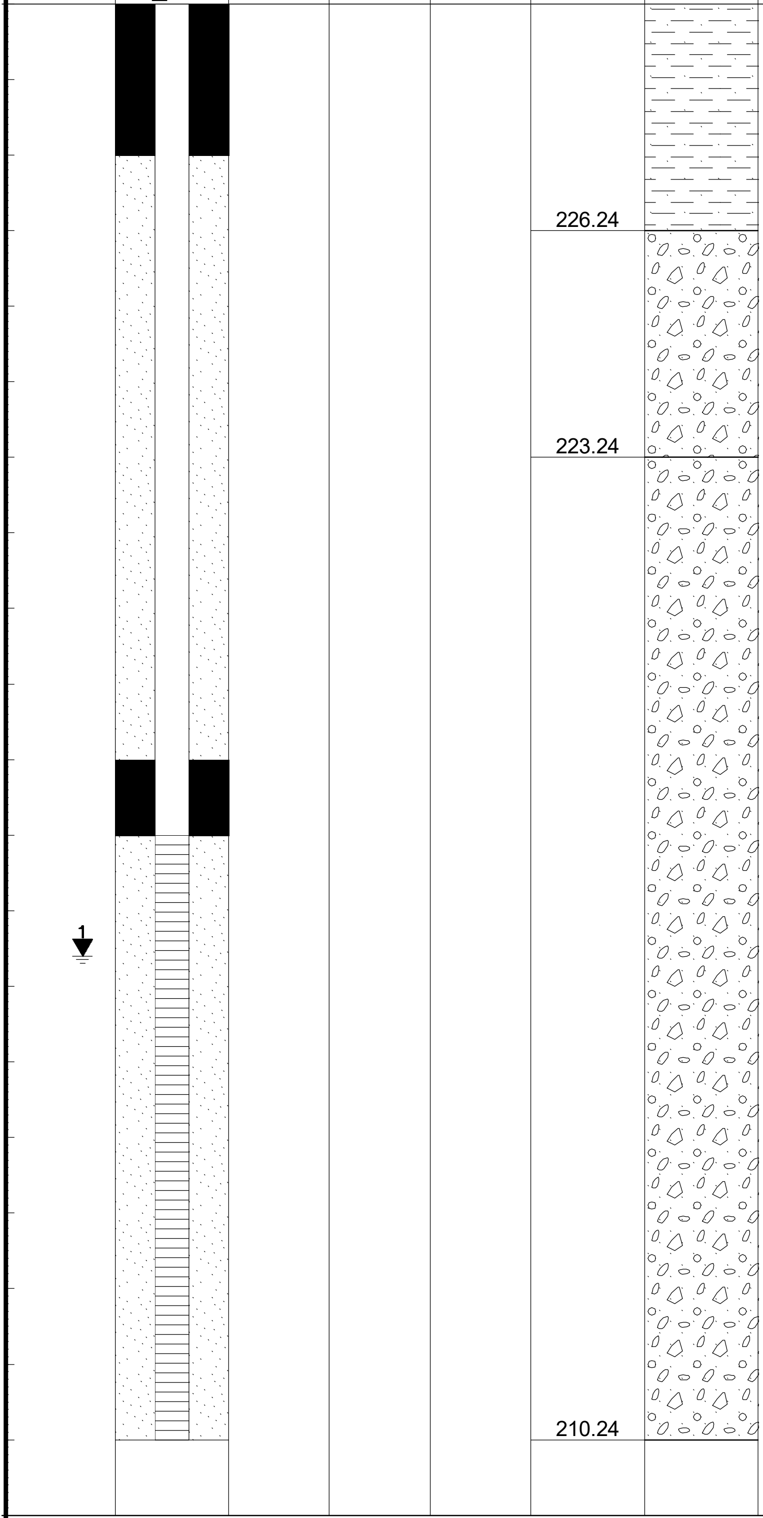
Contractor :

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: SPT 'N'	SAMPLES: Sample Type	SAMPLES: PID	STRATA RECORD: 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	
								Light to dark brown SAND & GRAVEL with angular to sub-angular clasts
1							(13.00)	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

GA.UKENV+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
					225.69		(3.50) 3.50	Brown silty sandy Gravel
								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
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

GAUKENV+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

GALIKENV+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

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

GAUKENV+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

GALIKENV+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
					261.40		(2.00) 2.00	Dark brown sandy gravelly CLAY
					253.40		(8.00) 10.00	Light to dark brown dry SAND & GRAVEL. Gravel is between 10mm and 15mm in size.
								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

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
					230.60		(22.80) 32.80	Light to dark brown dry SAND & GRAVEL. Large gravel being returned.
					229.40		(1.20) 34.00	Dark to light grey fine grained GREYWACKE
								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

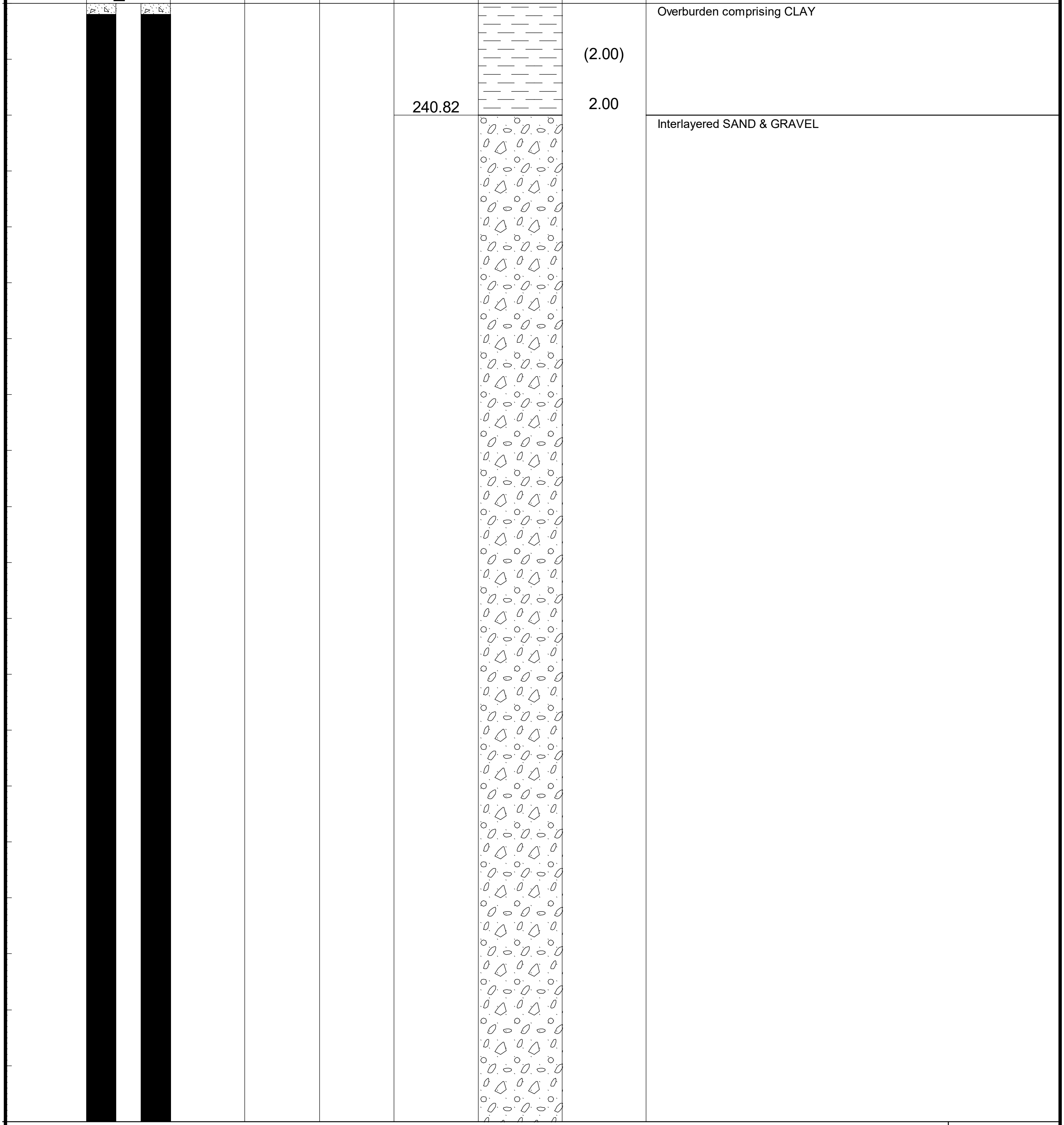
Scale 1:100

GALKENV+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
							(2.00)	Overburden comprising CLAY
					240.82		2.00	
								Interlayered SAND & GRAVEL



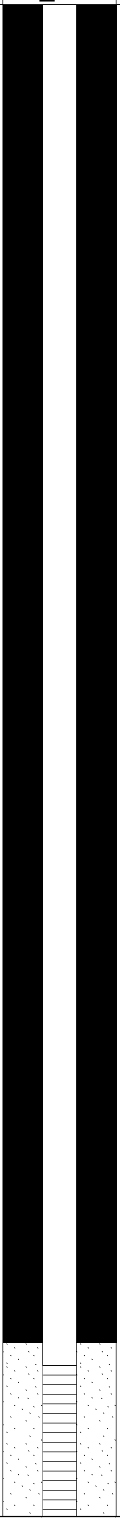
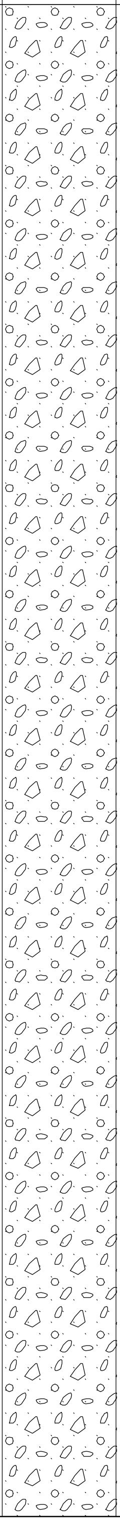
Remarks :
Bedrock at 43.5m bgl.
Groundwater encountered at 51m bgl.
End of hole at 59m bgl.
Installation: 0 - 38m bgl plain, 38 - 59m bgl slots.

Checked By: BB

Scale 1:100

GALKENV+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
							(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

GALKENV+GEO(1)
April 2008

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
					199.32		43.50	Interlayered SAND & GRAVEL
1							(15.50)	GREYWACKE - reddish brown arisings 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

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
							(2.00)	Overburden comprising CLAY
					261.38		2.00	
								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

GALKENV+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

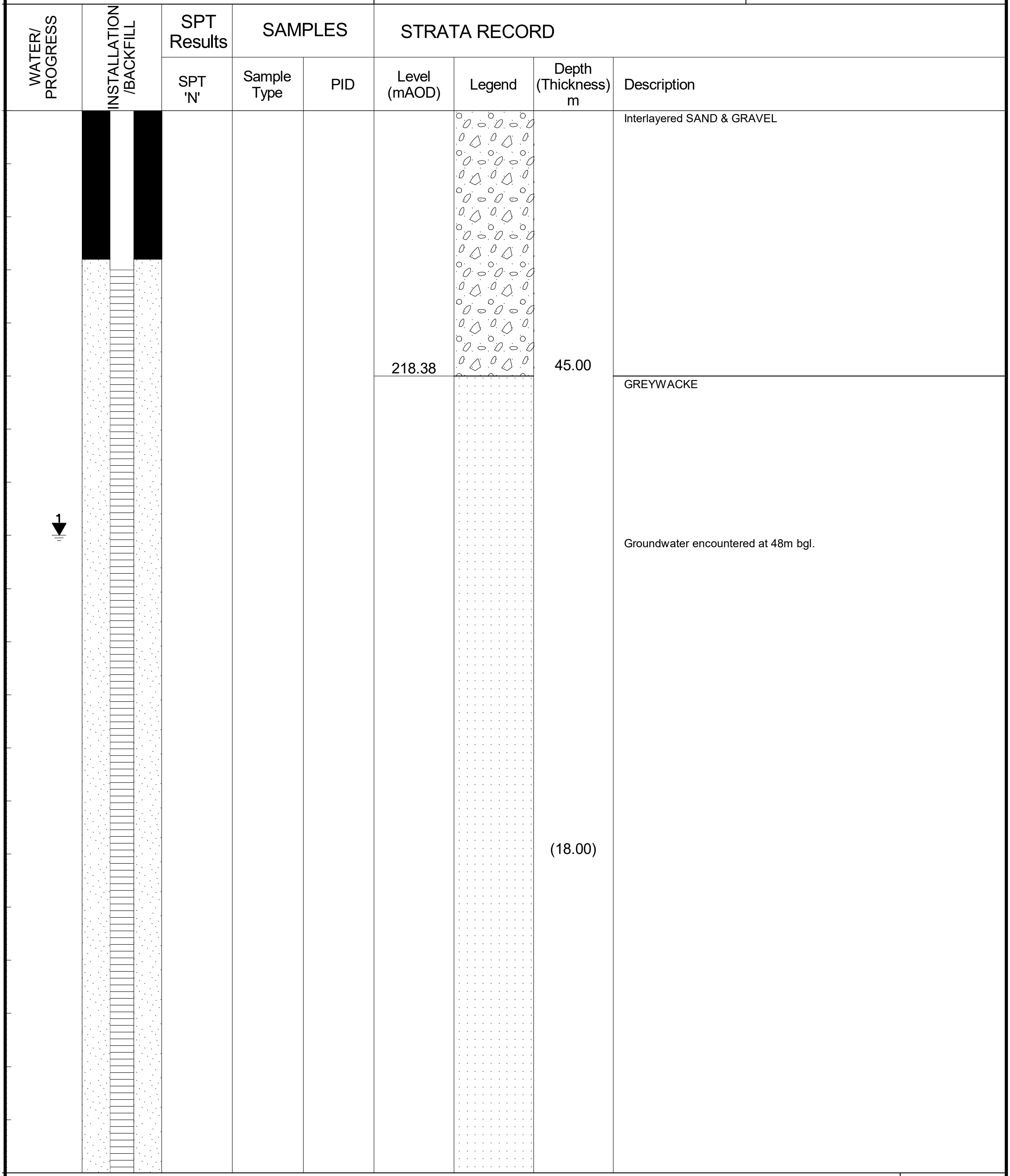
WATER/ PROGRESS	INSTALLATION /BACKFILL	SPT Results	SAMPLES		STRATA RECORD			
		SPT 'N'	Sample Type	PID	Level (mAOD)	Legend	Depth (Thickness) m	Description
							(43.00)	Interlayered SAND & GRAVEL

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

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

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

GALKENV+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
	▨				200.38	▨	63.00	GREYWACKE
								End of Hole at 63.00m

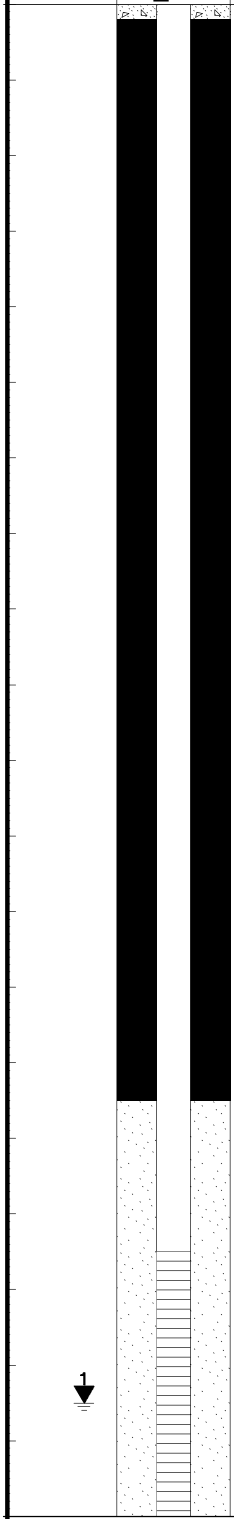
Remarks :
Bedrock at 45m bgl.
Groundwater encountered at 48m bgl.
End of hole at 63m bgl.
Installation: 0 - 43m bgl plain, 43 - 63m bgl slots.

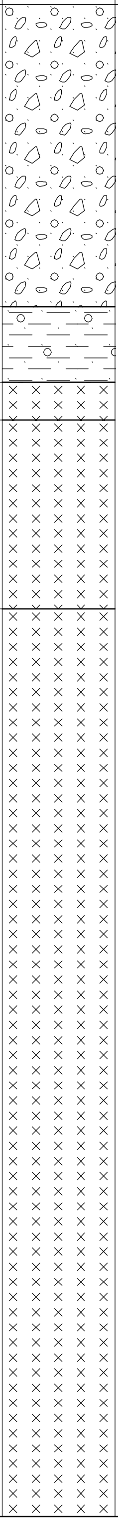
Checked By: BB

Scale 1:100

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





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
					(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

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
					213.98	× × × × ×	25.50	Brown to bluey grey SILTSTONE
								End of Hole at 25.50m

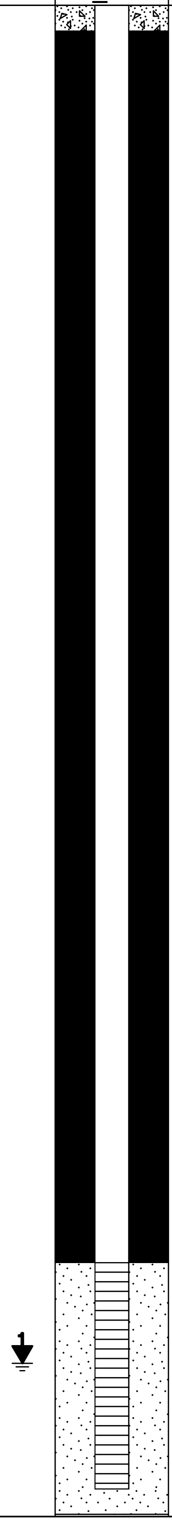
Remarks :
Bedrock at 5.5m bgl.
Groundwater encountered at 18.5m bgl and rose to 12.25m bgl (drill bit still in hole).
End of hole at 25.5m bgl.
Installation: 0 - 16.5m bgl plain, 16.5 - 25.5m bgl slots.

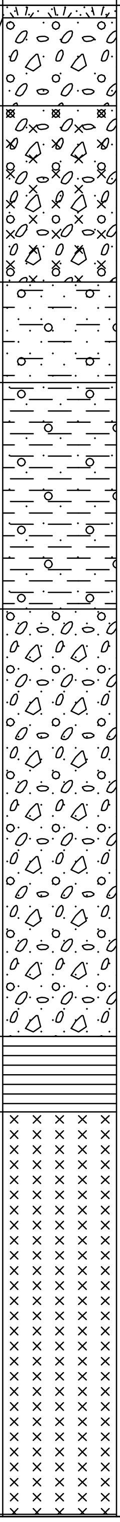
Checked By: BB

Scale 1:100

GAL/KENV+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				STRATA RECORD			
		Sample Top (m)	SPT 'N' Value	Sample Type	PID	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.
						201.53		(3.50) 4.00	Grey-brown slightly clayey very sandy GRAVELS. Gravels are fine to coarse subrounded. Sand is medium to fine.
						194.53		(7.00) 11.00	Light brown silty SAND AND GRAVELS. Gravels are fine to medium subrounded. Sands are fine to coarse
						190.53		(4.00) 15.00	Slightly clayey gravelly SAND. Sands are fine to coarse. Gravels are fine to medium subrounded. Drilling becoming harder with depth from 14.0 m bGL
						181.53		(9.00) 24.00	Brown sandy gravelly CLAY. Gravels are medium subrounded to subangular. Sands are fine to coarse.
						164.53		(17.00) 41.00	Brown clayey SAND and GRAVEL.Gravels are fine to medium subrounded. Sands are fine to medium.
						161.53		(3.00) 44.00	Brown MUDSTONE
						145.53		(16.00) 60.00	Greyish blue SILTSTONE. Waterstrike at 54m

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

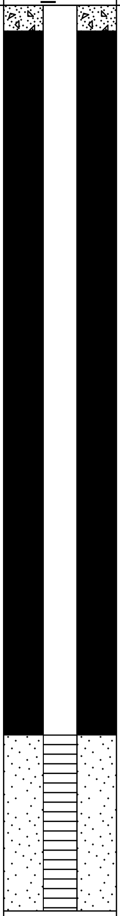
Scale 1:301

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

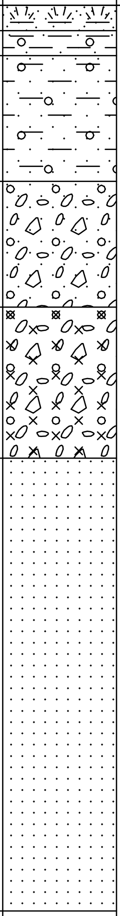
INSTALLATION /BACKFILL



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.
217.90		(5.00) 7.00	Brown clayey gravelly SAND. Sand is fine to coarse. Gravels are fine to coarse subrounded.
212.90		(5.00) 12.00	Grey clayey SAND AND GRAVELS. Gravels are fine to medium subrounded. Sands are fine to coarse.
206.90		(6.00) 18.00	Light brown silty GRAVELS. Gravels are medium subrounded.
188.90		(18.00) 36.00	Mottled greyish black GREYWACKE. Waterstrike at 31m
			End of Hole at 36.00m

1

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

Appendix 6E

BLESSINGTON GROUNDWATER BOUNDARY CHARACTERISATION

Blessington GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water bodies	Associated terrestrial ecosystems	Area (km^2)
Wicklow Co. Co. Kildare Co. Co. Hydrometric Area 09	Minor Streams	Poulaphouca Reservoir (731)	7

Topography		Blessington is approximately 48 km southwest of Dublin and 10 km southeast of Naas. The Blessington area is on the western side of the Wicklow Mountains with elevations between 180 m and 250 m OD. The topography of the region reflects the glacial overburden rather than any change in bedrock structures. Surface drainage is southeastwards into the Pollaphuca Reservoir and then northeast and west via the River Liffey.
Geology and Aquifers	Aquifer type(s)	Lg: Locally important sand/gravel aquifer
	Main aquifer lithologies	The dominant sediments are the gravels, deposited in a subaqueous environment by glacial meltwaters which drained into a glacial lake which existed between the Wicklow Mountains and the margin of the ice sheet
	Key structures.	The gravels occur as delta deposits on the flanks of a ridge. The deposits are characterised by steeply dipping foreset beds and interbedded sands and gravels. Limestone is the dominant clast type.
	Key properties	The Blessington sand and gravel aquifer has a high permeability and transmissivity although some evidence indicates this permeability may be patchy in places. Groundwater gradients in the general area may range from approximately 0.007 to 0.07. A number of quarries are located within the aquifer, which typically indicates deposits with very little silt or clay.
	Thickness	The aquifer varies in thickness, but is generally 10 to 35 m thick.
Overlying Strata	Lithologies	To the west, south and east of Blessington there are poorly to moderately permeable Lower Palaeozoic tills, matrix supported and characterised by a generally silty to silty sandy texture.
	Thickness	West and north of the reservoir the Lower Palaeozoic tills seem to be much thicker (up to 14 m) and locally overlie gravelly deposits.
	% area aquifer near surface	High
	Vulnerability	High
Recharge	Main recharge mechanisms	This GWB is recharged from rainwater percolating through the topsoil and unsaturated sand and gravel deposits. Surface runoff from such gravel aquifers is considered to be low and no more than 20% of effective rainfall. The presence of less permeable layers in the deposit, even if thin, can create perched water tables and prevent recharge of the true water table. Where the water table lies below the local river network it is likely that some stream water may pass into the aquifer. This will be most likely in the higher elevations where a river flows onto the aquifer from where it has previously been flowing over impermeable subsoil or bedrock.
	Est. recharge rates	*[Information to be added at a later date]*
Discharge	Springs and large known abstractions	Blessington PWS (400 m^3/d)
	Main discharge mechanisms	Groundwater will discharge from this aquifer where the water table comes to the surface of the gravel deposits e.g. at springs and at the southern boundary of the aquifer.
	Hydrochemical Signature	Analyses indicate a calcium bicarbonate type, which is hard and typical of a limestone-dominated gravel aquifer. The samples contained abnormally high chloride values (75-80 mg/l) and 57 mg/l of sodium. While these values for sodium and chloride pose no threat to health, they may indicate some contamination and further monitoring should be carried out to establish if this aquifer is being contaminated, perhaps by salting of road surfaces.
Groundwater Flow Paths		The groundwater flow direction is generally to the southeast towards the Pollaphuca Reservoir but locally it is dependent on topography. Groundwater is generally close to the surface. The static water levels in wells range up to 20 metres below ground level.
Groundwater & surface water interactions		The interaction between surface waters and groundwater within the area of this GWB is complex. The nature of this interaction is determined by the location of the water table within the aquifer. It can be seen that local streams are discontinuous and apparently sink below surface where the aquifer is highly permeable and the water table is below the river stage.
Conceptual model	The Blessington GWB is approximately 48 km southwest of Dublin and 10 km southeast of Naas, on the western side of the Wicklow Mountains. Elevations range between 180 m and 250 m OD. The extent of the GWB is defined to the south and east by the location of Pollaphuca Reservoir and to the north and west by the extent of gravel in the area. The GWB is composed of high permeability sands and gravels derived from limestone. The permeability is variable in places i.e. at higher elevations where the water table may be below the more permeable layers. Recharge occurs diffusely through the subsoils. Groundwater flow in the aquifer is unconfined and is generally in a NW to SE direction. This aquifer will discharge via springs and seeps at the extremities of the deposit.	

Attachments	
Instrumentation	Stream gauge: Borehole Hydrograph: None EPA Representative Monitoring boreholes: WIC033, WIC048
Information Sources	McConnell B, Philcox M, Sleeman A G, Stanley G, Flegg A M, Daly E P, Warren W P (1994) *A Geological description to accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 16, Kildare-Wicklow*. Geological Survey of Ireland, 70 pp. Wright G R, Woods L (2003).*County Wicklow Groundwater Protection Scheme* Report to Wicklow County Council. Geological Survey of Ireland Woods L, Wright G R (2003) Blessington Gravel Aquifer. Groundwater Source Protection Report. Report to Wicklow County Council. Geological Survey of Ireland
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae